The Incredible Broadband Bowtie

Truly designed for solid-state finals, this 75m antenna features 50 Ohms at the feed—and less than 1.5:1 swr across the band.

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"Yeah, I've got a transistorized transceiver. . ."

"Do I like it? Sure, I like it a lot. . ."

"What do I think of the solid-state finals? Well, they are not as great as they sound. The finals are really sensitive to swr. I ended up buying an antenna tuner just to get the thing to load up."

If you're the owner of an all-transistor rig, you've probably had a QSO like the above. While these rigs are nice, they do have their own set of problems. Chief among the problems is their best known feature—the solid-state final amp.

Transistor rigs differ substantially from their tube-final cousins. Tube finals use an impedance-matching (pi) network to match the tube's impedance to the antenna's impedance. Transistors do things another way. Power from the broadbanded final transistor is fed through a bandpass filter into a 50-Ohm load.

This new system means that theoretically you can set the tuning dial to any frequency and generate a signal with no further adjustment to the transmitter. This possibility intrigued me because I enjoy rag-chewing on 75-meter phone and I operate a transistorized rig. However, a little experimenting showed me that it wasn't going to be as easy as it sounded. There's a catch.

While the transistor finals are broadbanded, they require that the load they feed be 50 Ohms or very close to it. Unfortunately, a dipole antenna is not broadbanded. Keeping the swr low as you tune across the band—that's the catch.

According to the theory books, a dipole should be able to cover a band equal to three percent of its design frequency. That's 100 kHz on 75 meters without exceeding a 2:1 swr. That's not much of a spread.

I decided that what I needed was a broadbanded dipole. The design requirements were:

1. Uses no exotic or expensive material.
2. Easy to construct.
3. Achieves a 1.5:1 swr or less over the 75-meter phone band.

Design requirement number one eliminated double bazookas and folded dipoles. They require expensive coax and ladder line or an impedance-matching network. I wanted to keep it cheap and easy.

As I searched, my mind wandered back to a short blurb in William Orr's *Radio*

Swr meter showing the swr (the tuner was bypassed).

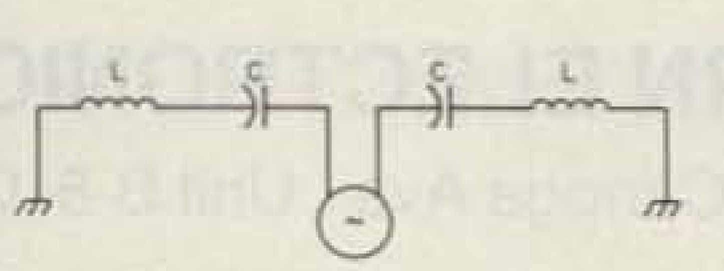

Fig. 1.

Handbook. In his description of a tuned doublet antenna, he mentioned that the antenna could be made more broadbanded by fanning the ends of the antenna. Could the answer to my search be a simple adaptation of this idea? I decided to find out.

To start, I cut enough wire for two dipoles. The two dipoles were tied together at the center insulator while the legs were fanned one foot apart. Swr measurements indicated that I was heading in the right direction although there were a couple of problems.

The first problem was that the new combined dipole was too long. The old dipole formula just didn't work in this situation. This change was an unexpected confirmation of a lot of the antenna theory I had learned.

Remember that an antenna is equivalent to a series-resonant circuit. In fact, we could substitute a series-LC circuit for an antenna as in Fig. 1. The resonant frequency depends upon the values of L and C. If either L or C changes, the resonant frequency shifts.

Now let's go back to a real antenna. The LC relationship still applies. By spreading the ends, we have increased the antenna's capacitance. This, of course, shifts its resonant frequency. The only way to bring the frequency back is to compensate by changing the inductance, too.

Inductance is changed by shortening the antenna. In this case, the antenna had to be shortened a total of ten feet to bring the frequency back. It's the reduction of inductance, incidentally, which increases an antenna's broadbandedness.

The second problem was mechanical—how to keep the antenna in its proper position. On my first attempt, I used strips of wood to spread the antenna ends apart by about one foot, with a halyard attached at the center. This worked, but when hoisted into the air, the ends wanted to windmill, twisting the wires together and reducing capacitance.

No sweat. I just hung a brick to the bottom of each spreader. That solved that problem but created another. The whole thing took on a Rube Goldberg appearance; it was a visual embarrassment. Besides, there was the practical problem of having these two bricks suspended forty feet in the air on the ends of some rope. Needless to say, the XYL was quick to point out these problems, too.

Eventually both problems were resolved with the development of the "Broadband Bowtie Dipole" seen in Fig. 2. One look at the drawing should explain how the antenna got its name.

