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A Square Antenna

THE story of the square antenna should be preceded by one or two Twentieth Century observations. First is: hams are vacating the cities for the promised land of suburbia. Unfortunately, there is no more land in suburbia than downtown. This writer recently moved from a downtown Baltimore row house (with a spacious yard) to a Los Angeles suburb (with a putting green). The second observation deals with antennas and, in a sense, with lot size. I can't remember the last time I talked to anyone who wasn't using: a beam, a quad, a vertical, a dipole, or a "long wire." How about you? Have you talked to anyone using an antenna-exotica lately?

The square antenna about to be described not only works but is an amazing conversation piece. The user of this antenna is automatically "one cut above" the dipole or vertical user. In addition to these benefits, you don't have to be a whiz at antenna theory to put it up, nor do you need fancy test equipment, a big yard, a 70 foot tower, or 200 bucks. All you need is about $15.00 and a day. You only need $5.00 and half a day if you already have a tower or mast.

The bi-square antenna is four half-waves in phase, which makes it three half-waves and about 4 db better than a dipole. The bi-square to be described is for 15 meters, but I have used them on 20 and 40 in years past with the same success.

The advantages of this antenna are many. It's cheap (prime consideration). You need only one pole, 35 feet or over, to hang it on. It is bi-directional. You can hang two of them on one pole and cover 360 degrees. It's easy to tune. It has 4 db gain, which puts it in the well tuned two-element beam class. It is also good competition for the "pre-tuned" or untuned three-element beam. In short, it's a great little antenna. And yet it's as rare as a democrat in Maine.

The bi-square filled my needs perfectly. It's a foolproof wire with adequate gain which can be erected in a small space (see Fig. 2). My first three contacts were Hawaii twice and a maritime mobile off the East coast of South America. S-9 or better all the way around, with a mere 150 watts of sideband.

Figure one almost tells the whole story. Each side of the bi-square is a half wavelength at the high end of 15 meters. It is open at the top, terminated at a dipole insulator. The ends are held aloft by strain insulators to ropes to fenceposts to trees, lightpoles, or other handy anchors. The base of the bi-square, which in my case is about 4 feet from the ground, is terminated in a quarter wave, shorted stub, 12 feet long. The whole fandangle is fed with twinlead. The only stopper is the matching stub and that's no hill for a climber.

Since the base of a bi-square is a voltage point, it has to be matched with a quarter wave, *shorted* stub. The stub is 12 feet long, before shorting, and can be an extension of the legs of the bi-square or "ladder-line" or any other size wire that's handy. I used number 18 enamelled wire spaced at 3 inches. Stub spacing should be 4 to 5 inches for larger wire.

