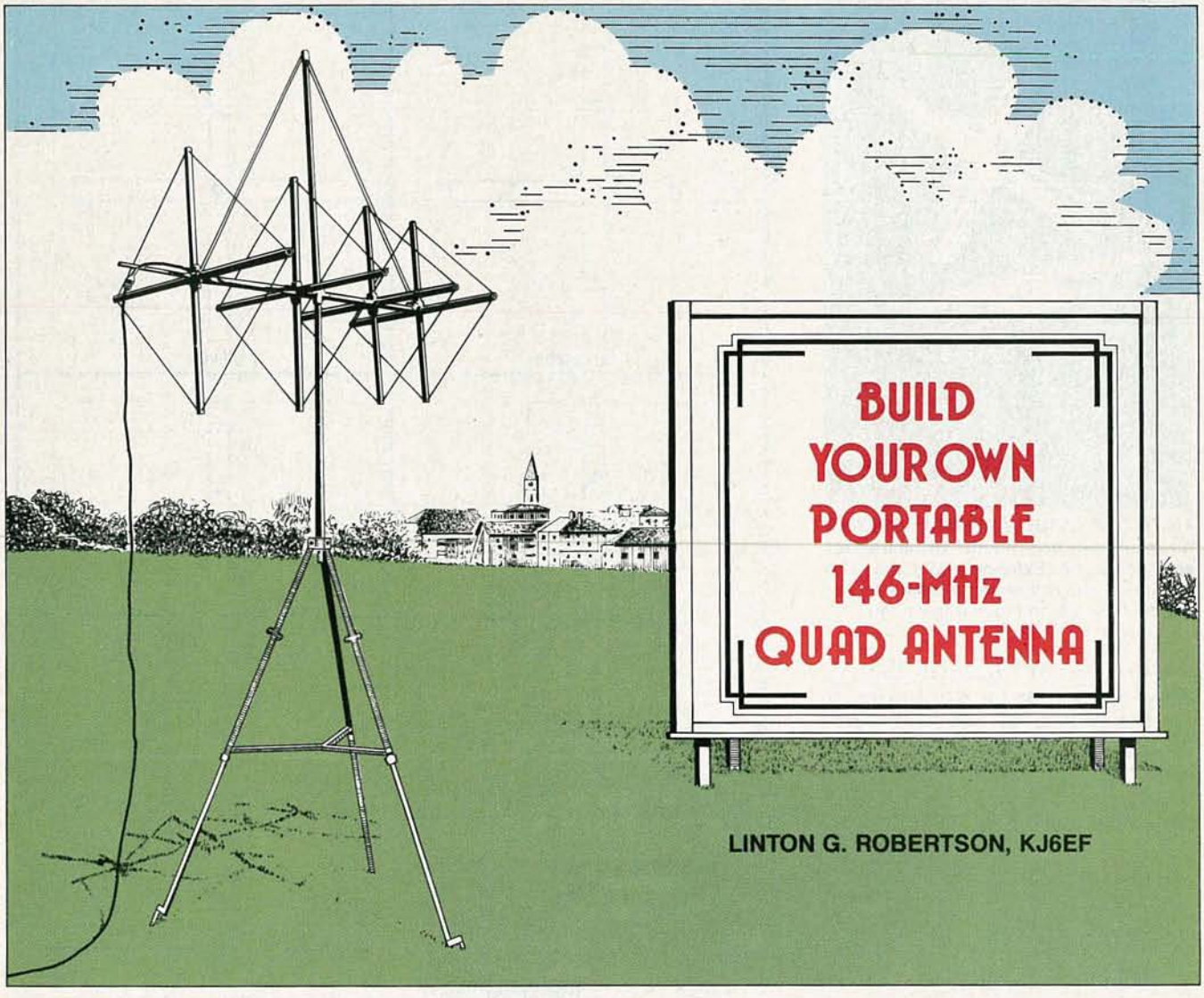

Build this portable 2-meter quad antenna. It offers plenty of punch to the pound for your next Field Day adventure.

IF YOU'RE AN AVID VHF HILL-TOPPER, or just thinking about becoming a "ham", you'll be interested in this inexpensive and easy-to-build antenna for the 2-meter band. Join in the spirit of public-service by taking this light, portable quad antenna into the great outdoors on Field Day, an annual event held every June. On Field Day, amateur radio operators take their equipment into the field and, using power generated at the operating site, test it to prepare for their response in the event of a disaster.

