# How to Build an 80-Meter Midget Antenna

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**We know of many Novice licensees who were chagrined to find that an 80-meter antenna when stretched out flat occupies quite a bit of space. Obviously, the answer for the fellow with the small backyard is to erect an antenna that goes straight up. This is often no solution either, so W6SAI has devised a "midget" to do the job.—Editor.**

Now that the sunspot cycle is approaching a new eleven year low the trend of amateur operation is towards the use of the low frequency amateur bands. The 10-meter band, which held thousands of signals a few short years ago, will this winter be practically useless. Even 20-meters has become very spotty, and DX activity on this band is slowly dropping off. Imagine! One can even hear the QSL managers getting on the air nowadays!

To balance this slackening at high frequencies, activity on 40 and 80 meters is picking up. A lot of 14 and 28-mc followers have suddenly become aware that there are pleasant contacts and lots of DX on "eighty meters." The 7-mc antenna is not too much of a problem, but even a simple 80-meter dipole is often too huge for a city ham. The fellow usually ends up with a high-loss Marconi, and after pumping all his r-f energy into the neighbor's petunias, mutters," Fooey with this band! Think I'll go back to ten and work some short skip stuff."

Fortunately there is a relatively simple solution. There is usually plenty of room straight UP. A quarter-wave whip antenna, however, is quite a thing for this band, becoming some sixty-odd feet long. One was erected at W6SAI, but died a quick death under the scowls of the neighbors. I sorrowfully took it down after a few contacts had given me just a hint at how "hot" a vertical whip might be. (No guts!—*Ed.*)

After a few exploratory tries a simple and highly effective loaded whip only about twenty-four feet high was evolved. It is a big brother to the loaded whips that are employed for mobile operation. Such a whip, properly loaded and working against a good ground system, is a star performer in the eighty-meter band. This so-called midget ground plane has been in use at W6SAI and W6FHR for the past year or so and has proven very satisfactory in every respect. WAC has been made on 80-meter CW, and many European contacts have been made from the west coast. Contacts with Europe on 3.5-mc from W6-land certainly separate the men from the boys in regards to an efficient antenna system. This little whip will stand up to the best of 'em!

### The Midget Ground Plane

The overall height of the whip is twenty-four feet. Four resonant radials are used as a ground system. These, as well as the whip, may be so loaded with inductances that they do not physically cover too much backyard area. The whip is composed of three parts: The lower part is eighteen feet of fairly heavy 24ST dural tubing. Two ten-foot pieces of telescoping tubing are used for this section. The base section is ten feet long and 1⅝" diameter; the telescoping piece is also ten feet long, and is 1½" diameter. Do not use tubing much smaller than this or it will tend to buckle when the antenna is raised. The two pieces of tubing are bolted together with 10-28 *cadmium plated* machine screws; the inner section of tubing being tapped to take the screws. The overlap should be a little over one foot.

The top section of the antenna consists of a five foot length of ⅜" diameter 24ST dural tubing. This section has very little wind loading, and almost any piece of tubing or rod will do. A flexible automobile whip will be excellent, if it is a one piece whip. A sectionalized whip will give noisy results on receiving after a short time, due to the wiper springs.

