A 5 ELEMENT QUAD-YAGI FOR 20 METERS

BY RONALD LUMACHI,* WB2CQM

This antenna is designed for optimum side rejection and front to back ratio to aid in picking up that elusive signal buried in the QRM. In this quad-yagi combo the yagi element is driven.

The increased participation in the realm of amateur radio necessitates the need for more sophisticated and elaborate equipment. At one time, the dipole, 20-30 watts of a.m., and a grid leak type t.r.f. receiver were all the components necessary to "work the world" at leisure. Today's improved methods of communication, elaborate receiving apparatus, and a reasonable 2-3 element beam array are not truly sufficient to combat the chaos on the high frequency bands. This beam antenna article presupposes the fact that a three element beam, because of its inherent shortcomings, cannot cope with the QRM level to the side and rear of the listening station.

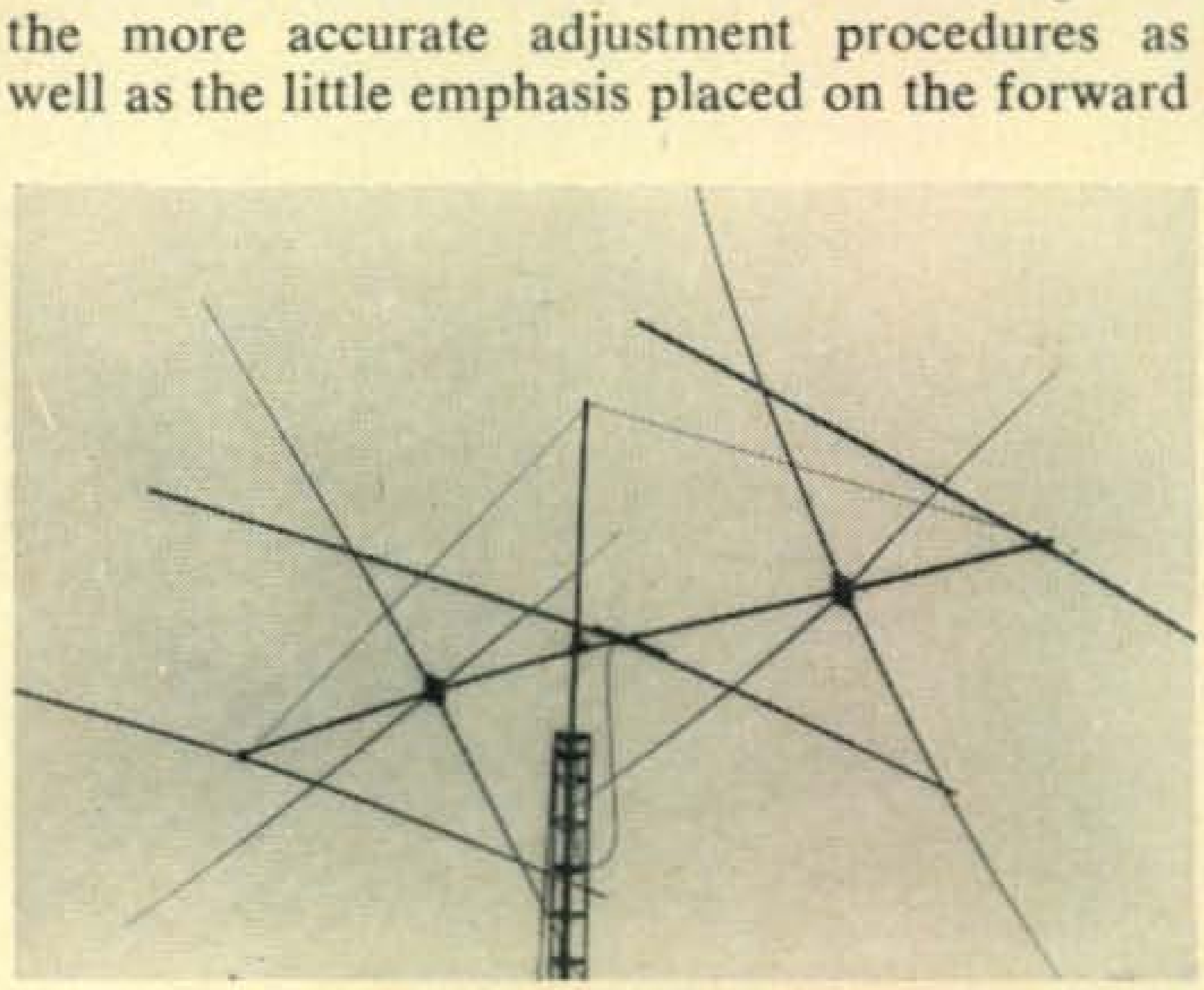
For example, most east coast amateurs will not argue the fact that a yagi's 25 db front-to-back ratio is unable to cancel out signals emitted from the central and western states while Europe and East are being scanned. They will also agree that the gain of the 3 element array, in conjunction with even moderate power, is sufficient to project a signal to even the most remote parts of the world; however, listening for the faint S2 reply in a backdrop of S7 QRM is disheartening. Carrying this antenna problem to its logical conclusion, a design was arrived at for maximum attenuation to the side and rear, with perhaps some slight sacrifice in forward gain.

