The Inverted L Ham Antenna

By Robert M. See, W5LTD

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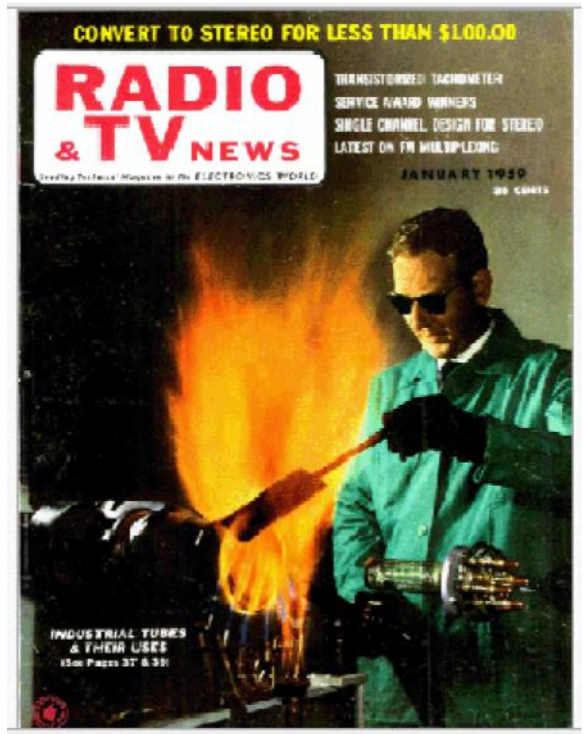
Construction of simple antenna and matching network that provides a good compromise in height, cost, and coverage.

After moving into a new home it was hoped that a satisfactory solution could be found to the problem of installing an amateur antenna without detracting from an appearance of the neighborhood landscaping. This, of course, ruled out any type feedline which would hang suspended and flapping in the Oklahoma breeze. Naturally the buried coax feedline and all-band vertical came to mind. After considerable thought (this is always the hard part), it was decided to modify the vertical radiator to include some horizontal polarization. It was believed that this might increase the field strength, on 80 and 40 meters, over that of a vertical- at least within a 300-mile radius. In other words, we didn't want our signal to skip our local friends. As a consequence, the Inverted L Antenna- which is a compromise in height, cost, and coverage- was adopted.

The utility pole was set 5 feet into the ground and has withstood 70 mph wind gust without guy wires. It is located on the rear of a city lot, nestled in a group of eastern red cedar trees. It takes a sharp eye to detect any discontinuity in the landscape.

The XYL believes this to be the best part of the entire installation, however, the author is partial to its operation and the strong signal reports received.

Figure 1 shows the horizontal radiation patterns on three bands for which the antenna was designed. It would be possible to operate the antenna on 15 and 10 meters with the proper matching networks but these bands have not been investigated.



Radio and TV- news, January 1959

Antenna Construction

The vertical portion of the antenna is made from a 32.5-foot section of ½-inch I.D. copper water tubing. It is mounted on 4-inch ceramic stand-off insulators which are, in turn, fastened to the telephone pole. The copper tubing can be purchased in coils of varying length and was used because it was easy to handle and workable. The horizontal portion of the antenna is 32.5 feet of # 12 AWG (2-mm) stranded copper antenna wire.