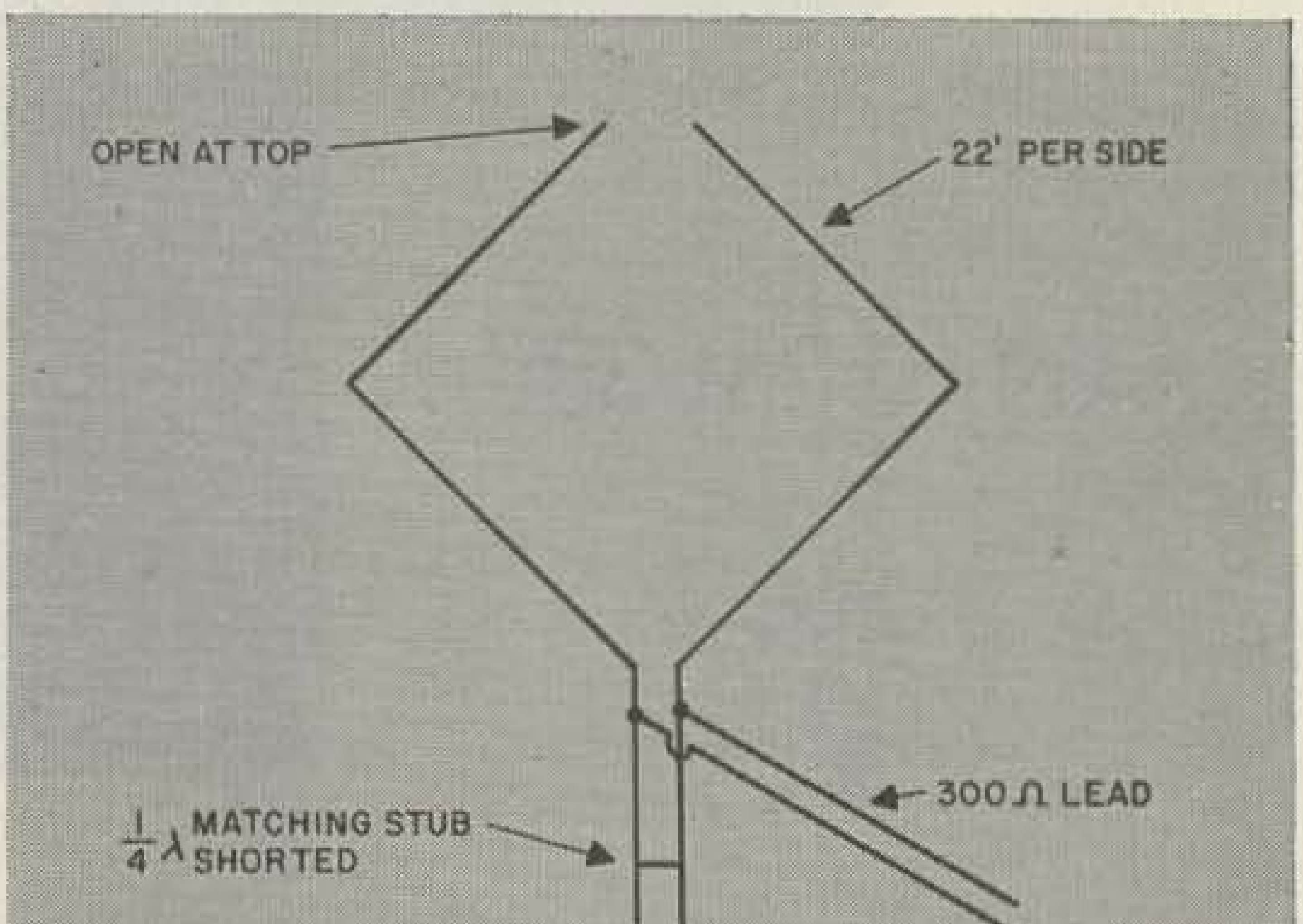

Fig. 1. Bi-square antenna for 15 meters. A horizontally polarized, broadside, bi-directional array with a gain of about 4 db. It is constructed with ordinary antenna wire and fed with twinlead. It requires only one 35 foot (or taller) pole for support.

As can be seen in Fig. 3, stub wires are held a constant distance apart by TV standoffs, but the purist would want spacing insulators. My stub runs vertically up the mast from the base of the bi-square. This is probably not the best direction to take a stub, but I had little choice. At least it keeps everything symmetrical, which is a consideration.