This quad appendage project is geared primarily toward the amateur who presently boasts a commercial yagi installation and who has, at least on one occasion, wished for improved side and rear rejection. Taken into consideration in the subsequent text is the beam-less station with a discussion related to the simple construction of the three element yagi component.

Much work by amateurs has been undertaken in perfecting the quad system with yagi additions, and the results have stimulated this beam project along those lines. However, this system added a *quad director* and *reflector*, parasitically coupled, while maintaining yagi matching and feed points exactly as found with only some slight element resonance adjustments. Primary justification includes a reasonably accurate knowledge of the yagi's driven element input impedance since most commercial beams incorporate the driven dipole as the exciting source. Rudimentary data depicts the high current input terminals of the dipole as a roughly 72 ohm load with only slight variations in the practical installation. Consequently, an estimate of reasonable accuracy concerning the load impedance can be assumed. Data concerning the high current points of the quad are diverse. However, personal experiences indicated a roughly 100-120 ohm antenna line terminus. Needless to say, alteration of the quad feed point for impedance matching is cumbersome and the amateur usually tolerates the excessive s.w.r.

Of equal import in choosing to feed the yagi element was the very convenient method of frequency adjustment. The telescoping provisions of the yagi elements in conjunction with very accurate length versus frequency formulas provided simple element-to-element relationships. With the driven quad, stubs are the usual method of altering frequency, however, the geometric and electrical balances are disturbed by these additions. It might be well to mention that perhaps some loss to the low angle of radiation results with yagi drive.

This was considered and overlooked in light of the more accurate adjustment procedures as well as the little emphasis placed on the forward



View of the complete 5 element 20 meter quad-yagi antenna atop the mast.