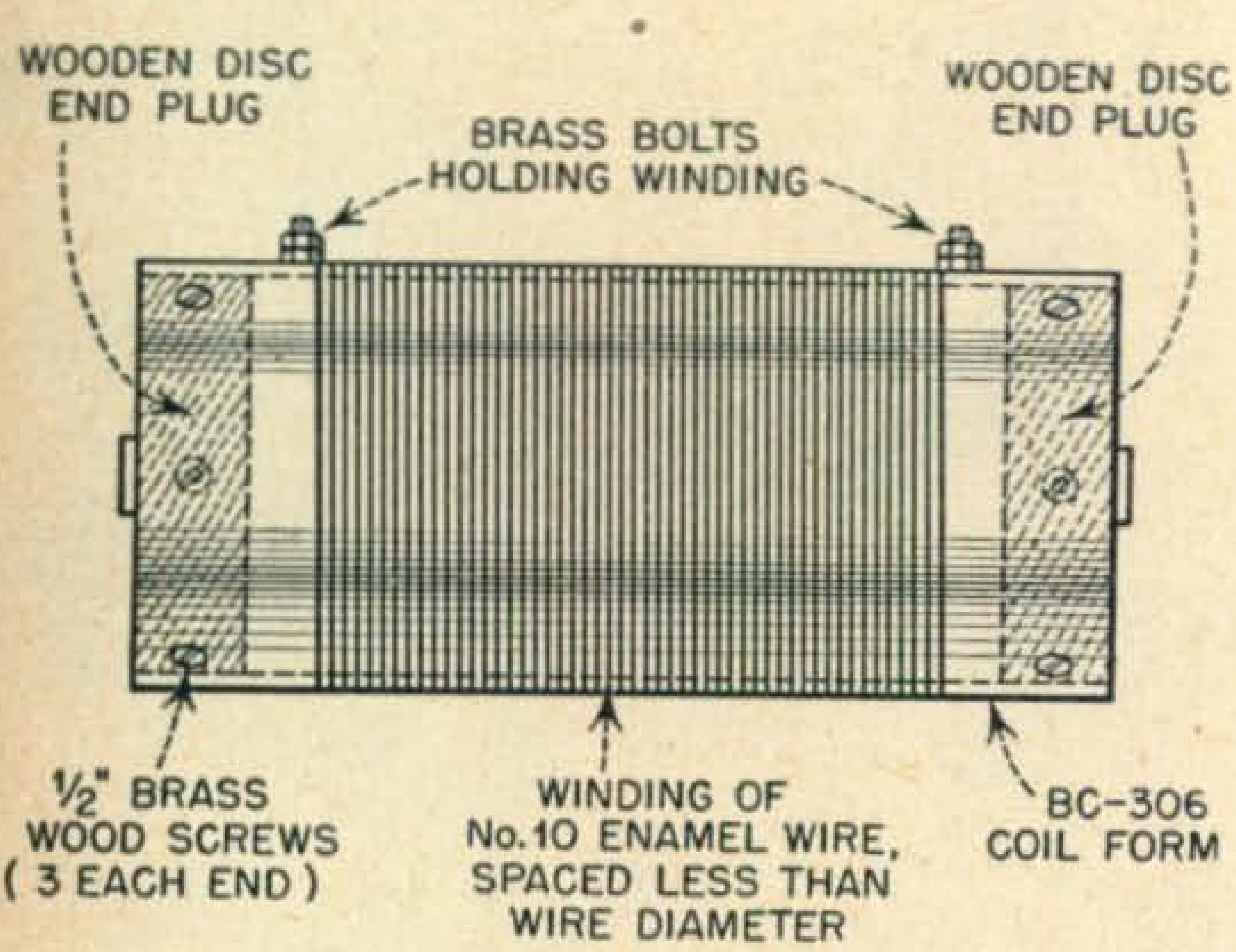


**Fig. 1. The solution to the problem is to do just what the "mobiles" do. Build a center loaded vertical with dimensions that will improve the efficiency. The most important part of the antenna is the loading coil. While a war surplus coil form is specified, any form of the proper dimensions and strength could be used.**

The heart of the antenna is the center loading coil. This coil—to keep the antenna efficiency high—must be made of heavy copper wire, wound on a large diameter, low-loss coil form. Upon looking through the radio catalogs you will certainly find a scarcity of "large diameter, low-loss coil forms." The surplus market is your only salvation. The *Antenna Loading Unit* (BC-306) for the defunct BC-191 liaison transmitter is still available for a few bucks on the surplus market, and is just the ticket. It was used to load a few hundred watts into a short wire over the range of 200-500 kc. If you purchase one, you will have a fine vernier dial, a ceramic bandchange switch, a nice black-crackle box full of holes AND a "large diameter, low-loss coil form." This form is made of very good material, and is exactly what we need.[1]

All the hardware should be stripped from the metal cabinet and all the Litz wire from the coil. I momentarily toyed with the idea of leaving the little rotary inductance in the center of the coil for tuning the whip from 3.5 mc. to 4.0-mc., but finally resisted temptation and junked the link. Now, here is what you do to this coil:

(1) Drill two holes at each end of the form (or you may use the old mounting holes) and insert *brass* 6-32 bolts in the holes. These bolts, when supplied with lockwashers, will serve as anchor points for the coil winding. The coil should now be space wound with #12 enamelled wire. The wire is spaced slightly less than its own diameter by concurrently winding the wire and a heavy string on the coil. After the wire is fastened securely to the brass bolts, the string may be unwound, leaving a perfectly spaced coil. Do not use any coil dope or shellac on the coil. The wire will stay in place just as it is. The coil consists of 64 turns and should occupy about 8¼ inches of the form.

