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The 10-Meter Beam for $4

Great returns for minimal money.

by Peter A. Bergman N0BLX

A title like this usually implies that the author has several PhD's and owns shares in the local aluminum tubing industry. The reader, in the end, is left with his enhanced Novice privileges, a wire dipole on 10 meters and a hole in his pocket. By way of contrast, this author just wants to share a success story on what to do with the gift of a non-working television antenna.

In the Beginning

It all began one day when the XYL walked into the shack and said, "Honey, I know that you are having a great time on ten meters but wouldn't it be better if you had a tri-band beam like those other guys? What do they cost?" My response elicited, "Oh! That much? And you'll need a bigger rotator?"

A good hard look at Orr's Handbook,[1] a re-examination of an old TV antenna, and a discovery trip to the junk pile in the woods with tape measure and pliers followed. Gold! Well, nearly as good: another (very bent) TV antenna, a ten foot pipe, and a five-and-a-half foot section of steel tee-stock.

The Handbook had a description of a two-element yagi that could give 5.5 dB of gain and a front-to-back ratio of 7 to 15 dB. The second element, the parasitic element, could become a reflector—in which case it should be about 5% longer than the driven element—or a director if cut about 5% shorter. Using the parasitic element as a director gives slightly more gain and the advantages of a shorter element with the mechanical advantages of reduced weight, turning radius and wind load.

The Handbook yielded the following formulas;

Driven Element Length (feet)
$= 476 \div$ frequency (MHz)
Director Length (feet)
$= 450 \div$ frequency (MHz)
and Element Spacing (feet)
$= 120 \div$ frequency (MHz)

Assembling the Materials

A 28.400 MHz center frequency (the phone sub-band) required about 16′ 9″ for the driven element, 15′ 10¼″ for the director, and an element spacing of 4′ and 3″.

The $4 Ten-Meter Beam Materials List:
2 each junk TV antennas free
2 each 1½″ x 4″ u-bolts$1.80
1 each 100 pF variable cap. 1.00
Small nuts, bolts and Misc. 1.20
Total: $4.00

References:

1. Radio Handbook 21st Edition by William Orr W6SAI
2. ARRL Antenna Book, 1974 Edition

Disassembly of the inherited TV antenna provided a 13′ piece of one-inch aluminum tubing; 10′ of one-inch galvanized pipe; a couple of pieces of ¾″ aluminum tubing 45″ long; and several pieces of ⅜″ aluminum tubing between 36 and 48″ long held together in pairs by mounting brackets. The harvest included a handfull of wing-nut bolts, a couple of bakelite blocks measuring 4″ by 2″ by ½″, two usable u-bolts with nuts and lockwashers, an assortment of little brackets, and two chunks of boom from the second antenna that could telescope into the water pipe.

The various bits and pieces laid out were evidence that a ten-meter mono-bander was about to take shape. If the new antenna would be small and light enough, that small TV rotator could handle the additional load.

A pair of the ⅜″ diameter tubes attached to each end of the 13′ former TV boom with ¼″-20 bolts yielded a driven element more than 17′ long. Connections with U-bolts enable length adjustments without cutting.

The ten-foot piece of pipe was stretched in similar manner. A couple of feet of aluminum tubing were telescoped into each end and secured with bolts before adding the former TV elements.

The tee-stock was next drilled to accommodate a two-foot triangle of counter-top material that had been "weather-testing" behind the clubhouse. After adding a pair of U-bolts, this assembly provided a secure mount to the mast.

Antenna Matching

Three methods of matching were available. The Delta-match would have required a matching section about

