The Low Profile Quad Antenna

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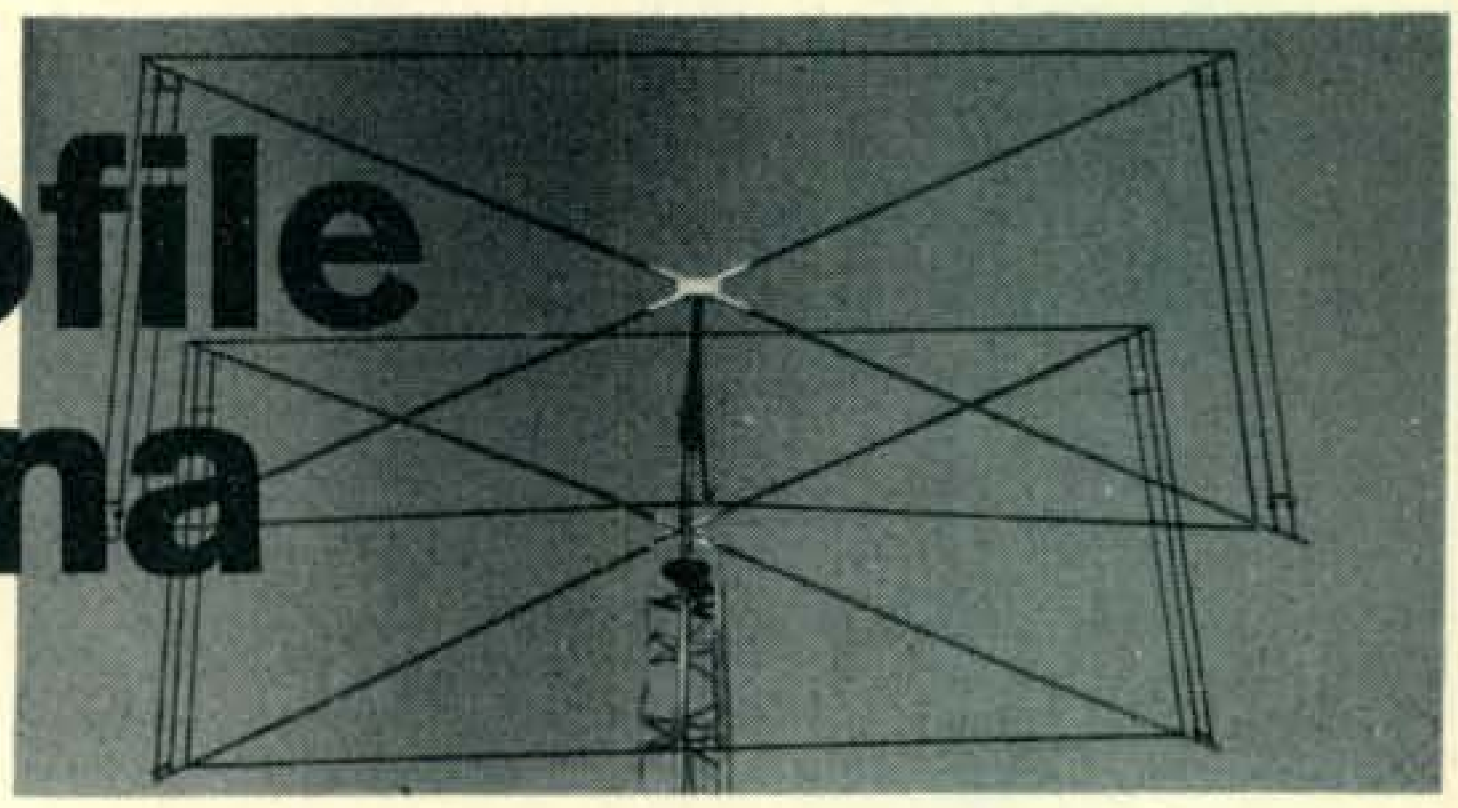

QUADS should be heard and not seen. After viewing a real live 20 meter cubical quad for the first time, I could not understand why such an antenna using ¼ λ long elements looks so huge! This first encounter with a full-sized quad was sufficient to postpone my trip to the friendly bamboo pole supplier.

While experimenters have succeeded in reducing the size of yagi antennas with some sacrifice of performance, the quad antenna has not received similar attention.