(2) The next step is to borrow the use of a wood lathe and turn out two circular discs of wood that will make a close fit in each end of this coil. These plugs should be about 1" thick. They can be firmly held in place by ½" wood screws spaced circumferentially around the ends of the coil. The coil form should be drilled to pass the wood screws, and the screws should clear the winding on the coil by a reasonable amount. The completed coil will look like *Fig. 1.*

(3) Before the whole antenna is put together, the wooden plugs are center drilled to slide over and separate the two pieces of dural tubing used for the top and bottom sections of the antenna. Several holes are

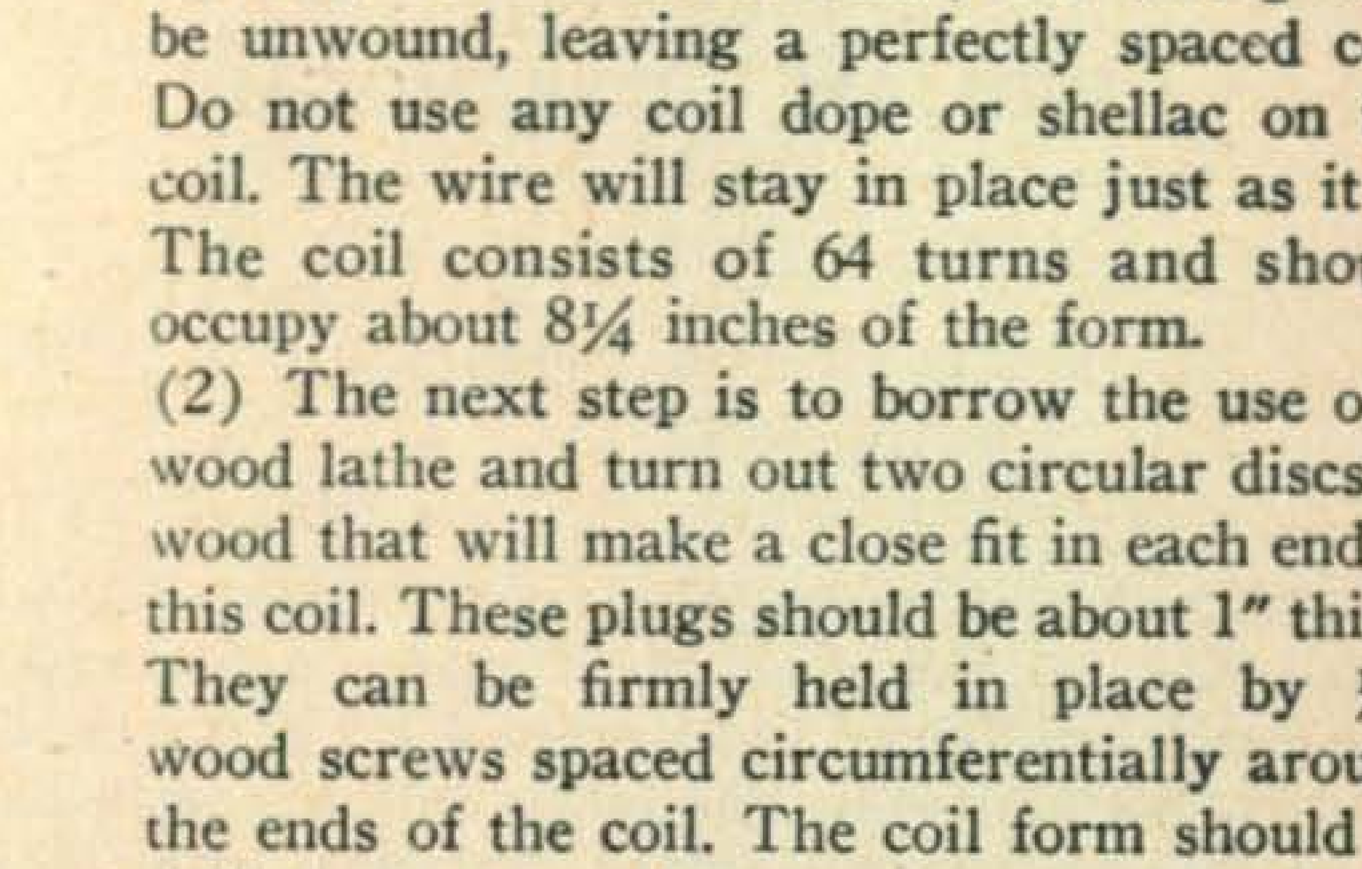


**Fig. 2. The wood plugs at either end of the coil form are drilled out to permit attaching them to the dural tubing. The text surrounding this drawing gives additional details.**

then drilled through the edge of the wooden discs into the tubing. Long, flat-head 6-32 brass machine screws may be run through the disc and tubing, and bolted inside the tubing to hold the two together (*Fig. 2*).