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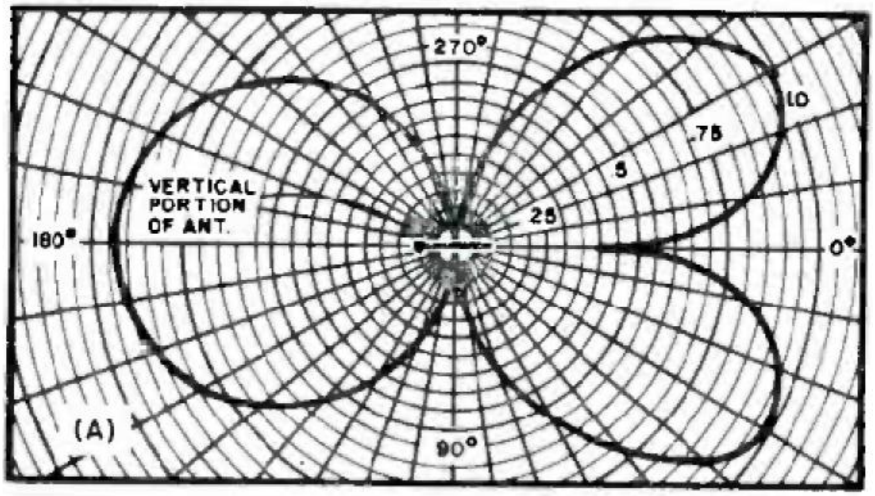

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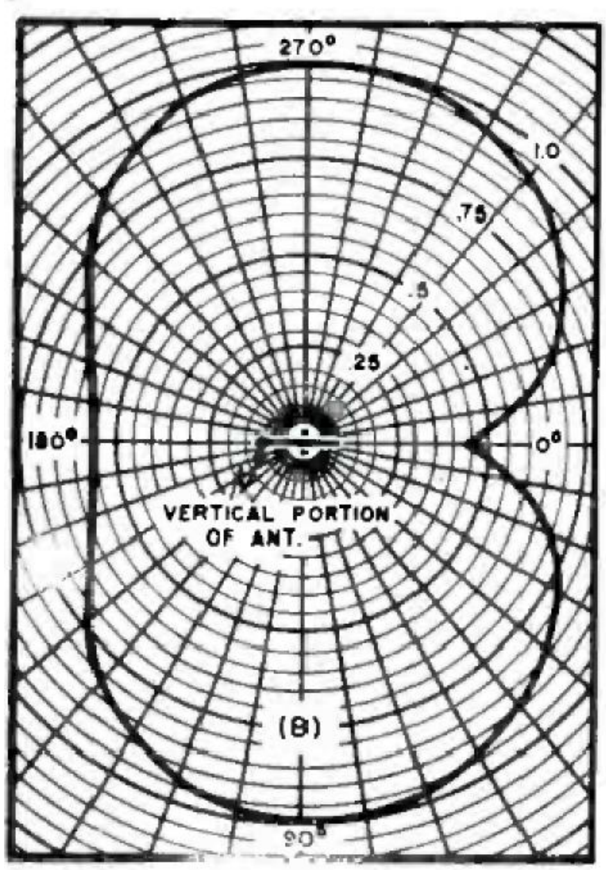

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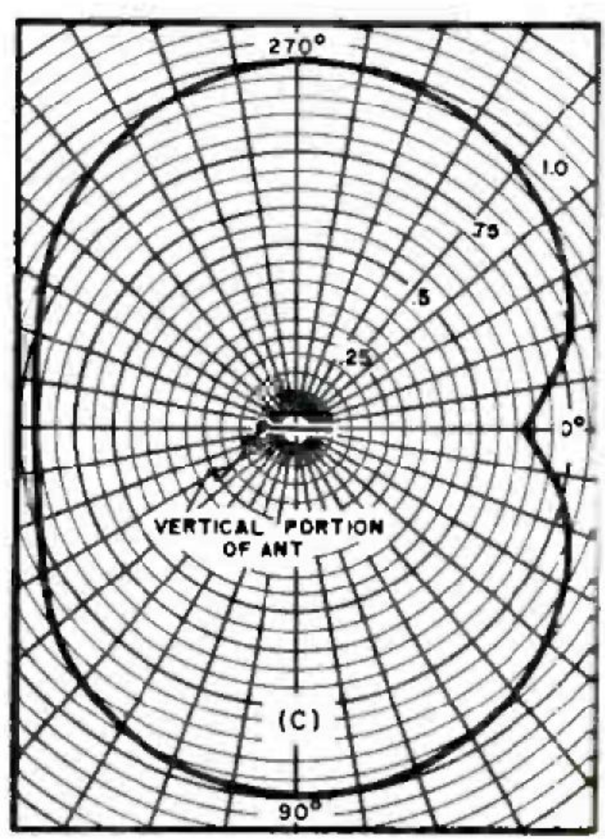

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Figure 1

The horizontal radiation patterns for the Inverted L Antenna are shown here on **A** for the 20 meter, **B** for the 40 meter, and **C** for the 80 meter bands. Field strength shown are all relative.