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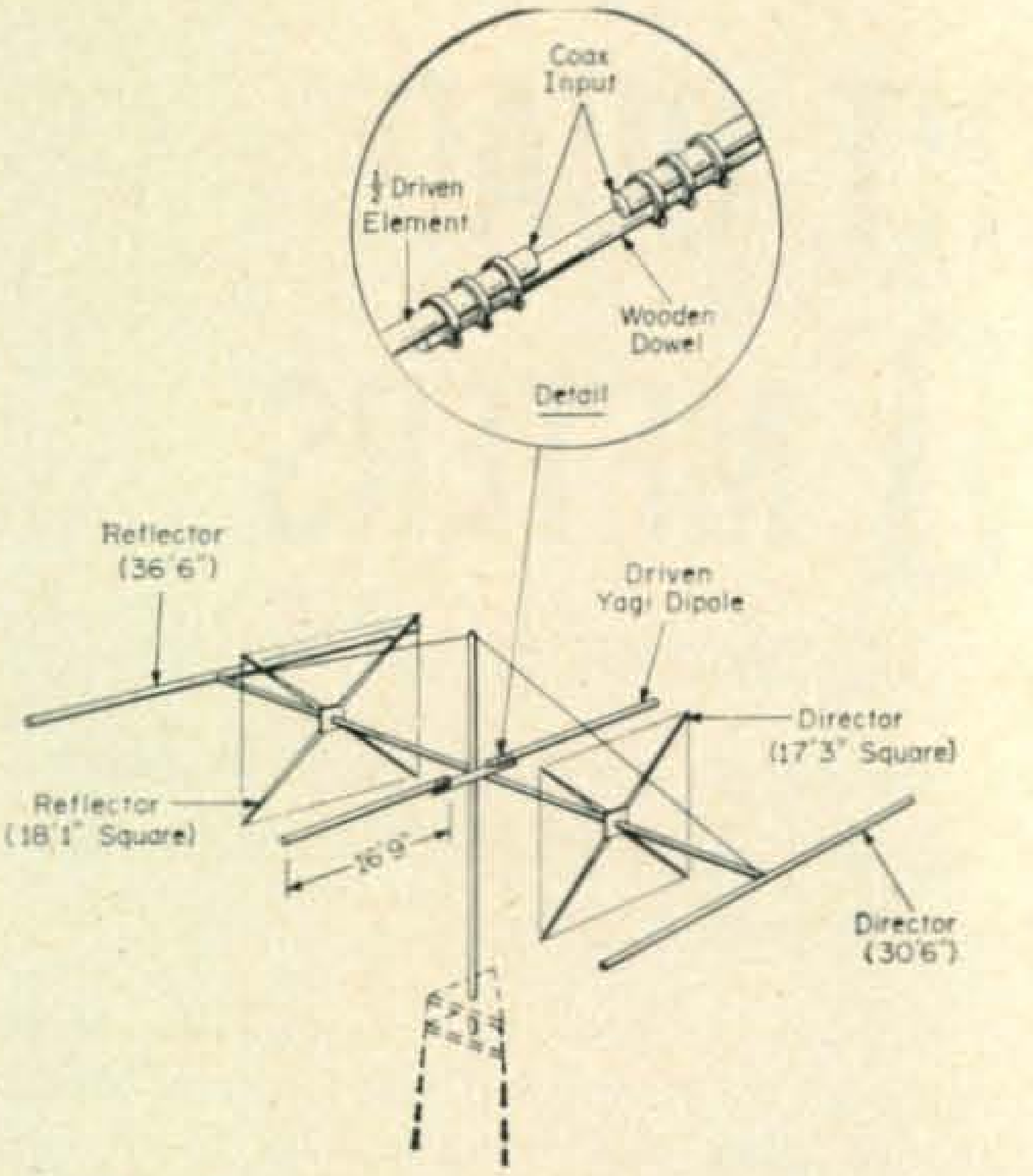