(4) The antenna may now be assembled into one piece by attaching the coil to the two wooden discs, using the flat-head woodscrews. The final step is to attach short jumpers from each end of the coil to the two antenna sections. The whip is now complete, and looks like *Fig. 3.*

[1] This coil form bears the Signal Corps part number 7462814. It is 9¼ inches long and 4¼ inches in diameter.

### Construction of the Radials

At least three and preferably four radials should be used. They should be 66 feet long, and may be made of insulated wire, such as annunciator or bell wire. Their physical placement is not critical. They should radiate from the base of the whip in a generally horizontal plane and about 90 degrees apart. They may wrap around the house, run along fences, thru hedges, or otherwise disguise themselves. They may twist and turn with little effect upon the operation of the antenna; however, they should not run higher than the base of the whip, though they may run lower with no pronounced ill effect.

When the radials are in place, two of them should be connected together, and grid-dipped. The resonant frequency of the pair should fall within 100 kilocycles of your most-commonly-used operating frequency. If this is not the case, a small amount of wire should be added to or subtracted from the free end of the radials. After this is done, the remaining radials should be cut to the same length as the grid-dipped pair. This simple plan insures efficient operation of your ground system.

The voltage at the base of the whip is very low. A cheap and dirty mount is a ten-foot 4x4, one end sunk about a foot, or so, into the ground, the other end nailed to a roof stud. The vertical whip has two small holes drilled through the bottom tube, one about an inch up from the base and the other about two feet farther up. Two heavy nails are driven through these holes into the pole—attaching the whip directly to the wood without further insulation. Unless you expect high winds no guy wires are required.

### Tuning the Whip

The whip should now be temporarily connected to the junction of the radials through a two-turn link. A grid dip meter is coupled to this coil and the resonant frequency of the antenna ascertained. If the antenna resonates too low, a few turns (one at a time) should be trimmed from the loading coil. However, the same effect can be accomplished by snipping off a few inches of the whip atop the loading coil. If, on the other hand, you find the resonant frequency of the antenna is too high, the easiest way to bring it to frequency is to add a small loading coil at the base of the whip to act as a trimming inductance. If this is needed,, it should consist of nine or ten turns of #12 or #14 wire wound one inch in diameter and about 2 inches long. This will lower the resonant frequency some 400 kilocycles. It is much easier to add this small amount of loading at the base than lower the whip and fool around with the center loading coil. If a surplus coil can be obtained that has a roller contact, it will work as a cheap and dirty means of tuning the whip to any spot in the eighty-meter band. If the antenna resonates at too low a frequency, a few inches will have to be snipped off the whip atop the loading coil.

The radiation resistance of this antenna system is in the order of 18 ohms. It will operate over a range of some 60 kilocycles (30 kilocycles plus or minus the resonant frequency) and exhibit very little reactance. One who does not make a fetish of antenna reactance can operate over a much wider range of frequency, provided his transmitter has means of tuning out the reflected reactance.

### Feeding the Antenna

The best way to feed the midget ground plane is with a coaxial line, such as RG-8/U cable. Since the radiation resistance of the antenna is only about one-third the surge impedance of the RG-8/U cable, there will be a standing wave ratio on the line of 3:1 at the resonant frequency of the antenna. This v.s.w.r. will increase from the minimum value of 3:1 as the whip is operated at some frequency removed from the resonant frequency. If

