The Motorola 80D on 220 mc F.M.

Part III—Antennas

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PART I of this series of three articles about f.m. operation on the 220 to 225 mc band described the modification of a high-band 30-watt transmitter from the Motorola -80D equipment. Part II detailed the conversion of the high-band "G" receiver strip to 220/225 f.m. Now we will describe two easy-to-build vertically polarized 220/225 antennas suitable for general operation on this band.

Why Vertical

Remembering the history of f.m. on 6 and 2 meters, it follows that vertical polarization is a must for *general* operation on 220-225 mc. (We are *not* talking about the use of 220/225 for point-to-point control links for repeaters.) This is logical, for the same reasons that operation on the high end of the 220 /225 band is suggested; that is, the fact that most a.m. and DX operators are on the low end, and *they* are using horizontal antennas. For general f.m. operation, considering the lack of crowding on the high end, omnidirectional vertical antennas are more practical. Furthermore, they are real easy to build; and, looking to the future, mobile 220/225 f.m. with a vertical antenna on the car is likewise logical. The trump card, winning for vertical polarization, is that TV antennas are horizontal. When we use vertical antennas the possibility of TVI is greatly reduced. It works the other way around, too. Image interference *from* TV stations to our receivers is drastically reduced when our antenna is vertical.

The Ground Plane

Construction of a ground plane antenna for the 220-225 mc band is is simplicity, itself. The photograph should be sufficient; however, fig. 1 details an L-shaped mounting bracket. A coax chassis connector, an SO-239, is mounted on the bracket which can fasten to a length of TV mast via the two U-bolts shown. The length in inches of the quarter wavelength radials and the vertical radiator is figured by dividing 2770 by the operating frequency in mc. For 224.95 mc this comes out to 12⅝/16"[sic: $12\frac{5}{16}$"]. The material used was #18 copperweld electric fence wire. Put a small loop on each end to prevent injury to anyone while handling. The four radials are fastened under the four screws that mount the connector to the bracket. The radials should be bent down at roughly a 45 degree angle. A UG-106/U hood was used underneath to mate the coax to the connector.

The vertical radiator was soldered into a pin plug, one of two removed from the -80D dynamotor. The cap from a PL-259 can be used with a short length of plastic tubing to