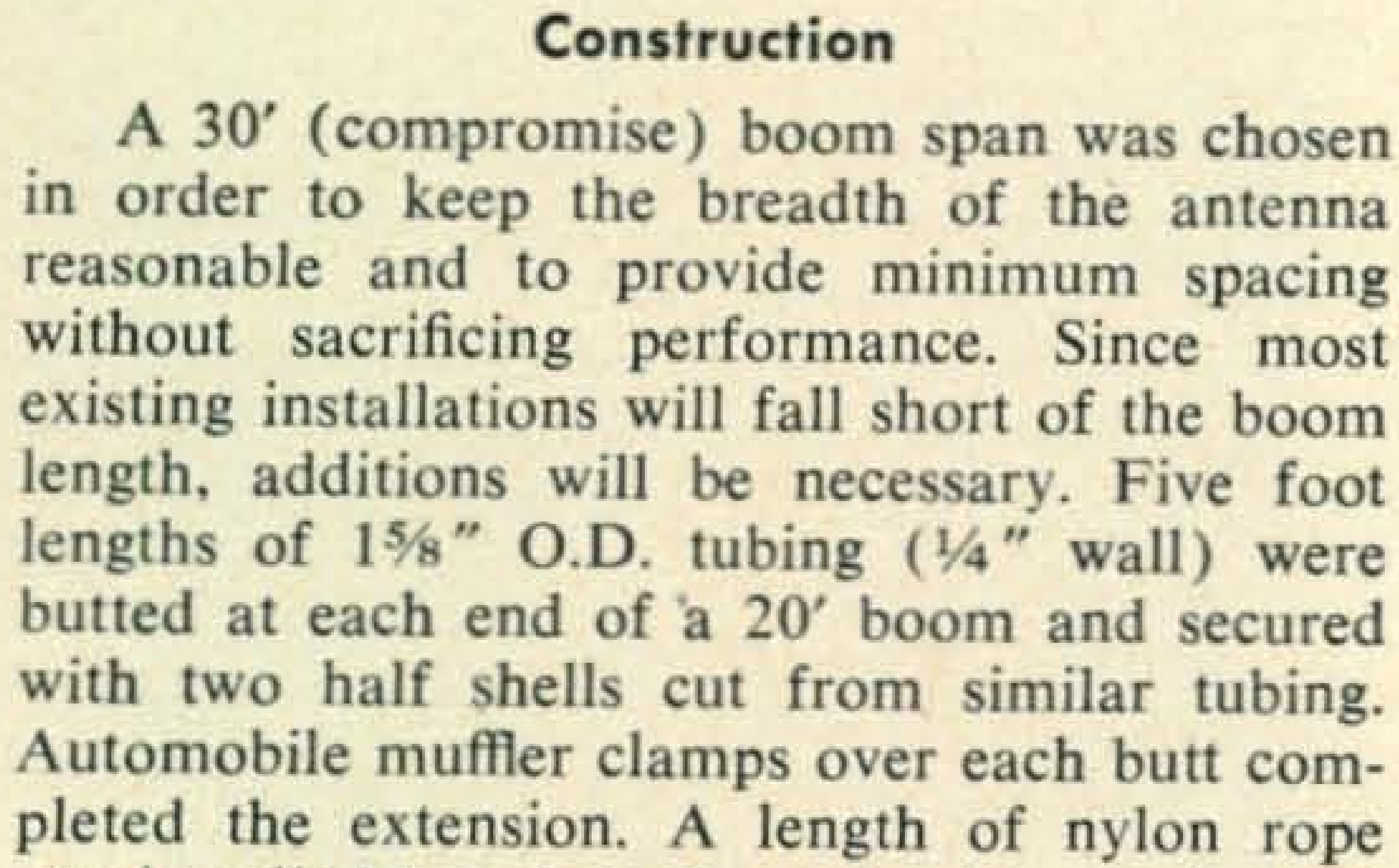
Fig. 1—Overall view of the quad-yagi five element array for 20 meters.

gain factor. I might also mention that maximum gain and minimum signal attenuation to the rear do not occur simultaneously, and one is available to the amateur only at the expense of the other.

Construction

A 30' (compromise) boom span was chosen in order to keep the breadth of the antenna reasonable and to provide minimum spacing without sacrificing performance. Since most existing installations will fall short of the boom length, additions will be necessary. Five foot lengths of 1⅝" O.D. tubing (¼" wall) were butted at each end of a 20' boom and secured with two half shells cut from similar tubing. Automobile muffler clamps over each butt completed the extension. A length of nylon rope was installed to reduce the sag and secured about three feet above the boom-mast bracket via a mast extension.

For those with no previous beam system, yagi construction was accomplished rather cheaply and simply by utilizing a product manufactured by Rota-Lock, Berkeley, California. These units were designed for rapid assembly of



View of two interlocked members of the array using a one bolt adjustment Rota-Lock made by the Up-Right Scaffolds, 1013 Pardes Street, Berkeley, California.

Parts List

Quad Components

2 pieces 12" × 12" plywood ½" thickness.
2 Nu-Rail #40 floor flanges 1¼" I.P.S.[1]
8 Fibreglass hollow spreader arms.[2]
16 carriage bolts, nuts, washers 2½" × ¼".
2 rolls #14 copper wire 72'.
8 lengths of 12" × 1⅛" wooden dowel.

Yagi Components

3 lengths of 12' × 1½" o.d. tubing 0.058" wall thickness.
6 length of 6' × 1⅜" o.d. tubing 0.058" wall thickness.
6 lengths of TV masting, 10'.
6 stainless steel hose clamps 1½".
6 stainless steel hose clamps 4".
1 length of wooden dowel 4' × 1½".
3 Rota-lock scaffold clamps 1¼" I.P.S.[3]

[1]Available from: Hollaender Manufacturing Co., 3841 Spring Grove Avenue, Cincinnati 23, Ohio, or, Whitehead Metals Inc., Milik Street, Carteret, N.J.
[2]United States Fibreglass Co., 5101 NW 36 Avenue, Miami, Fla.
[3]Rota-lock, 1013 Pardes Street, Berkeley, California.

