The Field Day Special—The "Ray Gun"

A Concentric Combo Mode B Antenna

by Jack Douglas KA5DNP

Several years ago I was invited to speak to a new local ham club, the Northwest Area Radio Society, about amateur satellite operations. This led to my joining the club, and soon our first Field Day activity was under way.

I took along the basics for operation on RS 5 and RS 7, the simplest way of earning satellite operation bonus points. After a while I heard the beacon from the best pass we were to experience, and then a beautiful "CQ Field Day" call.

At that moment, our HF CW station was changing operators. When the new operator came on I went running to ask for a 15-minute break in the CW activity, but to no avail. They simply did not understand that I had only 15 minutes to earn the bonus points and that their powerful CW signal was not kind to a high-sensitivity Mode A receiving system. Alas, no satellite operation that Field Day!

In 1988 I didn't give much thought to satellite operation at Field Day, but while I was at our site an idea hit. Maybe I could use the all-mode 2m in my car to hit RS 10/11. Then if a friend with HF in his car could pull up door-to-door with me, maybe we could make a contact. It worked! We made a good contact, but it could hardly be called a real satellite operation. Somehow we slipped this one in between CW calls from the "real" Field Day station.

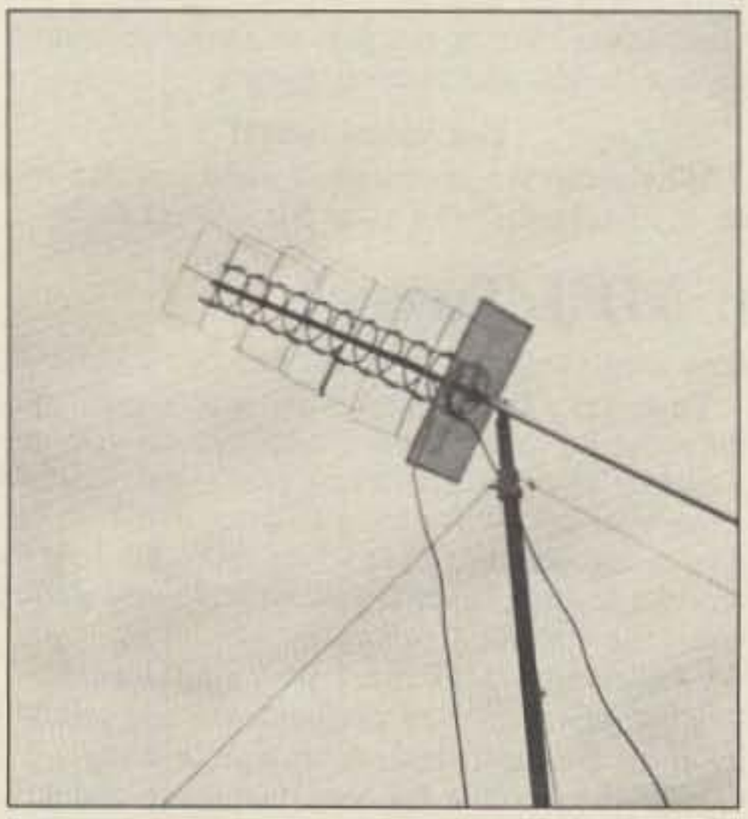

Photo A. The "Ray Gun" Mode B concentric combo antenna installed for Field Day operation. Note the string (horizontal line from the mount, lower right corner of the photo) used to adjust the elevation.

Photo B. The antenna installed at the motor home operating point.

In early spring of 1989 the club Field Day chairman called to ask if I would make a satellite effort for Field Day. I was noncommittal until a friend, Ken Edinborgh W5BKK, said we could use his radios if I could get an antenna set up.

I have operated on the high-flying birds (Oscars 10 and 13) for over five years using home-brew "Armstrong" operated antennas. Maybe I could construct a simple antenna system, thus avoiding the need for taking down someone's antenna system just for Field Day. This resulted in the "Mode B Concentric Combo," dubbed "The Ray Gun" by one of the fellows at Field Day.

What is the Ray Gun?

