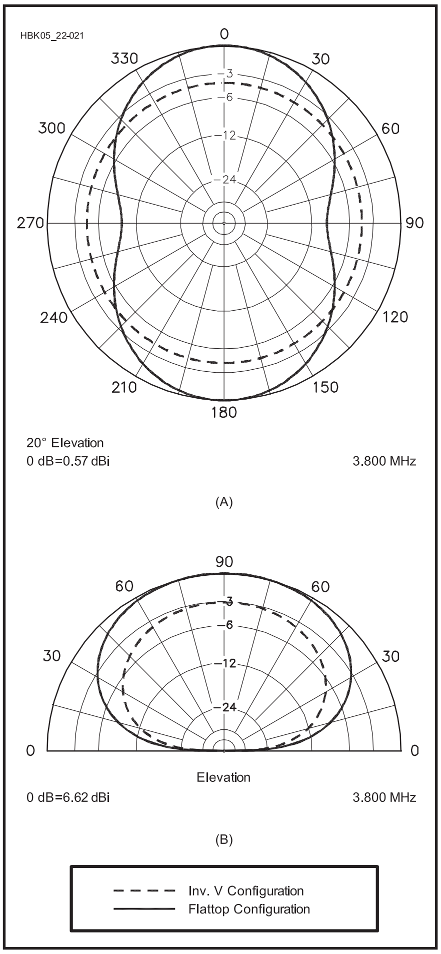

Figure 21.26 — Patterns on 80 meters for 135 foot, center-fed dipole erected as a horizontal dipole at 50 feet, and as an inverted-V with the center at 50 feet and the ends at 10 feet. The azimuth pattern is shown at A, where the conductor lies in the 90° to 270° plane. The elevation pattern is shown at B, where the conductor comes out of paper at a right angle. At the fundamental frequency the patterns are not markedly different.

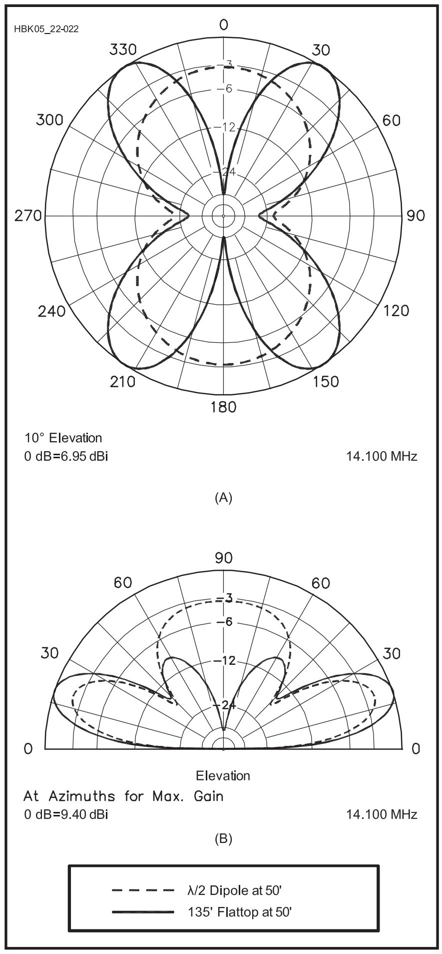

Figure 21.27 — Patterns on 20 meters comparing a standard ½ λ dipole and a multiband 135 foot dipole. Both are mounted horizontally at 50 feet. The azimuth pattern is shown at A, where conductors lie in the 90° to 270° plane. The elevation pattern is shown at B. The longer antenna has four azimuthal lobes, centered at 35°, 145°, 215°, and 325°. Each is about 2 dB stronger than the main lobes of the ½ λ dipole. The elevation pattern of the 135 foot dipole is for one of the four maximum-gain azimuth lobes, while the elevation pattern for the ½ λ dipole is for the 0° azimuthal point.