scaffolding where lengths of pipe are fitted perpendicular to each other. The 1¼" units worked perfectly and provided a rigid boom-element connection with the tightening of only one bolt. The yagi elements consisted of two 6' lengths of 1⅜" 0.058" wall tubing inserted 6" into each end of a 12' length of 1½" 0.058" wall tubing. A small hole was drilled through the interlocked elements and secured with a self-tapping screw for a low loss electrical bond. Inch and a quarter TV masting, (10' lengths) available universally, were inserted into each end of the 1⅜" units and adjusted to resonance (fig. 1). Since subsequent adjustments will probably be made with each element due to installation pecularities, slit the 1⅜" tubing lengthwise about 2" and install a 1½" stainless steel hose clamp over the joint, facilitating a telescoping movement.

After completing construction of the driven element yagi component, measure the exact center of the 1½" tubing and cut through with a hack saw. The exciting element is in essence a dipole and must be insulated above the ground potential of the boom. A 4' length of 1½" diameter wooden dowel serve as the insulator. Several coats of varnish protected the raw wood. Three stainless steel hose clamps (4") secured around the tubing and the wooden dowel supported the elements and have proved adequate. In this high current application, the wood has

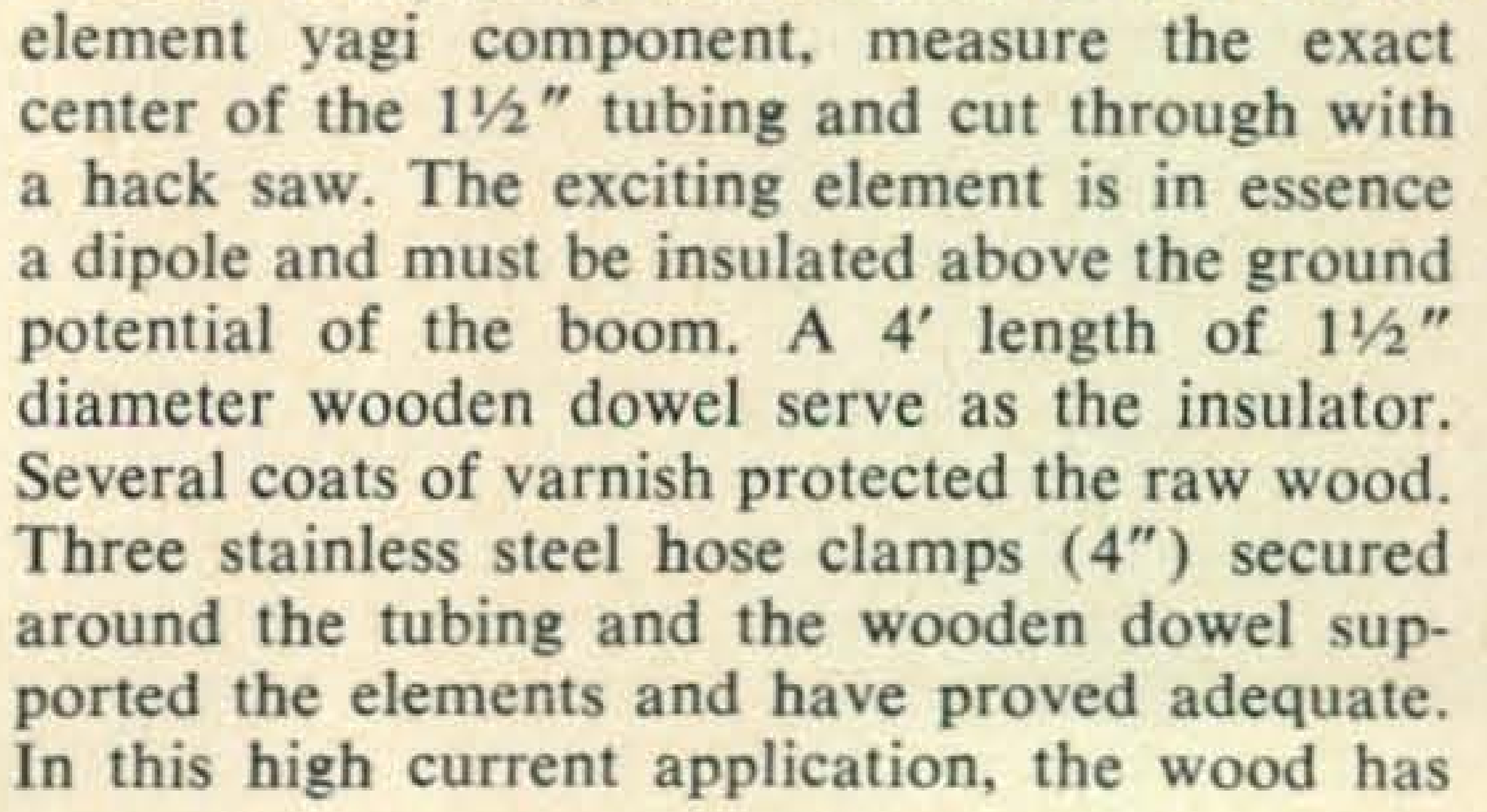
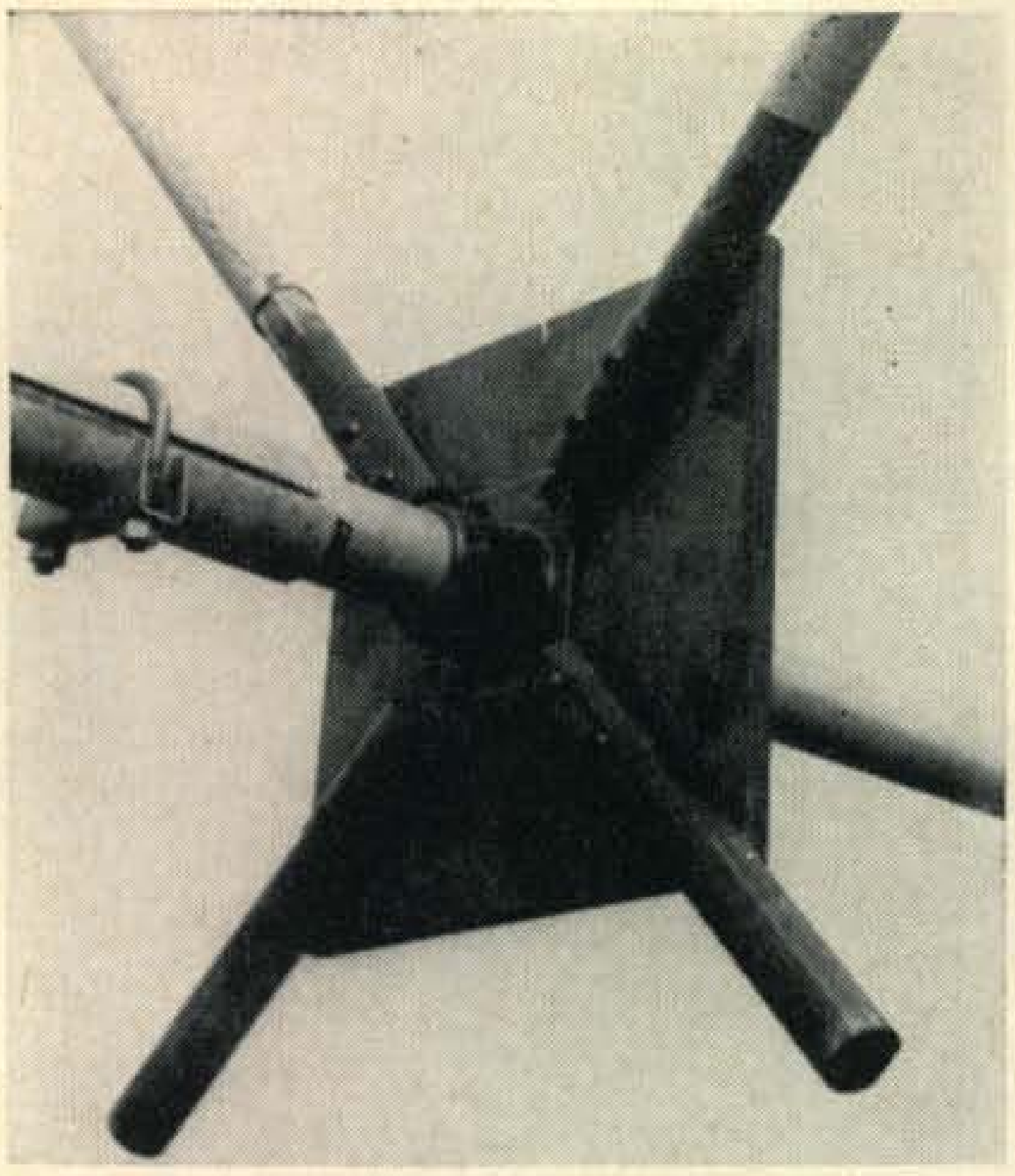