The Ray Gun is a 5-element 2m quad with a ten-turn 70cm helix wound inside it, concentric on an eight-foot wooden closet pole boom. The quad is an adaptation of information from the *The Satellite Experimenter's Handbook* and the 1986 *ARRL Handbook.* The helix is an adaptation of a design passed on to me by Jim McKim WØCY. (I used Jim's information to construct my home station 70cm antenna—the only 70cm antenna I have ever used!)

Photo A shows the Ray Gun in all its glory mounted at the Field Day site. (The thin horizontal line running to the right is the string used to vary elevation.) Photo B shows the antenna installed next to the motor home of Vince Hayes KCØLM, which was the operating point. Photo C shows the antenna in its "test mounting" (a rope thrown over my breezeway). We made sixteen contacts from the "test mounting" setup. Not too shabby, since elevation and azimuth weren't easy to change!

The Ray Gun is mounted on a 2" x 2" pole. A tie string handles elevation; azimuth changes are made by rotating the pole. With this setup our station logged 40 contacts on the Saturday night pass of AO-13, albeit with some difficulties from rains.

The advantage of the Ray Gun is that you only need to haul one antenna to Field Day, along with one small pole and some rope and tent pegs. The disadvantages are that there will be some desense because the two systems are so interlaced, and problems with wooden construction materials getting wet and reducing the efficiency of the 70cm helix. Note that I have referred to the antenna as a Mode B combo. This is because with the actual setup we had, be it antenna design or whatever, desense on Mode J was simply too great to allow operation.

I didn't have to buy anything to build this antenna—I already had everything I needed. If you want to build your own "Combo" I estimate you can buy everything for less than $50.00. An operational Mode B antenna for fifty bucks is not too common an animal!

Photo C. The "Ray Gun" in its "test mounting" (a rope thrown over KA5DNP's breezeway).

