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The Universal Loop

A novel, efficient, modularly constructed receiving loop antenna covering from 55 kHz to 40 MHz (or even more).

This receiving loop antenna covers a frequency range from 55 kHz–40 MHz (i.e., low LF to low VHF). It uses a range of plug-in loopsticks plus spiral and frame loops. The listening enthusiast will be able to follow the simple instructions to make a system for all-band listening or for just those portions of the spectrum of personal interest. The experimenter will be able to use the base unit as a test-bed for trying out some personal loop designs. Or, maybe, to modify and/or improve some of the ideas presented here. In such cases, much time and effort will be saved in avoiding repetitive constructional work, and trying to locate such components as suitable variable capacitors and other bits and pieces.

While experimenting with small loop antennas for reception and transmission for many years, I have employed a simple tuning/matching unit for initial loop design work. This test-bed base was built into a well-used plastic box. The built-in components consisted of tuning capacitors, optional variable coupling capacitors, a coaxial socket, plus a selection of terminals connected to the various components to enable a variety of new loop configurations to be tried over a wide range of frequencies. In many cases, experimental frame loops were "lashed up," on a simple flimsy lightweight cardboard body. Thus much time and effort was saved, initially, in evaluating a new loop design concept. This established the best dimensions and number of wire turns. When a prototype was eventually made, there was a 95% chance that it would be satisfactory. Again, much time, money and frustration were saved.

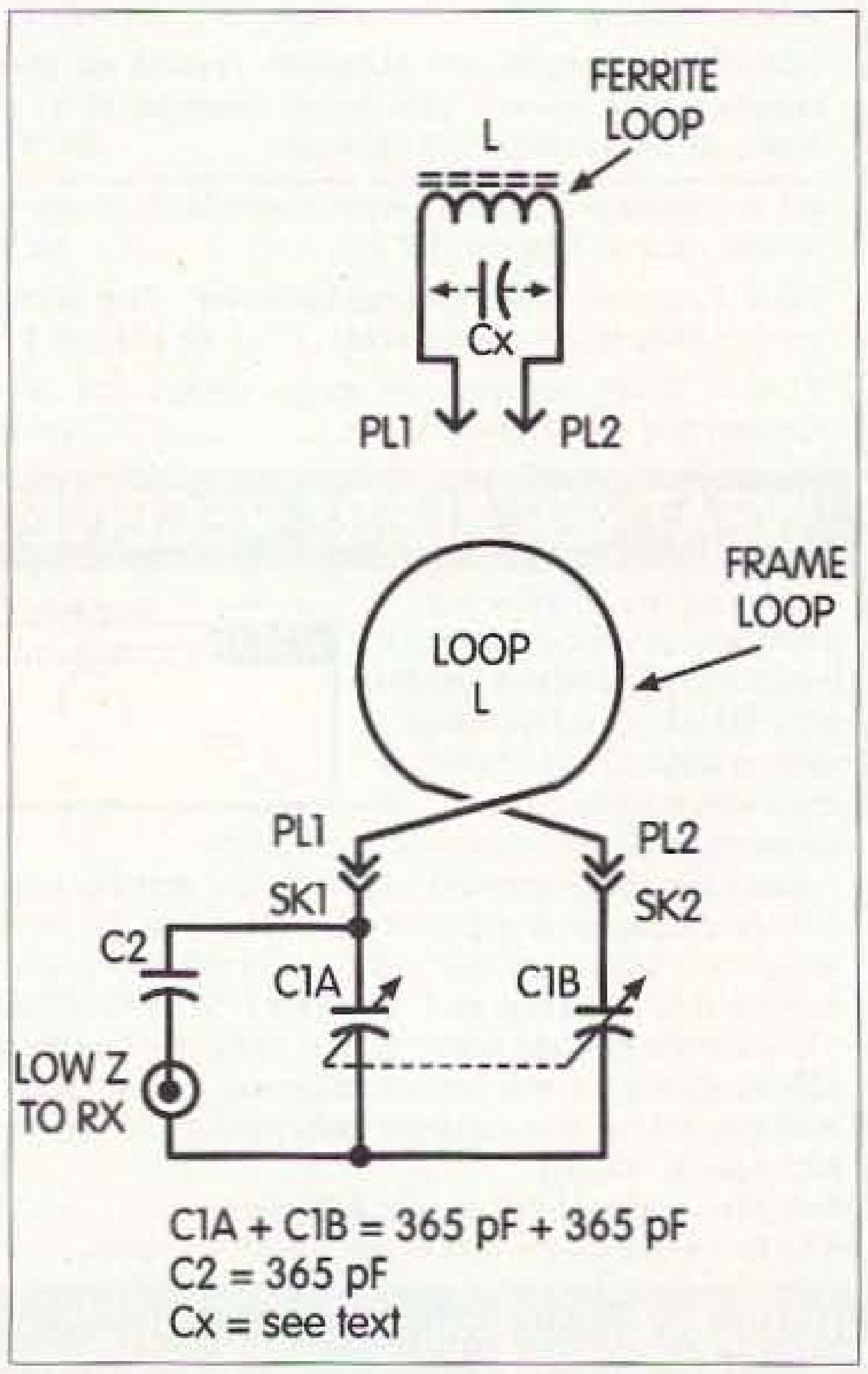

Fig. 1. The versatile schematic of the Universal Loop.

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Fig. 1 shows the versatile schematic of the Universal Loop, and **Figs. 2(a)** and **2(b)** the alternative profiles using frame loop configurations and ferrite loops [**2(b)**].

