A CHEAP AND SIMPLE ANTENNA FARM

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The main antenna consists of stacked 8JK sections that operate on 20, 15 and 10 meters. The guys for the mast are inverted vees for operation on 40 and 80 meters. The entire installation is fairly compact and rather inexpensive.

THE antenna system to be described here was the result of a move to a new QTH, this move being one of a great many which I have made over the past years as a result of work assignments. Since most of these moves have been of a short duration, there has been the constant problem of trying to get on the air in the fastest and simplest way possible. However, because of wanting to work DX and contests, there were several requirements which had to be met: all band operation from 80 to 10 meters, and efficiency—especially a reasonable amount of gain on the 20, 15 and 10 meter bands. Being a temporary QTH only, the system also had to be cheap enough that it could be built, used and if necessary, discarded at the end of the period without much loss of money. Looking back on the whole thing, the final result cost very little and should be of interest to anyone with the urge to get up an excellent all-band system with a minimum of cost. Of course, there have to be some compromises—for example, no rotators are used, so some directivity has to be sacrificed. However, as will be seen this is not a great disadvantage.

The main component of this system is a compact, four element all-driven array which works on 10, 15 and 20 meters—and also on 40 meters for that matter, though its gain or directivity on this band is not too pronounced. Old-timers will recognize it as a pair of 8JK arrays stacked and fed together. Figure 1 shows the basic diagram for a single section 8JK, in which the length is made about 33 feet and the spacing about 8 to 8½ feet. The two elements are connected in the center by a transposed section of line, and an open wire transmission line is connected to the center as shown.

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By the use of tuned feeders, this simple array will work well on the three bands, as many a ham has found out in the past. The array can be hung either horizontally or vertically, and the cost is practically nil. However, even though this array is very effective and gives several db of gain, its performance can be increased considerably by stacking a second array under the first, and feeding the two together. Again, the low cost of materials makes this a practical thing to do. The supporting structure must be higher of course, but not to the extent of being either costly or unmanageable.

Mast Construction

The final design which was used at VE1TG is shown in fig. 2, at least as far as the 8JK array was concerned. Since the antenna itself is a simple thing to construct, the first attention should be paid to the supporting structure. There are occasions when one might have a couple of trees or the good fortune to have a telephone pole or two, but in this case the antenna had to be erected on a barren hillside, exposed to the ocean and constantly swept by high winds. So the masts had to be made up from scratch.

As shown in fig. 3, each mast is made up from three lengths of lumber. Most hams are familiar with the simple "A" Frame type of construction, and this could be employed very well. However, the style shown will also prove to be very sturdy. Bearing in mind that the antenna should be at least 15 feet high—from ground to the bottom elements—select lengths of lumber that are as solid and knot-free as possible. Having had rather dubious success in finding good clear lumber in the lengths desired, and bearing in mind the cost factor, I would suggest going to the local yard and look over what is available. Most yards will let you measure and puzzle to your heart's content, knowing that you will undoubtedly buy at least something before you leave. In the average small-town yard I think that about 16 or 18 feet is the maximum length you will find readily available. I would strongly suggest using 2 × 4, but if you wish you can use 2 × 3 or even 2 × 2. But remember, although you will only be supporting light wire, in a high wind the strain on the masts is multiplied by the whipping and pull of the elements, and so select the wood accordingly. The extra cost for 2 × 4 is well worth while.

In addition to the long lengths, a quiet chat with your friendly lumber dealer should enable you to get a few bits and pieces of 2 × 4 at a very reasonable figure, as well as two pieces about 8½ feet long to use for the spacers on the bottom elements.

