The Table Topper 160-Meter Loop

Compact, low-noise—and effective.

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Many amateurs and SWLs find it very difficult, if not next to impossible, to erect an effective 160m antenna. First, there are those in "no antennas here" zones. Others do not have the space to erect an effective conventional antenna. And any who live in an urban environment will probably have to exist with a high noise level anyway, which may be so high that the band is impossible to use.

At my QTH I do not have the space to erect one. Even with a short loaded wire, the noise level is intolerable.

Noise at these frequencies is either atmospheric or manmade. Both types are picked up by the antenna, as is QRM. Atmospheric noises are radio waves, produced by natural causes, of irregular waveform and usually very short, repetitive duration. They cover a wide range of frequencies, and the noise level increases as the operating frequency decreases. This noise may be directional or non-directional, depending on the cause—an extreme case being nearby electric storms.

Manmade noise seems to be getting progressively worse as the years go by. It can be produced by inside sources such as thermostats; dimmer switches; TVs; computers and other electronic devices; and, of course, the main power supply—house wiring.

Externally, you can also pick up many of these noise sources from neighbors (especially in apartment complexes); external power supply cables; road traffic; neon signs; and so on.

Fortunately, much of all this noise interference is directional, and can be eliminated or greatly reduced by using a directional antenna such as a well-designed loop.

Coming back to the 160m band after some years' absence, I decided to design a narrowband, narrow beamwidth, small transmitting and receiving loop to specifically combat these noise problems on 160m.

Small, tuned-frame loops can be either solenoid-wound "box" types, or "spiral"-wound loops. With symmetrical matching/feeding, they should produce the well-known "figure eight" polar diagram radiation pattern, giving a theoretical zero signal null at 90 degrees to the line between the TX to RX signal path.

The box loop is the most convenient to construct, but unfortunately signals cannot be completely eliminated at 90 degrees. However, the more difficult to design and construct spiral loop can eliminate all signals at 90 degrees to the TX-RX signal path. Also, it does not need direct earthing/grounding.

The Table Topper 160 loop configuration

First, I constructed a spiral octagonal loop. This was tuned with a variable capacitor and successfully loaded with a low-power 160m CW TX. On a good RX, both European and trans-Atlantic signals came through when conditions were OK. However, living in south central England, I found that North American stations were received on the forward lobe, while European signals were recoverable on the reciprocal or opposite lobe. The nulling at 90 degrees effectively eliminated all signals. Noise levels were dramatically reduced.

I then conducted experiments with alternate shapes of spiral loops, using the same amount of wire turns and alternate methods of feeding/matching. At each stage, I did comparisons with the original octagonal spiral loop, the object being to (1) increase signal strength in and out and (2) if possible, reduce the size of