Fig. 2—Element location and spacing along the 30' boom of the 5 element quad yagi.



Spider construction showing the two vertical fibreglass members wedged in place.

been a satisfactory insulator. A more detailed sketch is shown in fig. 2.

Quad Construction

The spider complex was designed around an aluminum flange 1⅝" O.D. (with set screws) and a 12" square of ½ or ¾" plywood. A 1¾" hole, centered on the plywood, allowed for movement on the boom. Since the fibreglass arms were hollow, with an inside diameter of 1⅛", dowels of equal diameter, 12" long, were cut and attached at each right angle corner of the plywood by drilling and installing 2" × ¼" carriage bolts and nuts. To prevent the dowel from splitting, small half shells made from a length of TV masting were drilled and placed between the bolts and dowel. This rather crude but efficient spider unit mates perfectly with the spreader arms. To ease construction, the two upper support arms were assembled at ground level by simply placing the spider dowel into the fibreglass base for a "jam fit".

The perimeter of the quad reflector measured 72'5" and the director element measured 69' (resonance at 14.270 kc). Heavy formvar #14 wire was stretched and marked along its length (fig. 3) with a small dab of white paint. ⅛" holes were drilled in each fibreglass arm 12' 9" and 12' 1" above the hub of the reflector and director respectively. The wire was installed horizontally between the two upper elements and the remaining lengths allowed to hang freely. The yagi elements and quad components were then positioned on the boom (fig. 4) while still at ground level convenience. The antenna was then raised about 9' and the four remaining lower support arms lifted from the tapered ends and fitted into the dowel rods. The dangling wire was then passed through the lower vertical support at the pre-drilled points and the two loose ends bonded together and soldered completing the closed loop. The antenna was then raised to its operating height for the completed installation.

Performance

On-the-air performance at an operating height of about 40' has netted extremely gratifying results. For example, a local 5-9/40 db signal was attenuated below the noise level when the antenna was at right angles to that station and the signal reduced to S4 with the back of the antenna pointing in that direction. These figures are certainly an advantage to the DX'er ever-searching for the rare one that can now be heard.

Dut to the mutual impedance affects of the close spacing, the radiation resistance measured approximately 40 ohms. Those with the modified commercial yagi systems can easily adjust their matching devices for a perfect power transfer, however, for the average homebrew installation, connect the center conductor and shield of the coax to each dipole element directly.

Feeding a balanced dipole with an unbalanced coax seemed to produce no ill results. I purchased a 1:1 balun for $10 from Fugle labs. 1835 Watchung Ave., Plainfield, New Jersey and it proved worthwhile. The coax is now free from r.f. and the bridge shows a very low s.w.r. ■

Simple Mobile Power Source

BY VICTOR H. ORTEGREN,* W6WFR

Now you can go mobile without a d.c. to d.c. supply if you car has an alternator instead of a generator. When the automobile salesman said that the car had a three phase alternator I started checking. Sure enough, it was 3 phase. It took a little fishing to find the single phase pair of the three wires leading from the field windings to the diodes.

I connected directly to these two wires, before the diodes, and came out to a duplex a.c. receptacle and a 0-130 v.a.c. meter and mounted both beneath the dash. (The voltmeter can also serve as a tachometer.) The output is about 80 cycles.

At the peak engine r.p.m. it is possible to get 130 volts a.c. output. I have been operating a KWM-2 s.s.b. rig on this for 10,000 miles now and it has held up fine.

When driving in heavy traffic some extra shifting is required to hold the engine r.p.m. at the correct level for a 117 volt output. If the voltage drops or rises the transmitter frequency is not too stable. A voltage swing of 95 to 130 volts seems to have no adverse affect on the receiver stability. ■

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