Our portable quad antenna weighs only two and three quarter pounds, and has good gain compared to a four-element Yagi. Assembly of the antenna is made simple by the use of PVC pipes and cross-tees. All the materials you need for this project are available at your local home-improvement center, and they are quite inexpensive. The author's antenna cost about fifteen dollars, including the coaxial matching section. No exotic tuning devices are required; all you need is a simple SWR (standing wave ratio) meter. Figure 1 shows a view of the antenna with the spreader elements taken apart, ready to be transported.

Construction

The quad antenna consists of four element spreaders (reflector, driver, and two director sections), four boom sections, a boom support and mast, five cross-tees and two support lines. The spreaders are four legs that hold the actual elements. The spreader elements should be assembled first. The boom support and boom sections can be assembled later. Figure 2 shows how all sections are connected.

Cross-tees C1 through C4 are used in the construction of the four element spreaders. Cross-tee C5 is used for final assembly. Four spreader legs are cemented into the four openings of cross-tees C1 through C4. The legs, which hold the antenna elements, should be cut following

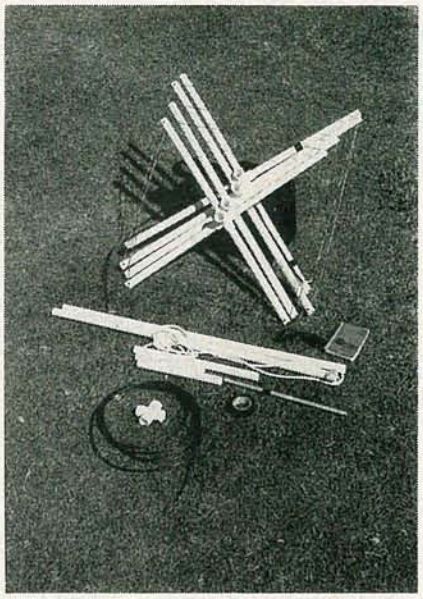

FIG. 1—THE ENTIRE ASSEMBLY BREAKS down and sets up in about five minutes for easy portability. Extremely light, it can be packed in and out of some places where two feet can go and four wheels can't.

the dimensions given in Fig. 3. The dimensions shown in Fig. 3 are the length of each spreader. The spreader length is measured from the drilled hole on one end to the drilled hole on the other end. Make sure you leave an extra