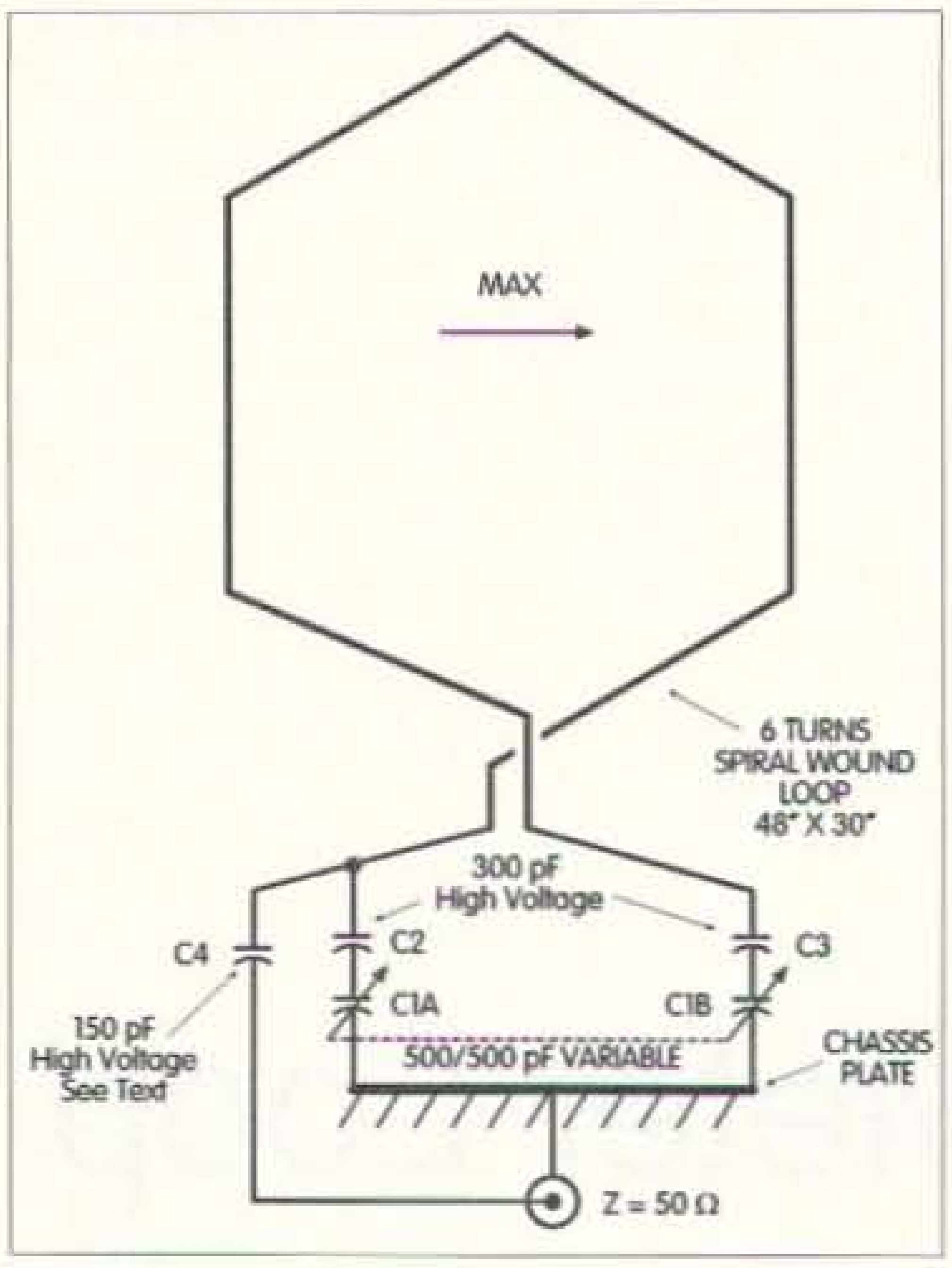

Fig. 1. Loop schematic.

the rear lobe while increasing that of the forward. This would reduce the reciprocal bearing QRM (on receive) and increase the signal strength on receive and transmit. Atmospheric noise would also be further reduced.

The final TT160 loop is shown in **Figs. 1** and **2.** I found that by reducing the loop's width dimensions and increasing its height, the signal strength significantly increased when compared with the original octagonal spiral assembly. The excellent nulling at 90 degrees was increased, too. Experiments also indicated that by adopting an asymmetrical feed, as in **Fig. 1**, the forward lobe could be increased and the reciprocal, decreased.

The end result was most satisfactory when the loop was pointed toward North America, where excellent W and VE signals could be heard, although the reciprocal European signals were greatly reduced. Rotating the loop through 180 degrees meant the opposite happened. Furthermore, the new shape and feed method gave the loop a narrower beamwidth which, with the loop's usual narrow bandwidth, reduced manmade noise and atmospheric noise to acceptable levels. The new radiation pattern was similar to **Fig. 4b**.

Loop construction

Refer to **Figs. 1** and **2** for the final loop assembly, just 30 inches wide and 54-3/4 inches in overall height, including the base mounting chassis. This is a size which can easily be accommodated on a tabletop and then stowed away when not required.