The schematic consists of a balanced arrangement using a 2 x gang 365 + 365 pF variable capacitor (C1A and C1B), connected to binding post sockets SK1 and SK2. Alternative "plug-in" ferrite and frame loops are fitted with 4mm plug pins. Coupling to the RX input is achieved by variable capacitor C2 (365 pF) connected to the

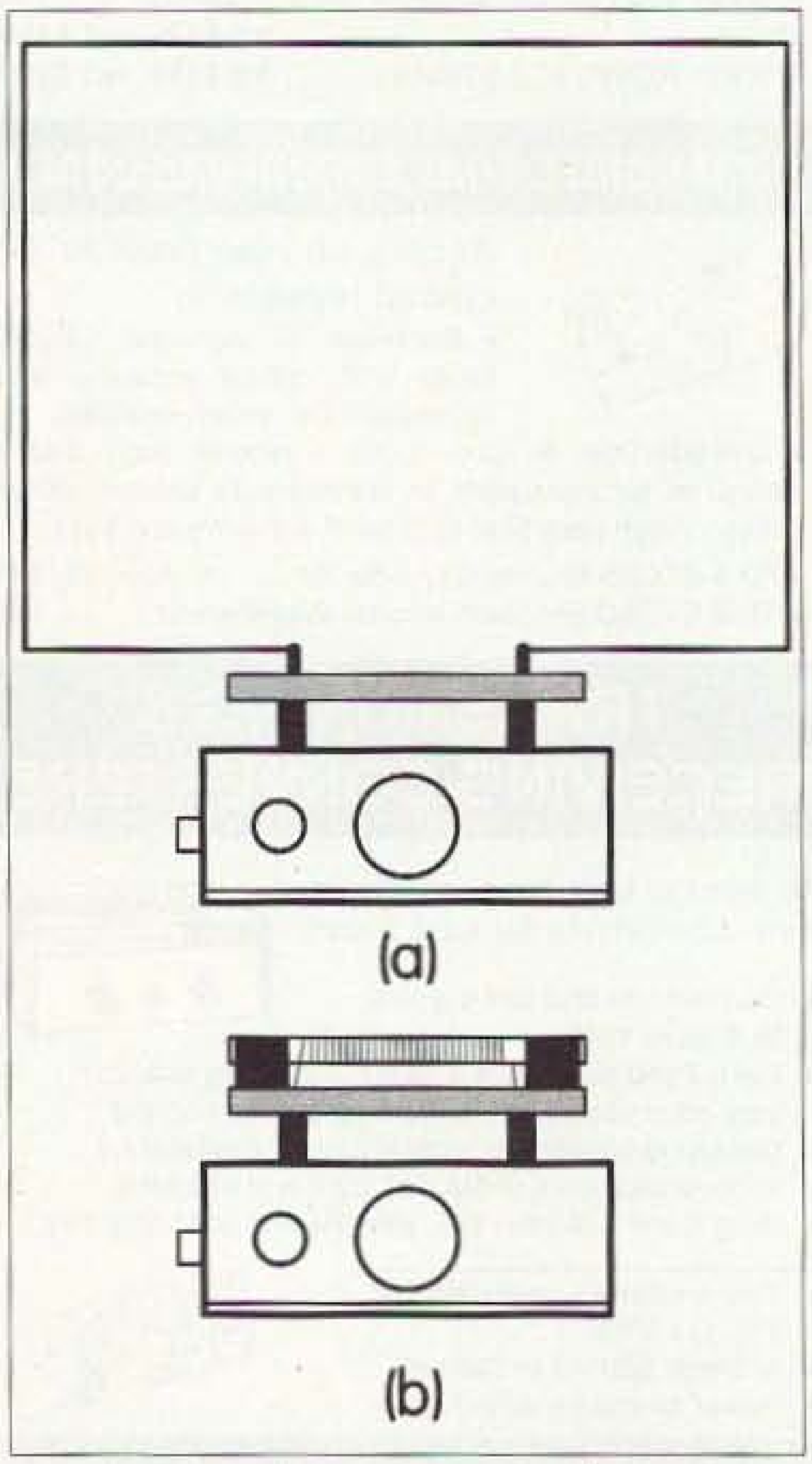

Fig. 2(a) Profile of the frame loop configuration. (b) Profile of the ferrite loop configuration.

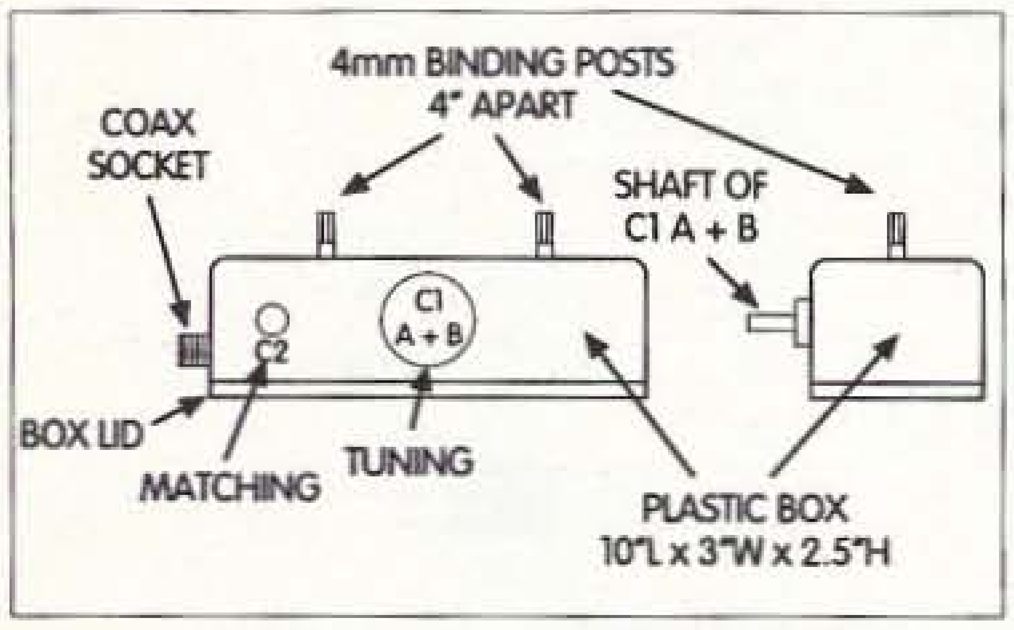

Fig. 3. The tuning/base unit.

coaxial socket. The coaxial feedline can be matched by C2 to 50–80 ohms impedance.