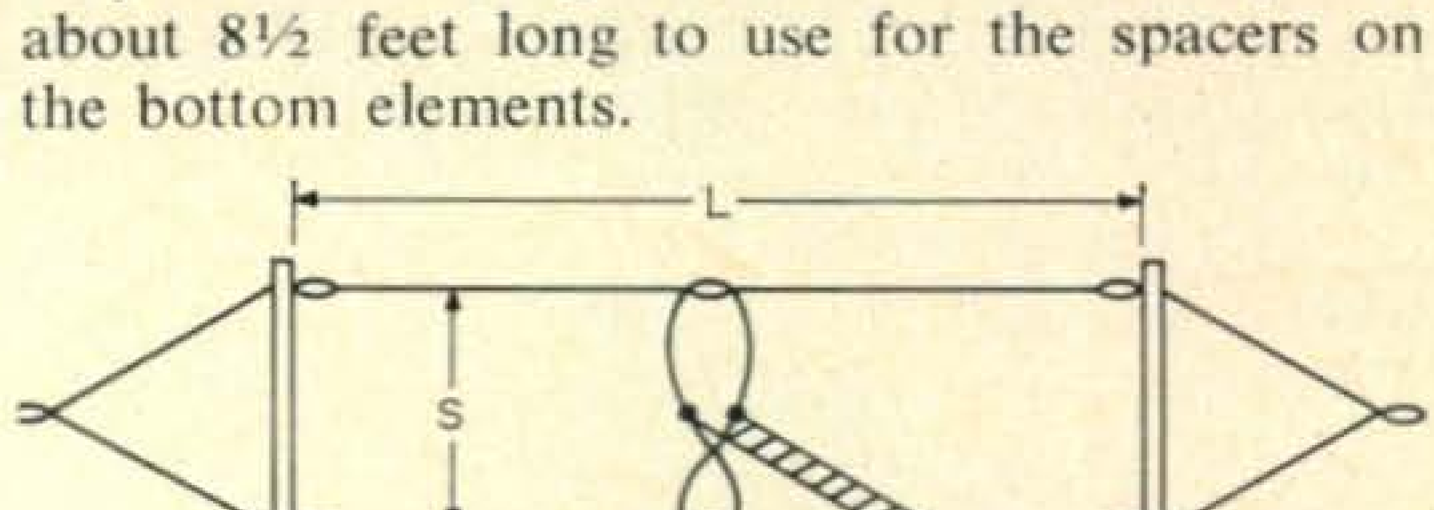

Fig. 1—The basic design of an 8JK antenna. The length is between 33 and 40 feet with an 8½ foot spacing.

be the light weight synthetic fiber ropes although almost anything in the line of clothesline rope of something similar would do.

After two masts are completed, and the hoisting ropes put into place, some thought should be given to the erection site. Providing that space is available, and remembering that the array is bidirectional, the antenna should be placed so that one lobe will be firing in the direction in which one is most interested. In my case, I hung the antenna in a fairly north-west to south-east direction. Considering that the element length will be from 33 to 40 feet, one should decide on the exact length he is going to use, then allow a few feet extra for insulators, spacers, etc. and mark the positions of the two masts. If an extra body or two is now available, the masts can be stood up and guyed in place. Giving a quick glance back at fig. 3, it can be seen that when the array is in place the hoisting ropes can be used also as guys on the outside of the masts, while the array itself will serve as an inner guy for both masts. Therefore, only minimum guying will be required to hold the masts vertical until the antenna can be installed.