The TT160 consists of six spiralwound turns of PVC-covered wire (24/0.2 mm) with an OD of 2.05 mm and rated at 6 A. Any 6 A-minimum PVC-covered wire would suffice. The turns are supported by six-way terminal blocks, cut from 12-way standard ones (Radio Shack™ #274-679). It is important that the loop turns are wound counterclockwise starting at the outside and fed progressively through the terminal block holes. The inner wire end goes to a three-quarter-inch standoff insulator (**Fig. 2**), which ensures that the wire end drops down to the VC (variable capacitor) with a half-inch clearance away from the loop turns. The loop frame is made from well-seasoned hardwood as shown in **Fig. 2**.

The baseboard is 12 x 9 x 3/4-inch timber, onto which is mounted the simple chassis. This is a piece of 8 x 4 x 1/2-inch timber faced with single-sided copperclad Fiberglas™ board (8 x 4 inches), with the copper surface upwards. It is fronted by an identical board to form the panel. The copper surfaces of both boards should be seam-soldered together. At the rear of the baseboard is mounted a timber vertical loop frame support 13 inches long by one and three-quarter inches in diameter (see **Fig. 2**). The edge of this should be planed off to a small flat surface to allow the loop frame to be screwed to it as shown.

The two-gang by 500 pF-per-section variable capacitor (C1A and B) is mounted on the front panel. This VC should be of the larger, rigid, well-spaced, receiver type, with ceramic-mounted stators, which could well be salvaged from an old tube receiver. I used a Jackson type "L". In series with