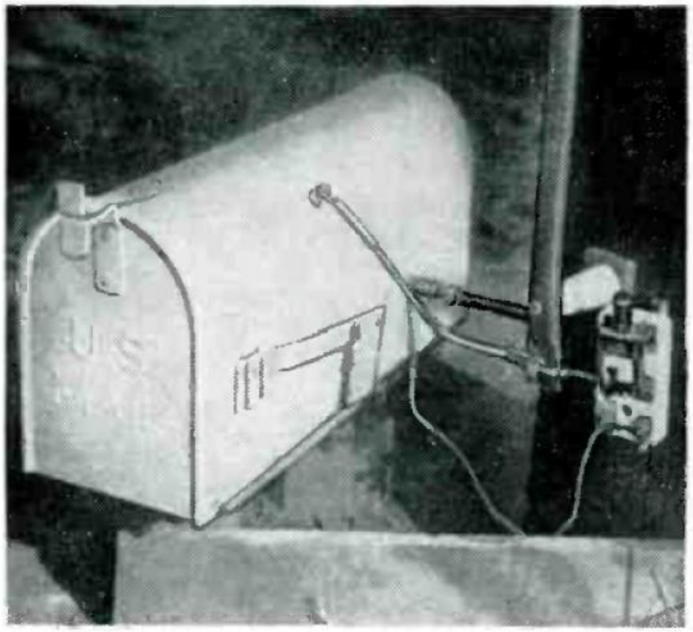


Photo 2

Matching network is inside rural mailbox at base of antenna. Adjustments are accessible through door and back of mailbox. Switch is for lighting protection

The transmission line is buried about 6 inches in the sod and runs from the house to the base of the antenna where it enters the housing for the impedance matching networks.

The ground radials are made of four lengths of # 12 AWG copper wire 35 feet long. They stretch out in four directions from the base of the pole and buried about six inches into the turf. They are securely bonded together at pole to reduce losses and are connected to the matching network by a copper braid. In dry, sandy soil the radials should be made no less than 60 feet long and their number increased to six. It is imperative that the antenna have a good ground system, securely bonded to reduce losses.

The efficiency of this antenna on 80 meters is better than that of the 33-foot and 44-foot verticals because the high current (and high radiation) portion of the antenna has been raised.

Almost any length of wire or antenna configuration can be made to look like 50 ohms or any other transmission line impedance. This is the job of the impedance matching network. Since an R.F. Bridge wasn't available, the impedance of the antenna was measured with a Q- Meter and calibrated SWR Meter. The results are given here as a matter of information only: 14.2 MHz., Z= 650 – j100 Ohms; 7.2 MHz., Z = 5000- j100 Ohms; 3.8 MHz., Z= 26 + j0 Ohms.

