A Single Element Delta Loop Antenna for 15 and 20 Meters

BY HARRY K. BOURNE, ZL1OI

Many amateurs living in urban areas are frustrated by their inability to erect a Yagi beam or a quad owing to space or height limitations, or aesthetic considerations. In such a situation I have obtained considerable success on the 14 and 21 MHz bands with a wire delta loop antenna, one which is efficient, unobtrusive, has a low wind resistance and is light in weight. This type of antenna is much simpler to construct than a quad as the supporting structure is less elaborate, and it is less susceptible to wind damage. The delta loop antenna has an advantage over a dipole for DX transmission as it produces a strong lobe of radiation at a low angle even when mounted close to the ground. Although it will perform well at a low mounting height, as in any other antenna, the performance will improve with height.

When a delta loop antenna is close to the ground its operating performance depends on interference between the direct radiation and that reflected from the ground, so that for maximum efficiency, the surrounding ground should have good conductivity. If the ground conditions are not good, the performance of the antenna may be degraded to some extent. Any obstructions around the antenna may distort the directional pattern and attenuate the low angle radiation and thus degrade the performance.

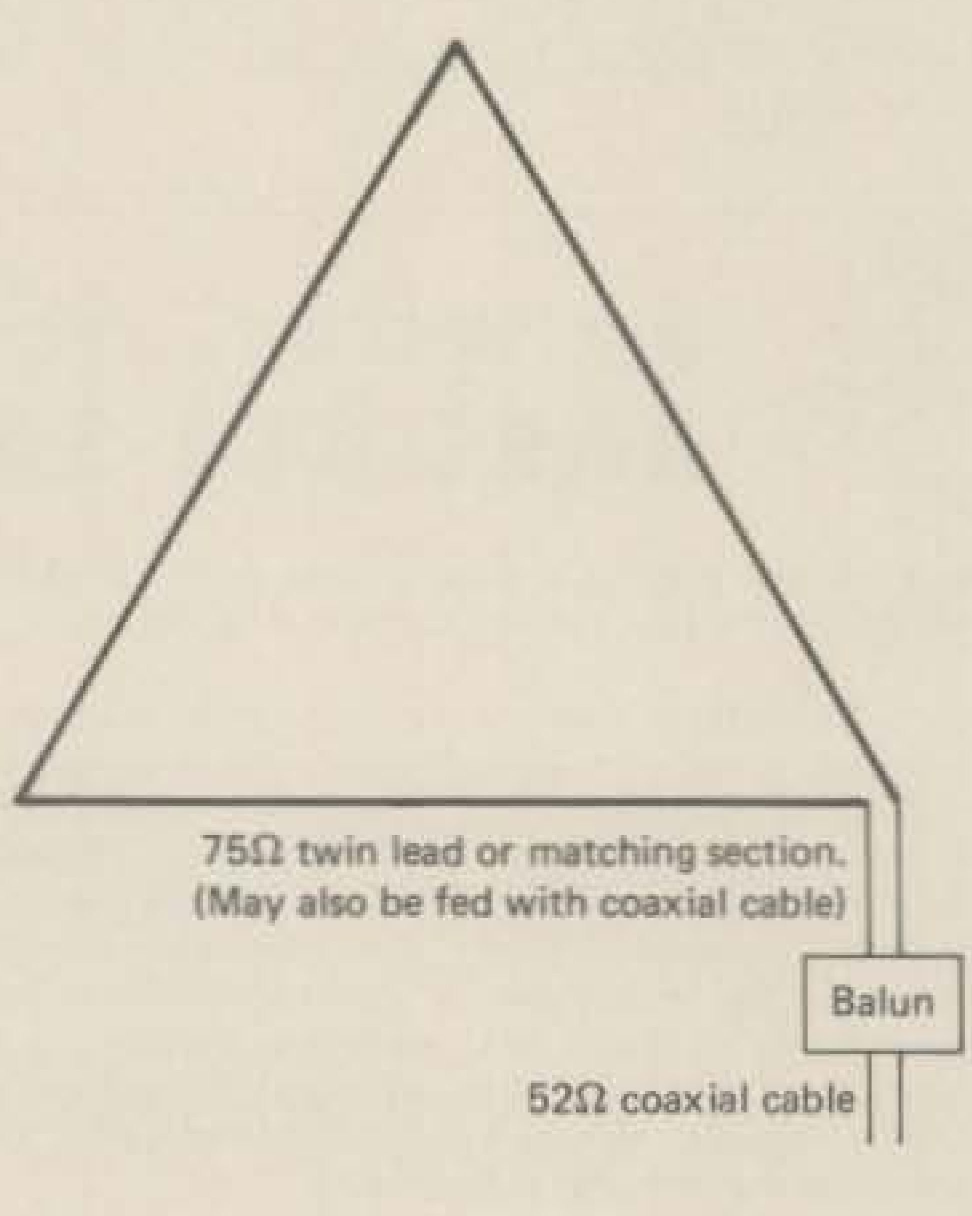

Fig. 1—A Delta loop, base down. It may also be fed directly with coaxial cable.

Two possible configurations of the delta loop antenna are shown in figs. 1 and 2. In fig. 1, the simplest arrangement, the antenna, constructed entirely of wire, requires only a single central support, which may be a mast or tree. Good low angle radiation characteristics are obtained by feeding the antenna at one end of the base. The impedance of the loop is approximately 100 ohms and it may be fed with 75 ohm coaxial cable without introducing a serious mismatch, the shield of the cable being connected to the base of the delta. The base should be not less than ten feet above the ground and should be higher than trees or other obstructions around the antenna.