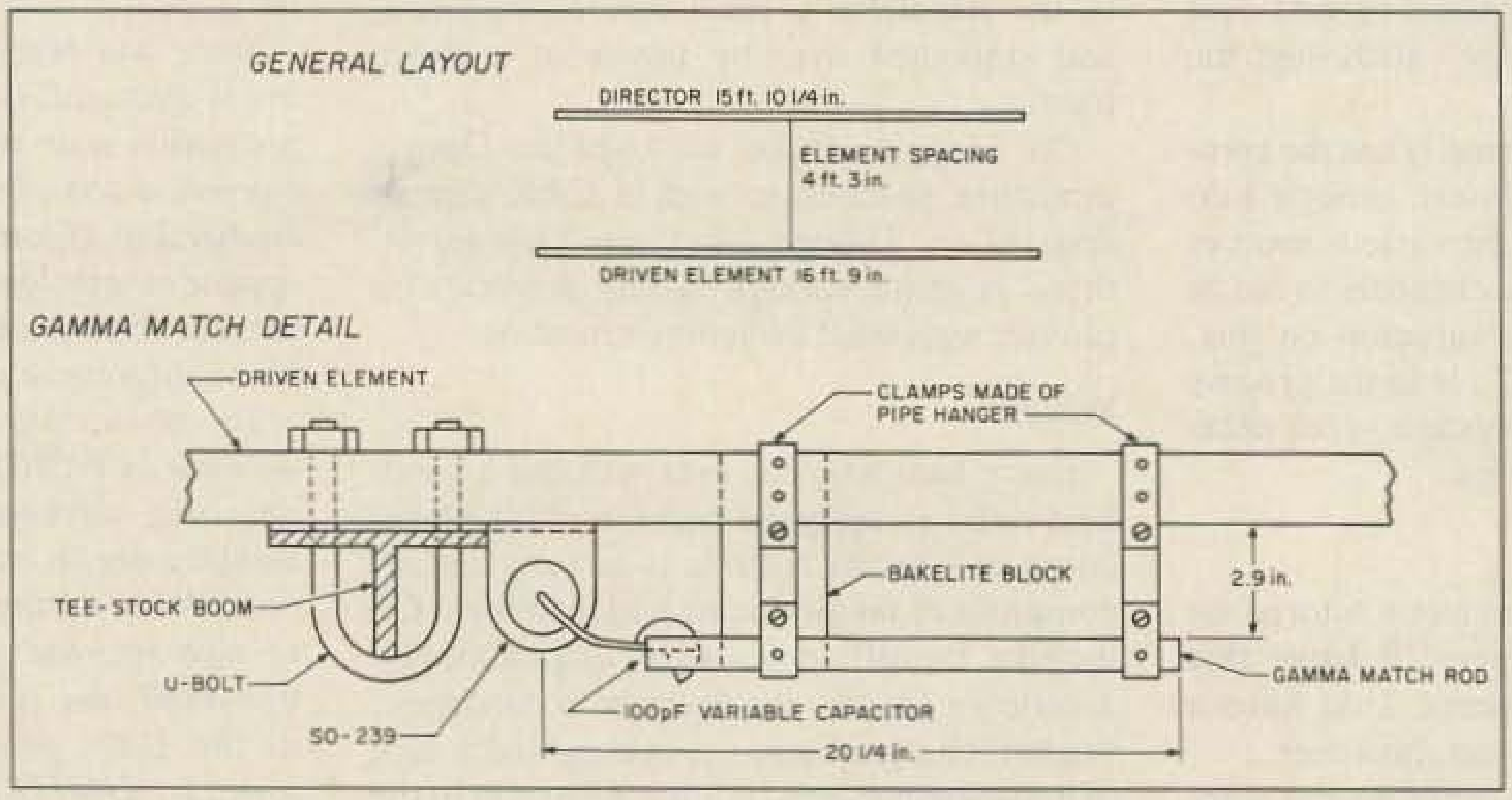


Figure 1. General antenna layout and Gamma match detail. #14 wire connects the SO-239 to the variable capacitor. The antenna resonates at 28.400 MHz. The SWR across the ten meter Novice band (28.1 to 28.5) ranges from 1.18:1 to 1.6:1.

meters. My very meager junk box produced only one 100 picofarad variable capacitor. Back to the drawing board.

The Delta-match might be cheap, and the T-match might be a little bit more efficient, cheap—just one matching-rod one-third the diameter of the driven element and one variable capacitor.

A 20″ scrap of aluminum close to the recommended diameter served as the matching rod. A pipe hanger strap became a clamp, and one of the bakelite blocks became a support for the driven end. The driven end of the rod was flattened and holes drilled to mount the capacitor. After final adjustments the capacitor was covered with a plastic vitamin bottle. Following the formula in the book, the Gamma-matching rod was spaced 1.70 of the length of the driven element from the driven element.