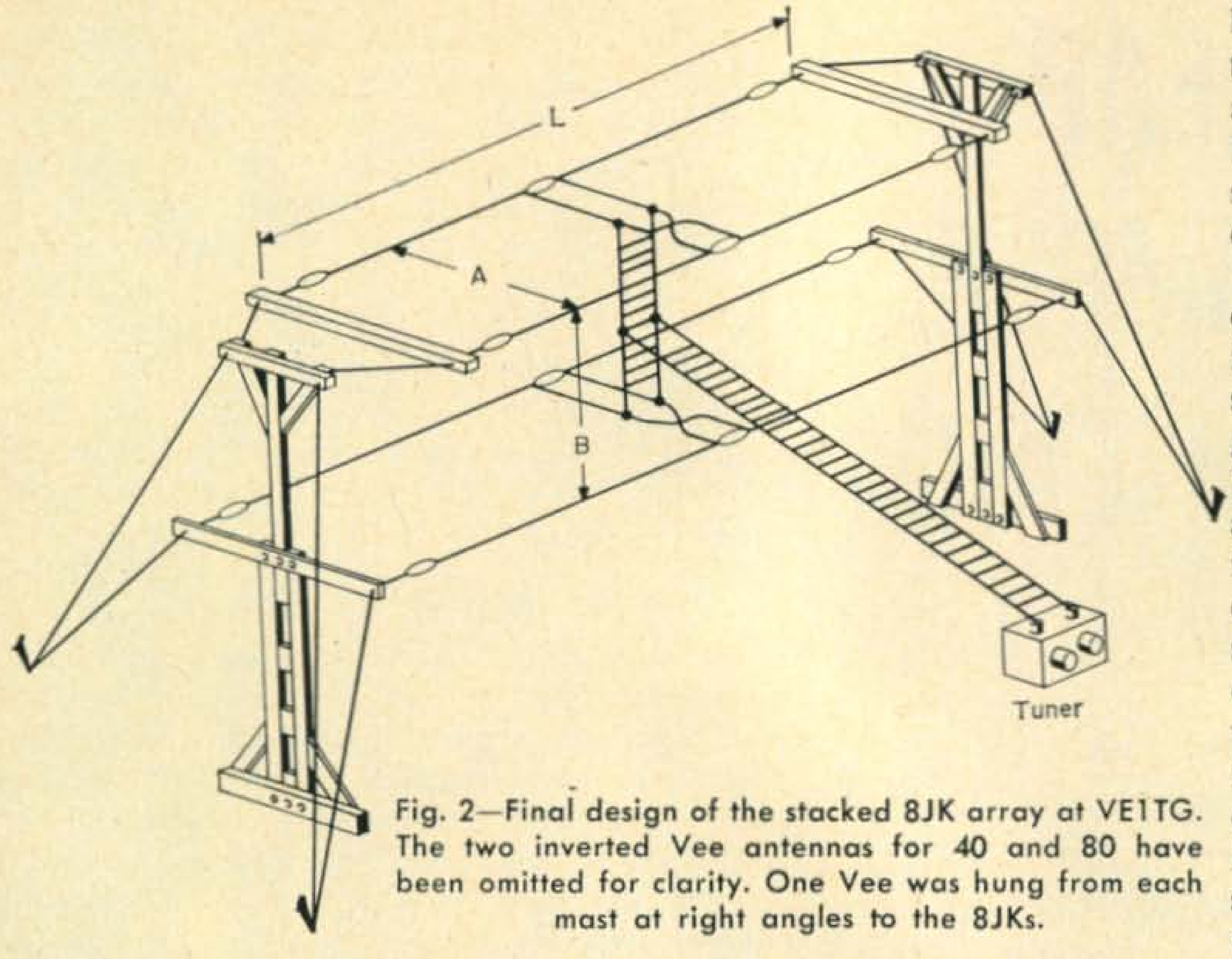

Fig. 2—Final design of the stacked 8JK array at VE1TG. The two inverted Vee antennas for 40 and 80 have been omitted for clarity. One Vee was hung from each mast at right angles to the 8JKs.

Make sure the wood is dry and free from grease or other material, and then give the long sections at least one coat of good exterior paint. Use aluminum paint if you can afford it, as it will give considerably better protection to the wood. Buy it in the gallon size—it's cheaper that way, and you'll use most of it if you do a good job on all the wood.

By laying the long lengths out on a couple of saw-horses, the mast can be assembled very easily. Two good sturdy bolts, about ½ × 6 inches, should be used at point *A*. They should be galvanized or brass, especially in a salt-air region. Allow about a 2 foot overlap at point *A*. Several strengthening blocks should be inserted to hold the bottom 2 × 4's together and in line. At the base, a length of 2 × 4 about 4 to 6 feet long is spiked as a foot, with side braces from the outer ends of the foot to the mast. This foot arrangement is of great value in holding the base steady when the mast is being raised. By driving a piece of pipe into the ground and tieing the base to the pipe, the mast can be raised easily since the foot will not slip out from under, and the width of the foot will help prevent the mast from tipping to one side.

At point *A*, the 8½ foot cross-piece should be bolted to the mast on the opposite side of the mast from the antenna itself. This will give maximum strength. At the top of the mast, a 4 foot length of 2 × 4 is bolted and braced. This will be used to hold the top elements and their spreaders.

Considering the fact that the masts are best raised one at a time, and the antenna put up later, some arrangement must be made for hoisting the elements into place. A small pulley should be placed at the outer ends of the cross pieces but considering the usual cost of brass pulleys, satisfactory results can be obtained by the use of large eyebolts which can be fastened securely to the wood and small diameter rope passed through the eye. The best bet here would be the light weight synthetic fiber ropes although almost anything in the line of clothesline rope of something similar would do.