The configuration of fig. 2 is to be preferred in locations where there are obstructions near the antenna which might attenuate the low angle radiation. In this case the delta is reversed, with the base at the top. Again, the antenna may be constructed entirely of wire and may be supported between two masts or trees. However it is more convenient to use a base consisting of a boom of aluminum tubing which may be supported from the center from a single mast, as shown in fig. 3. The antenna may be rotated by swinging the boom around. A strong lobe of low angle radiation is obtained by feeding the antenna at the vertex, which is at the bottom, an arrangement which is very convenient as the antenna need be lowered only a few feet to make the feed point accessible from the ground and to enable the length to be trimmed to obtain resonance.

This form of the antenna may also be fed with 75 or 52 ohm coaxial cable. If 52 ohm cable is used, minimum s.w.r. may be obtained by inserting a quarter wavelength matching section of 75 ohm twin lead between the loop and the coaxial cable. However this is not essential, as even with direct feed by 52 ohm coaxial cable, the s.w.r. is acceptably low. This antenna is balanced with respect to ground, and it should be connected to the coaxial feeder through a 1 : 1 balun to preserve symmetry and avoid distortion of the radiation pattern.

The writer has tested both configurations, and in his particular location he has found that of fig. 2 to be the better, probably owing to its greater effective height as the center of area and the positions of the current maxima are higher above the ground, and screening from surrounding trees and foliage is reduced. In the fig. 1 configuration, the base of the antenna was below the trees and these caused distortion of the radiation pattern and attenuated the radiation to some extent.

A single element delta loop for operation on 14 and 21 MHz bands, with the base-up configuration, has given better results in both transmission and reception than those obtained with any other single element antenna tested by the writer. The arrangement used at ZL1OI for the 14 and 21 MHz delta loop is shown in fig. 3. The antenna is supported by a 32 foot high water pipe mast. A boom of aluminum tubing 26 feet long forms the top section or base of the delta for 14 MHz, and the two sides are of wire hanging from the ends of the boom to form a V. The delta loop for 21 MHz, made of

Freg. (MHz)	Base* (ft.)	Sides (ft.)	Match. Sect.† (ft.)
14.050	26′	22′9″	14′6″
21.100	16′6″	15′6″	9′6″
28.100	12′9″	11′6″	7′3″

*Aluminum tubing telescoping from 1 inch diameter through ¾″ to ⅝″ diameter.
†75 ohm twin lead.