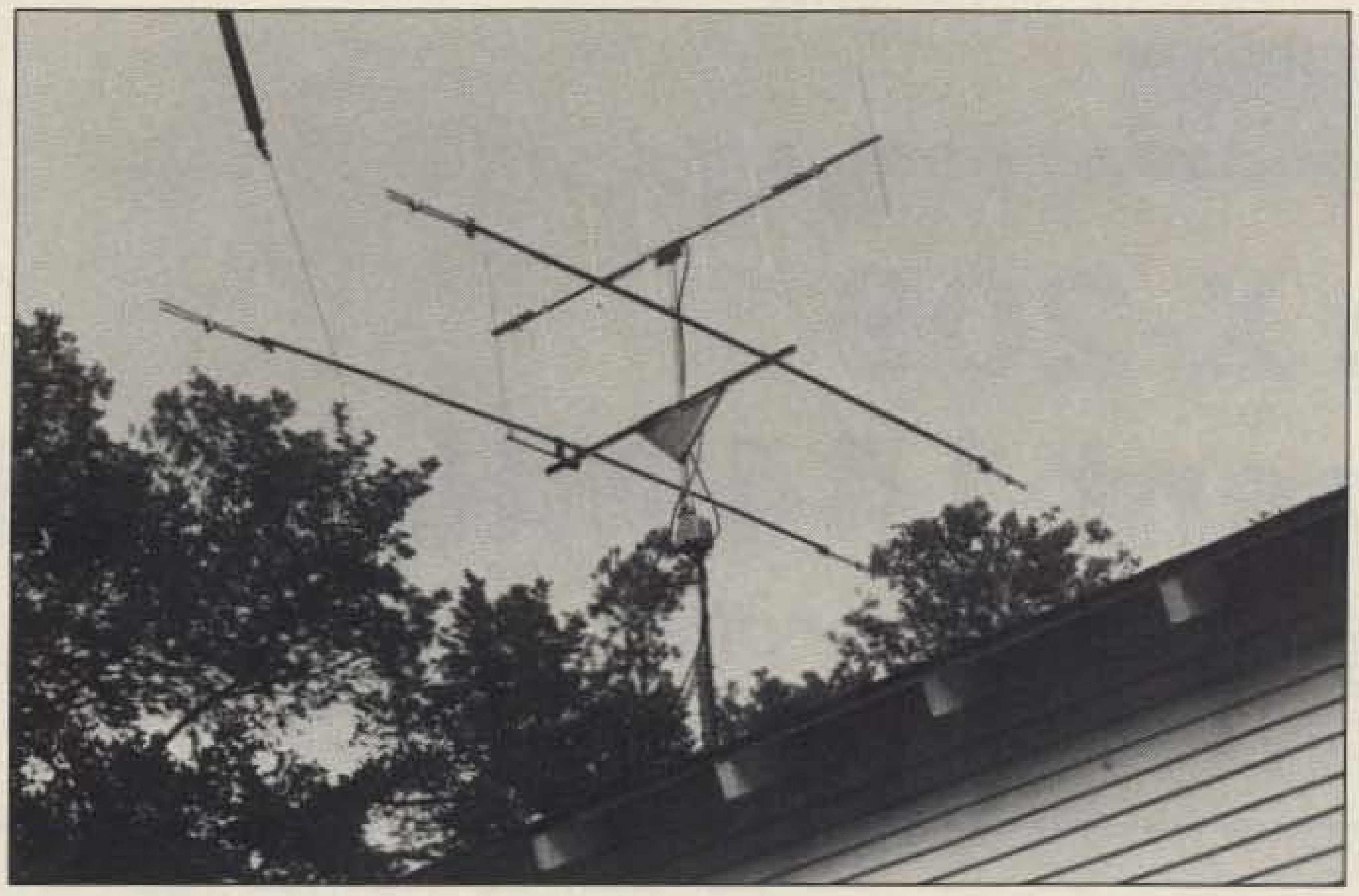


Photo A. The completed beam is in place a few feet below a two-meter antenna. The end detail of the driven element displays the spacing of the rods which affects the tuning. 1¼″ at the ends works best.