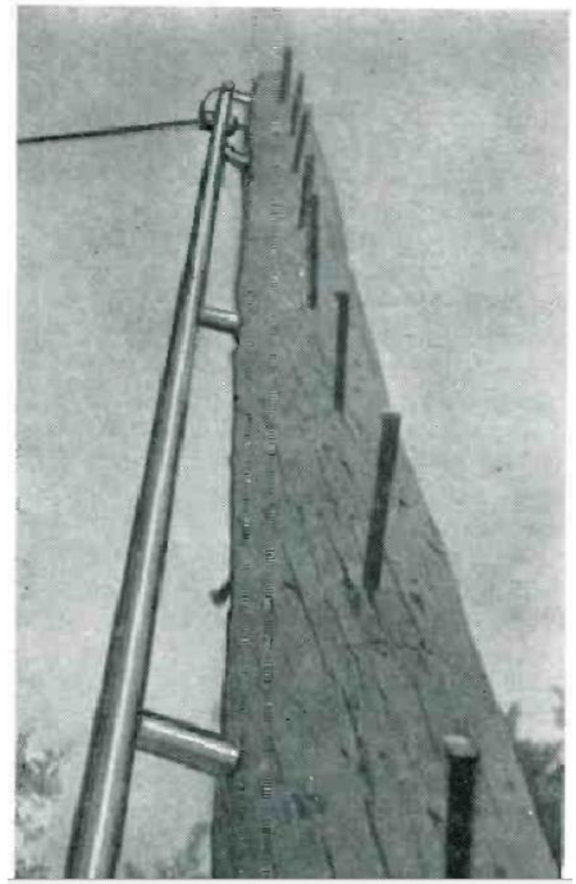


Photo 1

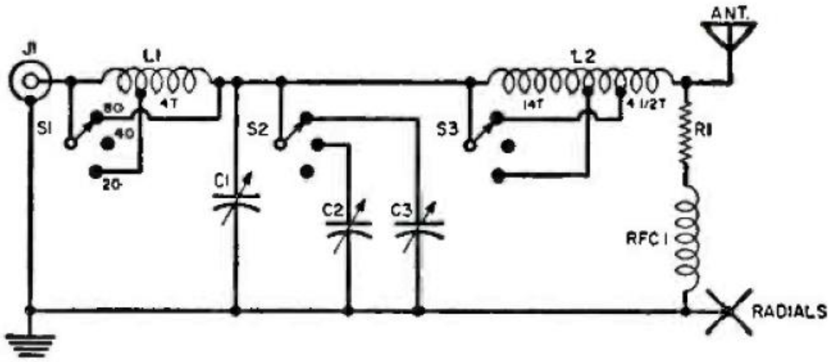
Vertical portion of antenna made of copper water tubing, fastened by stand-off insulators

As can be seen from the circuit diagram of **Figure 2** and the **Photo 3**, band-switching was handled by three separate switches. If the builder substitutes a ganged switch and different parts layout, it is suggested that the coils be placed at right angles to each other to reduce mutual coupling.

All components were mounted on a plywood board which is slightly smaller than inside dimensions of the RFD- Type mailbox. The finished unit is slipped into mailbox which provides excellent protection from the weather.

In the author's unit, C2 was made up to 50- pF unit and 30- pF variable capacitor in parallel since the variable was on hand. The actual capacity needed is 70- pF. The 400- pF mica capacitor used as part of C3 should be of the high current type. The one used here is a surplus Sangamo Type A2LH (2500 Volts). The switches should also be able to withstand high current if high power is to be used because they will carry the full antenna current. The switches shown in the **Photo 3** were taken from an army surplus antenna tuning unit.

Fig. 2. Complete schematic diagram and parts list for the antenna matching unit.



R_1—10,000 ohm. 5 w. res.
C_1—100 μμfd., 1000 v. var. capacitor
C_2—70-100 μμfd., 1000 v. var. capacitor
C_3—500 μμfd. capacitor (400 μμfd. mica in parallel with 100 μμfd. var. unit)
L_1—6 t. #3905-1 B&W "Inductor," 2½" dia., tapped 4 t. from output end
L_2—22½ t. #3905-1 B&W "Inductor," tapped 4½ t. from ant. end and 14 t. from input end
J_1—Coax receptacle
RFC_1—2½ mhy. choke
S_1, S_2, S_3—Single-pole, 3-pos. low-loss switch (see text)