Table I—Dimensions for Delta Loop Antenna

wire, is mounted inside the 14 MHz loop and is supported from it with insulators at the top corners. Either loop may be connected through a coaxial switch to a single 52 ohm coaxial feeder, or each may be connected to its own separate feeder, with a 1 : 1 balun connected between the loop and the feeder, or between the feeder and the end of the twin lead matching section if one is used. The writer has used lighting cable,[1] which is light in weight and flexible, for the V section of the antenna. The delta loop has a relatively broad bandwidth so that quite thin wire may be used without sacrificing bandwidth.

Although a wooden mast rather than a metal one, is probably to be preferred to avoid distorting the directional characteristics of the antenna, the writer has not observed any adverse effects from using a metal mast, probably due to the fact that the antenna is symmetrical with respect to the mast and to the ground.

The dimensions of the antenna elements for operation at the low frequency end of the bands are given in Table I. The tuning of the full wave

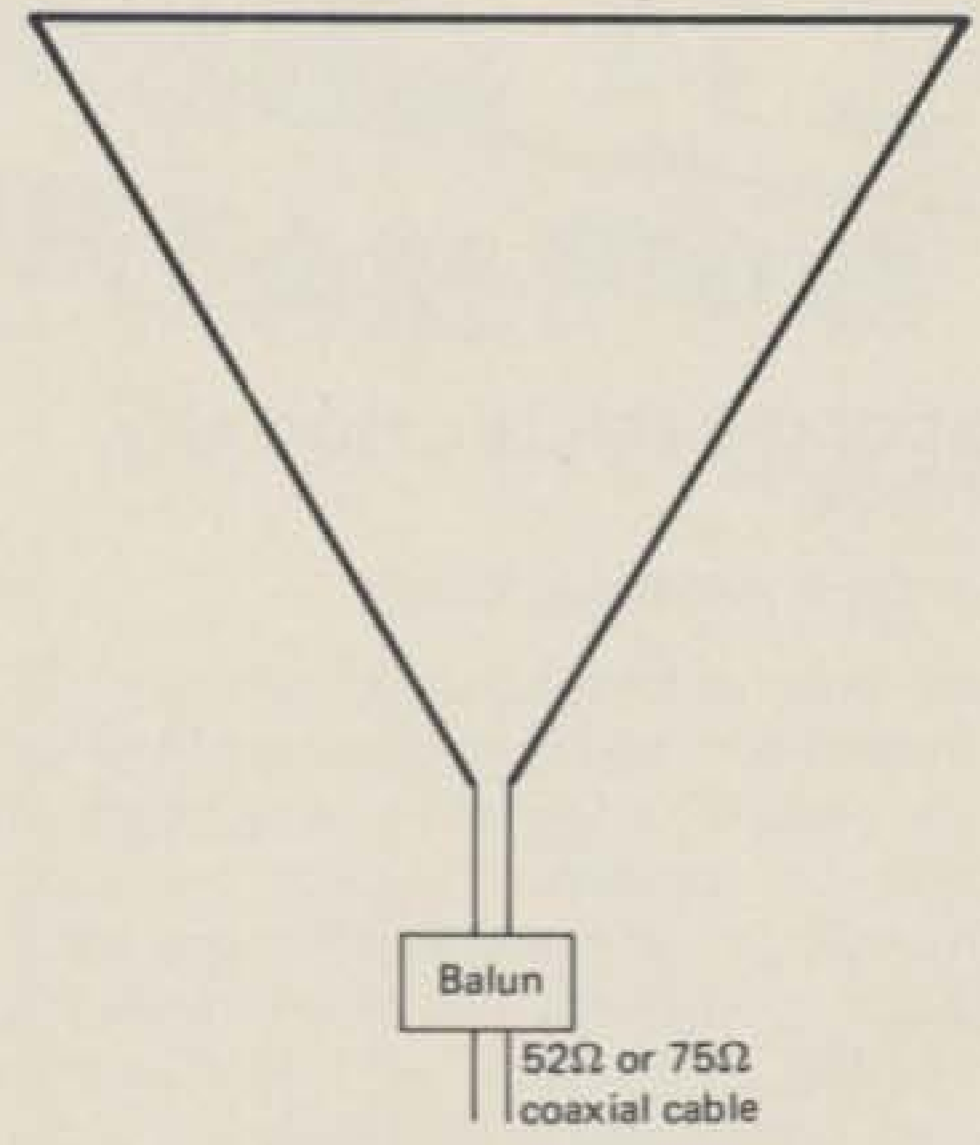

Fig. 2—The Delta loop shown base up.

loop is relatively broad and its approximate length may be calculated from the formula

$$L = \frac{1005}{f}$$

where f is the frequency in MHz and L is the length in feet. The three sides of the delta may be made equal in length, but if it is desired to increase the height of the feed point above the ground, the base of the delta may be made slightly longer than that of the two sides as shown by Table I.

The sides should initially be cut a little longer than that indicated by calculation so that they may be trimmed to resonate at the desired frequency. Resonance may be measured by joining the ends