The tuning/base unit (**Fig. 3**) housing the above is built into a plastic box 10" x 3" x 2-1/2" high. For readiness of availability, at a reasonable cost, a translucent white micro-oven/fridge box is used. However, some dimensional tolerance can be allowed. C1A, C1B, and C2 are mounted on the front as shown in **Fig. 3**, with the socket at the end. 2 x 4mm binding posts are mounted on the top, as shown, exactly 4" apart. Binding posts are about 1" high, with a 4 mm socket in the end. There is also a side terminal connection. Tandy/Radio Shack nylon binding posts, #274-662, were used on the prototype.

In-box interconnection wiring, to **Fig. 1**, should be robust and securely soldered, using 18 or 16 gauge tinned copper wire. *Do not rely on mechanical joints.*

Various alternative loop configurations are used (**Figs. 6–10**), all using a standard plug-in chassis as shown in **Fig. 4**. The chassis consists of a strip of rigid insulated board (up to 1/8" thick) 8" x 1-1/4" wide (**Fig. 4**). Two 4 mm plug pins are mounted as shown, exactly 4" apart, for plugging into the binding posts on the base unit (**Fig. 3**).

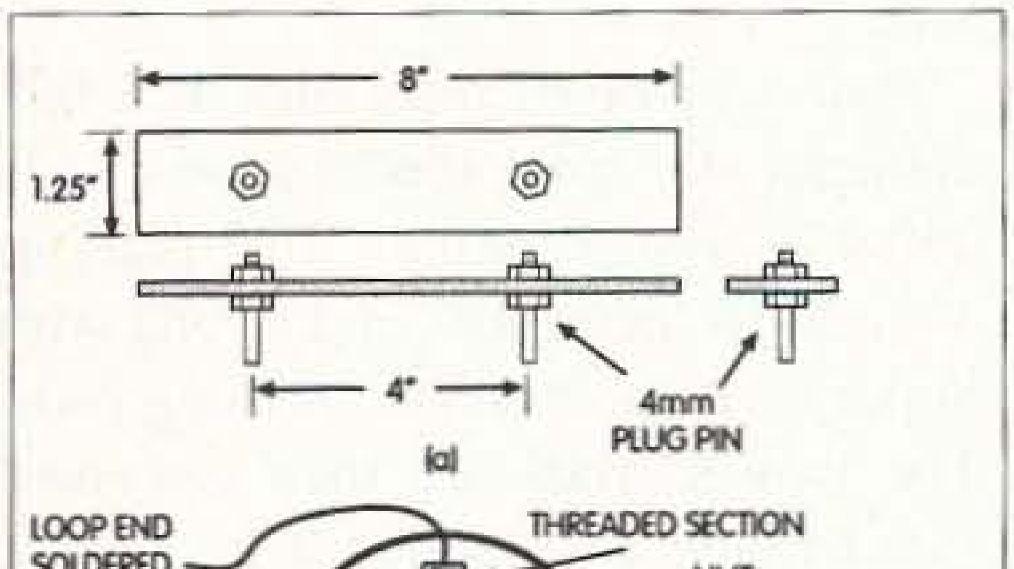

Fig. 4(a) Loop "plug-in" chassis. (b) Plug pin detail.

The 4 mm pins are quite standard, with a screw thread on one end to fasten to the chassis board (**Fig. 4**) with nuts and washers. These pins are available from various suppliers. On the prototype, Maplin type MF72/54403/WB43 pins were used. In the USA, Antiques Electronic Supply was advertising these in their catalog. The various loop configurations (**Figs. 6–10**) are mounted on these loop "plug-in" chassis.

Individual "plug-in" loop construction: the MF (MW) loop — 550–2100 kHz (see Fig. 6)

The starting point is this ferrite loop. I will also describe subsequent loops that just overlap the LF and HF ends of its range.

The unit uses a standard MW bands loopstick 5" long x 0.375" in diameter. This can be salvaged from an old radio, or can be purchased new. In this case, I used my Maplin type LB12N MW/LW ferrite loopstick. This uses a 5" long x 0.375" diameter ferrite rod. The inductance range quoted is 370 μH (MW) and 4.1 mH (LW), giving frequency ranges of 550–1550 kHz and 150–280 kHz respectively. The LW coil was removed and kept for the LP loopstick (described later). An alternative MW coil is advertised in the USA by Antique Electronics Supply, under type number P-FRL.

Using the tuning circuit, as shown in **Fig. 1**, the MW coil will cover from about 550–2100 kHz. The use of a 0.375"-diameter salvaged MW coil of other manufacture may give a slightly different frequency range, but this can be compensated for (see later).

The loopstick is mounted on a loop "plug-in" chassis (**Fig. 4**). Construction is simple. The two ends of the ferrite rod are secured with plastic "P" clips, and the ends of the winding are soldered to the 4 mm plug pins.