Figure 2
Complete schematic diagram and parts list for the antenna matching unit

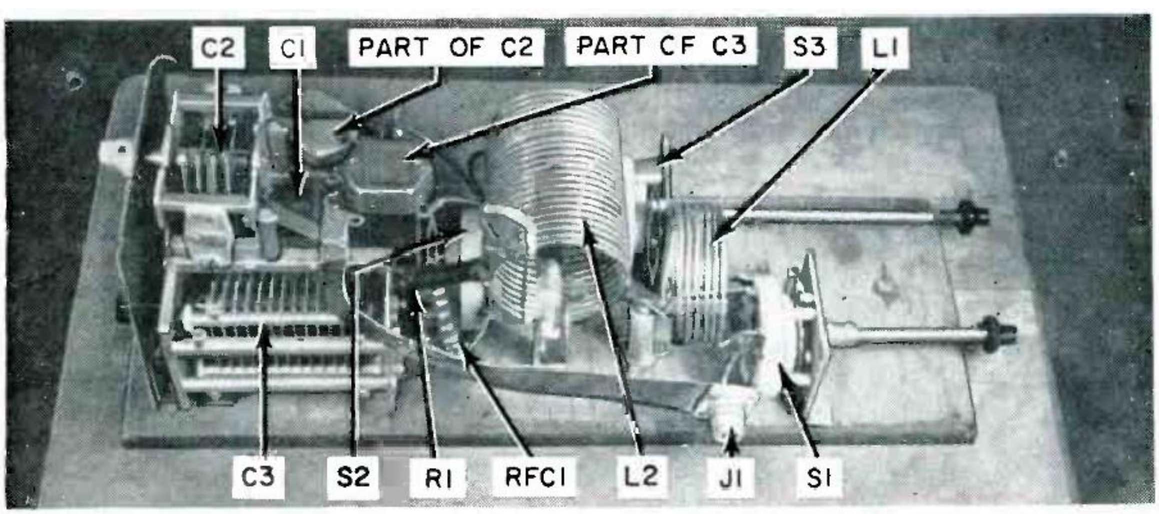


Photo 3
Photo showing the construction on the network, which is built on a plywood board

R1 and RFC were added to the circuit to bleed off any static charge which might develop during thunderstorms. The knife switch mounted on the utility pole is used to short the antenna and protect the station equipment when the station is not on the air during heavy electrical storms. This matching network has handled a 400- W transmitter for a year and shows no signs of heating or arcing of components.

Calibration

As mentioned earlier, it is not necessary for anyone who plans to duplicate this antenna to do any design work to assure a good impedance match.

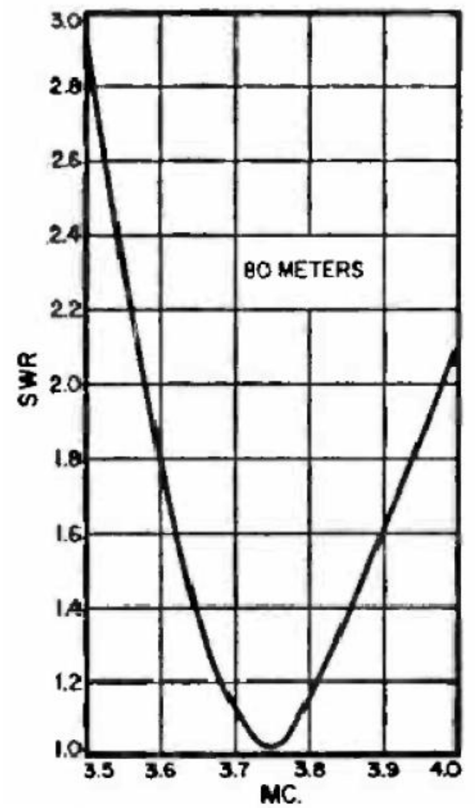
It is necessary, thought, to have a SWR in the line while making the adjustments for low SWR on each band. Start your adjustments with the switches set on the 20- meter band. While watching the SWR indicator, rotate C1, until the lowest reading is indicated.