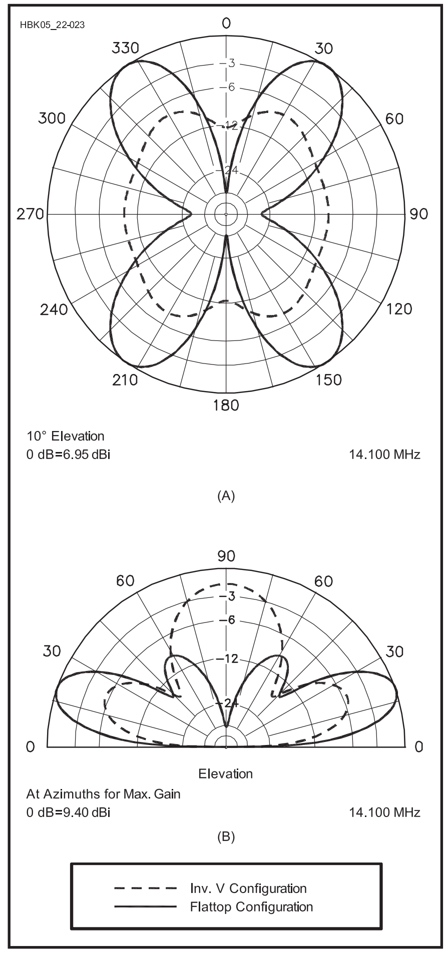

Figure 21.28 — Patterns on 20 meters for two 135 foot dipoles. One is mounted horizontally as a flat-top and the other as an inverted-V with 120° included angle between the two legs. The azimuth pattern is shown at A, and the elevation pattern is shown at B. The inverted-V has about 6 dB less gain at the peak azimuths, but has a more uniform, almost omnidirectional, azimuthal pattern. In the elevation plane, the inverted-V has a fat lobe overhead, making it a somewhat better antenna for local communication, but not quite so good for DX contacts at low elevation angles.

with a balun at either the output or the input of the tuner. Don't be afraid to experiment!

This configuration is popular with other lengths for the antenna:

- 105 feet — 80 through 10 meters
- 88 feet — 80 through 10 meters
- The next lower band may also be covered if the impedance-matching unit has sufficient range, although the adjustment will be fairly sharp. Six meter coverage is possible, but depends on the station layout, length of feed line, and impedance-matching unit abilities. Again, don't be afraid to experiment!

For best results place the antenna as high as you can, and keep the antenna and ladder line clear of metal and other conductive objects. Despite significant SWR on some bands, the open-wire feed line keeps system losses low as described in the **Transmission Lines** chapter.

ARRL staff analyzed a 135 foot dipole at 50 feet above typical ground and compared that to an inverted-V with the center at 50 feet, and the ends at 10 feet. The results show that on the 80 meter band, it won't make much difference which configuration you choose. (See **Figure 21.26**.) The inverted-V exhibits additional losses because of its proximity to ground.

Figure 21.27 shows a comparison between a 20 meter flat-top dipole and the 135 foot flat-top dipole when both are placed at 50 feet above ground. At a 10° elevation angle, the 135 foot dipole has a gain advantage. This advantage comes at the cost of two deep, but narrow, nulls that are broadside to the wire.

Figure 21.28 compares the 135 foot dipole to the inverted-V configuration of the same antenna on 14.1 MHz. Notice that the inverted-V pattern is essentially omnidirectional. That comes at the cost of gain, which is less than that for a horizontal flat-top dipole.

As expected, patterns become more complicated at 28.4 MHz. As you can see in **Figure 21.29**, the inverted-V has the advantage of a pattern with slight nulls, but with reduced gain compared to the flat-top configuration.

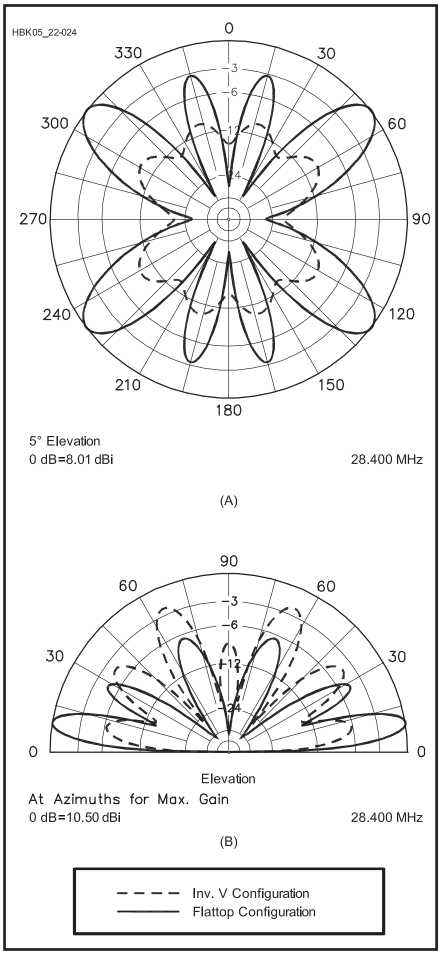

Figure 21.29 — Patterns on 10 meters for 135 foot dipole mounted horizontally and as an inverted-V, as in Figure 21.28. The azimuth pattern is shown at A, and the elevation pattern is shown at B. Once again, the inverted-V configuration yields a more omnidirectional pattern, but at the expense of almost 8 dB less gain than the flat-top configuration at its strongest lobes.

Installed horizontally, or as an inverted-V, the 135 foot center-fed dipole is a simple antenna that works well from 3.5 to 30 MHz (and on 1.8 MHz if the impedance-matching unit has sufficient range). The feed line impedance at the transmitter end may be out of range for the impedance-matching unit. In such a case, add ⅛ wavelength of feed line at that frequency. This may change the impedance to a value the impedance-matching unit can handle..