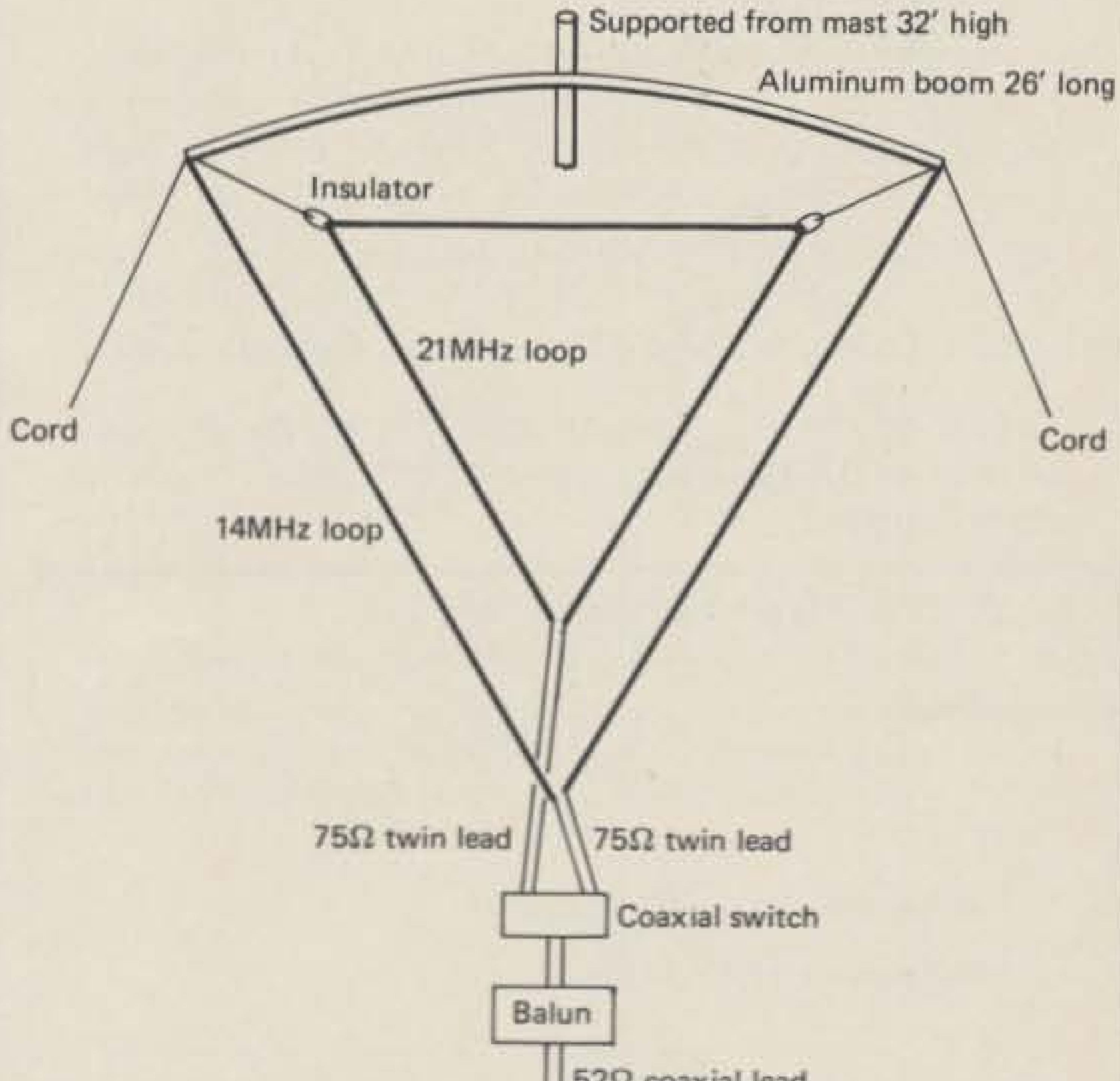

Fig. 3—A 14/21 MHz Delta loop antenna. Dimensions of the loops are shown in Table I. A matching section may be used instead of the 75 ohm twin lead.

[1]In the U.S. this material is ofter referred to as "zip cord."

of the loop through a two turn coil which may be coupled to a grid dip oscillator. The length may be finally adjusted to give minimum s.w.r. at the required operating frequency. The s.w.r. may be measured at the transmitter end of the feeder if the length of the feeder is a multiple of half a wavelength. This will ensure that the s.w.r. will be the same as that obtained by measuring it at the antenna end of the feeder.

With such poor conditions prevailing recently on the 28 MHz band, no provision has been made for operating on this band. However the 14 MHz loop will resonate as a 2 loop on 28 MHz. Tests made by the writer show that the antenna loads up well on this frequency but no opportunity has yet arisen to test the antenna properly on this band. If desired, an additional full wave loop for 28 MHz may be mounted inside the 21 MHz loop and fed by a separate feeder as before. Suitable dimensions for this loop are given in Table I. The resonant frequency may be affected slightly by the proximity of the 21 and 28 MHz loops so that the lengths may require slight adjustment.

The delta loop is bidirectional, with a front to side ratio of about 9 db and it should therefore be oriented in the desired direction. Two mutually perpendicular directions are generally satisfactory in practice, and these may be obtained by swinging the boom around by light cords attached to it. At the location of ZL1OI in Auckland, New Zealand, the antenna is oriented to give radiation to the northeast for North America, and to the northwest for Europe.

Good DX results have been obtained on the 14 and 21 MHz bands. Direct comparisons have been made on hundreds of contacts by switching over between the delta loop and a quarter wave vertical ground plane antenna used as a standard. An improvement of 3 to 6 db in signal strength is generally obtained in transmission and reception using the delta loop, the actual gain depending on prevailing propagation conditions which affect the radiation angle and the angle or arrival of the received signals. Results also appear to depend to some extent on the type of antenna used at the distant station.

On reception, background noise from man-made and power line interference is much less than that received on the inherently noisy vertical antenna. The amount of reduction depends on the nature of the interference. It is quite common to find that signals which are unreadable when using the vertical antenna, may be copied with ease with the delta loop. The directional properties of the delta loop are also advantageous in reducing interference from directions other than from that of the desired signal.