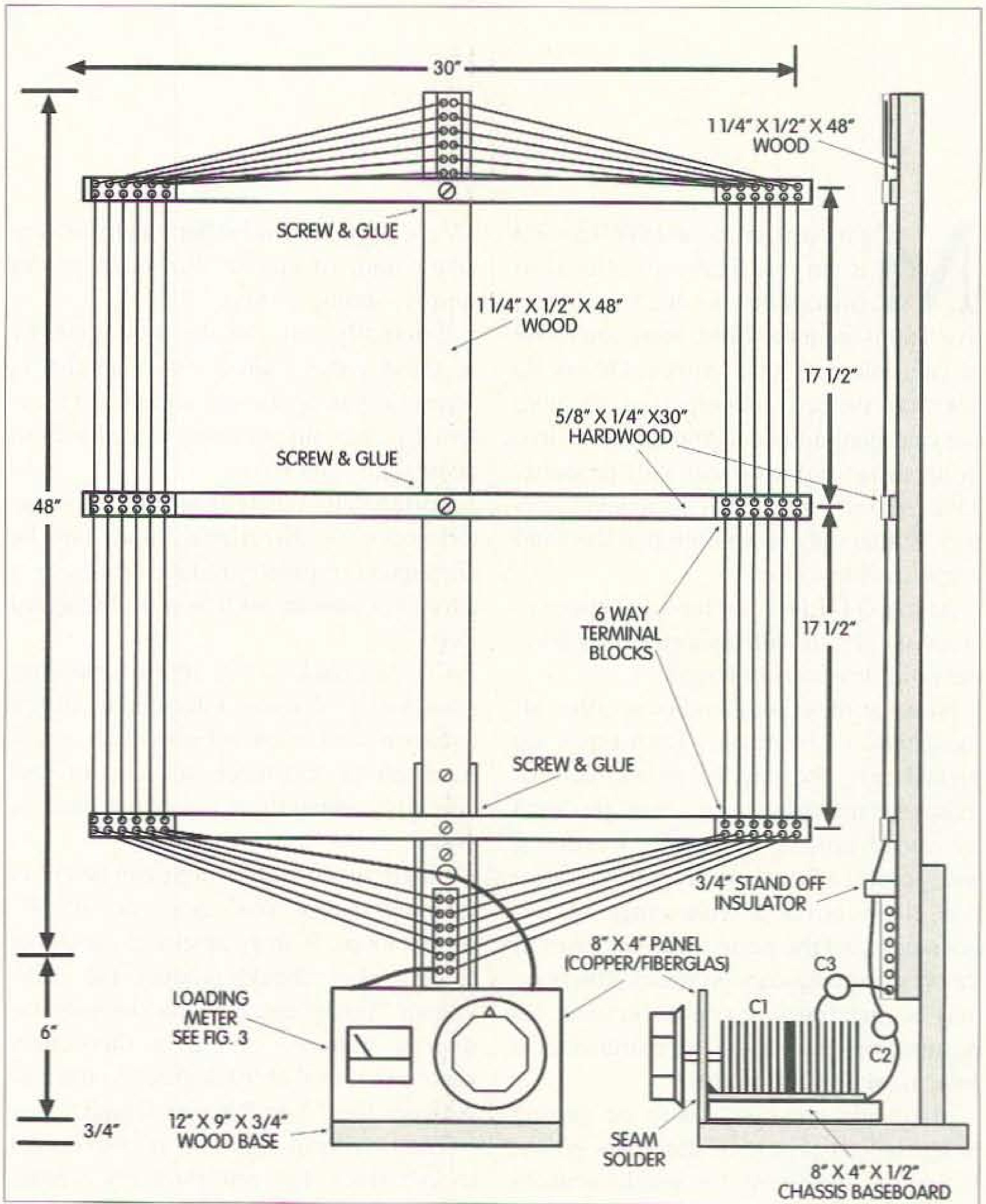

Fig. 2. Loop construction.

C1A and B are two 350 pF high-voltage ceramic disc capacitors (8 kV) which were from the junk box. Each is fitted to a small piece of perforated board and incorporated in the wiring between the loop and VC.

> ***"There are no prizes for electrocuting the cat!"***

The coupling loading capacitor (C4) is 150 pF high-voltage. Once again, an 8 kV rating from the junk box. The ceramic discs could be, say, 2 kV working, depending on what is obtainable. C4 couples the outer end of the loop winding to the 50-ohm coaxial socket, mounted facing the rear, so that the cable exits at the zero signal area of the radiation pattern.

Setting up and operating

The TT160 is fitted with a simple front-panel loading/tuning meter as shown in **Fig. 3**, consisting of a 250 µA meter with two diodes and a pickup coil. 1N4001 diodes were used, but any small ones would suffice.

The meter could be 100 µA if available. It is mounted on the front panel, as shown in **Figs. 2** and **3**. The pickup coil is a few turns of PVC hookup wire wound on a three and a half-inch length of three-eighths-inch diameter wood or plastic rod. Two pins are pushed through the rod, as shown in **Fig. 3**, forming the connecting point for the diodes and the pickup coil ends. The number of wire turns will depend on the type of meter and TX power used (see below).