My approach to reducing quad size was to retain the ¼ λ horizontal portion of the quad element while reducing the dimension of the vertical portion. Conventional thinking indicates that it can't be done, but our experiments prove otherwise. The Low Profile Quad elements described here measure around ⅛ λ in height.

Various approaches to low profile design were tried at 145 mHz under controlled conditons, using a conventional 2-element quad as a reference. Helicoidal, loop, stub, zig-zag and folded vertical sections were tried. With the better sections comparative measurements indicated performance nearly identical to the reference quad. From the mechanical and performance standpoints the 3-wire folded vertical section seemed most suitable for use on the h.f. bands, as well as being adaptable to tri-band use. The trip to the bamboo works was finally made.

As shown in fig. 1, the 3-wire section is actually comprised of ⅜ λ of wire folded back on itself twice yielding ⅛ λ physical spacing between the two horizontal ¼ λ portions. Why the use of a total driven element wire length of 1¼ λ yields proper resonance is beyond the scope of this author's investigation. Nevertheless, in the configuration shown, it is resonant and it works quite well. Further work with this quad design will no doubt establish the "why" of it. As determined by experiment, the total driven element wire length is calculated from:

$$L\ (\text{feet}) = \frac{1192}{f\ (\text{mHz})}$$

The reflector should be about 4% longer. To facilitate tuning, two adjustable shorting bars are used per element, each made of two Fahnestock clips strapped together with copper flashing for a total center-to-center spacing of 3½".

Spider Construction

A well-equipped shop is necessary to duplicate the spiders exactly as shown in fig. 3, but the result will be an extremely durable spider which will make assembly of the LP quad simple and accurate. Lacking access to such a workshop, however, the builder can improvise with plates, muffler quad hardware. The critical dimension is the 26° angle above and below the horizontal center-line. This 52° spreader angle should be closely adhered to in order to be able to accommodate the ¼ λ horizontal sections across the top and bottom of the quad element.

In the absence of welding equipment, the builder can fabricate the parts by hand and using scrap plywood for a jig, precisely locate the parts using nails. The local welding shop should then be able to tack the parts in place and finish the job with continous welds (c.w.).

A boom length of 8′ was used. Wider spacing might yield better overall performance. Use standard boom-to-mast hardware.

Driven and Reflector Elements

Figure 1 shows the 18 ft. 4 in. × 9 ft. diven element. The bamboo spreaders were spiral wrapped with glossy finish PVC electrical tape, one ¾" × 66′ roll per spreader. At the butt end, black friction tape used to build up a uniform diameter to make a good seat within the angle iron. As the spreader pole diameters will vary, the builder will have