Project: 40 to 15 Meter Dual-Band Dipole

As mentioned earlier, dipoles have harmonic resonances at odd multiples of their fundamental resonances. Because 21 MHz is the third harmonic of 7 MHz, 7 MHz dipoles are harmonically resonant in the popular ham band at 21 MHz. This is attractive because it allows you to install a 40 meter dipole, feed it with coax, and use it without an antenna tuner on both 40 and 15 meters.

But there's a catch: The third harmonic resonance is actually higher than three times the fundamental resonant frequency. This is because there is no end effect in the center portion of the antenna where there are no insulators.

An easy fix for this, as shown in **Figure 21.30**, is to add capacitive loading to the antenna about ¼ λ wavelength (at 21.2 MHz) away from the feed point in both halves of the dipole. Known as *capacitance hats*, the simple loading wires shown lower the antenna's resonant frequency on 15 meters without substantially affecting resonance on 40 meters. This scheme can also be used to build a dipole that can be used on 80 and 30 meters and on 75 and 10 meters. (A project for a 75 and 10 meter dipole is included with the downloadable supplemental content.)

Measure, cut and adjust the dipole to resonance at the desired 40 meter frequency. Then, cut two 2-foot-long pieces of stiff wire (such as #12 or #14 AWG house wire) and solder the ends of each one together to form two loops. Twist the loops in the middle to form figure-8s, and strip and solder the wires where they cross. Install these capacitance hats on the dipole by stripping the antenna wire (if necessary) and soldering the hats to the dipole about a third of the way out from the feed point (placement isn't critical) on each wire. To resonate the antenna on 15 meters, use an antenna analyzer to adjust the loop shapes until the SWR is acceptable in the desired segment of the 15 meter band. Conversely, you can move the hats back and forth along the antenna until the desired SWR is achieved and then solder the hats to the antenna.

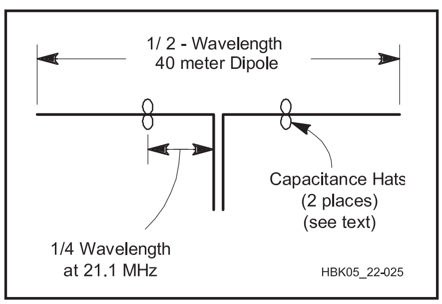

Figure 21.30 — Figure-8-shaped capacitance hats made and placed as described in the text, can make a 40 meter dipole resonate anywhere in the 15 meter band.

Project: W4RNL Rotatable Dipole Inverted-U Antenna

This simple rotatable dipole was designed and built by L.B. Cebik, W4RNL (SK), for use during the ARRL Field Day. For this and other portable operations we look for three antenna characteristics: simplicity, small size and light weight. Today, a number of lightweight collapsible masts are available. When properly guyed, some will support antennas in the 5 to 10 pound range. Most are suitable for 10 meter tubular dipoles and allow the user to hand-rotate the antenna. Extend the range of the antenna to cover 20 through 10 meters, and you put these 20 to 30 foot masts to even better use. The inverted-U meets this need. **Figure 21.31** shows the basic kit for the antenna. Complete construction details and more information about antenna performance are available with the downloadable supplemental content.

A dipole's highest current occurs within the first half of the distance from the feed point to the outer tips. Therefore, very little performance is lost if the outer end sections are bent. The W4RNL inverted-U starts with a 10 meter tubular dipole. You add wire extensions for 12, 15, 17 or 20 meters to cover those bands.

You only need enough space to erect a 10 meter rotatable dipole. The extensions hang down. **Figure 21.32** shows the relative proportions of the antenna on all bands from 10 to 20 meters. The 20 meter extensions are the length of half the 10 meter dipole.

Not much signal strength is lost by drooping up to half the overall element length straight down. What is lost in bidirectional

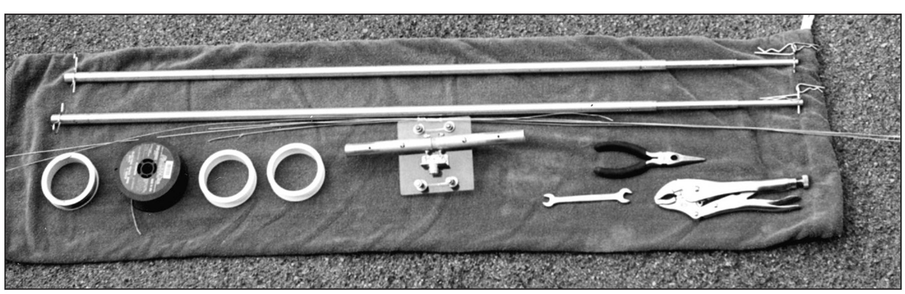

Figure 21.31 — The entire inverted-U antenna parts collection in semi-nested form, with its carrying bag. The tools stored with the antenna include a wrench to tighten the U-bolts for the mast-to-plate mount and a pair of pliers to help remove end wires from the tubing.