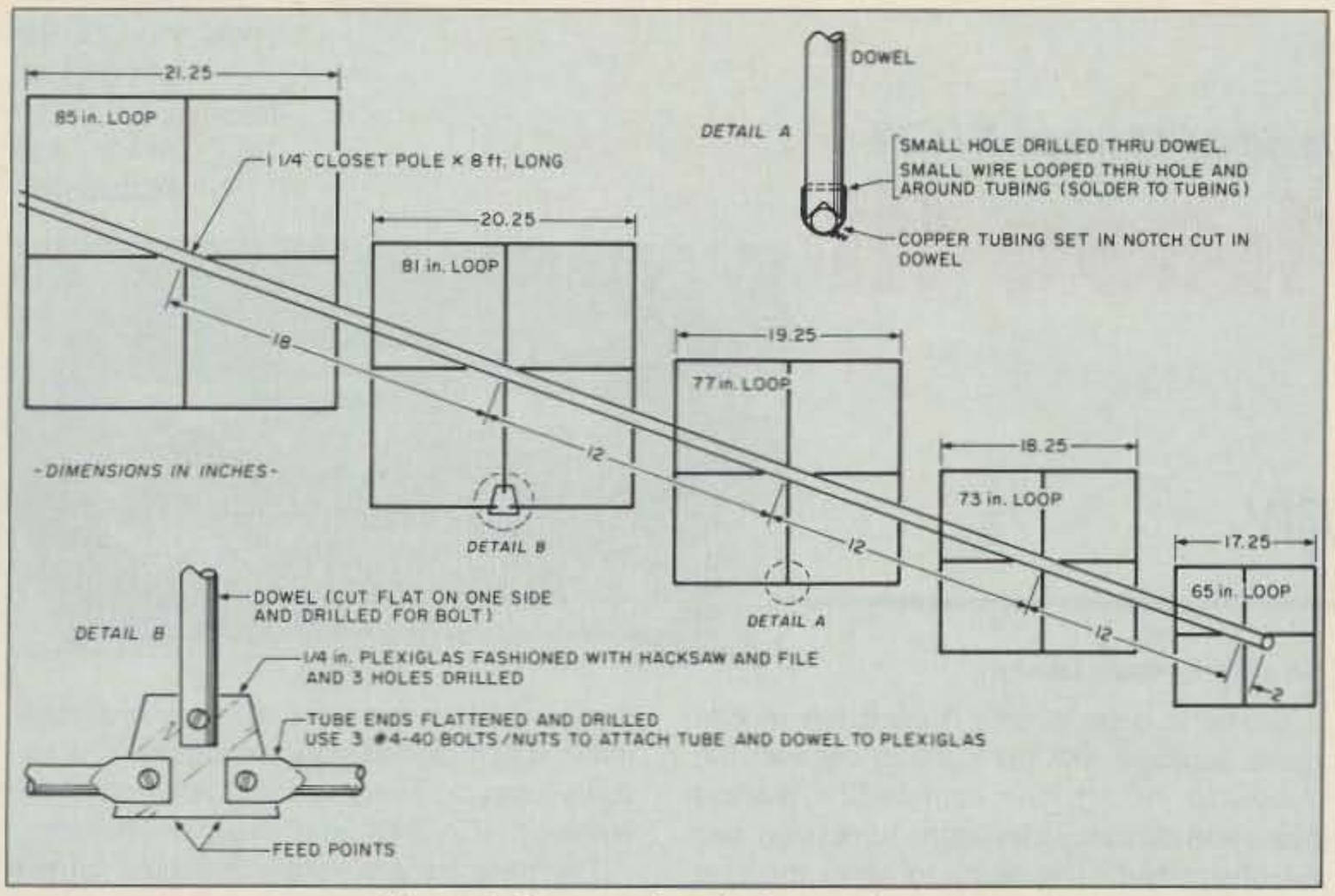

Figure 1. Constructing the 2 meter beam.

