Jim Gray W1XU
73 Magazine Staff

Those Amazing Bobtails

—the current-fed connection

The Bobtail antenna system described in the references has created quite a stir. Various combinations of construction methods and feed systems have been suggested through a great deal of correspondence between various amateurs.

A nagging problem has been the lack of a satisfactory explanation of the operation of the antenna when it is current fed. It is hoped that this article may shed some light on this subject and spur others on to try this excellent antenna.

To begin, we need a couple of definitions: 1) Voltage feed—feeding an antenna at a point where a voltage loop (or maximum) occurs. 2) Current feed—feeding an antenna at a point where a current loop occurs.

Antenna theory shows that whenever you have two vertical radiating elements spaced 1/2 wavelength apart, the radiation will be reinforced in a direction perpendicular to a line drawn between the antennas. By using three vertical radiating elements (or four, five, or more) all spaced 1/2 wavelength apart, the radiation will be reinforced in the same directions as before, approximately proportionally to the number of radiating elements. Such an antenna is known as a curtain. Because our antenna has only three elements, it is known as a short, or Bobtail, curtain.

Curtain antennas of the type described are bidirectional, with radiation patterns that look like elongated figure-eights viewed from the top of the antenna looking down. The figure-eight pattern extends perpendicularly from a line drawn between the antennas, and when many elements are phased, the figure becomes longer and skinnier and the result is a bidirectional beam: a *broadside array*.

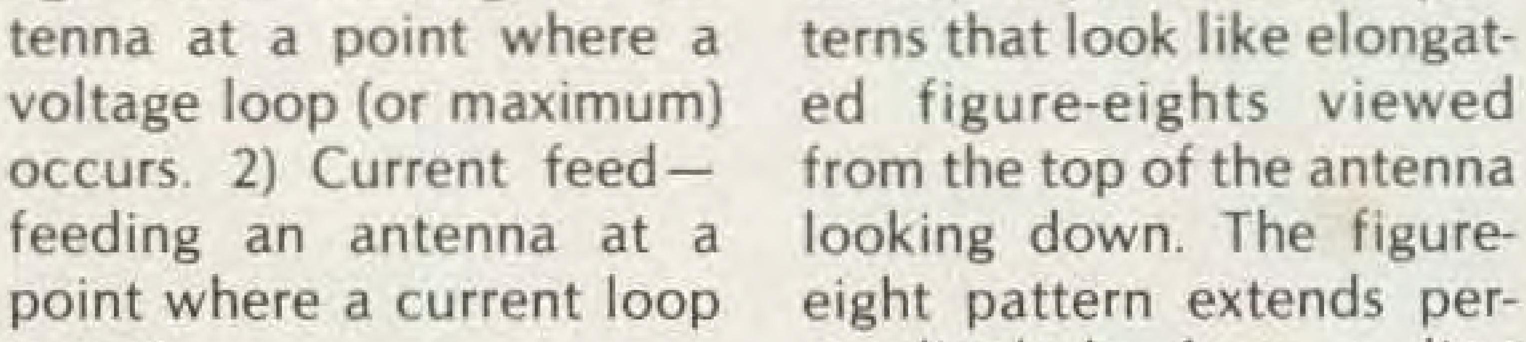

Fig. 1. The current-fed Bobtail.

In order to understand the operation of the Bobtail curtain antenna, one must consider the antenna currents in terms of their magnitude and phase relationship. Ideally, in an antenna of this type, all radiation is from the vertical elements, and little or no radiation occurs from the horizontal sections (flat-top portion) because these exist merely to achieve the proper phase relationship between the vertical elements.

Heretofore, the Bobtail has been *voltage* fed by means of a coupling network attached to the bottom of the center element, although it is possible, if desired, to attach the coupling network to the bottoms of either of the vertical end elements.

For many reasons, including convenience, ease of matching, simplicity, elimination of coupling networks, and other factors, it has been considered desirable to find another way of feeding the Bobtail, and such a method has been reported as having been used with success by a number of different amateurs. Here's how it works:

In Fig. 1 observe that the Bobtail array, as before, consists of the three quarter-wave vertical elements at A, B, and C. The two end elements at A and C are essentially a portion of the flat-top and connected directly thereto.

The center vertical element is separated from the horizontal flat-top portion by a small insulator at G, and the conductors of a coaxial feedline are attached to the flat-top and to the vertical element, across the insulator, with the center conductor connected to the vertical, and the braid connected to the exact center of the flat-top, at B.

Vertical element A is separated by 1/2 wavelength from element B, and vertical element B is separated by 1/2 wavelength from vertical element C. Flat-top sections A-B and B-C act as phasing lines to make the current relationships in the antenna come out properly, i.e., the current in section A-B is 180° out of phase with the current in B-C, and therefore they cancel.

The currents in the vertical elements are in phase and add because the current is traveling in the same direction at any given instant (but the currents are not equal in magnitude). The reason for this is that the vertical elements are each only 1/4 wavelength at the operating frequency. The current divides between the vertical elements in a ratio of two to one.

In order to satisfy the phase requirements, the magnitude of the current in the end elements must equal the magnitude of the current in the center element. Since there are two end elements and only a single center element, the current in the center element must be twice that in each of the end elements.

If you study Fig. 1, you will notice that for a particular given half-cycle, the + and − signs are as shown, changing sign at each 1/2-wave point. We have assumed the feedline to be exactly 1/2-wavelength long. The arrows between the plus and minus signs show the direction of current during the particular half-cycle we've chosen to illustrate. During the next half cycle, note that the polarity at each of the half-wave points will change and the current arrows will reverse direction, but also note that, once again, the currents in flat-top sections A-B and B-C will cancel. The currents in the vertical elements will again add in-phase in spite of the fact that their direction is reversed. Thus, on each half of every full cycle the vertical elements always add in-phase and the flat-top sections always cancel.

Interesting Side Notes

If you turn a current-fed Bobtail upside down, it looks like a much more familiar antenna system. By eliminating the phasing line (flat-top) and substituting ground, you have three 1/4-wave verticals spaced a 1/2-wave apart. This is very common practice in antenna systems, for example, in the broadcast industry for directional beaming.

The disadvantage of all but perfect ground systems is the resistance loss in imperfect conductors. Consider, now, what happens when we use the Bobtail array: The "ground" becomes the horizontal wire or flat-top—nearly loss-free compared to ordinary ground and, better still, elevated above earth by at least a 1/4 wave.

What this means is that the antenna becomes more efficient and the radiating portion is raised. The high-current portion of an antenna is the portion which does the biggest share of the radiating and that is why it is best to get it as high and as in the clear as possible. The Bobtail array accomplishes these things and, therefore, is a good antenna compared to one in which the radiating portion is low and the losses in ground resistance are high.

One more item. Radiation from a Bobtail is *vertically* polarized and therefore, when placed as in the configuration shown in Fig. 1, exhibits not only gain, but a very low angle of "take-off," as is typical of many vertical radiators. Hence, it's a good DX antenna. ■

References

1. Jerrold A. Swank W8HXR, "The 20-Meter Double Bobtail," *73 Magazine*, May, 1980.
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