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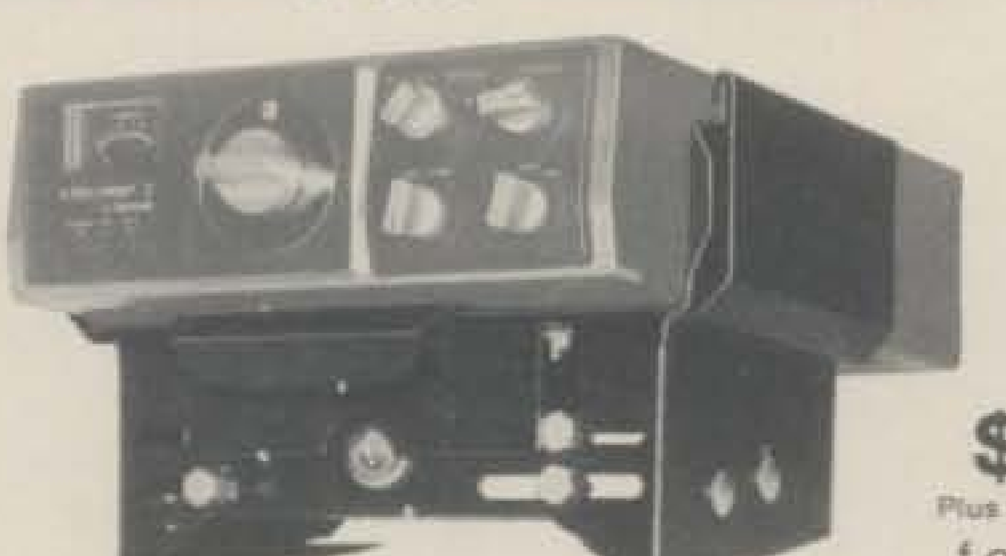

A Single Element Delta Loop *(from page 24)*

This form of antenna offers some scope for further experimentation. For example it would be a simple matter to support a second loop behind the driven element to act as a reflector with a consequent improvement in gain and directivity. This would be particularly simple with the fig. 1 configuration but could also be used in the fig. 2 configuration without difficulty.

It may be of interest to note that in the writer's case the mast which supports the 20 and 15 meter delta loops also forms the central support for 80 and 40 meter inverted V dipoles fed from a single 52 ohm cable, so that all the antennas for bands from 80 to 10 meters are accommodated on one mast and fit into a small suburban garden.

There is no doubt that the delta loop antenna can provide a marked improvement in communication, both in transmission and reception. The antenna is very inexpensive, light in weight, has a low wind resistance, is unobtrusive in appearance and uses readily available materials. It provides strong low angle radiation even when mounted near the ground and the noise level in reception is low. This form of antenna is particularly suitable in locations in which the normal type of beam may not be erected. ■

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mechanic adjust the voltage regulator. Years ago most regulators could be adjusted with a screw driver, but in the interest of economy (?) this feature has been eliminated and it is now necessary to bend the contacts carefully to achieve the desired charging voltage.

Conclusions

The Horizon 2 is an "honest" transceiver. Straightforward design and good components result in excellent performance. The lack of a meter to indicate received signal strength, relative power output or receive frequency deviation may be a negative factor for some operators. The lack of these provisions stems no doubt from the transceivers heritage, the land mobile and marine radio services. There is a red LED to indicate when the unit is in the transmit mode.

Standard does not advertise a list price, but the unit sells for under $300.00 with microphone, mounting bracket and crystals for 146.94 MHz (simplex), 146.52 MHz (simplex) and 146.16 MHz/146.76 MHz (repeater). ■

Putting the MAW on 2 *(from page 37)*

Adjust C-101 to C-110 for maximum. This will be only one or two divisions. Next peak C-116 to C-125. Set the alignment switch to normal and S-101 to off.

The set is now ready for operation. Since this set