Five Half-Waves in Phase on 144 Mc

A "Gain" Antenna for 2-Meters

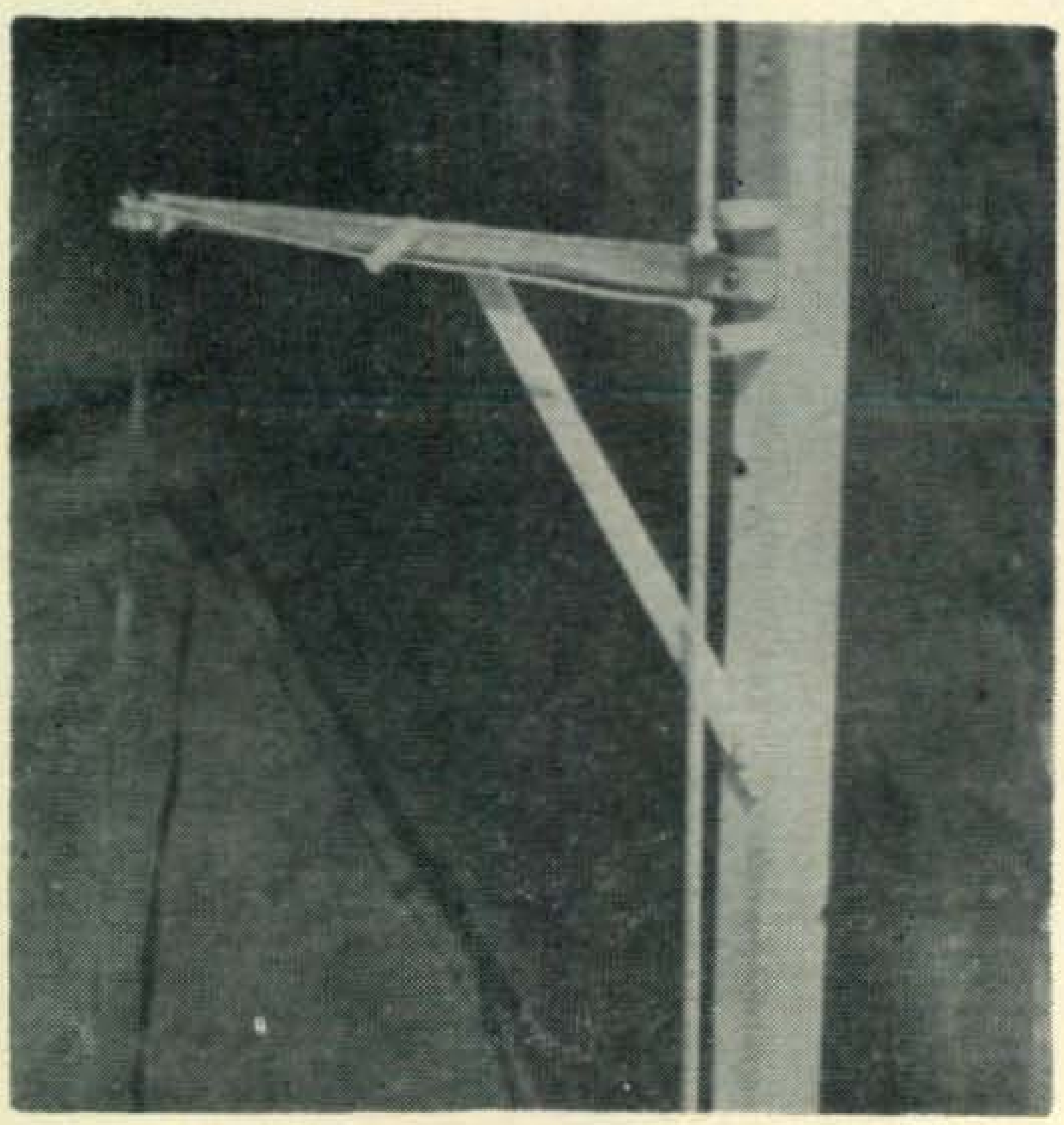
BY BYRON H. KRETZMAN*, W2JTP

On two meter mobile and f.m., the vertical antenna still holds the edge on popularity with its omnidirectional characteristics and simplicity. Add to this, though, a little omnidirectional gain on the order of 5 db and the vertical begins to look even more enticing than ever.