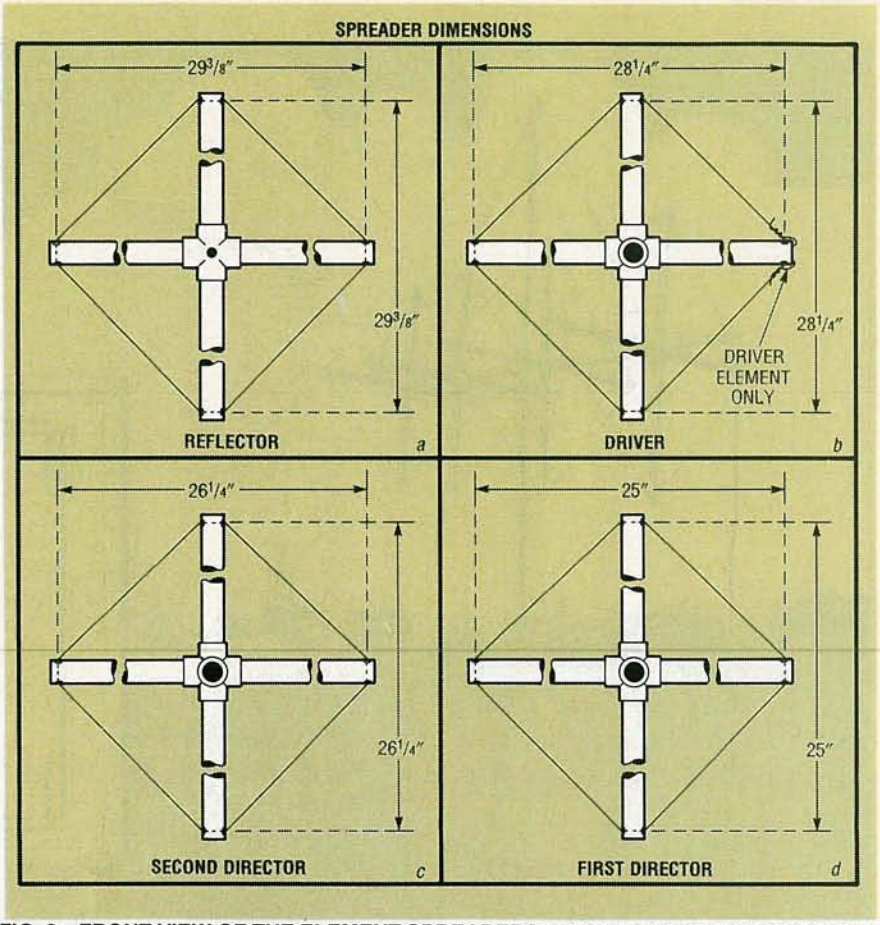

FIG. 3—FRONT VIEW OF THE ELEMENT SPREADERS with dimensions; (*a*) is the reflector, (*b*) is the driver, (*c*) is the second director and (*d*) is the first director.

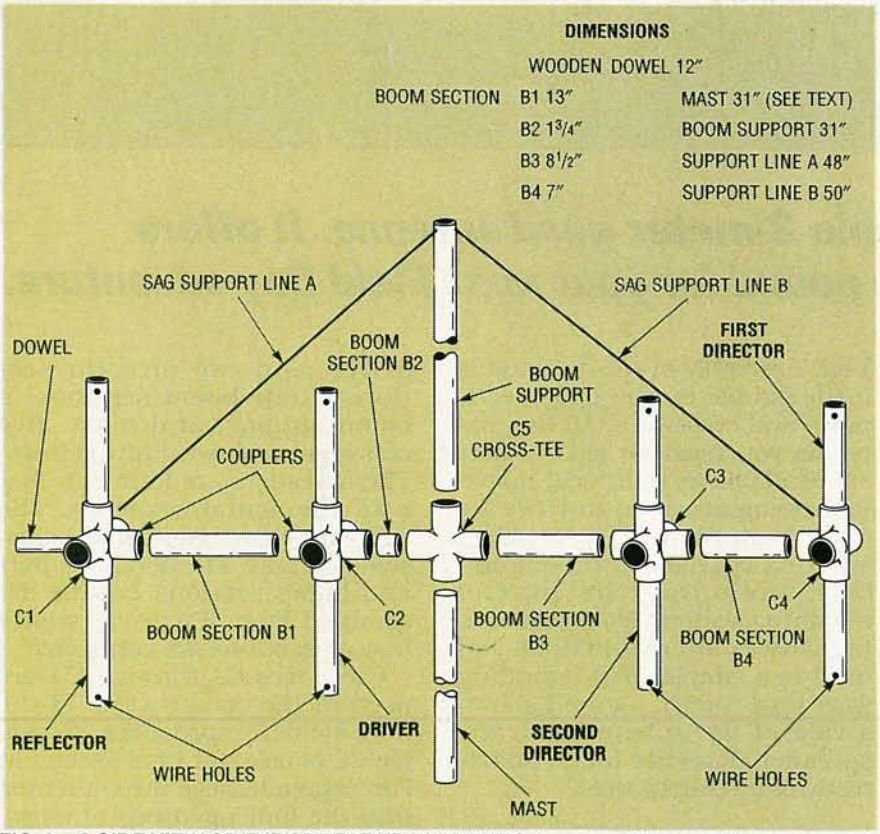

FIG. 2—A SIDE VIEW OF THE SPREADER ELEMENTS, boom sections and boom support. The driver section is where the RG59/U coaxial cable is connected.

half-inch beyond the drilled opening on the end of each leg, and an extra three quarters of an inch where the pipe fits into the cross-tee. The exact length of each spreader leg is not critical at this point; exact measurements will be taken after the legs are cemented to the cross-tees.

Glue the spreader legs into the cross-tees with a silicone sealing compound. Try to avoid using standard PVC cement—repair of an individual element may be difficult later on if it becomes damaged in field use. Cement all the remaining spreader legs into the cross-tees and let them dry for one hour. Figure 3 shows a front view of a finished spreader element.

While the four spreader elements are curing, cut boom sections B1–B4, the mast, and boom support. Measure the nylon cord that is to be used to keep the boom ends from sagging. Now, drill two holes in the support section at one end for the sag lines and attach the lines to the support piece. At this point, it might

be a good idea to label all the elements, boom sections, mast, and sag support for final and future assembly. Mark each section, according to Fig. 2 to avoid any mixups, or use different colored paint to mark mating pieces.

When all spreader sections are dry, drill two holes at the end of each spreader leg for the wires to pass through. Use a drill bit a few sizes larger than the wire you're using—stringing the wire is much faster with a larger opening. Measure as accurately as possible or the antenna will be difficult to tune. A good way to do that is to divide the spreader dimension by two, and measure from the center of the cross-tee. Mark your measurement on the end of each spreader element and then drill two 3/8-inch holes, one hole drilled directly opposite the other.