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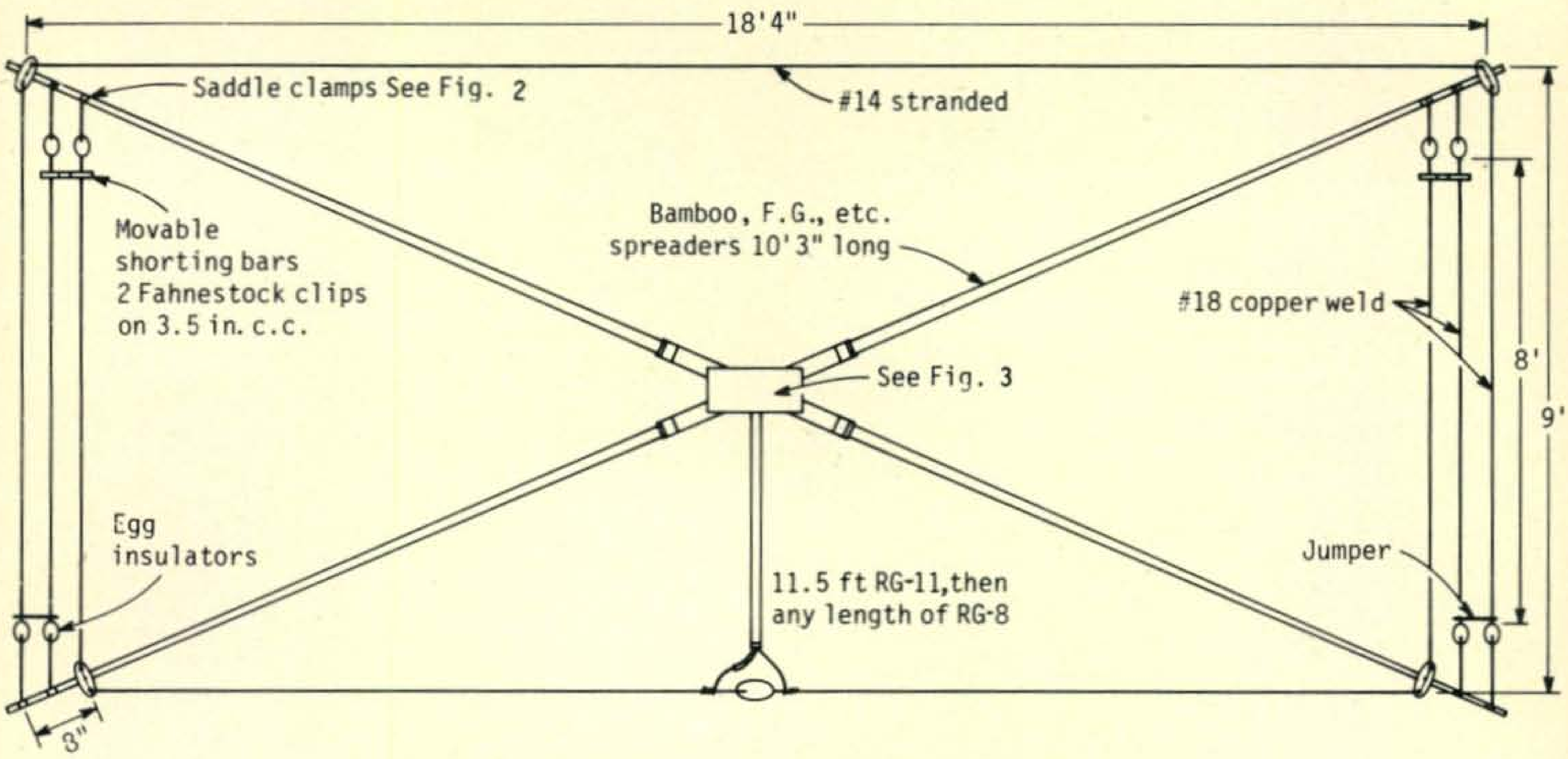

Fig. 1—Driver element construction for the LP Quad.

to form his own spreader and saddle clamps, hence no detailed dimensions. Pass safety wire through the outer cross-arm clamp and hole to prevent accidental clamp slippage.

The spider-spreader assembly is laid flat on the ground and wire stringing begun. Trying to do the job with one continuous piece of wire is quite hopeless. Besides, we are using two different sizes of wire. A guage stick 9 ft. 2 in. long, is butted between the inner side of the saddle clamp at the top spreader and the lower egg insulator wire wrap joint. The #18 copperweld wire is passed around the saddle clamp's lower 10-32 machine screw and fastened. It is then threaded through the egg insulator, drawn firmly and wrapped. Leave several inches of extra wire to make the jumper and connection to the #14 top element wire. Do not rely on the saddle clamps for electrical continuity. With the guage stick in place, the other two parallel #18 wires are then strung. Don't forget to install the movable shorting bar. With a tilt-over tower the shorting bars are more accessable as shown. If necessary the shorting bars and jumpers can be interchanged. Transfer the guage stick to the opposite side and repeat the wire stringing.

Next, the #14 wire horizontal sections are fastened at one end around the other saddle clamp screw, pulled up taut, wire