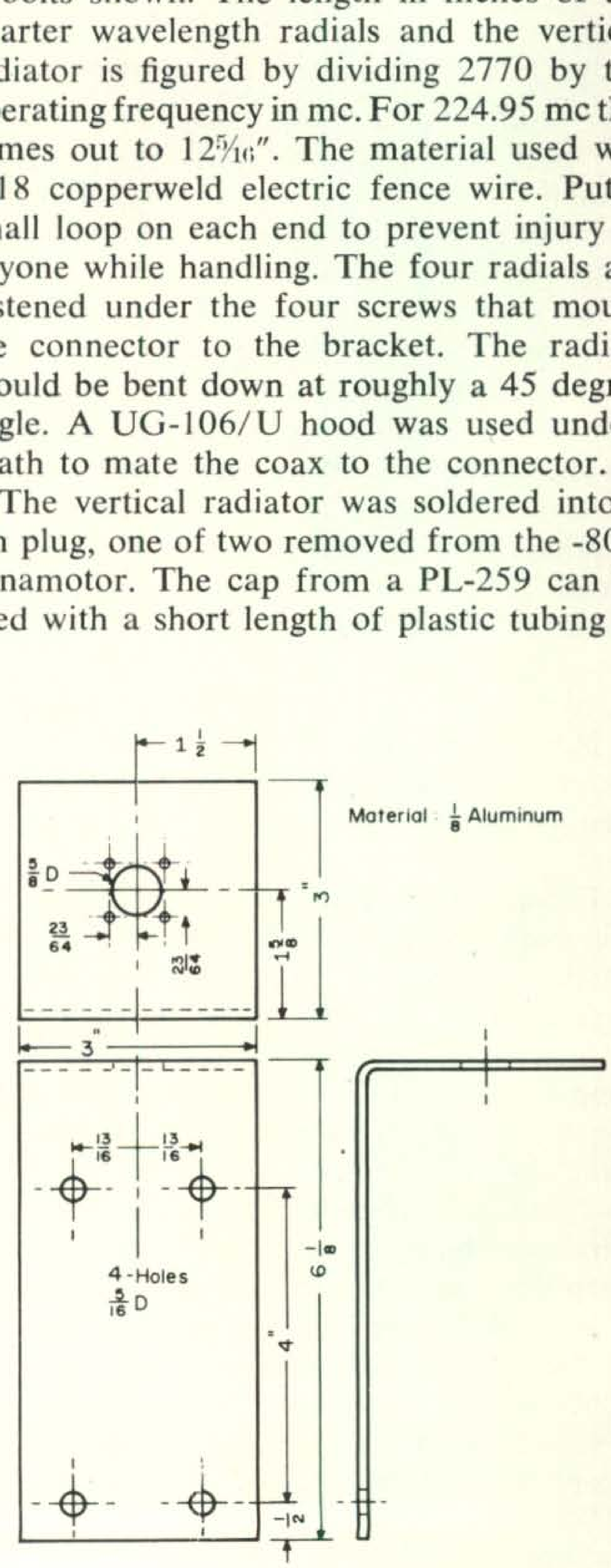

Fig. 1—Ground plane mounting bracket, mechanical details.