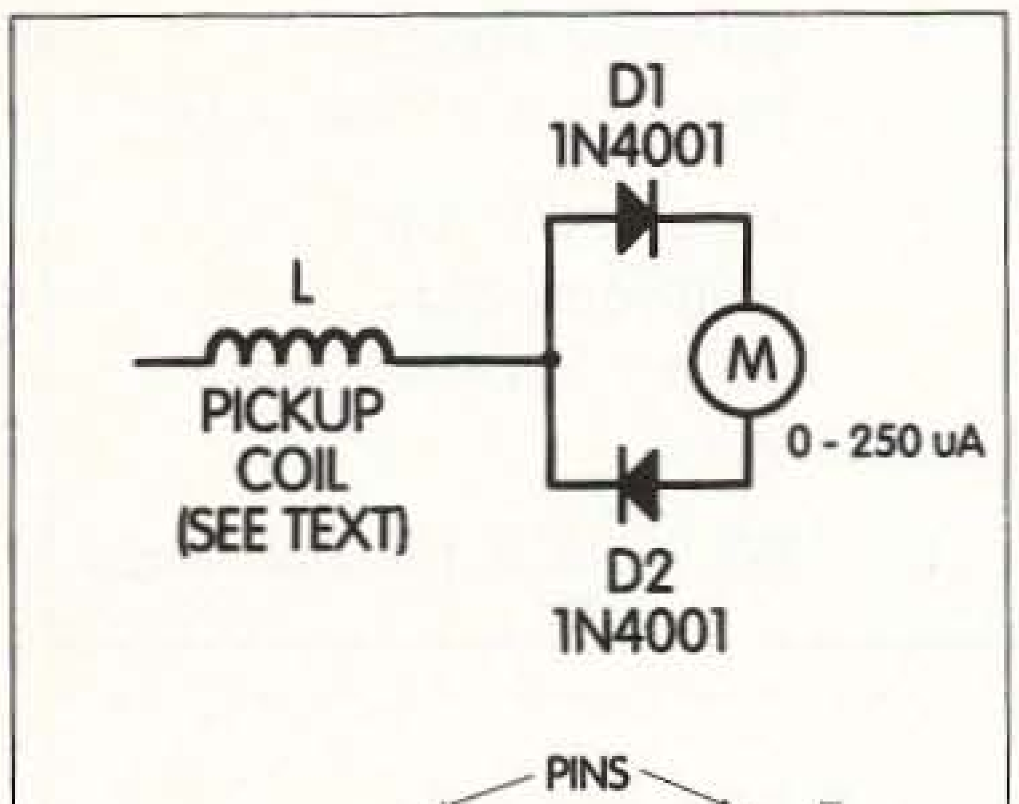

Fig. 3. Loading meter.

No ground connection is required for the loop, although of course the TX and RX should be grounded.

The loop's narrow bandwidth ensures that no harmonic output, or TVI, can be detected when you are running about 15 watts CW. C1A and B have been found to be okay when tested up to just over 20 watts. If a much higher power is to be used, then a TX-type variable capacitor and thicker loop wire will be necessary. For safety reasons, higher power is not recommended for use in an indoor environment. There are no prizes for electrocuting the cat!

A simple loop-rotating turntable would be an advantage. This turntable should not be of the free-running ballrace type, since the stiffness of the coaxial cable would take charge.

A few feet of RG-58 coaxial feedline should be connected between the loop and the TX/RX.

An operating frequency should be selected for the initial tests. The TX/RX should be loaded into a dummy load. On receive, the loop tuning capacitor should be carefully rotated to resonance by noting an increase in signal strength. Then rotate the loop for maximum signal, i.e., to the bearing of the station being received. Then, with a field strength meter nearby, switch to transmit. If necessary, readjust slightly for maximum indicated radiated signal on the field strength meter.

Next, put a few turns of hookup wire on the dowel rod and note the indication, on the panel microammeter, of the loading/tuning meter. The number of turns should be increased/decreased to the point where maximum radiated power from the loop produces about three quarters of a full-scale reading. The number of turns depends on the power of the TX. In the future, this three-quarter-scale meter reading will be your reference that all is well. When retuning the TX to another frequency, it may be necessary to slightly adjust the loop tuning knob to frequency, indicated by your maximum meter reading.

Remember: The bottom line for best TX performance is *maximum indicated output!*

The Table Topper 160 is an effective, low-noise, compact antenna. Its frequency range is 1600 kHz to 2000 kHz, with overlap at either end. It is equally useful for the transmitting and/or listening amateur, and will give a good account of itself as an indoor 160m TX antenna, too. No doubt someone will devise a remote control version for use in the attic—I'd love to hear about it.

On receive, the DX performance is quite dramatic when used with a good RX (no preamp being used). The low noise level, along with narrow beam- and bandwidth, ensures easy and comfortable listening. The TT160 has also been used for receiving DX and other beacons between 1600 and 1700 kHz. This also makes it a good prospect for those licensed for the MEDFER experimental transmitting band. Happy looping!

Suggested reading

Admiralty Handbook of Wireless Telegraphy, Vol. 2, 1938.