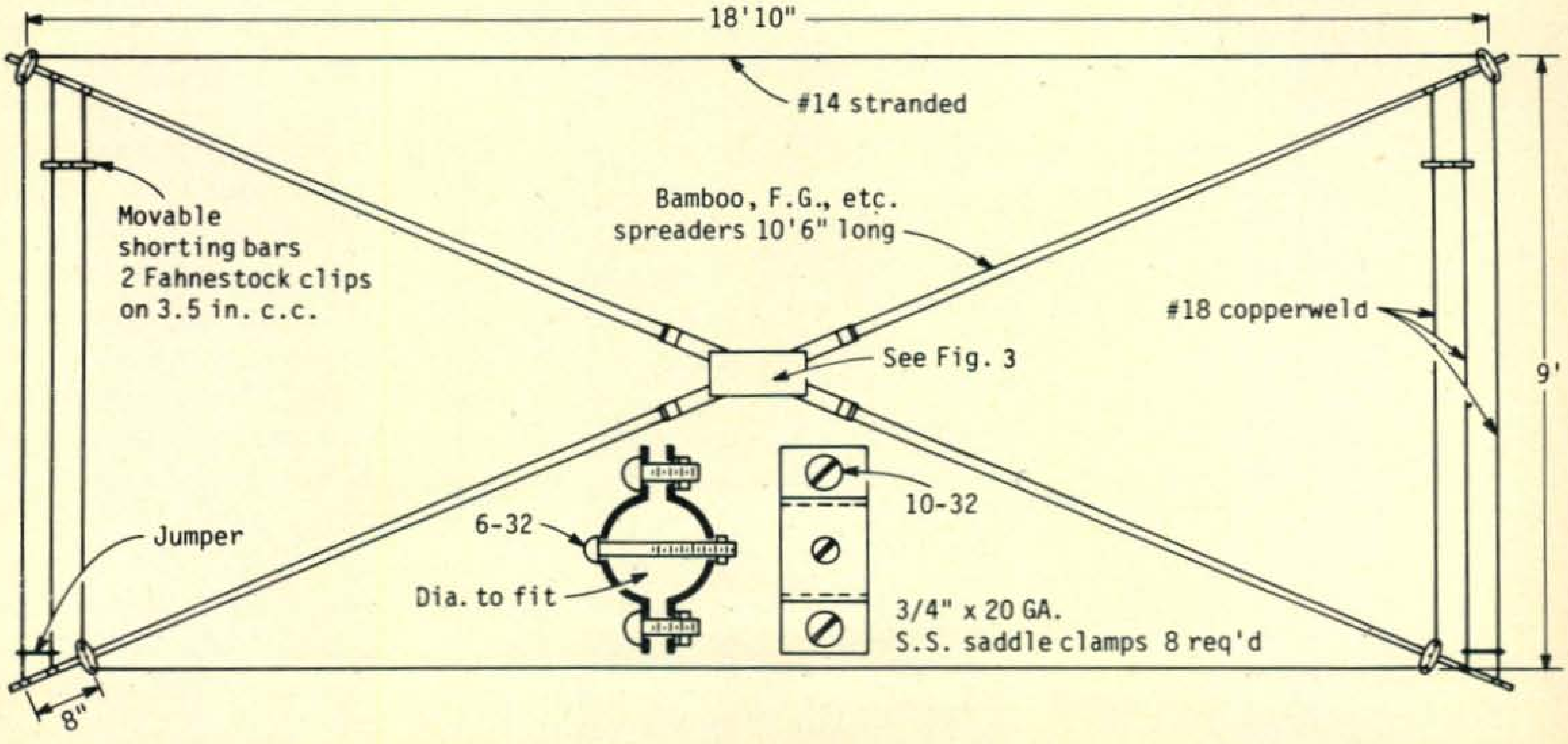

Fig. 2—Construction of LP Quad reflector and saddle clamps.

