How to

COMPACT MULTIBAND DIPOLES

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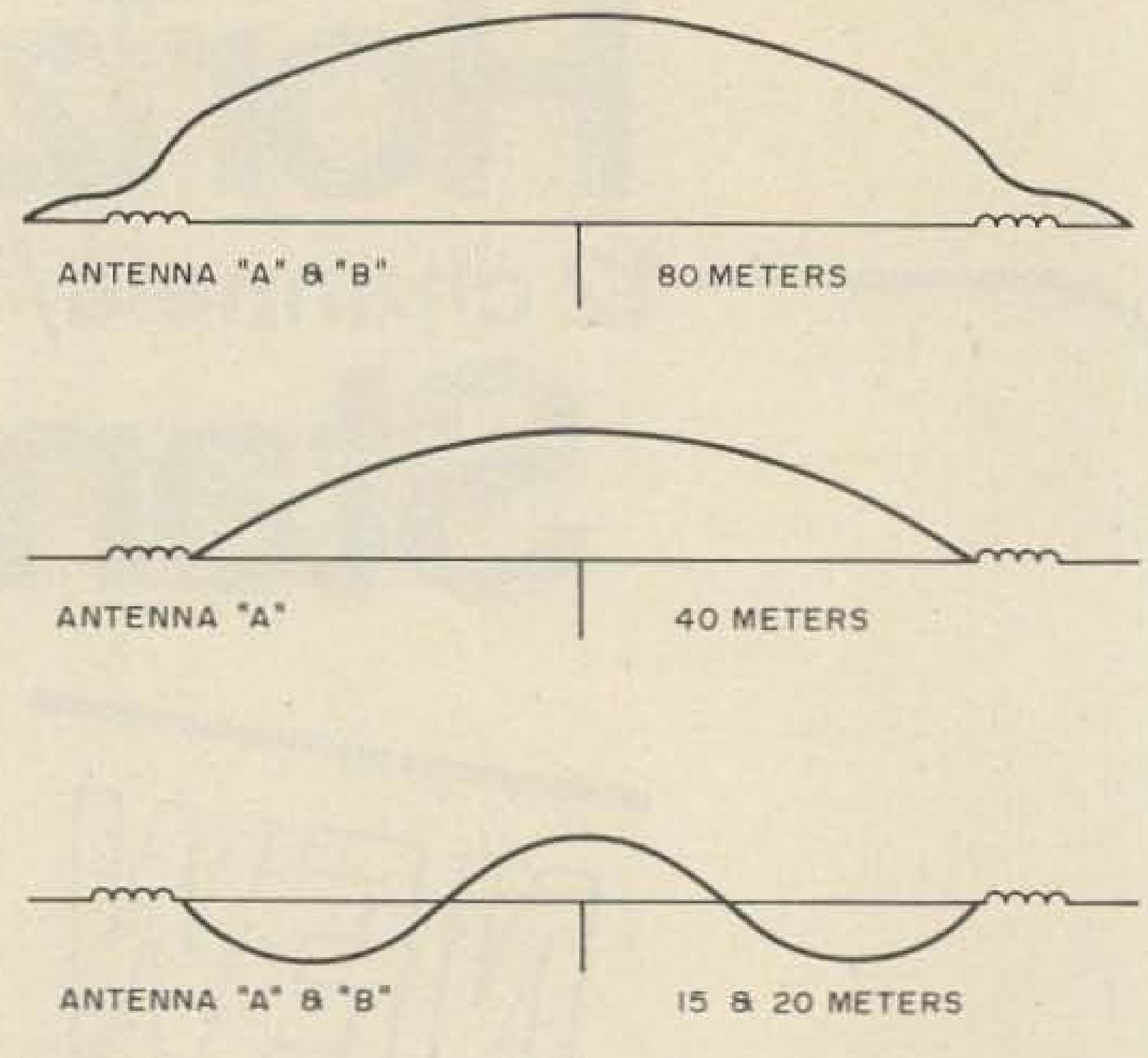
Often the need arises for a temporary or permanent low cost antenna. Usually, a dipole or inverted vee antenna is the logical choice. They are easy to install and certainly cheap to build. One of the disadvantages of such an antenna is that they are only usable on a single band, unless they are fed with an open feeder line (300–600Ω) in combination with an antenna tuner. This article describes two types of dipoles for operation on A) 80, 40 and 15 meters; and B) for 80 and 20 meters.

These dipoles are fed with a random length of 50Ω coax, and they can be strung as straight dipoles or inverted vees. The latter configuration makes it easier to adjust the antenna for resonance and requires only one high support. Each antenna leg has one loading coil to obtain the desired resonance points on the described amateur bands.

Theory

Generally, centerfed dipoles can be fed with 50–75Ω coax if the current maximum of an operating frequency occurs at the antenna feedpoint. Therefore, a dipole with the leg dimensions of 67, 35, 18 or 11.5 feet will show a feedpoint impedance of 50–75Ω for 80, 40, 20 or 15 meters accordingly. If a portion of each 67 foot leg (80 meter halfwave dipole) is substituted with a loading coil, and that loading coil is placed at the correct position, the dipole can be made to have current maxima at the feedpoint at 40 and 15, or at 20 meters.

For example: If a loading coil is placed about 35 feet from the feedpoint, a current maximum will occur at the feedpoint for 40 meters. With the correct coil dimensions and top-wire length, the dipole can also show current maximum at the feedpoint for 80 meters. In both cases, the dipole functions electrically as a halfwave dipole.



Graph 1. Antenna current distribution.

Coincidentally, since the 35 foot wire portion from the feedpoint to the loading coil corresponds to 3 x 1/4 wavelength on 15 meters, there will also be a current maximum at the feedpoint for 15 meters. Thus, the antenna will work on 80, 40 and 15 meters when fed with a 50–75Ω coax.