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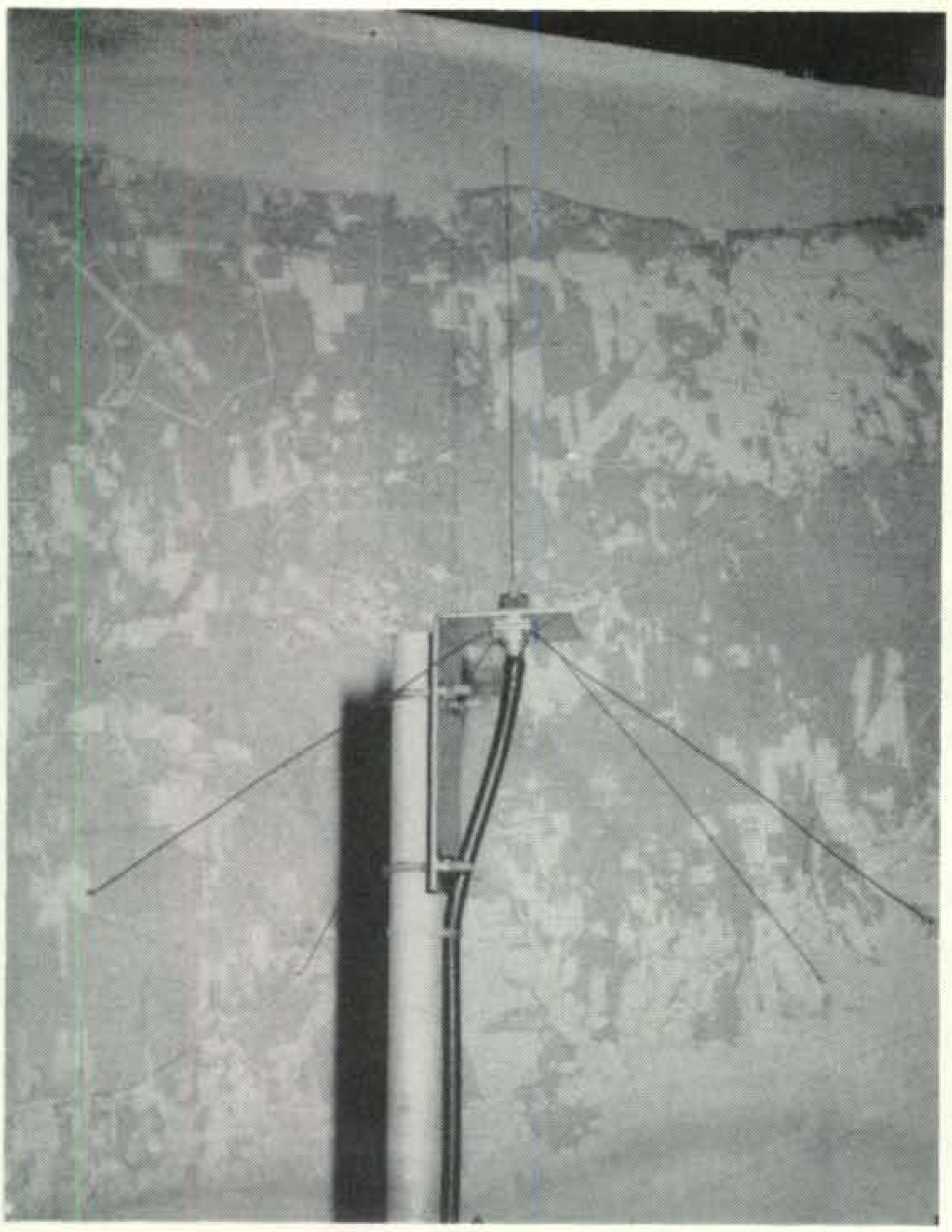