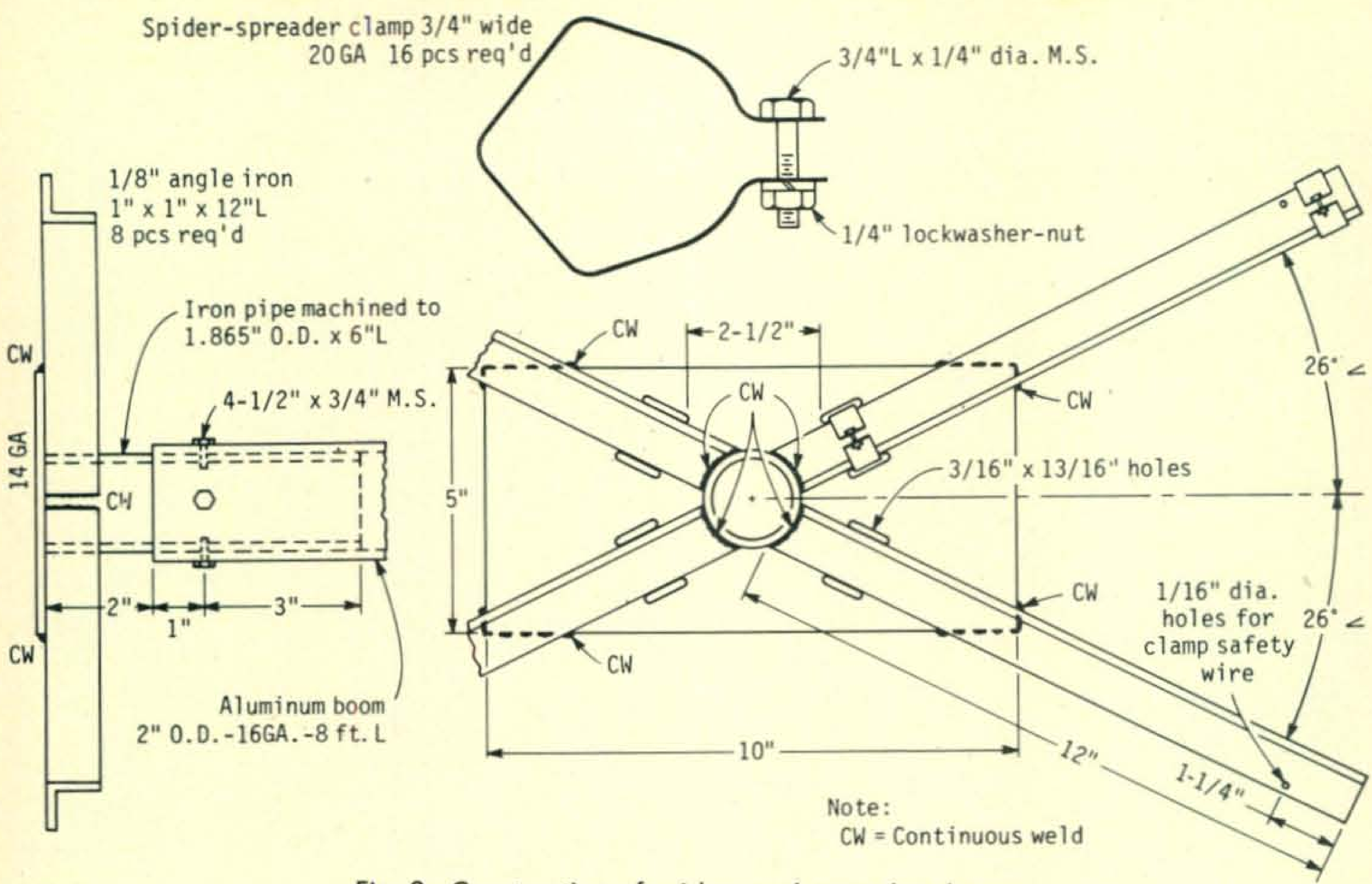

Fig. 3—Construction of spiders and spreader clamps.

wrapped and the pigtails over the saddle clamps soldered.

The 18 ft. 10 in. × 9 ft. reflector element, shown in fig. 3, is assembled in the same manner, minus the egg insulators. The normal power input here at W1HXU is 500 watts d.c. and the bamboo spreader insulation appears to be adequate. However a 2000 w.p.e.p. signal probably could use the egg insulators or at least fiber glass spreaders.

Feeding and Adjustment

The input impedance is made to order for RG-11/U: around 75 ohms. However my underground coax installation uses the more common 50 ohm RG-8/U so it had to do. If operation is confined either to the phone band or c.w. portion, the v.s.w.r. is acceptable when centered in that working portion. By simply inserting a ¼λ matching section of RG-11/U, 11.5 ft. long between the driven element and the 50 ohm feed line one can expect a v.s.w.r. curve as per fig. 4. Of usefull interest is the 50 kHz shift between wet and dry conditions, so tune up for your prevailing WX.