To test this assembly, just plug the completed unit into the binding posts

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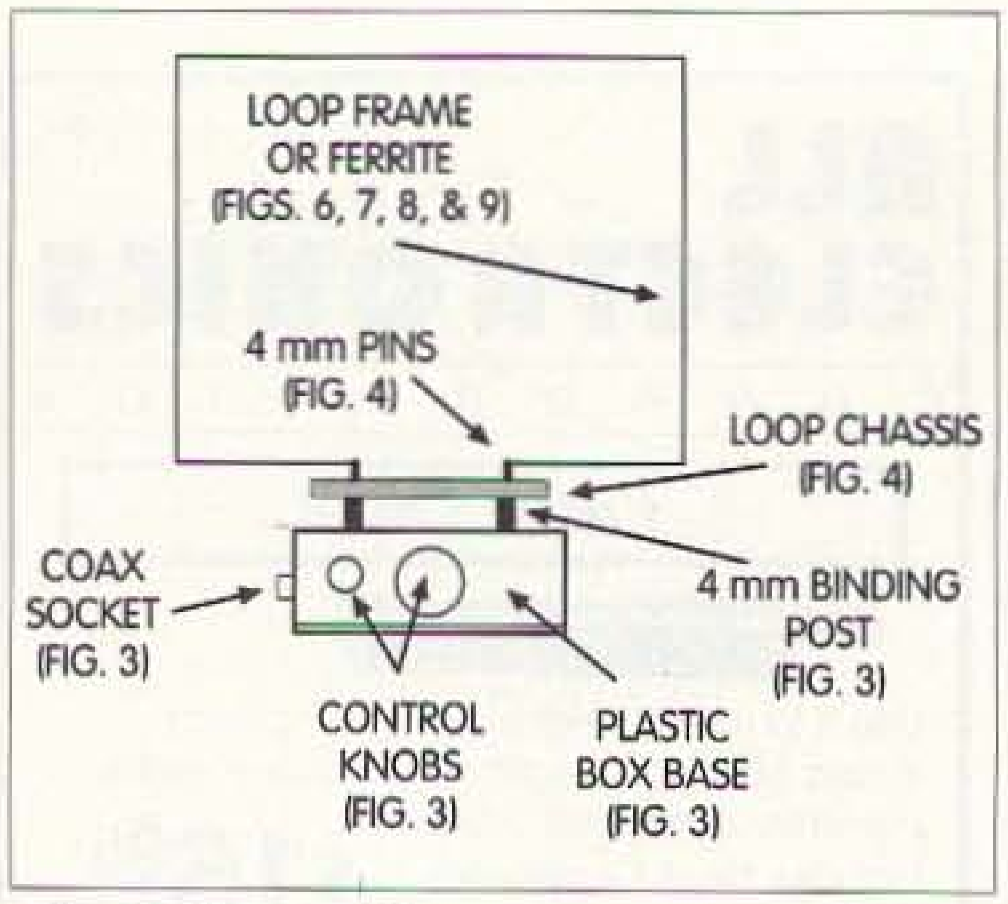

Fig. 5. General layout.

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on the base unit [**Fig. 2(b)**]. Connect the unit to a suitable RX with a short length of coaxial feedline.

Set C2 to about 20% meshed. Select an MW BC station on the RX, and rotate

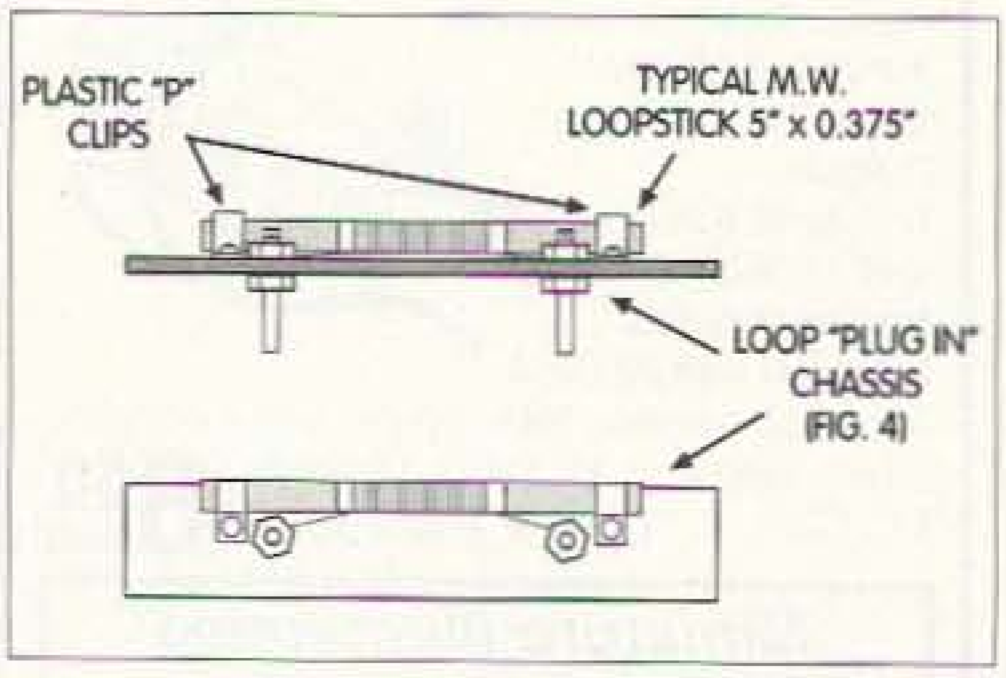

Fig. 6. MF (MW) loop — 550–2100 kHz.