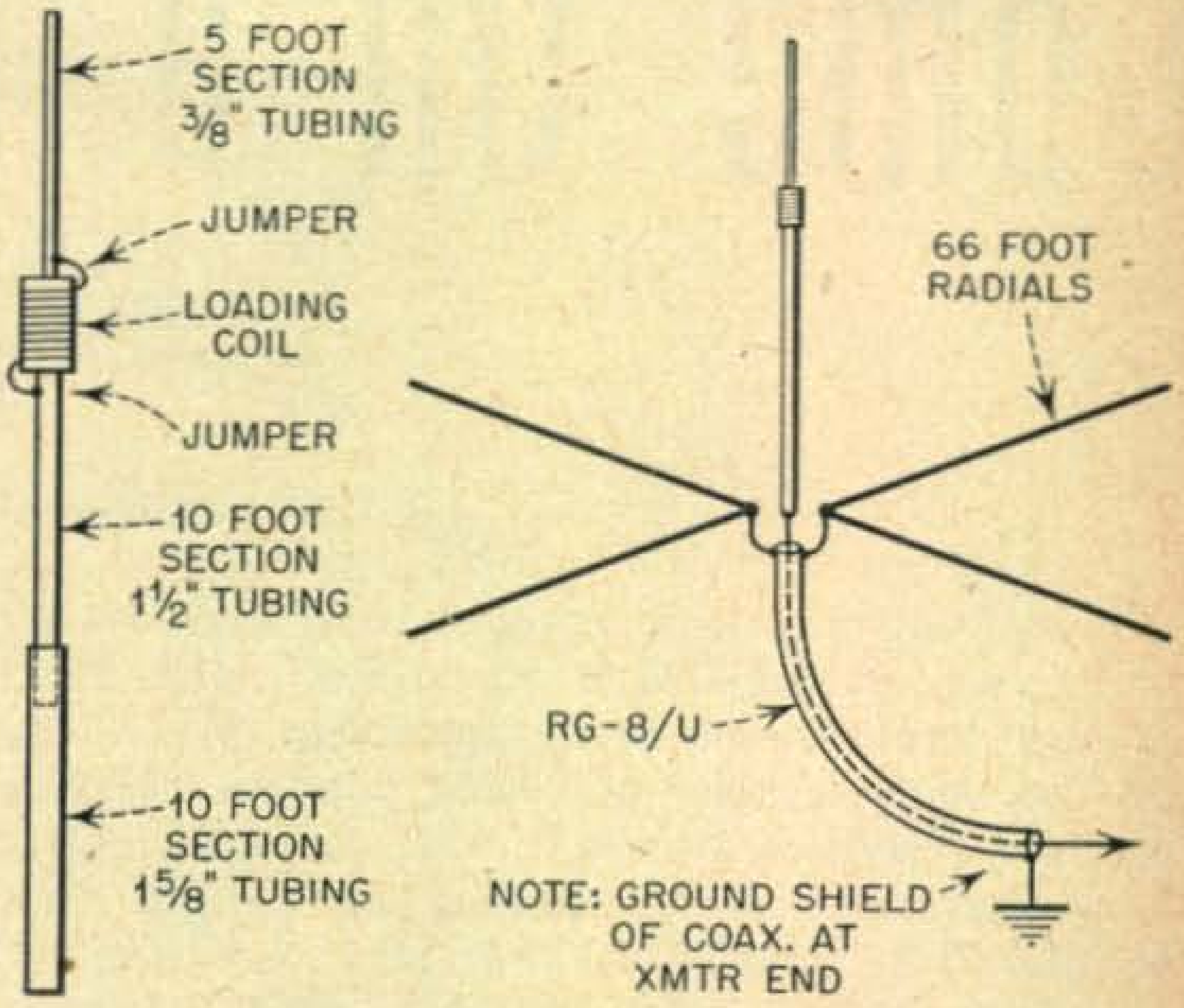


**Fig. 3. The completed whip should look like the left hand drawing. Don't forget the connection jumpers between the loading coil terminals and the dural. The radial system is drawn at the right.**

a 45-foot length of RG-8/U is used as a feedline, it will act as a quarter-wave matching transformer and the resulting load impedance presented to the transmitter and receiver will be of the order of 150 ohms, with a very low value of reactance. As the length of RG-8/U approaches 90 feet the load impedance at the transmitter drops down to about 18 ohms, since the coaxial line is now acting as a 1:1 transformer. In order to obtain low values of reactance at the transmitter, the coaxial feed line should be multiples of 45 feet. Deviations from these figures are perfectly permissible. For example, little difference will be noted with a coaxial feed line from 35 to 55 feet in length. Lengths in the order of 60 to 80 feet should be avoided, as they will present considerable reactance at the transmitter end of the line. Lengths of line below 30 feet may be used, but as the feed line gets shorter, the load impedance drops, and loading of the transmitter becomes difficult. The purist may insert a matching "L" network at the base of the whip to match the line in a more exact manner. Such a network is

*(Continued on page 92)*

## MIDGET ANTENNA

*(from page 41)*

If a variable condenser, and a surplus rotary variable inductor are used for the L-network, an excellent match can be obtained to the coaxial line. However, for everyday use the 3:1 v.s.w.r. on the line will cause no harm, even with the legal input to the transmitter. I have operated the whip with and without the L-network and can notice little difference in overall operation.