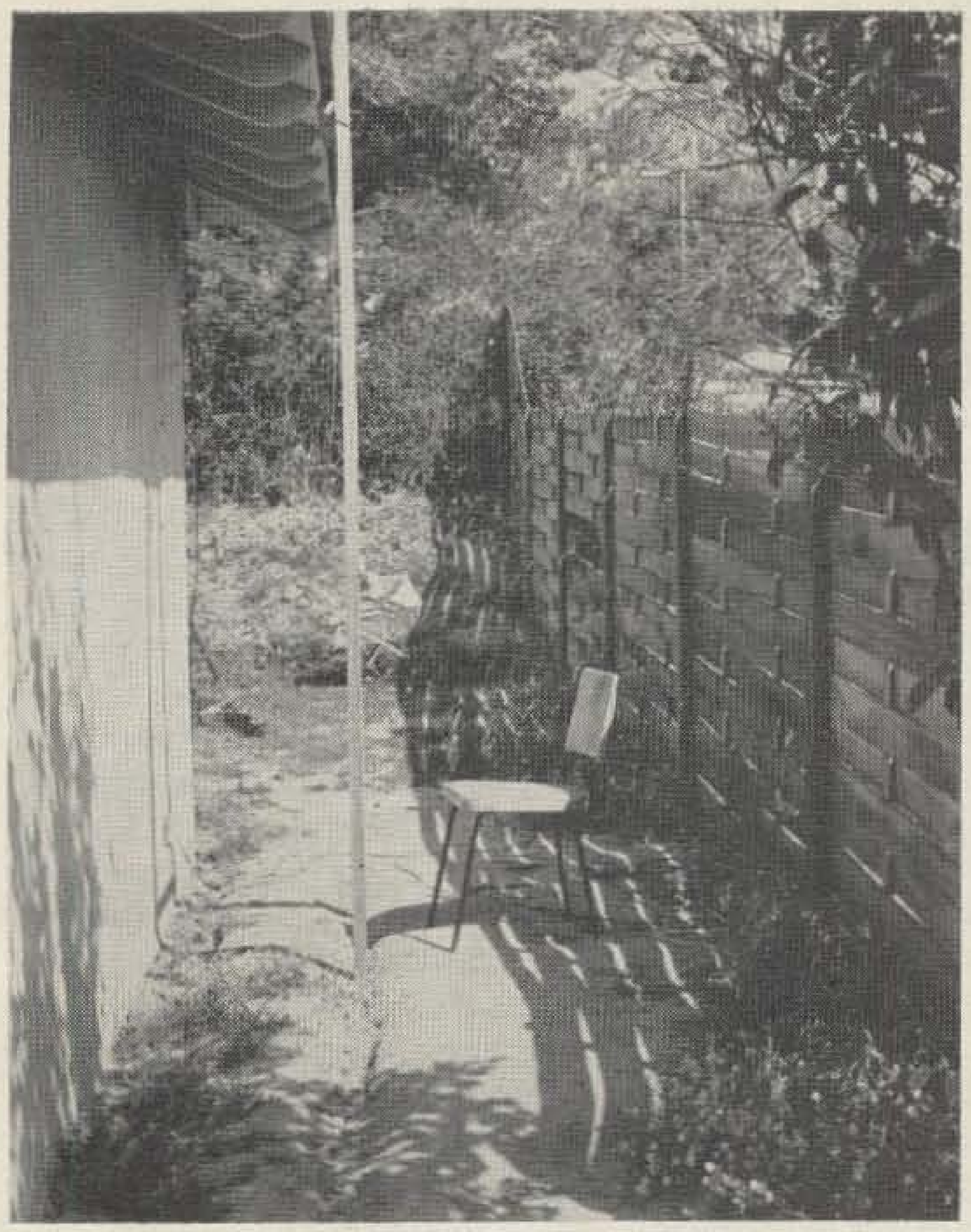

Fig. 2. The wide open spaces of Suburbia. The vertical board is actually an "A-frame," end view. The broadside of the bi-square is parallel to that lovely fence, dividing my tenth-acre estate from my neighbors.

The first step is to get the antenna in the air and get the stub attached. My mast has a rope-pulley arrangement a la flagpole. The next thing is to locate the point at which the stub is to be shorted. An easy way to do this is to "shock-excite" the bi-square. Fire up a nearby antenna with 15 meter energy and check for a high current spot on the bi-square stub. This can be done by using your simple light bulb rf detector. Shorting the stub with this gadget, find the point of maximum bulb brilliance, and that's where you make a permanent short. Use a low-current bulb (dial lamp) and be sure to scrape enamel from the portion of the stub you're testing. The short will probably come within thirty inches of the end. If you have a grid dip meter you may find it simpler to use that handy device in tuning the stub. Place a temporary short near the end of the stub, and with your dipper, check the frequency. Move the shorting wire until you're on the desired frequency. Instructions covering this procedure are detailed in your grid dip meter manual.