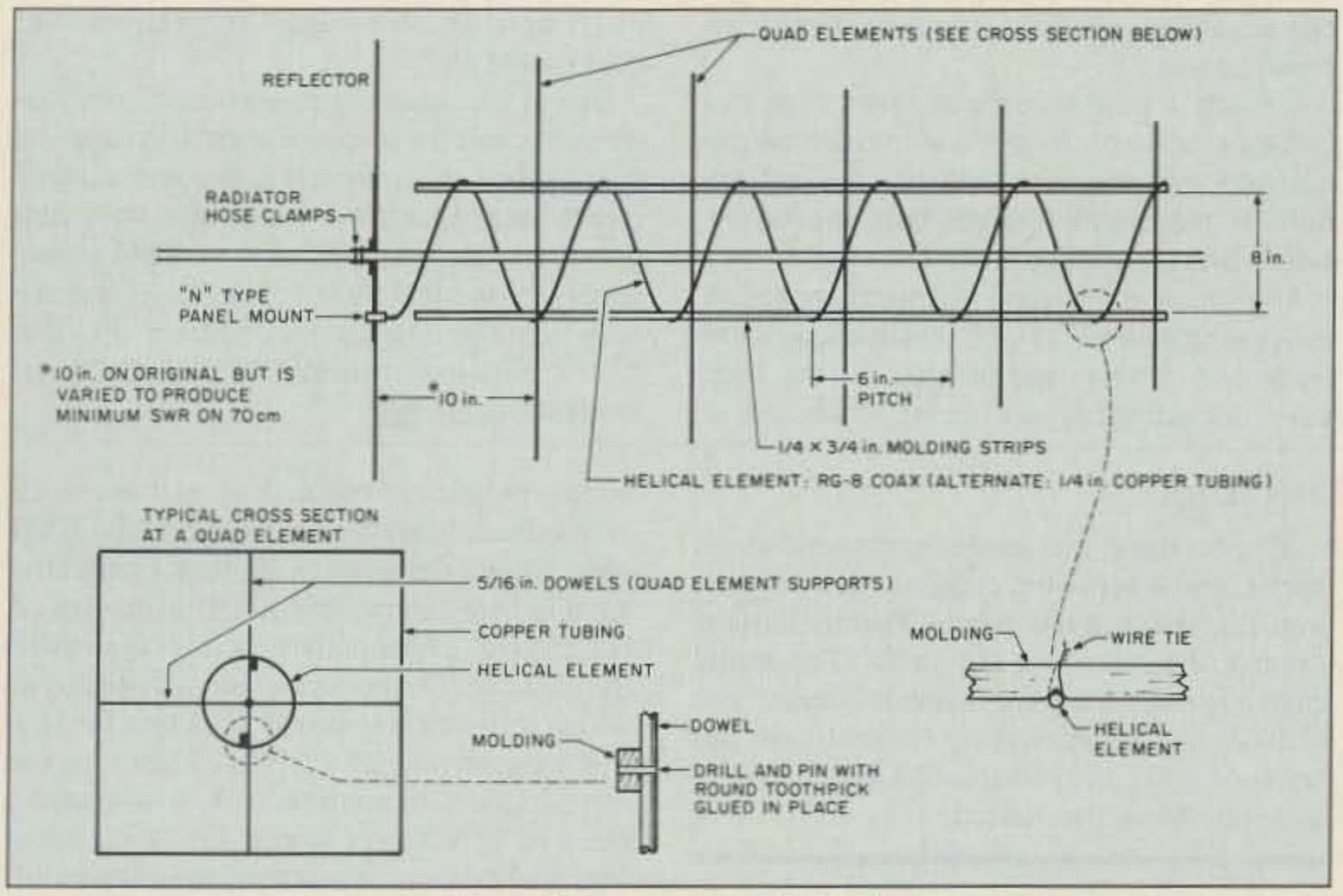

Figure 2. Constructing the helix.