After you have finished drilling the holes on the spreader legs, take cross-tee C1, used for the reflector element, and drill a 3/8-inch hole on both sides. The wooden dowel fits into this opening and is used for suspending the feedline far enough away from the reflector element to avoid detuning it.

The next step is to glue half-inch couplings to each of the elements. Two couplings are glued on the driver and second director elements, while only one coupling is glued to the reflector and first director. Figure 4 shows a closeup view of the coupling assembly used on the driver and second director elements.

A fast-drying, two-section epoxy is the best type of bonding agent to use for gluing the couplings, just make sure you let each section cure for one hour. Lay each element down on a flat surface, and rough up the side surface of each cross-tee as well as one end of each coupler where the two are to mate. Use a ruler to determine the center of the cross-tee and mark that point with a pencil. Mix enough epoxy for *four* couplings, which is about two tablespoons. Coat the four ends of each coupling with a medium amount of epoxy. Glue the coupling to each element's cross-tee in the center. Use only one coupling per element for now. Work as quickly as you can, as epoxy sets within a few minutes. All elements should dry for one hour.

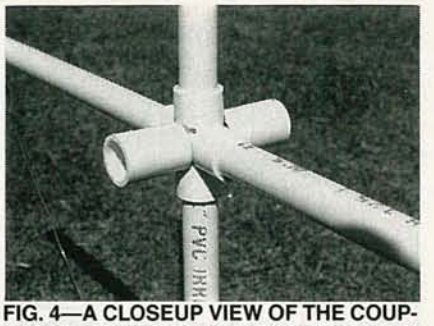

FIG. 4—A CLOSEUP VIEW OF THE COUPLING assembly used on the driver and second director elements. Note that the reflector and first director elements have only *one* coupling cemented to the cross-tee.

Turn the driver and second director elements over. Repeat the process so that those two elements have a coupling on each side of them, in the center. Let all elements dry for twenty four hours.

Stringing the wires

For the reflector, first director, and second director, pass the wires through the drilled holes and solder them together at a point between the spreader legs, making a large loop. You *must* use a heat sink on each side of the solder joint to prevent melting the plastic spreader leg. On the driver element, do not connect the wire to make a loop. Instead, pass the wire through the hole, make a loop and wrap it back on itself again a few times. Figure 5 shows a close up of that connection to the driver feed point. Again, make sure you use a heat sink, and solder as quickly as you can when you make that connection. The driver feed point is where the RG59/U matching coaxial cable will be soldered.

If you notice that there is a significant amount of slack in the wires, you can tighten the wire by doing the following: grab the wire with a pair of needle-nose pliers where it goes inside the spreader at each end of the spreader leg, one at a time. Pull gently straight outward from the center of the element. Repeat that on all four ends of each spreader leg on each element, except the driver, where you'll only have three points to grab. Don't pull too hard, or you'll warp the spreader legs out of shape.

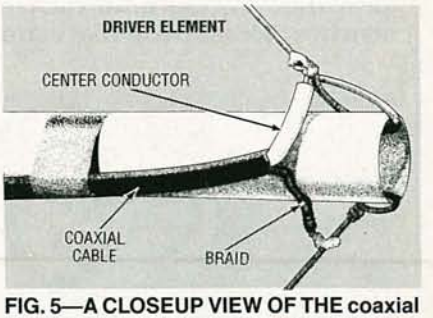

FIG. 5—A CLOSEUP VIEW OF THE coaxial cable connection to the driver feed point. Make sure you use a heat sink between the solder points and the plastic PVC pipe to avoid melting.

Next, cut back one end of the 36-inch RG59/U coaxial matching cable until you expose about 1.5 inches of braid and center conductor to work with. Solder the braid to one side of the driver loop. Don't forget to use a heat sink. Tape the first few inches of coaxial cable from the solder joint down to the spreader leg, letting the rest dangle. The cable will run down the center of the boom during final assembly.

Final assembly

For final assembly gently slide the sections of boom, elements, support, and mast together according to Fig. 2. The sections should slide freely out for disassembly. Be careful not to jam them in permanently—excessive force is not necessary as the coupling depth is only about 0.5–0.75-inch into the cross-tee.