In case you didn't know it, not all 2-meter activity consists of DX-chasing, meteor scatter, contests, *etc.* In many areas, I'll grant you metropolitan and suburban for the most part, local and extended-local communication exists on a highly reliable day-in and day-out basis. Mobile operation, quite naturally, is a regular part of this activity. This harkens back to the days of the old 5-meter band where such v.h.f. operation began. As the result, hamming in these areas becomes a much more personal thing; everyone soon gets to know everyone else. It becomes easy to round up a gang to help put up a tower or a beam for another band.

Keeping in mind that working mobiles is a requirement, you can see that vertical polarization is a must. Secondly, those who have tried beams quickly realize that, in these centers of high activity, beams are impractical. Too much can be missed off the back end. An omnidirectional antenna characteristic therefore becomes an additional requirement.

*431 Woodbury Rd., Huntington, N. Y. 11743.



Center feed arrangement showing how the linear matching transformer is twisted to enable the twin-lead feeder to drop straight down.

Omnidirectional antennas for 2-meters usually fall into two classes: the ground-plane or the coaxial-type. Both of these normally provide no gain in performance over a reference half-wave doublet, with the possible exception of the stacked coax antenna. What we are searching for is a 2-meter antenna which is vertically polarized and which will give us a power gain in *all* directions. Bear in mind, too; any gain achieved in the antenna system also results in increased range of reception. And, lastly, a high gain omnidirectional vertically polarized 2-meter antenna should be easy to construct at low cost. (This lets out the stacked coax unless you have the facilities of a machine shop available.)

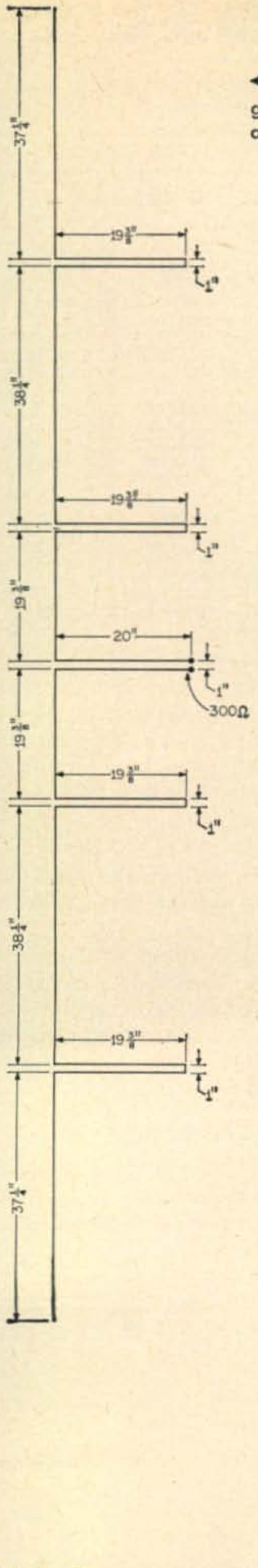
Theory

Gain in an omnidirectional vertically polarized v.h.f. antenna is realized basically by stacking half-wave elements, one above the other. The trick is to phase them properly and to feed them efficiently. This is nothing new. Twenty-five years ago this was called the "Franklin" antenna. Today a somewhat similar antenna is described in the ARRL *Handbook.*

From page 703 of the 4th edition of *Reference Data for Radio Engineers* (ITT), the gain of an omnidirectional stacked array is approximately equal to $2L/\lambda$ over the theoretical isotropic radiator, where L is the length. If we build an antenna of 5 half-waves in phase, the length, in terms of wavelength, is 2.5λ. Putting this into the above formula, the power gain is then $2(2.5)$ or 5 times. Since a half-wave dipole is considered to have a gain of 1.64 times the isotropic radiator, the antenna will therefore have a power gain of $5/1.64$ or 3.05. This, then, is an effective gain of 4.84 db.

A Practical Antenna

Figure 1 shows the schematic diagram of



◄ Fig. 1—Schematic diagram of the 2-meter gain antenna. (Antenna cut to 147 mc.).