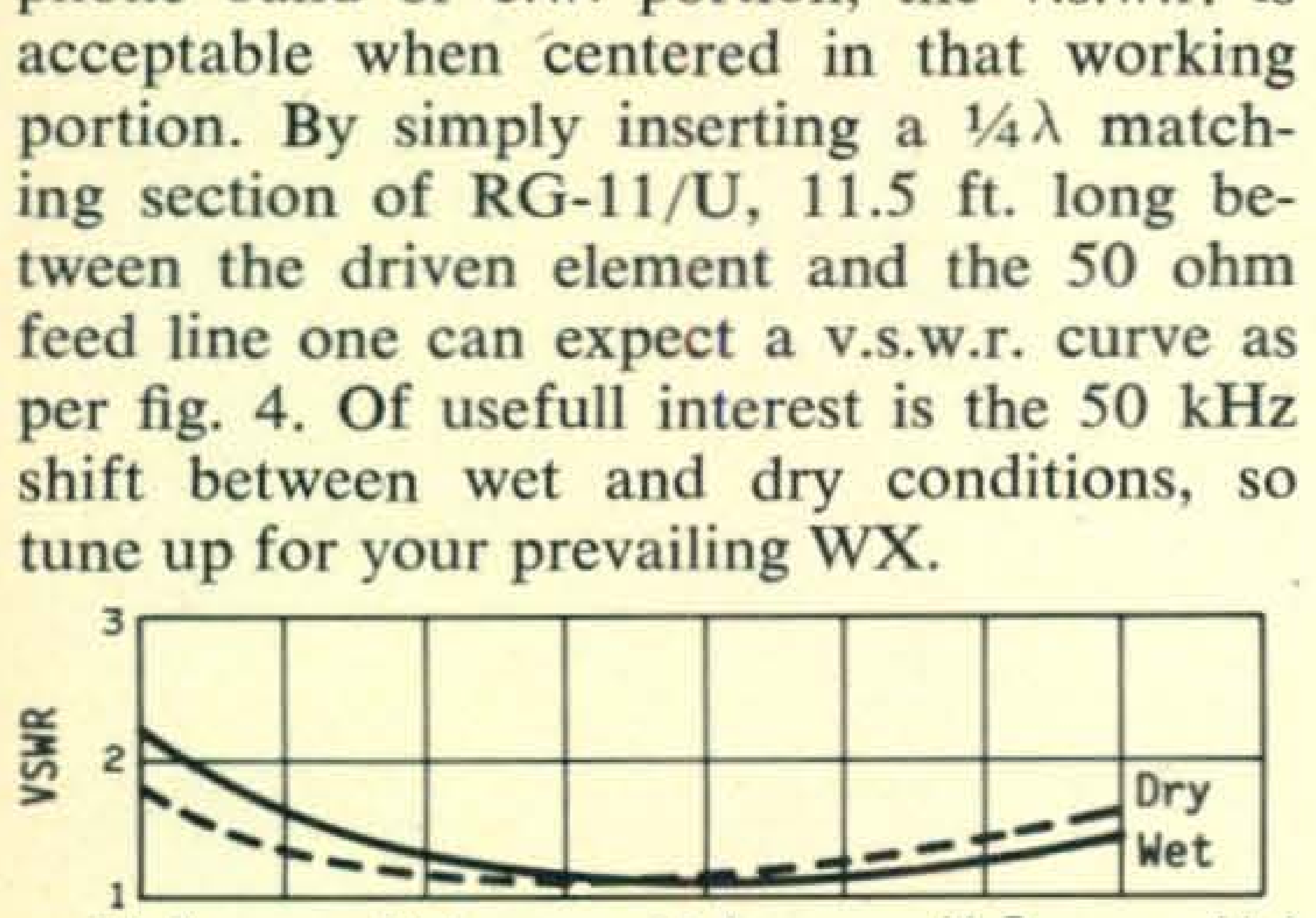

Fig. 4—V.s.w.r. curves of LP Quad.

Initial tuning is made with the shorting bars one foot from the top on both elements. Raise the antenna, apply low power, and take a v.s.w.r. curve. From the frequency of lowest v.s.w.r. on the curve, determine the desired frequency shift. Moving both shorting bars equal increments and in same direction will effect a frequency change of approximately 15 kHz per inch. To lower the frequency move the bars towards the top; to raise the frequency, move bars downward. Adjust the driven element only; raise antenna and repeat the plot of v.w.s.r. until the desired point has been reached.

The reflector is tuned for maximum forward gain or best front-to-back ratio by pointing the beam at a short dipole antenna in the attic 40 ft. from the quad. The transmission line from the dipole terminates in a diode and 0-1 ma meter in the shack. The reflector will tune quite broadly, and some corrective adjustments may be necessary to the driven element as both elements approach optimum resonance. Finally, solder the shorting bars in place. (Thank heaven for tilt-over towers).

A glance through our log book clearly indicates that this Low Profile quad outperforms the previously-used 2-element wide spaced yagi in percentage of contacts and signal reports, and it sure looks real pretty! ■