Antennas, Kraus.

Radio Engineering, Terman.

Handbook of Technical Instruction for Wireless Telegraphists.

Parts List

68 ft.	PVC-covered wire flex (24/0.2 mm), OD 2.05 mm, rated at 6 A. Other 6 A wire could be substituted.
1	500 and 500 pF 2-gang variable capacitor. Well-spaced rigid receiving type, with ceramic stator insulation. Jackson type "L" was used on the prototype.
4	12-way terminal blocks (RS #274-679), each bisected to form 8 6-way blocks
2	350 pF ceramic disc capacitors, 2 kV minimum
1	150 pF as above
1	3" diameter knob
2	8" x 4" Fiberglas™ single-sided copper board
1	1-1/2" x 1-1/2" meter (50, 100, or 250 µA)
2	Small diodes (1N4001 used)
1	3/4" standoff insulator
1	Wooden base 12" x 9" x 3/4"
1	Chassis, wooden baseboard, 8" x 4" x 1/2"
1	48" x 1-1/4" 1/2" hardwood, plus 13" x 1-3/4" diameter dowel
3	30" x 5/8" x 1/4" hardwood

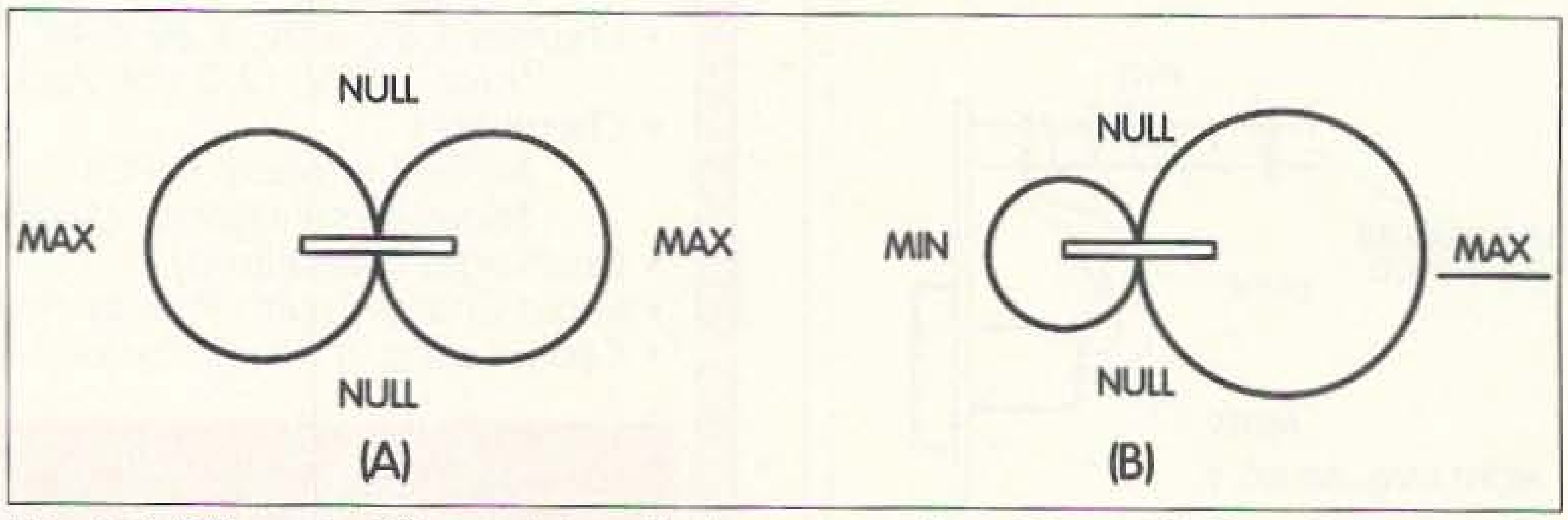

Fig. 4. (a) Theoretical figure eight radiation pattern of small loop. (b) Plotted pattern of the Table Topper 160.