After numerous cuts and tries, I found that one-hundred-ten feet seemed to make the antenna resonant about the middle of the 75-meter phone band. Experiments also showed that fanning the ends more than three feet offered little or no advantage. With the ends fanned three feet, my swr was less than 1.5:1 on the edges of the phone band (see Fig. 3). Now my transistor finals perk happily along with no need to tune.

Length of the transmission line is also important. To have your transistor transceiver see the same impedance as the antenna offers, the transmission line must be some multiple of one half wave. For solid dielectric RG-58, this is a multiple of eighty-three feet.

Mounting problems were solved with the double-halyard system also shown in Fig. 2. Rope spreaders replace the original wood spreaders. Be careful not to put too much tension on the lower halyard or the whole system will be dragged closer to the ground.

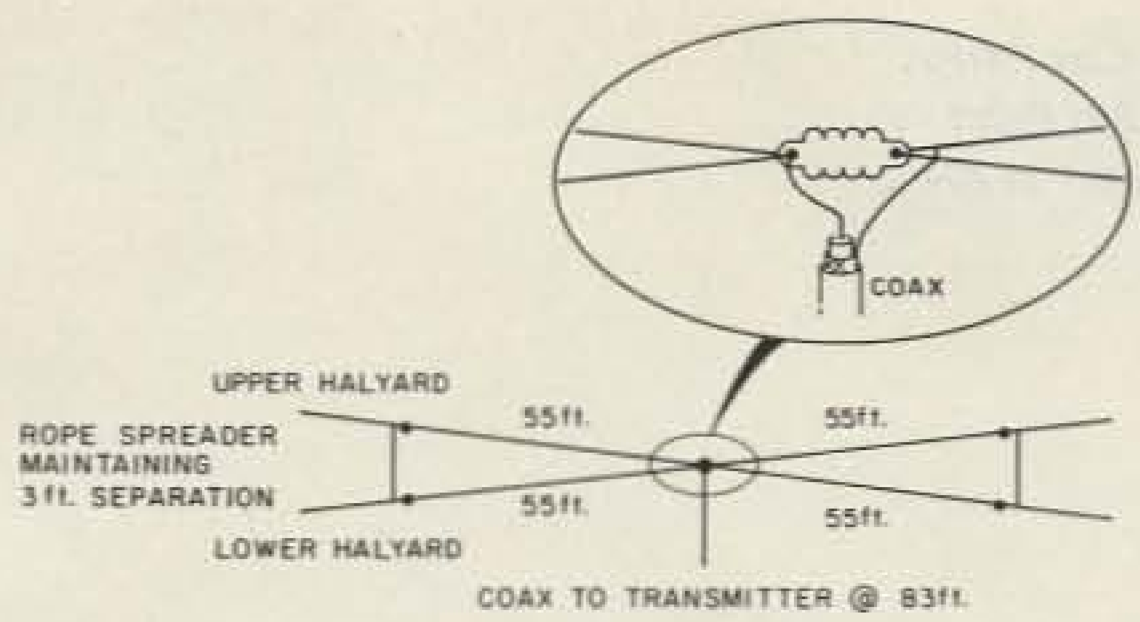

Fig. 2.

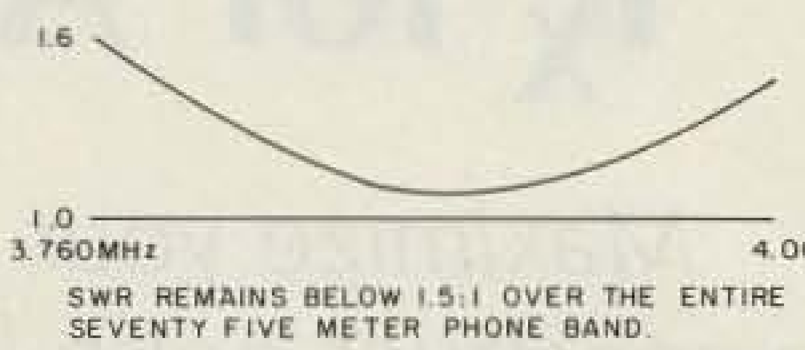

Fig. 3.

Incidentally, those interested in antennas might like to know that all antennas at station KC3HW are made from electric-fence wire. This 18-gauge steel wire comes on quarter-mile spools and is long-lasting. It's available through farm-supply stores and Sears for about ten dollars a roll.

More avenues of experimenting are open to you, the reader. How about a higher band? While I've not attempted to try the Bowtie on forty meters, it should have a flatter swr than on seventy-five.

Best of luck, and enjoy your newfound freedom. ■

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