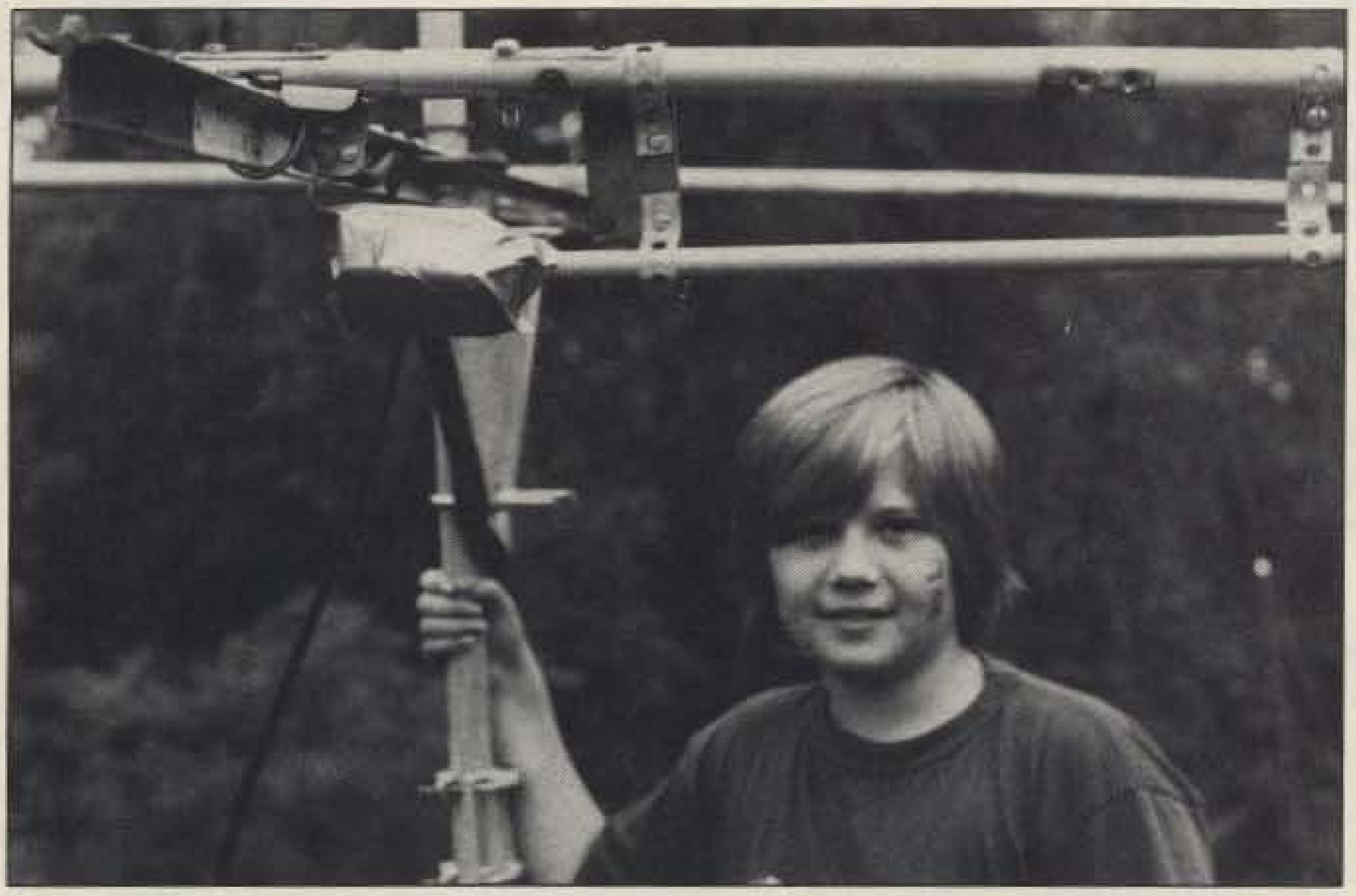
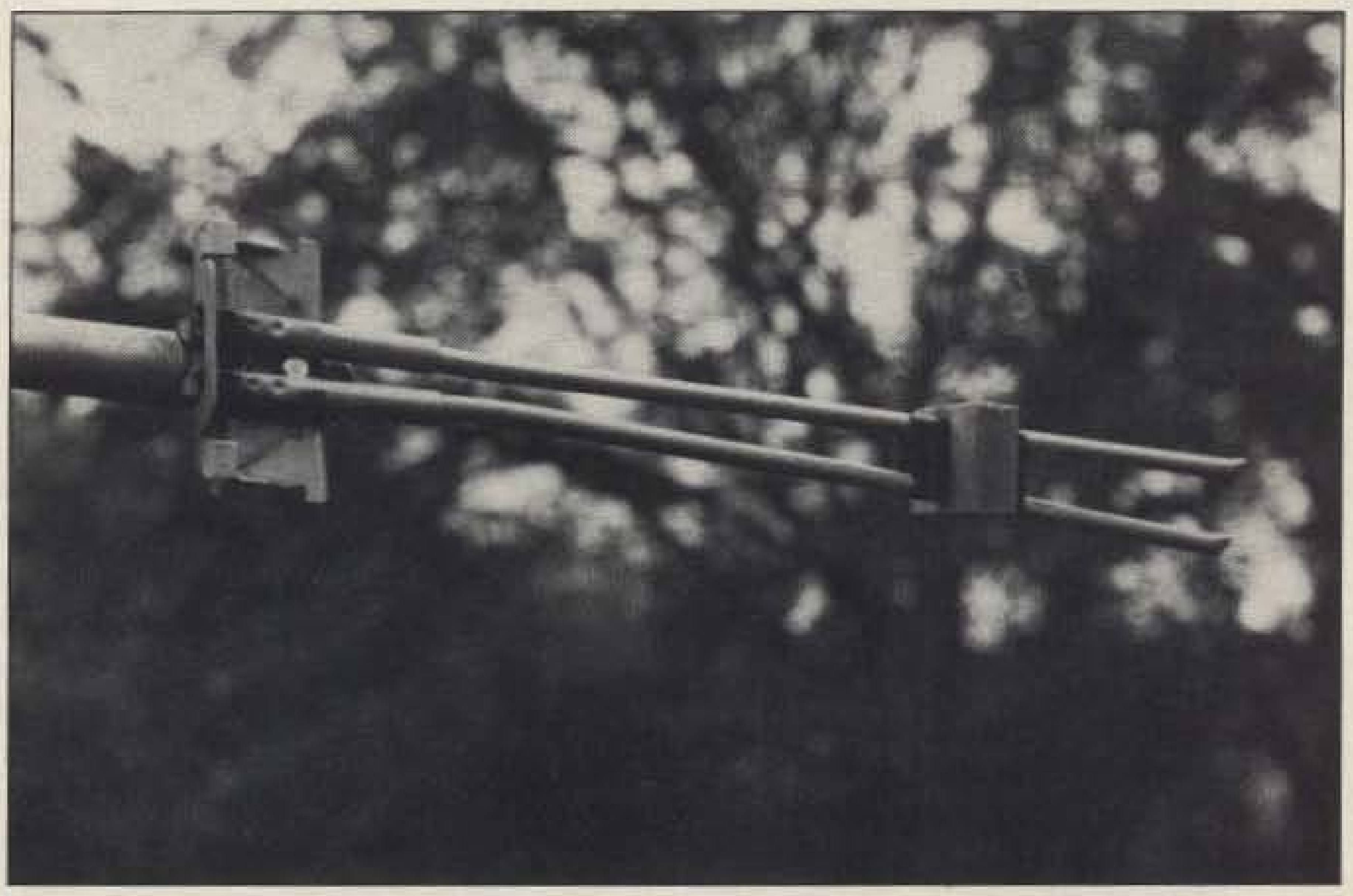