The ground plane antenna for 224.95 mc f.m. Drooping the radials reduced the v.s.w.r. to 1.1 to 1 at the design frequency. No other special matching was needed.

fit around the pin plug after it is inserted into the SO-239. The whole connector, both the top and inside the hood underneath, should be filled with silicone compound, such as Amphenol 53-307 or Motorola 11T834678. The idea is to keep out water.

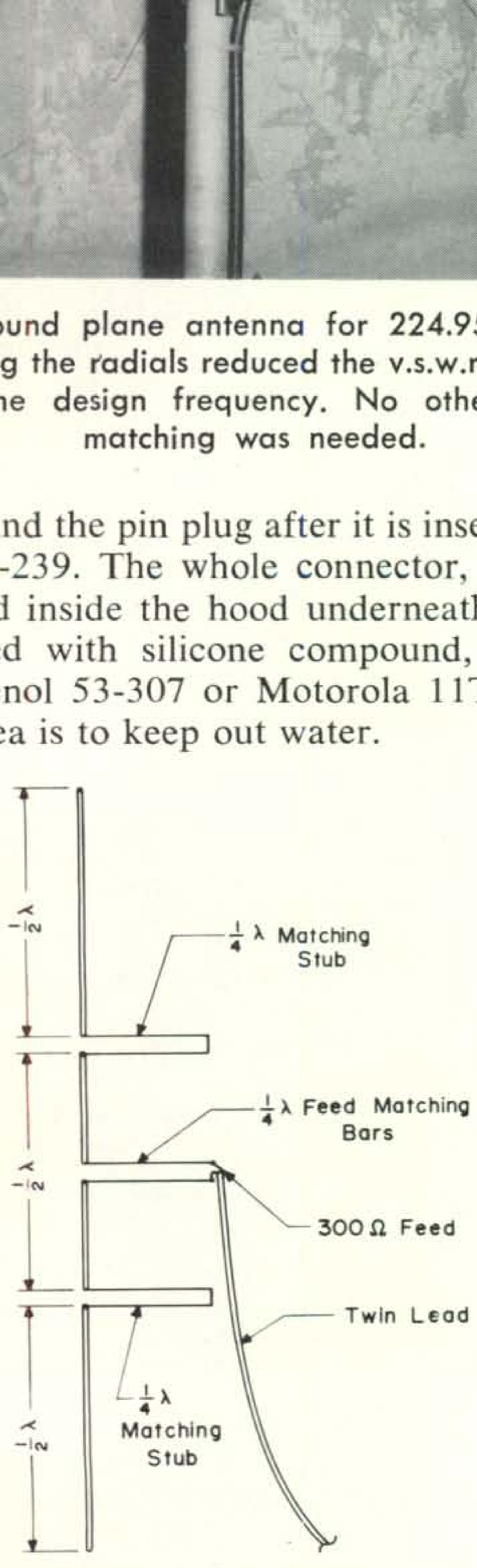


Fig. 2—Franklin antenna, or three half waves in phase.

A Gain Antenna

Gain in an omnidirectional antenna is obtained by vertical stacking of half wave elements. In the early days of ham v.h.f. the Franklin antenna was very popular, and very effective. Figure 2 shows three half wave elements stacked in this configuration. Building such an antenna is not easy. The quarter wave stubs can be bent into loops, but the feed should be brought out at a right angle to the antenna, kind of hard to do. Such a structure is inherently fragile, too.