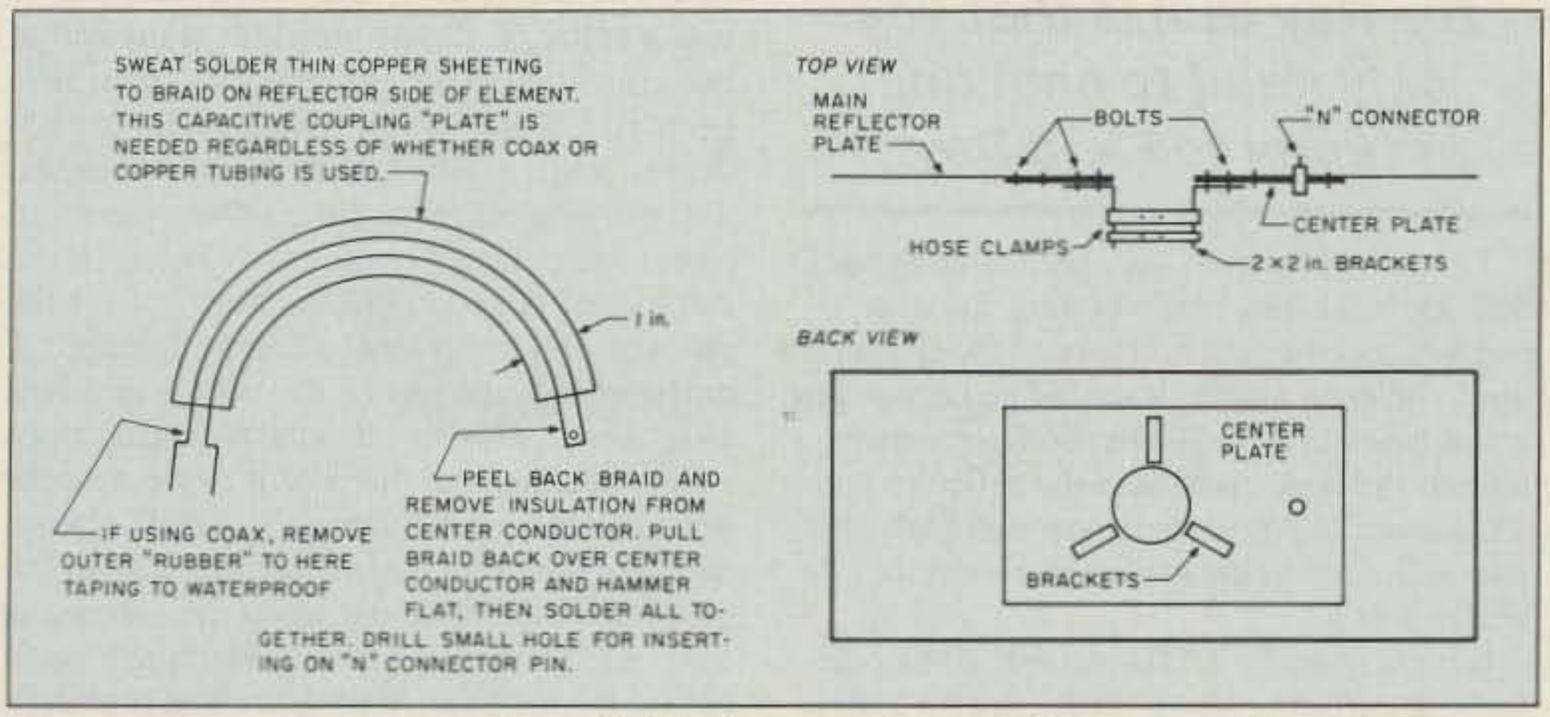

Figure 3. Final construction details.

Construction Details

I began by constructing the 2m beam (see Figure 1). The central boom is a 1¼" wooden closet pole eight feet long. (You can use less but it's nice to have plenty to work with.) The elements are squares made from 3/16" copper tubing (the tubing size is not critical). The element supports are made from 5/16" dowels. (Again, their diameter is not critical.) The insulator on the driven element was fashioned from a piece of plexiglas. The elements are connected to the dowel supports by the system Jim McKim WØCY used in his helix. (See Figure 1 for details.) The dowel supports are mounted to the "boom" by drilling 11/32" holes ½" deep in the boom. Fill the holes with fresh carpenter's glue and force the dowels into place.

The elements are not mechanically strong. I found it helpful and practical during construction to suspend the boom on small ropes thrown over the ceiling joists of my garage. The finished antenna is held up by a fitting on the boom. The mechanical integrity is more than adequate when supported in this manner.

The key element of the helix (Figure 2) is the reflector. The exact overall dimensions are not critical. To quote WØCY: "The helix is about the most tolerance-forgiving of any antenna." He used a 30" diameter circular reflector; I used a 24" x 30" rectangular reflector on my home base and a 14" x 27" rectangle on the Ray Gun because that is what I had on hand. However, I suggest you use something at least 24" x 24". A good source material is the design-punched aluminum sheets sold by most do-it-yourself stores for kick panels for screen doors. However, they are thin and you will have to brace them by bolting on flat metal or small angle iron strips, also available at local stores. The center area piece must be stronger. It can be made from an old aluminum rack panel or something similar. It should be 9" x 9", or a 10" circle (not critical as long as it is big enough to mount the 4" offset feedpoint). Bolt it to the larger reflector plate.

Refer to Figure 3 for the construction details of the next steps. Drill or cut a hole in the center large enough to allow the boom to pass through. (I suggest 1-5/16".) Place a second hole, to accommodate a panel mount "N" connector, 4" off center. Attach three 2" x 2" right angle brackets to the reflector at the edges of the center hole (at 120 degree angles). This can be done by drilling and bolting, using 6-32 bolts. The idea is to have the brackets placed so that when the boom is run through the center hole it can be secured by radiator hose clamps tightened around the brackets. Later you can "match" the antenna by varying the capacitive coupling between the first half turn of the helix and the reflector screen. The sweat-soldered copper on the first half turn facilitates this procedure.

When the reflector assembly is ready, set it aside and mount the helical element. Run strips of ¾" by ¼" molding parallel to the boom, with their outside edges 8" apart. (See Figure 2.) Lay them against the quad support dowels and hold them in place with C clamps. Use a small drill, sized to fit toothpicks, to drill holes through the molding and the dowels. Pin the molding in place by putting round toothpicks through the holes and gluing the toothpicks in place. Cut small notches in the outer edge of each molding at 6" intervals, offsetting notches on one molding 3" from