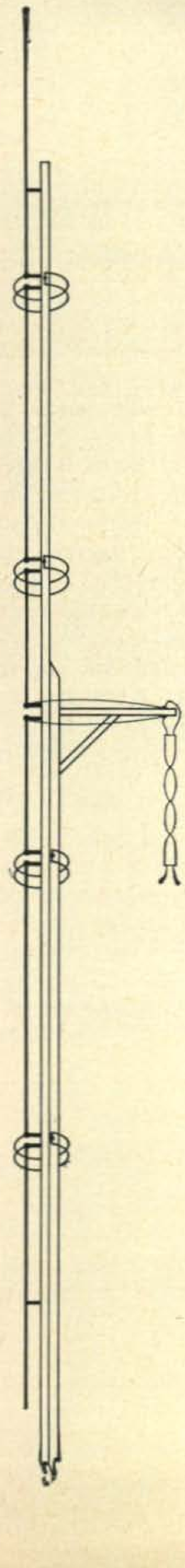
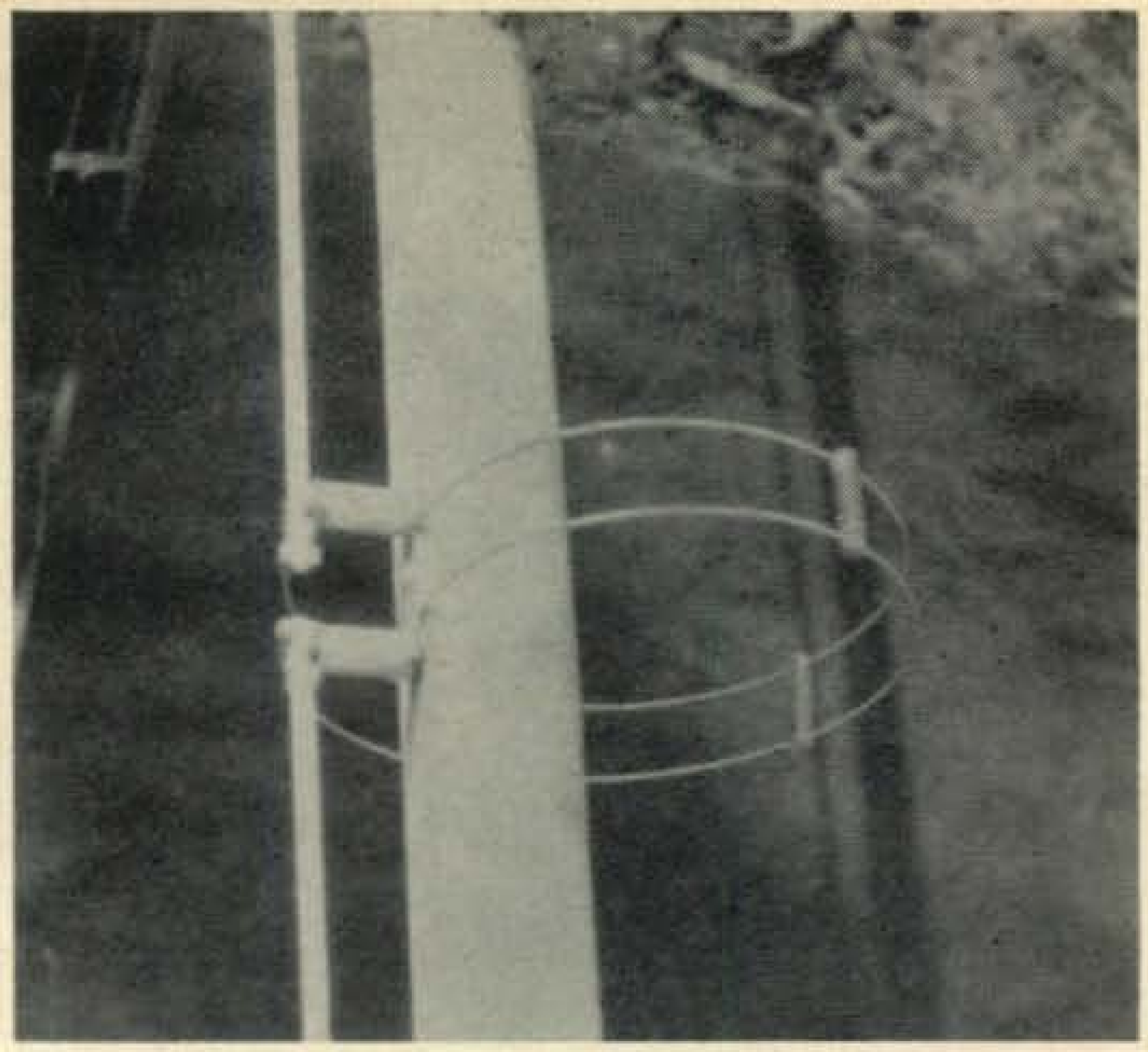


Fig. 2—Perspective view of omnidirectional antenna.►



One of the four quarter-wave matching stubs. Note how it is curved around into a halo about 6" in diameter.

our 2-meter "gain" antenna. As you can see, it consists of five half-waves in phase, one above the other. There are quarter-wave matching stubs in between each element, and the feed point is at the center of the middle half-wave element. *(Feeding this array in such a balanced manner is one of the tricks in getting efficient operation.)* The antenna feeder is ordinary 300-ohm TV "twin-lead." *(Horrors!?)* This was done for several reasons. First of all it is low cost, as compared to coax. Secondly, its losses are less than ordinary coax; and, thirdly, because it is a mechanically simple balanced transmission line with readily available inexpensive (TV) supporting hardware.