There *is* a better way to build this type of gain antenna, keeping the three half waves in phase for a gain in the order of 4 db. The Harris development[1] of the Franklin antenna neatly solves the electrical problem of feeding this array in the center by using coaxial cable for the lower half since coax can be readily formed into folded stubs. Figure 3 diagrams this antenna for 224.95 mc. (The lengths are figured from the ARRL *Handbook* formula where a half wavelength in inches is equal to 5540 divided by the frequency in mc.)

The top half of our 224.95 mc gain antenna is shown thinner than the bottom half only for the sake of clarity; both halves are made from RG-58/U. A piece of close-woven copper braid was used as a decoupling sleeve. (No ground radials are necessary with this antenna.) The braid was soldered to the

[1]Harris, E. F., "UHF Mobile Antenna," *Electronics,* May 1953, P. 181.

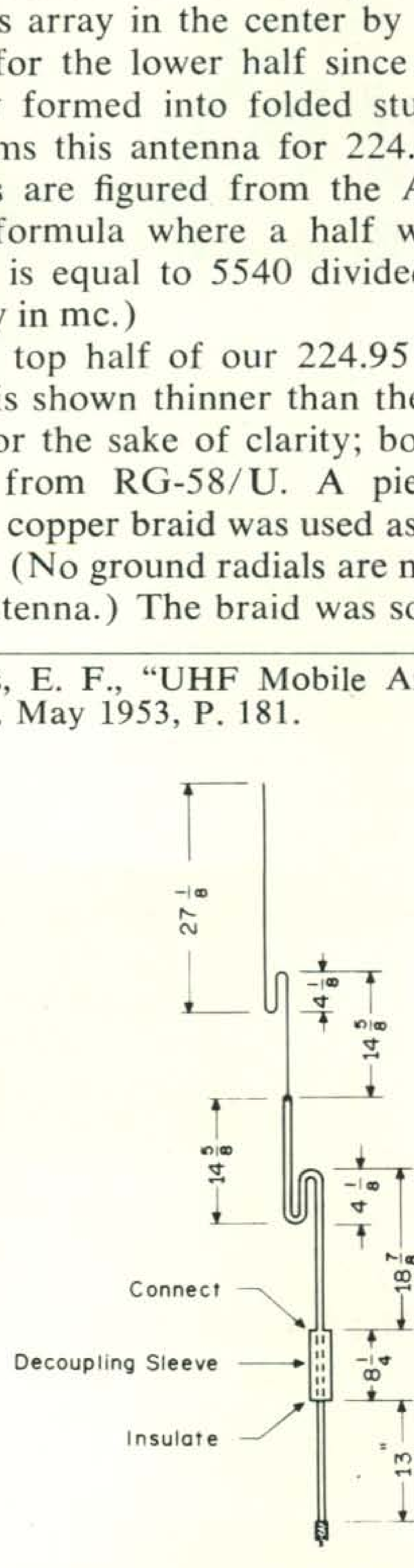
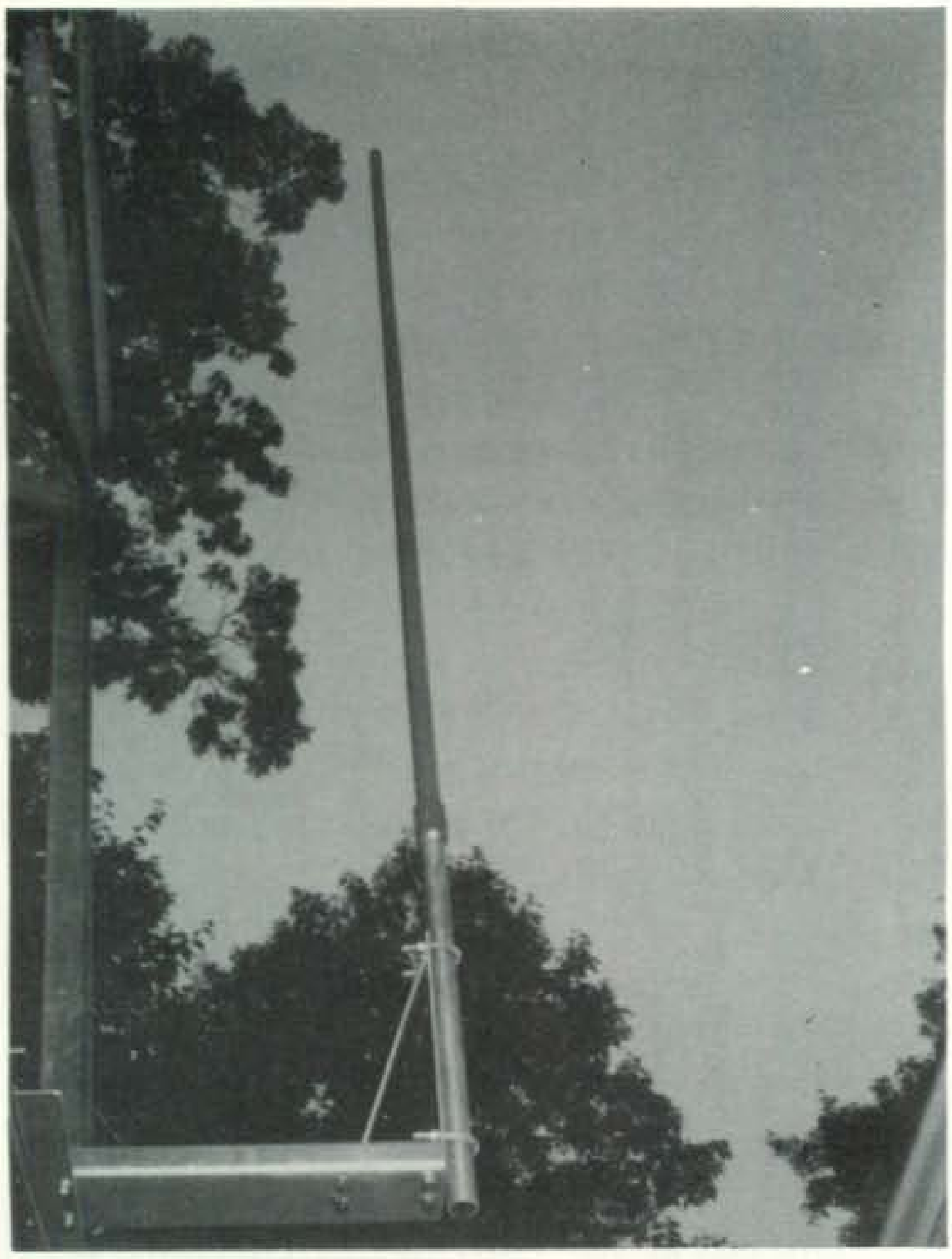