The 50Ω coax (RG8U, RG58U) is favored as the loading coils decrease the feedpoint impedance from a theoretical 75Ω (classical halfwave dipole) to about 50Ω.

If the leg- and coil-dimensions are altered, the antenna can be made to work on 80 and 20 meters. Here, the antenna functions as a halfwave dipole on 80 and as a 1½ wave dipole on 20 meters.

Ten meter operation is possible with both antennas, but the swr is in the order of 3:1 or worse.

Antenna Dimensions

Dipole A – 80, 40 and 15 meters

Overall length: 2 x 41.5 feet
Leg dimensions: 61 feet of wire, coil, 5 feet of wire

Dipole B – 80 and 20 meters

Overall length: 2 x 61 feet
Leg dimensions: 53 feet of wire, coil, 5 feet of wire
See Graph 1.

Antenna Assembly and Coil Data

Prepare the loading coils for the desired dipole, model A or B. For coils (antenna A) densely wind 70 turns of #20 copper enamelled wire on to a 1¼ inch O.D. plastic body. Use 24 turns for coil antenna B. Plastic sewer pipe is suitable and readily available everywhere. You need about 2 x 5 inches for A and 2 x 3.5 inches for B for convenient assembly. The coil windings are secured and weatherproofed with varnish or better with epoxy glue. The wire ends are soldered on to bolted solder lugs, which also serve to connect the antenna wire to the coils. (See Fig. 1.)

The antenna wire should be #14 or #16 copperweld for adequate strength. The dipole center is a porcelain strain insulator; it secures the wires at the dipole center and permits you to solder an SO-239 coax receptacle to the wires for easy coax connection. The far ends of the dipole are terminated on porcelain eggs. I recommend nylon or other nonmetallic line for fastening the porcelain eggs to a support. If wire is used, corona flashovers occur across the eggs at higher power levels.

Calculating Wire Length

Both dipoles should be cut specifically for your primary operating frequencies. Precise wire length can be calculated from the formulas given below, provided you stick with the recommended coil dimensions. Note that the wire lengths for 80 meters (A and B) include the wire portion from the center to the coil plus the coil to the porcelain insulator at the antenna ends.

Antenna A

80 meters: Ft. per leg = 153000/kHz
40 meters: Ft. per leg = 250000/kHz
15 meters: Ft. per leg = 750000/kHz

Obviously, if you optimize your 40 meter resonance for 7200 kHz you cannot reach optimum conditions on e.g., 21.100 kHz, since the 15 meter resonance occurs automatically on 3 times the frequency than that of 40 meters. You therefore have to compromise slightly. 7,100 kHz seems like a good compromise, keeping in mind that the swr on 15 meters is fairly low over the entire band.

Antenna B

80 meters: Ft. per leg = 227000/kHz
20 meters: Ft. per leg = 750000/kHz

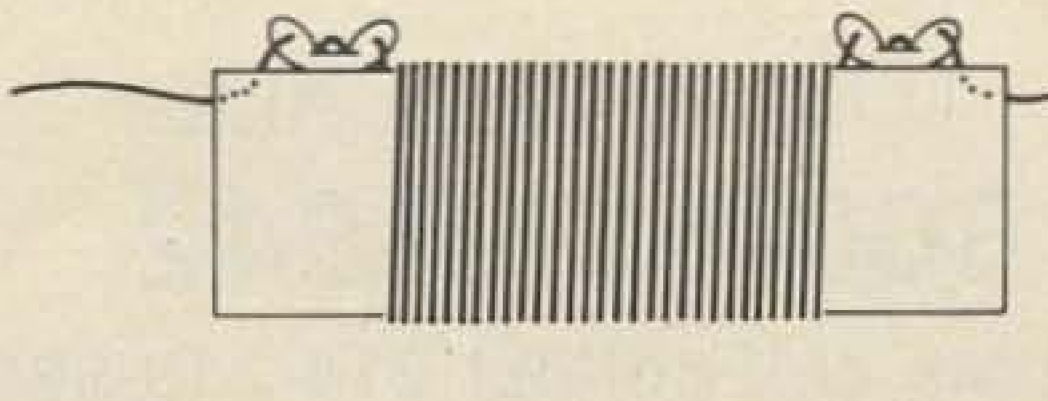


Fig. 1. Coil layout.

Tuning Procedure

First the antenna is adjusted for resonance (minimum swr) on the high frequency bands, 40 and 15 or 20 meters. This is done by lengthening or shortening the wire portion from the feedpoint to the loading coils. To increase the resonance frequency shorten this wire portion, and to decrease the resonance frequency lengthen the wire portion in each antenna leg symmetrically. A change in wire dimension will affect the resonance frequency for the 80 meter band. Therefore, the 80 meter tuning is done next by shortening or lengthening the 5 foot wire portion between loading coils and porcelain eggs. This last adjustment is critical; about one inch of wire results in 20 kHz resonance change on the 80 meter band. The second tuning step will not affect the first one. Do not forget to adjust both antenna legs symmetrically.

Comments

I tried both antenna versions as inverted vees, mainly because it simplified the tuning procedure very much. The swr at resonance for antenna A was 1.1:1 at resonance on 80, 40 and 15 meters.

Antenna B showed an swr of 1.5:1 on 80 and 1.1:1 on 20 meters at the resonance frequencies. I assume that the poorer 80 meters swr results from a relatively low Q and L of the loading coil of antenna B. The signal reports on 80 and 40 meters were excellent, and 20 and 15 meters showed a difference of about 3 S-units in receive mode as compared to my 2 element quad antenna. The antenna can also be tuned with a grid-dip meter.

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