Our antenna was cut to about 147 mc, and like any co-linear array it is reasonably broad, having a low s.w.r. out to at least 1 mc either side of that frequency.

You *could* feed this antenna in the center of the middle element directly with the 300-ohm twin-lead, that is if you don't mind a standing wave ratio of about 2 to 1. We did, so a quarter-wave linear matching transformer was installed at the feed point. The results were extremely gratifying. Its installation brought the s.w.r. down to 1.1 to 1.

Just one more point: Note that, in the interest of balance, the matching transformer is brought away from the feed point at a right angle; and, consequently, the twin-lead feeder is brought down at least a quarter-wave from the lower sections of the antenna thereby little affecting the feed impedance.

Construction

Our 2-meter gain antenna is built on wood. *(Horrors, again?)* Using wood greatly simplifies construction and reduces cost. You can't buy 2 × 2's twenty-four feet long but you *can* buy a 2 × 4 that long. Just a little sweet-talkin' to the lumber yard man and he will rip-saw it right down the middle for you. Of course you should get him to let you pick out a length as straight-

[*Continued on page 85*]

VHF Report *[from page 83]*

Memphis, Tennessee, seems to be the best place for winter skippers. Between December 14 and 17 alone, WA4IRX logged thirteen hours of DX worked. His four day catch included the states of Calif., Colo., Kans., Md., Mich., N.C., N.J., N.Y., N.M., O., Okla., Pa., S.C., Tex. and Wisc. This brought Al to 43 states with 204 counties confirmed.

Vince Varnas, K8REG, reports in this month from Dayton, Ohio, with news of his December DX. In addition to a list of states worked between Dec. 12 and 16 similar to WA4IRX's above, Vince worked WA6FQB on the 14th for a good 2,000 miler. Signals throughout the period averaged a few db over S9.

And to wrap up coverage of the *E* session, WAØDXZ checks in from Iowa City, Iowa, to tell of his DX heard on December 15th. Bob logged 50 mc stations in Ala., Ga., Iowa, Mich., Mo., N.J., N.C., Tenn., W.Va., and Wisc. Peculiarly enough, most were heard around 53.40 mc! By the way, WAØDJA and WAØDXZ will soon be sharing a six element 50 mc Yagi and a Clegg Thor VI.

Pre-Contest Reminder

Don't forget the Spring *CQ* V.H.F. Contest scheduled for the weekend of May 2-3. Our suggestion: make your plans now. Rules are identical to last year's Spring affair. Check page 32 of the March 1963 issue. See you in the contest!

73, Bob, K2ZSQ

Two Meter Vertical *[from page 81]*

grained and as free from knots as possible. Total cost? Less than $3!

After you get your lumber home, select the half most free from knots for the top section. A few minutes work with a carpenter's plane on the corners will save you from splinters while you are handling the antenna. It's time well spent. The remaining half we sawed in two to make the bottom of the classical "A" frame of hamdom. You could gain another 12 feet or so of height if you were to splurge and buy another (ripped) 2 × 4. We didn't.

The antenna elements themselves we recommend be made of aluminum to keep down the weight. We found some 3/16" solid rod in surplus, but almost any kind of aluminum rod or tubing up to about ⅜" in diameter can be used. Old discarded TV antenna elements, for instance. Another good possibility is #8 or #10 aluminum clothes-line wire. (This hard-drawn wire is stiff compared to the bare aluminum "ground wire" sold in TV parts stores.) Since we used the relatively stiff solid rod, only two ceramic one-inch high stand-off insulators were used with each element. The element was fastened to each insulator with nylon cable clamps, available in parts stores for pennies.

No doubt you have noticed that the quarter-wave matching stubs between each element have been curved around and have had their "shorting

For further information, check number 21, on page 110

bars" screwed down directly to the wood mast. *(Horrors, thrice!?)* Well, curving around these stubs makes the whole array lots easier to handle than if they were sticking straight out. No difference in performance was discernible when they were curved back, by the way.