The dowel should now be inserted into the reflector element. The dowel is used to support the RG58/U transmission line that is fed to the matching section. Route the coaxial matching section down the spreader leg away from the feed point and down the length of the boom as shown in Fig. 6. Tape the coaxial matching section to the boom with electrical tape—that's something you'll want to bring with you when you use the quad out in the field. Support the assembled unit on a tripod, if possible, or any other type of device that can hold the antenna steady while keeping it away from nearby metal objects that will distort it's field and play havoc with SWR readings.

Tuning the antenna

Tune your transceiver to 146 MHz. Trim the free end of the coaxial matching section back a couple of inches and solder it to a bulkhead SO-239 receptacle con-

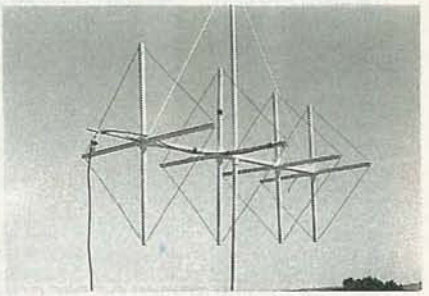

FIG. 6—A REAR VIEW SHOWS ROUTING OF THE coaxial matching line, the sag support tie points and the wooden dowel support for the antenna feedline.

nector shown in Fig. 7-*a*. That type of bulkhead connector provides a maximum adhesion surface for the silicone sealing step. Connect the coaxial matching line with a length of RG58/U cable and a PL-259 plug, shown in Fig. 7-*b*.

Use a Voltage Standing-Wave Ratio (VSWR) meter to help you tune the antenna. The VSWR is an important tool in matching impedances of a transmission system. A VSWR reading, usually called simply the SWR, indicates the ratio of the load impedance to the feedpoint impedance. For maximum power transfer to occur, the feedpoint impedance of the antenna should closely match that of the transmission line. If those impedances are mismatched, some unabsorbed power is reflected back down the transmission line. Not only is that inefficient, it can damage a transmitters output stage.

For proper tuning of the antenna, the SWR meter should measure below 1.5. If not, desolder the SO-239 connector from the matching coaxial cable, trim a quarter of an inch from the center conductor and the braid, resolder and measure again. Repeat that process until the SWR reaches at least 1.5. If that cannot be achieved, you've done something wrong, probably with the driver spreader dimensions. The models the author has built come down to 1.1 at 146 MHz, and rise to 1.5 at the band edges of 144 MHz and 148 MHz. Also, you might not want to push your luck in trimming the antenna past about 1.4 or 1.3. If the SWR suddenly rises after an adjustment, you've probably passed the null. You should still be able to get the SWR reading down very low.

After you've gotten the SWR down to an acceptable level, seal the feedline connector with silicone cement for a good, weathertight seal. Apply a heavy amount of silicone so that it completely covers the exposed area from the SO-239 connector to past the edge of the skinned coaxial cable.

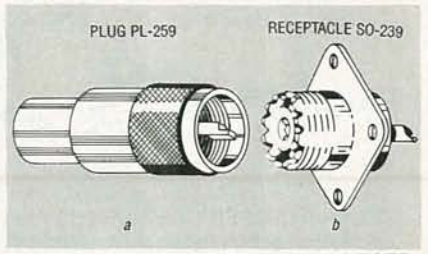

FIG. 7—A STANDARD PLUG AND RECEPTACLE used to mate two coaxial cable sections; (*a*) is a PL-259 plug and (*b*) is an SO-239 receptacle.

PARTS LIST

Schedule 125 PVC pipe—20 feet, ½-inch in diameter
PVC cross tees—5
#14 or #16 gauge wire—11 yards
Two-part quick-drying epoxy—1 tube
RG59/U coaxial cable—1 yard
SO-239 bulkhead connector—1
PL-259 plug—1
⅜-inch wooden dowel—6 inches
Nylon cord—8 feet
½" PVC couplers—6
Silicone sealing compound, or RTV—1 tube
Electrical tape—1 roll

Allow the feedline connector to dry for one day.

After the connector is thoroughly dried and cured, feed the antenna with the RG58/U cable. The cable length should be reasonably short—50-foot runs are not a good idea.

The antenna works well in the field. When tested over a one-hundred and fifty mile distance, strengths of S-9 were reported with as little as 3 watts from a hilltop locale. When we turned up the power on the quad to 30 watts, the receiving station operator said he'd send us a bill for a new S-meter! Apparently, the quad antenna does have good gain.

Mounting the antenna for field use is left to your imagination and individual needs. But try this little plumber's delight. We'll see you on a hilltop soon! **R-E**