After the stub is properly shorted, the next step is to connect the twinlead feedline. I soldered alligator clips to my twinlead for this little chore. All you have to do is move the feedline up and down the shorted stub until you have a desirable standing wave ratio. After only about 10 minutes of fooling I got

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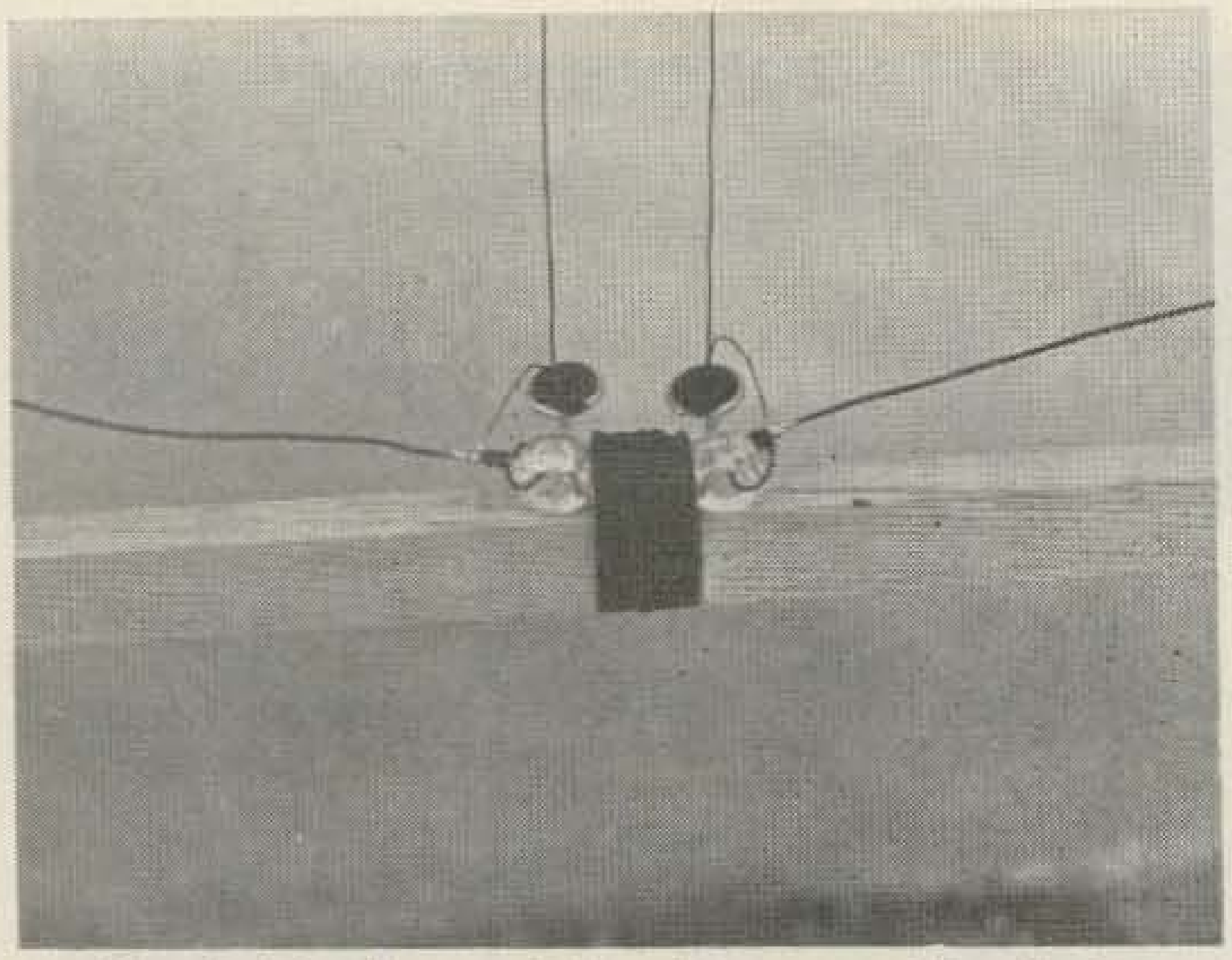