The actual stubs were made of a continuous piece of #14 wire, so there were no mechanical problems with a "shorting bar." Spacing was 1", and three spreaders made from ¼" diameter plastic rod were slipped on the wires. The squared-off "shorting-bar" end was directly screwed down to the wood mast since this is "cold" in so far as r.f. is concerned. This resulted in a fairly sturdy halo about 6" in diameter.

The quarter-wave linear matching transformer at the feed point is much simpler to construct than to describe. This "*Q*-bar" section, 20" long, is made from #8 aluminum ground wire spaced at 1". One spreader was installed in the middle. To facilitate the dropping-down of the twin lead feeder, this matching section is given a 90° twist so that the junction point of the section and the twin-lead is horizontal. This junction point terminates on a square bakelite block screwed to the braced strip of wood used to bring the feed point out at right angles to the antenna.

To forestall any possible electrolysis problems and to prevent any loosening of hardware which might be caused by wind vibration, we brushed coil dope on each screw, bolt, and nut, and on the spreaders on the matching stubs. This is real good insurance.

Guying

Wire guys should come no closer than a quarter-wave (about 20") from the end of the bottom element. This leaves about 15 feet of the mast free to whip around slightly in the breeze. If you live in a windy part of the country you should add an additional set of nylon guys, fastened about at the center matching transformer. Ordinary nylon fishing line is very good for this purpose.

Performance

We installed our 2-meter "gain" antenna about 20 feet from our "reference" dipole and about the same height. The reference antenna was fed with about 85 feet of foam-type RG-8/U coaxial cable. The antenna was fed with about the same length of cheap 300-ohm TV twin-lead. A coaxial balun, used to transform the balanced line to the unbalanced coax input of the transmitter was installed right at the transmitter. A Knight-Kit P-2 bridge was installed between the balun and the transmitter. The s.w.r. on the reference antenna was 1.5 to 1. On the gain antenna it was 1.1 to 1. About a 2-to-1 increase in signal strength of stations received was noted. Stations worked immediately noted the increase in our signal. Mobiles especially could now be worked out to much greater distances.

All in all, the week-end we used to put together this antenna was well worthwhile. Since initial tests the wood mast has been lashed to the top of a tree, elements above the tree tops, at a height of about 90 feet. The feeder length is now about 125 feet. Mobiles (f.m.) operating on eastern Long Island have been reliably worked out to distances of 30 to 40 miles. And we run only 60 watts input. ■

RTTY Tuning [*from page 51*]

cuit shown in fig. 1. All that remains now, is to wire in the selector switch, S_4. A step by step procedure is outlined below because this involves modifying some of the original circuitry. The switch contacts, as referred to, are shown in fig. 2.

1. Disconnect the wire from the arm of S_2 in the Modulation Analyzer which connects to pin 8 of the 3BP1 through a 0.01 mf capacitor, and connect this to the arm (wiper) of S_{4A}. Leave the 0.01 mf capacitor in the circuit.
2. Determine which position of S_4 you want for modulation, and run a wire from the appropriate contact of S_{4A} back to the arm of S_2.
3. Connect the remaining contact of S_{4A} (RTTY) to pin 6 of V_{5B} (fig. 1).
4. Disconnect the wire from the junction of C_3, S_1, and pin 6 of V_1 of the Modulation Analyzer which runs through a 0.01 mf capacitor to pin 11 of the 3BP1. Connect this to the arm (wiper) of S_{4B} leaving the capacitor in the circuit.
5. Connect the modulation position contact of S_{4B} to the junction of S_1, C_3, and pin 6 of V_1.
6. Connect the remaining contact of S_{4B} (RTTY) to pin 1 of V_{5A} (fig. 1).
7. Break the low voltage B plus line from the 6X5 after the 15 mf output filter capacitor and connect to the arm (wiper) of S_{4C}.
8. Connect the modulation contact of S_{4C} to the B plus line of V_1 and V_2.
9. Connect the RTTY contact of S_{4C} to the B plus line of V_{5A} and V_{5B} (fig. 1).

The addition of RTTY tuning is really much simpler to add than to describe. If you haven't already built the Analyzer, then perhaps this will inspire you to do so, for you will find it both a very useful and decorative piece of equipment for the shack. Then some day, perhaps, you'll join the gang on the green keys, and convert your Modulation Analyzer for double duty as an RTTY tuning indicator. ■