C1A/C1B to resonance, which is indicated by a dramatic increase in signal strength. Gradually adjust coupling capacitor C2 for a gradual increase in signal strength, to a maximum peak, which indicates the required narrowest bandwidth. If the coupling is increased

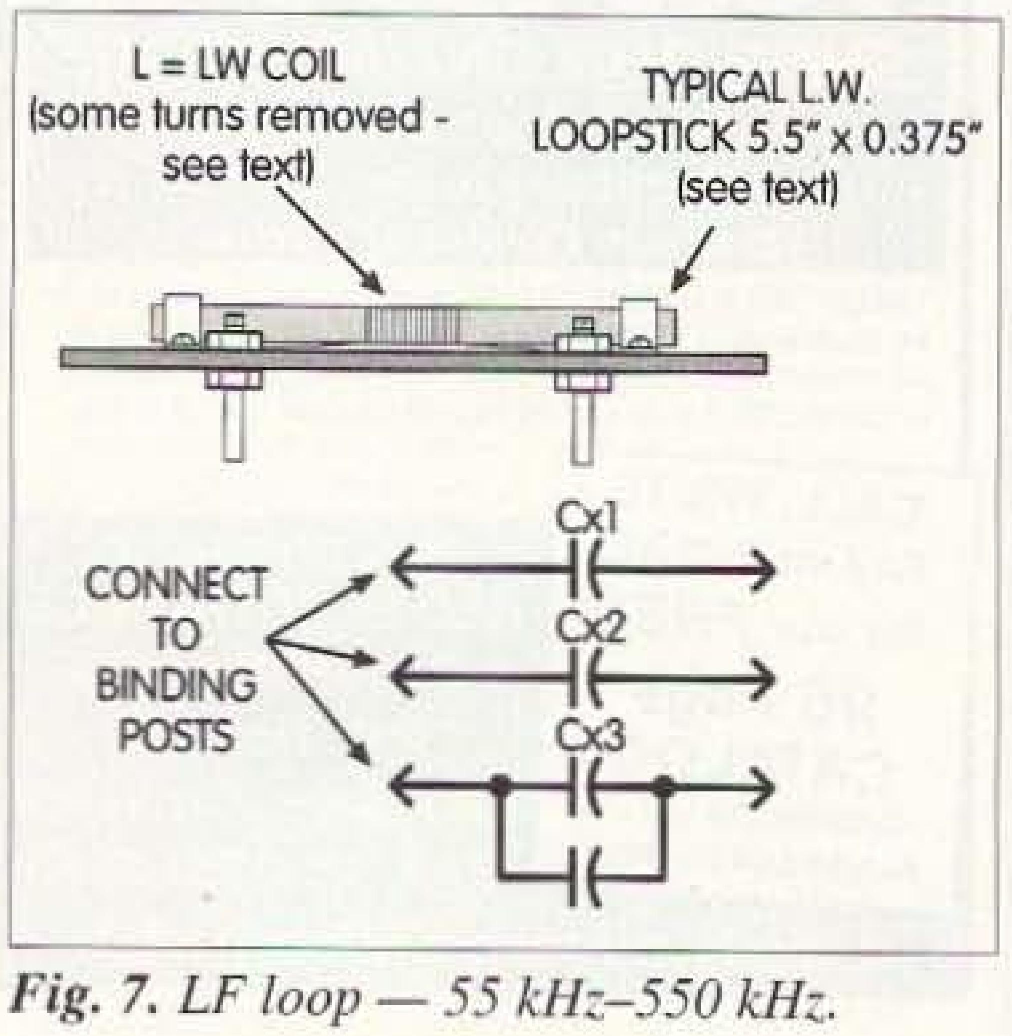

Fig. 7. LF loop — 55 kHz–550 kHz.

further, there will be a fall in signal strength and an increase in bandwidth. The operating point is at the peak signal. C1A/C1B may need a minor readjustment. The directivity range of this ferrite loop can be checked by rotating the loop.

NOTE: This testing/tuning procedure is used on all subsequent loops described.

The LF (long wave) loop — 150–550 kHz (see Fig. 7)

The construction of this unit is nearly identical to that of the MW loop just described.

A salvaged 0.375" diameter ferrite rod (with LW coil) can be used. However, the LW coil previously removed from the Maplin type LB12N MW/LW ferrite loopstick was slipped onto an 8" long x 0.375"-diameter ferrite rod. An Amidon #61 material rod would be ideal.

This coil assembly was fastened to a loop "plug-in" chassis (**Fig. 4**) with PVC "P" clips.

This unit was tested using the previously described method. The frequency range was found to be 135–425 kHz. To raise the HF end of the frequency range to overlap the LF end of the MW coil, some wire turns were gradually removed (step-by-step) until the HF end of the LW loop coil reached 550 kHz.

The assembly was now tested against a receiver, as previously described, and the revised range became 150 kHz–550 kHz.

55 kHz–170 kHz (see Fig. 7)

The above LW (LF) loopstick is used as the basis of an extended LF range by hooking a selection of capacitors across the coil. These silver mica or ceramic capacitors are each secured to a small strip of insulated card or board, with a wire soldered at either end. These wires are fixed across the coil by connecting to the screw terminal part of the binding posts.