Fig. 3. The base of the bi-square. The timber is the crossmember of the "A-frame." TV standoffs are used to space the stub wires about 3 inches apart. (The small wires are the stub, the heavy wires are the beginnings of the antenna.) That's friction tape securing the base insulator.

my SWR down so low it's not worth mentioning.

Once, before the popularity of the SWR bridge, I connected a bi-square feedline merely by finding the point on the stub where the transmitter loaded best. So, if you don't own an SWR bridge and can't borrow one, just hook the feedline for maximum output. (I am assuming that if you don't have an SWR bridge you don't have field strength measuring equipment. If you do, the use of said equipment would be preferable, of course. Field strength checks are worthwhile under any circumstances).

The only other problem is that of matching your transmitter to the 300 ohm feedline. If you have balun coils you're all set. If you don't, you might be interested in the balun I constructed. This particular balun idea was first given me by Jack, W8LI0. It is used occasionally to match coax to beams, but rarely as a balun, matching coax to twinlead. It's both simple and cheap. Fig. 5 shows the hookup. A 15′ 2″ (.66 times ½ wavelength) piece of 72 ohm coax is made into a loop and the outside shield is soldered together. (.66 is the velocity factor of coax. See April 73, p. 27 for details.) A similar 72 ohm coax from the output of the transmitter connects braid to loop broid and center conductor to one center conductor of the loop. This is, as is a balun, a re-entry transformer, effectively quadrupling the impedance of the line, which puts you at around 288 ohms. Close enough. The 300 ohm line is hooked to the center conductors of the loop as in Fig. 5. This, of course, is good for only one band—but what a simple device.

As might be expected, there are other ways to feed the bi-square. The chore is to transform the antenna impedance to the line impedance and then in turn match the line to the transmitter tank circuit. If you're feeling experimental, you might try a different method. Several are outlined in detail in the Handbook. I picked the quarter wave shorted stub system because of its simplicity.

As noted, this antenna is four half-waves in phase and a broadside radiator. There is a moderate null off the ends of this antenna. One interesting aspect is that despite the diagonal positioning of the elements, the array is horizontally polarized. In some quarters, this will be thought to be an advantage, especially when talking to the squad, beam, dipole group.

The mast used here is a simple "A" frame made of knotless, Douglas Fir. It is supported by nylon rope. The 40 meter bi-square I used a few years ago was supported by a 70 foot, steel tower. The air was full of steel guy wires and I had to string the bi-square elements between them. The successful use of both of these antennas would lead me to believe that you can use any available support, but probably a non-metal one is desirable.

