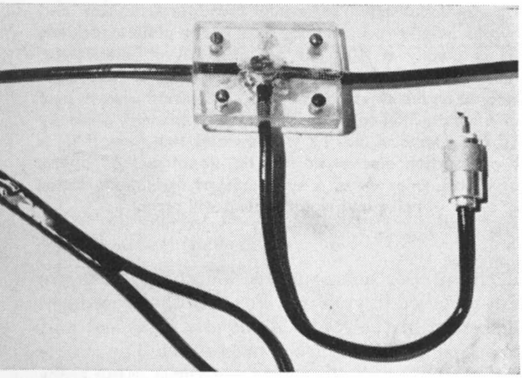
The "Double-Bazooka" Antenna

Broad-Band Dipole Using Coaxial Construction

BY CHARLES C. WHYSALL,* W8TV



Center support for the antenna and feed line. It is made of two pieces of Lucite bolted together to form a mechanical support and protect the joint from the weather.

This coax version of broad-banding by using reactance-compensating stubs is especially useful at the lower frequencies where an amateur band may be a considerable percentage of the center frequency. Although the principle is as old as the folded dipole, it has had comparatively little application in other antenna types.

Some years ago the staff at M.I.T. developed a coaxial dipole antenna for use in radar. This antenna used air- or gas-insulated coax with a velocity factor near unity, and therefore the diameters of the inner and outer conductors could be correctly proportioned for any desired surge impedance. As can be seen from Fig. 1, the antenna consists of a half-wavelength section of coaxial line with the outer conductor opened at the center and the feed applied to the open ends. The *outside* of the coax thus operates as a half-wave dipole. The inside sections, which do not radiate, are quarter-wave shorted stubs which present a very high resistive impedance to the feed point at resonance. At frequencies off resonance the stub reactances change in such a way as to tend to cancel the antenna reactance, thus increasing the bandwidth of the antenna.[1]

The antenna can be adapted for amateur work using readily available cable, and while the desirable condition mentioned above cannot be exactly met, the losses involved are not significant. As can be determined by reference to many handbooks, the resonant length in feet of a length of coax is $492/F_{Mc.}$ multiplied by the velocity factor of the cable. For solid polyethylene this works out to be $325/F_{Mc.}$ and for nitrogen foam insulation the factor becomes $393/F_{Mc.}$ These factors apply at any frequency. However, the cable velocity factor does not apply to the *outside* of the cable, which acts as a simple conductor. For example, a piece of RG-58A/U 83.3 feet long will be a half wavelength at 3.9 Mc. *inside*, but the *outside*, which does the radiating, would be resonant above 5 Mc. This is too short for the design frequency of 3.9 Mc., and therefore it is necessary to build out each end of the antenna to the necessary overall length. Ladder line is excellent for the built-out sections as it has a

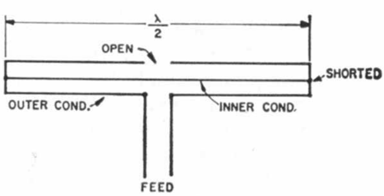


Fig. 1—The original coax dipole system, using air-insulated coaxial line. Velocity factor is essentially the same both inside and outside the line in such case.

* No. 9 The Woods, Marion, Ohio 43302.

[1] The same reasoning applies to the ordinary parallel-conductor folded dipole, insofar as the effect of the folded sections on bandwidth is concerned. However, the folded dipole also steps up the impedance at the feed point by a 4 to 1 ratio. This does not occur with the coaxial system discussed here. — *Editor.*

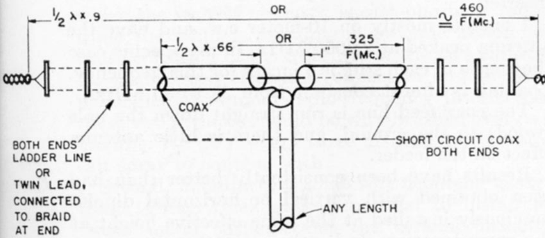


Fig. 2—Electrical construction of the antenna. In preparing the center opening, first cut off a 1-inch section of the vinyl covering, being careful not to nick the braid. Then cut the braid at the center, without cutting the polyethylene, and strip the braid both ways from the center to form pigtails to which the coax feed line can be connected.

greater effective diameter than an ordinary wire conductor, and the reduction in length-to-diameter ratio contributes to lowered radiator *Q*.

An antenna built in this way is shown in Fig. 2. Ideally, parallel-conductor line should be used to feed the antenna, since it is a balanced system, but many prefer to use coaxial feed. Little distortion of the field of the antenna will result if the feed line is carried away from the antenna at right angles for the maximum distance possible.[2]

The problem of strength at the center has been solved here by the use of two pieces of ⅜-inch Lucite, 3 inches square. As shown by the photograph, a 3/16-inch hole is drilled through the length, and another halfway through at 90 degrees to the first. A cavity nibbled out at the junction of the drilled holes accommodates the soldered connections at the feed line and two braids of the antenna sections.

Advantages and disadvantages can be listed for almost all antennas, and this is no exception. This is definitely not the antenna for the ham who wants one for all bands. It is a one-band job and will radiate practically nothing on the second harmonic since the stubs represent a short circuit at twice the design frequency. However, radiation will take place on the 20-meter band if the antenna is made for the 75-meter phone band, but the losses in the stubs will rise. Another disadvantage is that considerable care is required in construction. The advantage of the antenna is that an s.w.r. of between unity and 2 to 1 can be maintained over the 3.5–4 Mc. band if the antenna is cut for about the center frequency. Fig. 3 shows s.w.r. measurements made with two different lengths, the coaxial section (cut by formula for 3.9 Mc.) being the same in both cases.

Extensive experimenting by W8NSM and myself indicates that RG-58A/U coax has ample mechanical and electrical strength for this application. Hundreds of hours of legal-limit operation on RTTY, c.w. and s.s.b. have proved this.

Credit is due to Dave Walker, K8VPB, for the photo of the center construction, and to Burt Hayhurst, W8IZQ, for the s.w.r. curves. QST

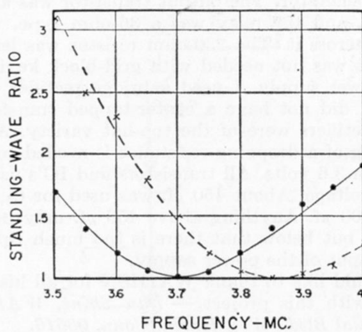


Fig. 3—Representative s.w.r. curves with the overall antenna length adjusted for resonance at 3700 kc. (solid line) and 3850 kc. (dashed line). In both cases the coax section of the antenna was the same, cut by formula for 3900 kc.

[2] It is of course possible to use a balun at the antenna if the direct coupling to the outside of the feed line causes "antenna" currents to flow on the line. With most random lengths of line these currents should be fairly small in a 3.5-Mc. system. — *Editor.*