Fig. 3—220/225 mc gain antenna details.



The 220/225 gain antenna in the air. Its length is 7 feet plus 18" for the aluminum mounting pipe. Note the absence of ground plane radials—none are needed.

coax at the point labeled *connect* in fig. 3. At first we simply ran the braid over the outer vinyl covering of the RG-58/U. A gradual increase in v.s.w.r. was traced to heating at the insulated end of the decoupling sleeve. The solution was to strip off the vinyl outer covering of the RG-58/U at the sleeve position and substitute a short piece of teflon tubing for the required insulation.

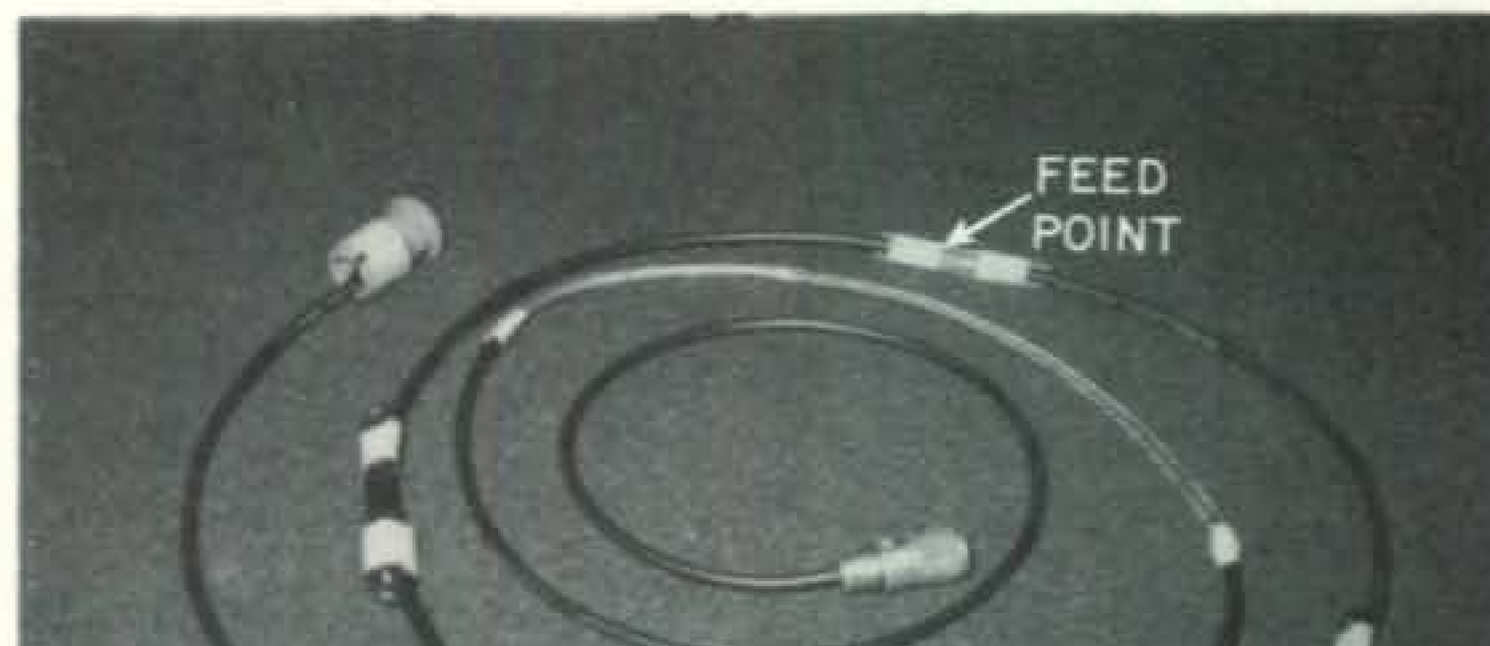
Construction of the Gain Antenna

Commercial gain antennas of this type are usually enclosed within the protective covering of a fiberglas tube. This material is sometimes available, in the form of fish poles or outriggers, near boat yards, but even in this form it is fairly expensive. A much more economical approach is to use plastic "PVC" pipe. This can be obtained from plumbing suppliers, or Montgomery-Ward and Sears-Roebuck, for around one or two dollars for a ten foot length. We used the standard 3/4" (ID) pipe size, also purchasing the special cleaner and PVC cement used to mate this kind of pipe.

We cut a seven foot length of the 3/4" PVC pipe and cemented it into a PVC adaptor to a 3/4" female pipe thread. This permits the antenna to be mounted on the end of a short piece of standard metal pipe. Aluminum thick-walled pipe or conduit is recommended since it is much lighter than iron pipe, and it doesn't rust. A piece of lacing twine was used to anchor the top of the antenna to a PVC plug at the top, cementing in the plug.

You can make a really waterproof assembly by pouring into the pipe (after the antenna is in, of course!) expandable polyurethane foam. Be *sure* that the bottom end is plugged with caulking compound, otherwise the solution will run right out before foaming. Polyurethane foam in liquid form, which must be mixed, is available in most well stocked hobby stores as it is used frequently in model airplane building.

While the gain antenna itself is made from RG-58/U, it *not* recommended that RG-58/U be used for the transmission line run. Reason? RG-58/U loss is about 6.5 db per 100 feet at 225 mc. RG-8/U has a loss of a little over 3 db at this frequency. And there are several varieties of a foam dielectric "RG-8" available. These have even less loss than the RG-8/U. In particular we suggest using the type T4-50 made by Times Wire and Cable. Be sure to use the silicone compound previously mentioned in the connector at the bottom of the antenna when you go to the better transmission line. And, of course, tape this connector junction with a good all-weather vinyl electrical tape such as the Scotch #88T. ■



This is what is inside the 220/225 gain antenna. Made from RG-58/U, it is shown coiled up to simplify photography. Observe the mechanical strengthening at the feed point by means of a couple of strips of PC board material. Also, more of the vinyl outer covering below the decoupling sleeve was removed than was necessary.