Capacitor attachments are required as follows: 110 kHz to 170 kHz, use a 130 pF capacitor. 85 to 110 kHz, use a

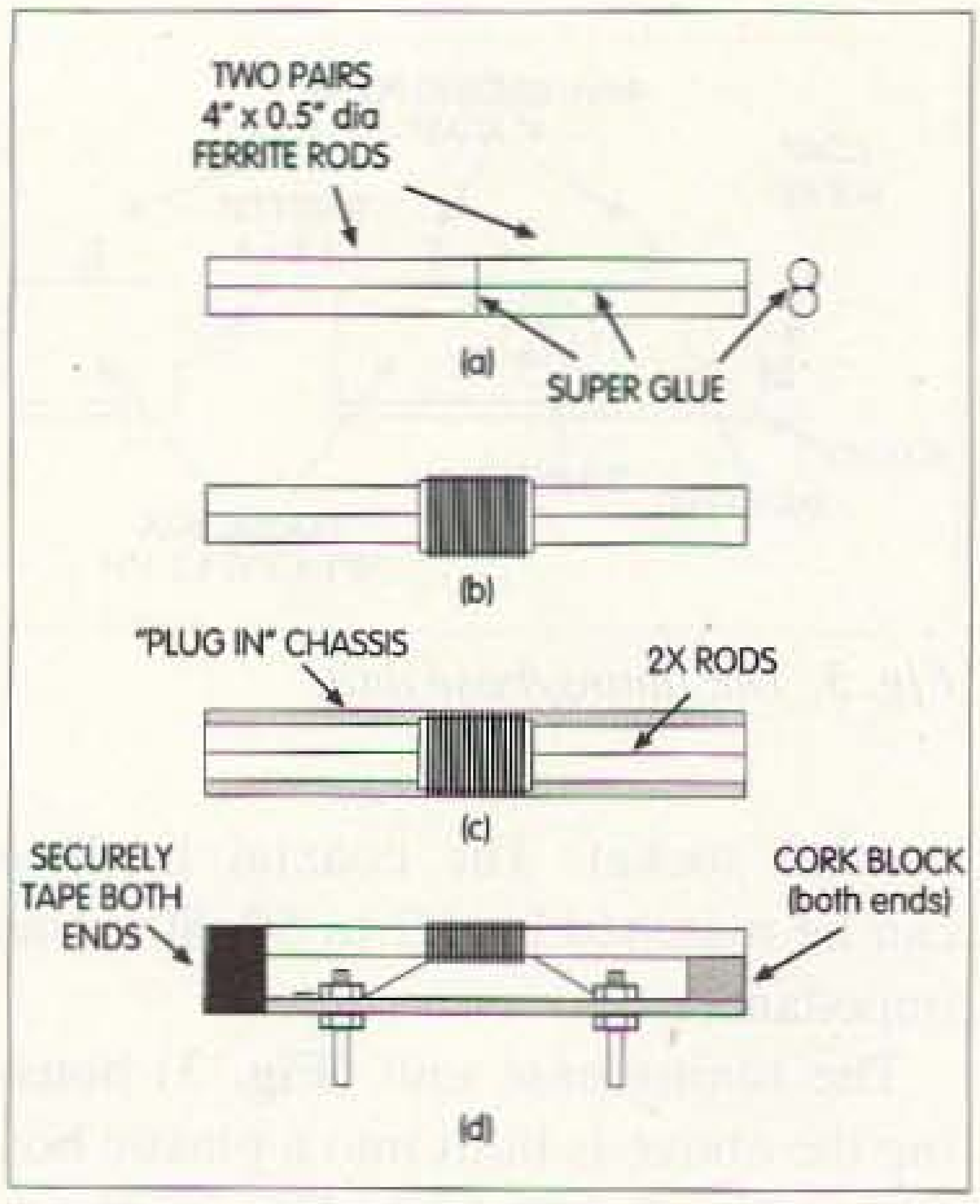

Fig. 8. The 1750–7700 kHz loop.
(a) Ferrite assembly.
(b) Winding assembly.
(c) Final assembly, top view.
(d) Final assembly, side view.

350 pF. 55 to 68 kHz, use a 1000 pF and 150 pF in parallel.

It follows that an even lower frequency can be obtained by using an even larger capacitor. Adjustment to the specified capacitor values will adjust the individual ranges to an enthusiast's needs.

The 1750–7700 kHz loop (Fig. 8)

This loop coil covers the next frequency segment up from the MW/MF loop previously described. It uses a ferrite rod core, but in this case a substantially larger core is used to increase the loop sensitivity. This large core is composed of 2" x 8" long 1/2"-diameter Amidon 61 rods, giving a core cross-section of approximately 1" x 1/2".

Four Amidon 61 rods, each 4" x 1/2" diameter are used (code number 61-050-400 from Amidon). Two pairs of 4" rods are cemented end to end with Super Glue to form two 8"-long rods. The two 8" rods are then cemented side-by-side to produce a 1" x 1/2" section core. See **Fig. 8**.

Next, wind on 2 layers of 2"-wide masking tape around the center of the rod. Over this, close wind 17 turns of 24 AWG PVC hookup wire (o/d = 2.05 mm). Leave 3" tails on the winding ends.