Photo B. Close-up of the Gamma match and the organic rotator. The variable capacitor has been covered with a plastic bottle and tape.



The Tuning Process

One of the numerous little brackets was reamed out to mount an SO-239 to the boom at its junction with the driven element. A short piece of #14 copper wire connected the center pin of the SO-239 to the stator of the capacitor. Soldering and clamping the coax directly to the antenna is a possibility, but the convenience of the connector is worth the 75 cents.

After assembling the antenna, a wooden step ladder served as a temporary mount for the tuning process. First, the antenna element lengths and spacing needed adjustment to optimize reception. Ideally, use a low-power transmitter feeding a dipole at the height of the antenna being adjusted and located several wavelengths away. otherwise, manually rotate the antenna to peak the signal strength of operators near the target frequency. Then trim the elements and adjust the spacing for signal improvement. If the reference signal fades, just hunt for another.

More and better test equipment makes transmitting adjustments more precise, but my Hot-Water 101 and a homebrew reflectometer served well. The Gamma rod clamp and the capacitor were adjusted for a maximum forward and a minimum reflected reading.

The antenna was installed at a height of 24 feet—only about 70% of a wave length above the ground and only 6% above the house. Yes, higher would have been better, but according to the Antenna Book [2] the wave angle could sometimes be as good as 20°.

Conclusions

Does it work? You bet! Stations barely heard with the dipole really peak up on the yagi. I get consistently better signal reports with the yagi, too. Some stations think I use an amplifier. Amplifiers are great, but they are more complex, more expensive, and do not help on receive. Comparing a beam with an amplifier, the former will definitely offer more bang for the buck.

It may not be the most technically sophisticated antenna around, but for $4 and a few afternoons of work with the family the returns are greater than can be measured on a signal-strength meter!

Want to improve your signal in and out? Scrounge around and build yourself a beam. Just avoid using two or three different types of metals, and get it up as high as possible—maybe build your own capacitor. Go ahead and try it. It could be the start of something big. 73

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