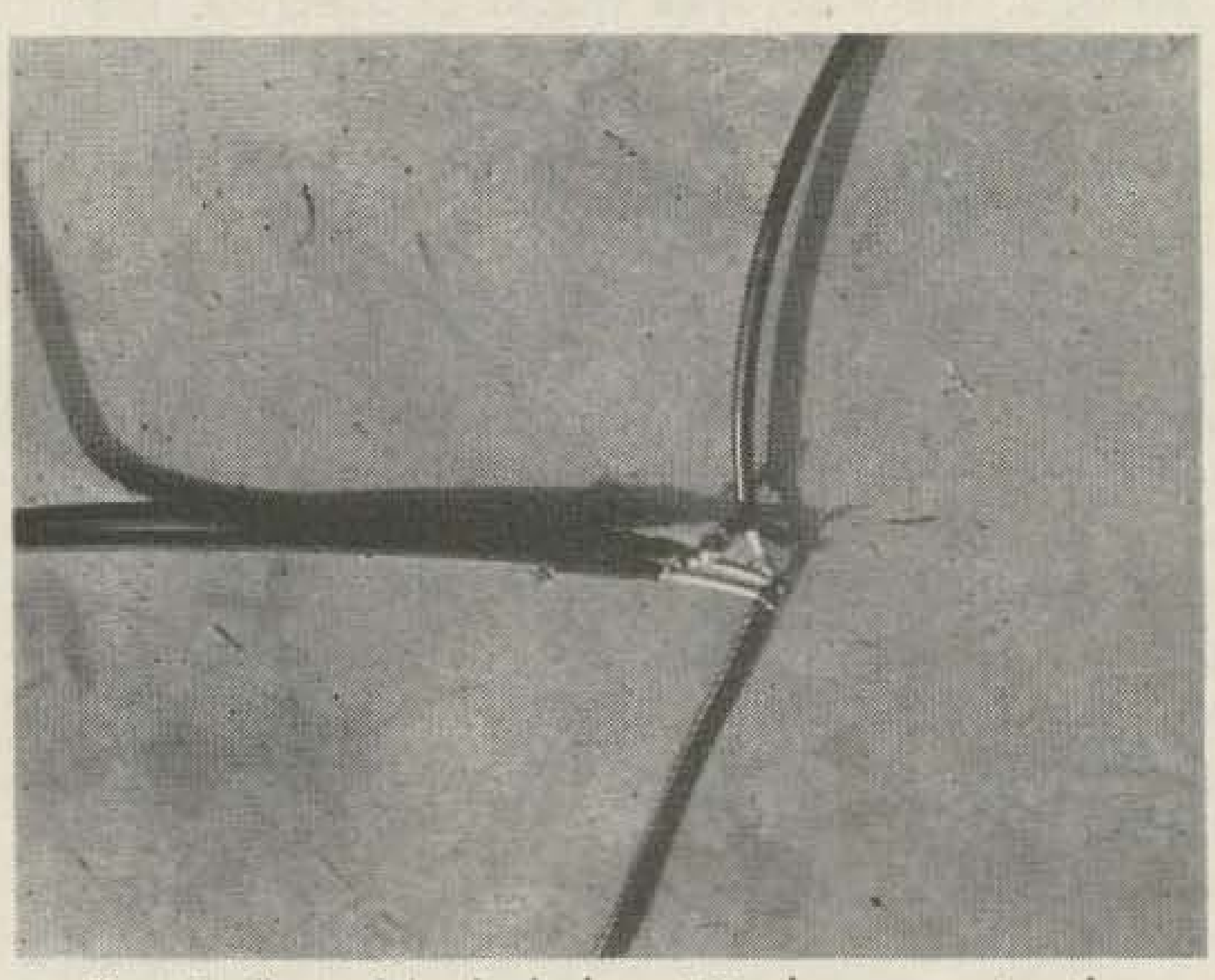

Fig. 5. Poor Man's balun. 72 ohm coax to the transmitter is at left, the balun loop is vertical in this photograph, and the 300 ohm twinlead is at right. All coax braids are connected. This system is sometimes used for matching feedlines to beams, but has been neglected in matching a transmitter to 300 ohm line—the use it's put to here.

If you already own a huge tower, by all means hang the bi-square as high as possible. In order to tune from the ground, you can use a ¾ wave shorted stub with nearly the same efficiency as a ¼ wave shorted stub. The same rule applies to this antenna as to all others—the higher the better.

It was mentioned earlier that two bi-squares could be hung on the same pole for 360 degree coverage. The only caution is that the stubs and feedlines do not parallel each other. Separate them by as close to 90 degrees as possible.