### Results

A vertical antenna produces quite different results when compared to the usual half-wave horizontal dipole on the 80-meter band. First of all, it is much better for contacts with mobile stations, since it has a vertically polarized field. Mobile signals will really stand out and attract attention when the midget ground plane is used. Local signals—those within 10 miles or so—will appear louder because of the strong low-angle lobe of the vertical radiator. From about ten miles away, out to about 350 miles, the vertical is slightly weaker than a good, high horizontal dipole. The horizontal dipole radiates considerable amounts of high angle energy which is reflected to earth by the ionosphere to fill in this region. At about 400 miles distant the two antennas are about equal in radiation intensity, and beyond this distance the ground plane rapidly becomes the more effective of the two. For DX work it is unbeatable. A fat S9 plus 20 db was obtained by W6FHR using this antenna on 80-meter phone from a KL7 on Attu Island, just a stone's throw from Siberia. Since Louie was only running 120 watts, and competing in the usual pile-up on a good DX station, this speaks well for the antenna.

On an "A-B" check against a good dipole, DX signals were readability 5 on the vertical and absolutely unreadable on the dipole. CN8BG was readable on the west coast as early as 5 p.m. using the vertical. (Bet the use of the vertical won't get you a QSL from CN8BG—*Ed.*)

The vertical is more sensitive to static and QRN in general than a horizontal antenna, a good indication that it is really outperforming a horizontal antenna. A few qualms were experienced by the author when the vertical was first used regarding the possibility of local TVI caused by blocking of the TV sets by the stronger ground wave. This however, has failed to materialize, and either antenna may be used with satisfactory results as far as the neighbors are concerned.

All in all, the operation of the midget ground plane has been very satisfactory. It permits 80-meter phone operation without the use of a full dipole. It is red-hot for contacts with mobile rigs. The radials, made of bell-wire, are unobtrusively wrapped around the eaves of the house and through the hedges. All that can really be seen is the unguyed whip. All of which led the XYL to remark, "Well, if that little thing is so good, why don't you take down that horrible tower and beam? It makes our house look like a power station!"

## TWO-METER CONVERTOR

*(from page 26)*

number of turns on the i-f link. Of course, there's a chance that the i-f receiver is on the bum—they often get pretty bad before trouble is noticed. Another quick check—remove the antenna feed line from the converter and short-circuit the co-ax fitting right at the connector—there should be quite a noticeable increase in the output noise level of the i-f receiver when the converter input is shorted. (Of course, to show up these changes in noise to best advantage the AVC should be off.) When the antenna is reconnected the noise level should come up and the character of it should change. It should consist largely of man-made noises—ignition and the like, or hissing precipitation static; in any event, the antenna noise level should be higher than the noise level of a pure 75-ohm resistor!

The foregoing alignment procedure did not specify whether the oscillator should be tuned on the high side or the low side of the band. It really makes little difference, except for the class of stations that will be heard on the image mode. If no trouble is experienced due to images, don't worry. But if they have you bothered, try rotating the oscillator trimmer to the point where a second noise peak is obtained—on the opposite side of the signal frequency band. Of course, it will then be necessary to recalibrate the dial; which can probably best be done by marking the dial setting of stations of known frequency until enough points have been taken to establish a smooth scale.

The r-f input coil is non-critical, but no doubt some would like to know how to check its tuning. It can best be checked by removing the tap completely from the coil. Then check the output noise level of the i-f receiver as the input coil turns are spread or squeezed. There should be a definite *dip* in noise level when the coil is tuned to resonance. (A better way of checking this tuning is with a "test wand" which has an iron slug in one end and a copper slug in the other.) The optimum location for the tap point depends on the impedance of the feed line looking back toward the antenna. We preferred to use a standard 75 ohm resistor (part of our noise generator) as an input load during the final tests, and we've spent considerable time trying to make the antenna feed line look like 75 ohms. As a result, we don't dare change the setting of the input tap after locating its position using the noise generator. The converters seem to be consistent enough and sufficiently non-critical that if you locate the tap as shown in the coil table you'll be durned near right—if your antenna looks like 75 ohms. If it doesn't—well, that's another article!