Small variables in the antenna installation may make it necessary to change the taps on the coils one or two turns. If this becomes necessary (it is if the SWR indicator cannot be made to read a low value) the C1 setting should be re-adjusted for a low reading after the taps are changed. When the SWR has been made as low as possible on 20- meters the procedure is repeated on 40 and 80 meters while adjusting C2 and C3 respectively.

In addition to matching the 50- Ohm line impedance to the antenna input resistance this network also corrects for reactance in the antenna and thereby affords easier loading to the transmitter. **Figure 3** shows how the SWR varies over the band in the author's installation. As can be seen, the lowest SWR was made to fall in the center of the band because both CW and phone operation were to be used. If the builder plans only CW or phone operation he may shift this low SWR on 80 and 40 by making his adjustments on the frequency to be used.

In conclusion, it might be well to add that if you are the band-hopping type of operator, remember that you will have to visit the base of the antenna to switch bands. However, even this small obstacle can be looked upon as a "blessing" when you consider that in this age of automation most of us could use a little exercise! Although this antenna cannot compete with a good beam, it has proved to be the answer to a serious problem at W5LTD. We have a sneaking suspicion that it will be in use for many years to come since it has provided excellent contacts all over the globe. We believe you will like it as well!

73! de Robert, W5LTD



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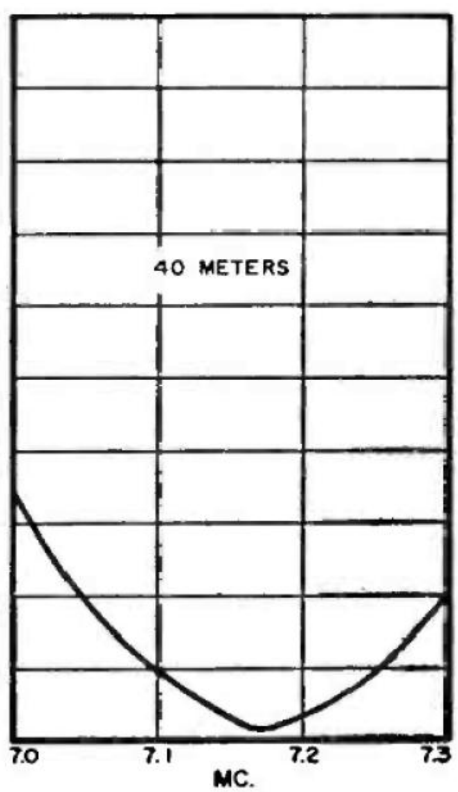

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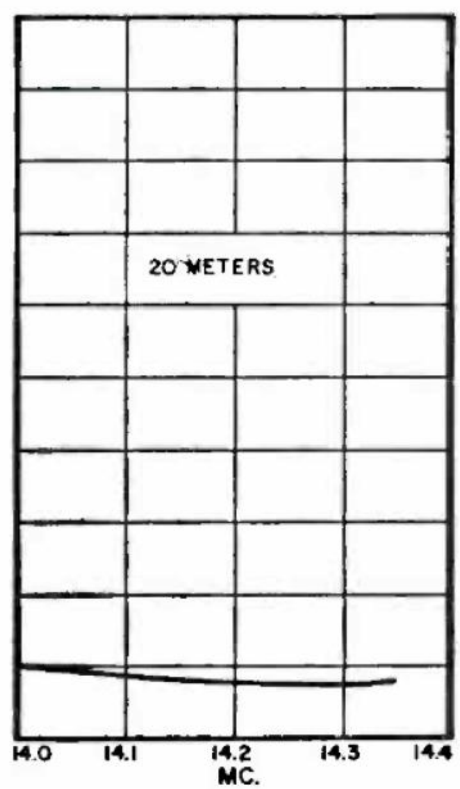

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Figure 3
SWR of the Antenna: A- 80 meter, B- 40- meter, C- 20 meter