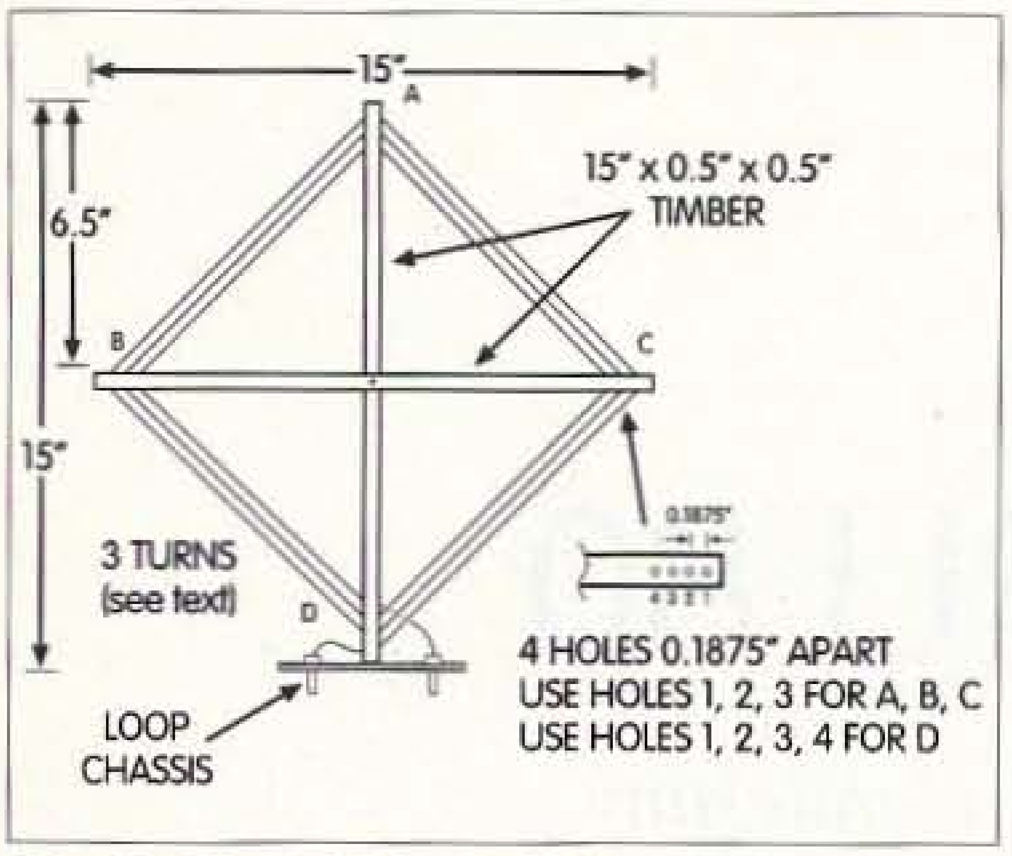

Fig. 9. The 4.300–14.500 MHz loop.

The above coil assembly is mounted on yet another loop plug-in chassis (**Fig. 4**) as shown in **Fig. 8**. The rod/coil assembly is uplifted from the loop chassis using cork blocks cut from wine bottle corks. Then securely tape into position as shown. The 3" tails of the winding are cut back, then securely soldered to the ends of the 4 mm plug pins.

Testing and tuning procedures are as previously described for the MW/MF loop, and should give excellent results from approximately 1750–7700 kHz.

The 4.300 MHz–14.500 MHz loop (Fig. 9)

Here a simple timber-framed spiral loop is used. A spiral winding is used, as it will give better nulling than a box-style loop.

A simple frame is made from two 15" x 1/2" x 1/2" lengths of hardwood timber. It is formed into a simple cross, as shown. It should be securely glued and bolted at the center of the cross.

Holes are drilled in from the tips of the crosspieces, as shown. The cross is then securely mounted to yet another standard loop plug-in chassis (**Fig. 4**). Use small nylon angle brackets.

Three full turns of PVC hookup wire are wound through the predrilled holes, as shown, with the ends soldered to the 4mm plug-pin ends.

Testing and tuning procedures are as previously described, and should give a frequency range of approximately 4.300 MHz–14.500 MHz, thus overlapping the previously described loop.

The HF to lower VHF Loop — 11.000 MHz–40 MHz (Fig. 10)

This is the simplest loop to construct. All that is needed are four lengths of brass tubing, each 12" long x 1/8" outside diameter, plus one 12" length of brass rod with an o/d such that it will just slip into the tubing. Also required is yet another standard loop plug-in chassis (**Fig. 4**). The brass tubing and rod were found in a store specializing in scale-model-making materials.