Now is the time to get out that old roll of antenna wire and try something different. If you're burning with ambition, you might try putting a reflector on your bi-square. Space it at around 0.15 wavelength and tune it with a stub too. In fact, with a little ingenious switching, you ought to be able to make either element in your "reflected bi-square" the driven element, and thus have a "reversible, reflected bi-square." There's an 8.5 db conversation piece for you. As Fig. 2 attests, I don't have room for a reflector—but if I did, I'd be out there tuning right now.

The bi-square was introduced to me years ago by Jack, W8LIO, who has used this and hundreds of other "far-out" antennas. When I got my first 40 meter bi-square into the air and talked to South Africa with 100 watts of AM phone, I was sold. You will be too.

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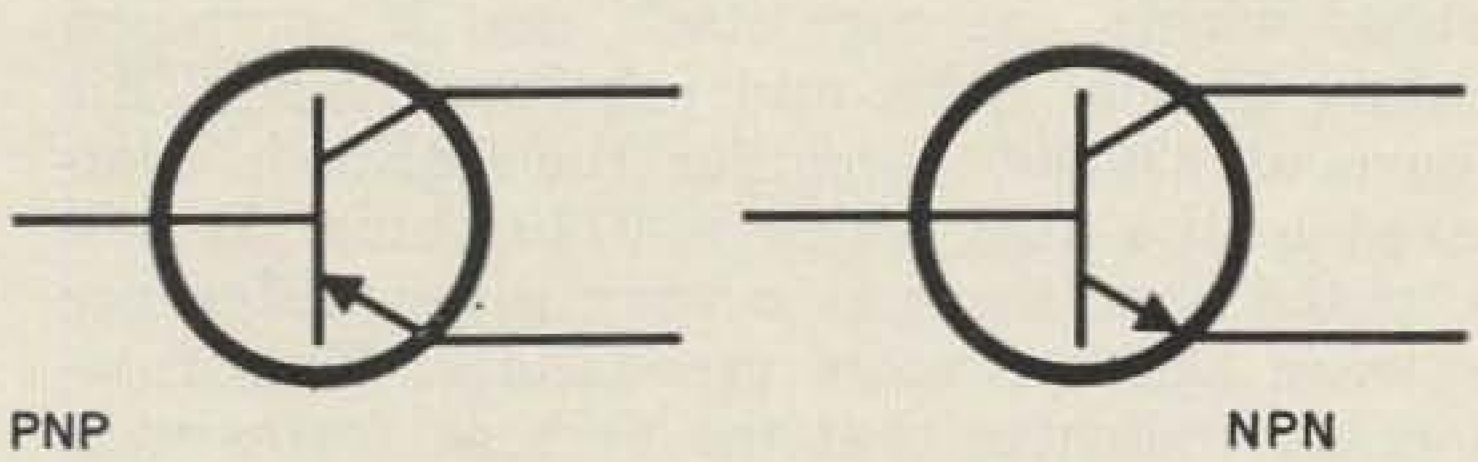
Easy Method to Remember

Transistor Symbols

Many people, especially those not working daily with transistors, have trouble identifying and telling the difference between the standard PNP and NPN transistor symbols as shown in Fig. 1.

The direction of the arrow, of course, tells the difference. That is, whether the symbol represents a PNP or an NPN transistor. But this in itself can cause confusion, not to mention embarrassment, when the ole' memory fails. Use of a simple memory "hook," or associated mental picture will prevent such forgetfulness.



PNP NPN

An excellent memory "hook" is one involving the positive and negative extremes of potential difference. When a difference of potential is visualized, ground potential is thought of as negative (N) and "down below" the positive (P) potential point. Likewise, the positive (P) potential point is thought of as "up above" ground. By picturing in your mind positive-P-up and negative-N-down and comparing this picture with the arrow direction of the transistor symbol, you will see that the arrow of a PNP transistor points *up* towards P, the first letter of the transistor type, and the arrow of the NPN transistor points *down* towards N, the first letter of this transistor type.

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