Assemble the brass tubing into a square loop as shown in **Fig. 10**. Fix

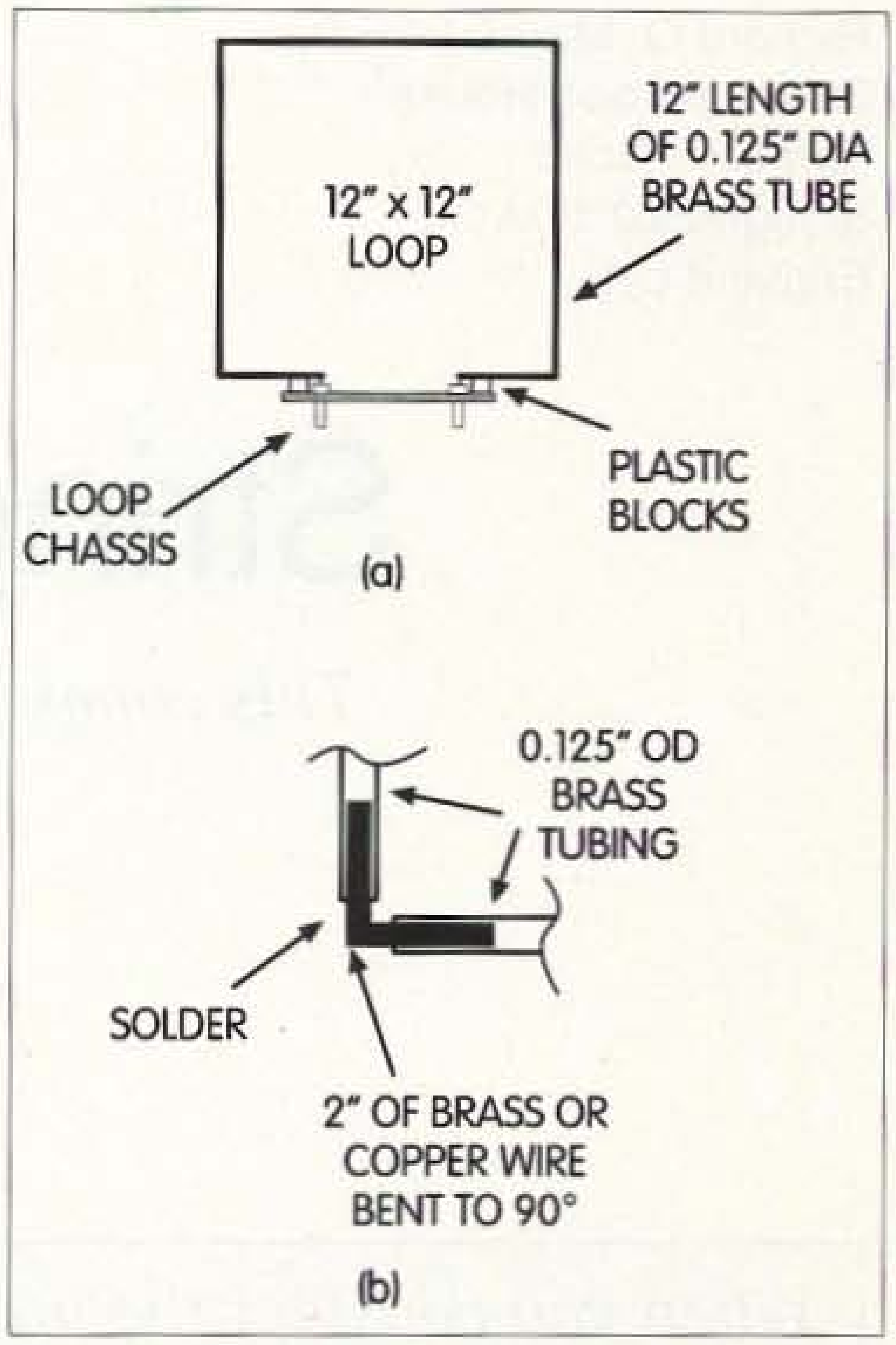

Fig. 10. The HF to lower VHF loop (11–40 MHz).

the four sides together at 90 degrees by cutting 2" lengths of the brass rod and bending them accurately to 90 degrees. After thoroughly cleaning the end, insert the resulting angles into the tube ends and securely and rigidly solder into a square. See **(b)** in **Fig. 10**.

Next, cut out a section of the bottom of the loop so that the ends lie on top of

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the 4mm plug pin ends, where they are securely soldered. Two small insulated blocks are next Super-Glued between loop and loop chassis, as shown, to prevent the loop "whipping."

The loop can now be tested, as previously described, and should effectively cover approximately 11 MHz–40 MHz.

It may be of interest to note that a replica loop was "lashed up" using lengths cut from wire clotheshangers. Contrary to what the textbooks tell us about the preferred use of copper or brass (over ferrous materials), there was no discernible difference in performance, apart from a small shift in frequency range!

General observations

1. The question of the use of a preamplifier between loop and RX now arises. I used high-gain souped-up receiving equipment. A preamplifier overloads this equipment, producing intermodulation. However, in those cases where a preamplifier is needed, there are many published simple designs for wideband preamplifiers. Also, they can be purchased at reasonable prices.

2. The loop design is such that experimenters' individual designs and ideas can be made and fitted to a loop plug-in chassis. With this in mind, a range of conventional, and fat, ferrite loops have been shown, together with a spiral and square loop. Obviously this leaves the enthusiast with plenty of scope for individual ideas and designs.

3. The total frequency range is shown as 55 kHz–40 MHz. The LF end was fixed to incorporate the UK Rugby MSF 60 kHz Time & Frequency Standard station, which comes in very loud and clear. A similar station in the USA is WWVB in Denver, Colorado, which also uses 60 kHz. The frequency range could be further lowered by addition of extra capacity across the LF Loop (**Fig. 7**).

Useful addresses

Maplin MPS
P.O. Box 777
Rayleigh, Essex SS6 8LU
United Kingdom
tel.: 011-44-01702 5540000
fax: 011-44-01702 554001

Amidon Associates
3122 Alpine Avenue
Santa Ana CA 92799
USA
tel.: (714) 850-4660

Antique Electronic Supply
6221 S. Maple Ave.
Tempe AZ 85283
USA
tel.: (480) 820-5411
fax: (480) 820-4643

Return of the Amazin' Hall Tree Vertical

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surrounding objects cannot be expected to operate as well as a full-size one in free space. Lately, sunspot activity has made 40 meters quite erratic and noisy at times. This has made it difficult to collect much data on this antenna's performance. It has been used surrounded by trees in my front yard, too. Still, using 10 watts QRP on CW and 100 watts on phone, I have been able to make several contacts over 500 miles distant. The usual report was between 5/5 and 5/8.

Please give this easy antenna a try, and let me know how you make out!

The Hybrid Vee

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extension. This becomes the basis for one of the antenna tuning elements.

Note: This tuning tee is NOT required unless the entire 20-meter band is to be covered, and is not required at all for the 17-meter band. If used, the upright tee can also be used to attach one end of the antenna wire. If not, the antenna wire is directly fastened to the end of the PVC pipe extension as shown in **Fig. 1**.

The basic antenna wire is #12 AWG THNN insulated electrical wire, available from your local hardware store.

The slanted leg of the inverted vee portion of the antenna is attached to the one end of the tee at the top of the mast, leaving a "pigtail" of wire for soldering to the shield braid of the coax feedline. (Note: The inner conductor of the coax feedline will be soldered to the top end of the vertical wire

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