The Array

The construction of the array is quite easy. Measure off the four elements, which will be essentially nothing more than four 20 meter dipoles, except that the length of each can be anywhere from 33 to about 40 feet. However, each one should be the same length as the others. Wire size should be at least #14 from the point of view of strength. Twelve insulators will be required, and in my case I bought a piece of ¾ inch hardwood dowel, sawed it into 6 inch pieces, boiled them in paraffin and used them

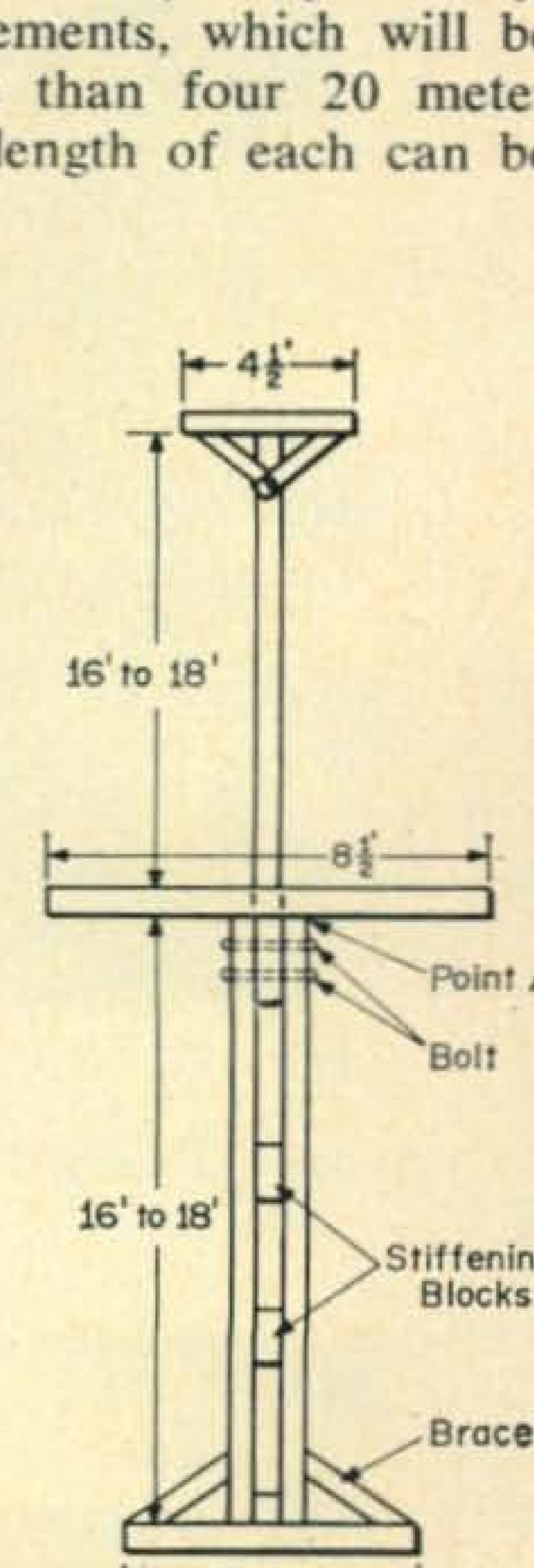

Fig. 3—Construction details of the two masts. Materials can be 2 × 2, 2 × 3 or 2 × 4 but 2 × 4 is strongly recommended. If desired, the masts can be constructed A frame style instead.

instead of regular porcelain types. I must point out that this was a matter of necessity since otherwise I would have had to order insulators by mail and I didn't want to wait.

Some thought must be given to the center spacer of each single array, in order to achieve proper transposition of the wires without shorting them together the first time the wind blows. Figure 4 shows my own method, with a piece of ½ × 1 wood used as the spacer and the center dowel insulators running right through the wood. Two small stand-offs complete the structure and the wires are supported well apart from each other. All wire joints should be well soldered. In places where the open wire type of TV lead-in is available, the transposing wires and connecting leads could probably be made from this, and would result in some saving in weight and probably also be neater in appearance.

Some care must be taken in erecting the array. The top elements should be hoisted up clear of the ground and the connecting line attached to the bottom elements. The open wire line leading to the shack should also be attached, at a point midway between the upper and lower elements. This line can be TV ladder-line, or can be home-made by using light hardwood dowelling and almost any wire that is available. The home-made line should be spaced from 4 to 6 inches.

By patience and some running back and forth, one man can easily assemble the whole array and get it into its final position. In the case of the top elements, I used a light wooden spreader on each end, and this arrangement can be easily seen in fig. 2. After the hoisting ropes have been fastened to stakes in the ground the whole affair will be found to be very solid. Of course, like most antenna structures, the quality of the over-all product will be only as good as the material and workmanship which went into it.

Feedline

It is always nice to be able to run the lead-in away from the antenna at right angles; however, in my QTH I wasn't able to do this and probably this will be the same with most people. There did not seem to be any noticeable deterioration of performance by the lead-in coming out at an angle.

Feeding the array, of course, requires an antenna tuner, which could be something of the

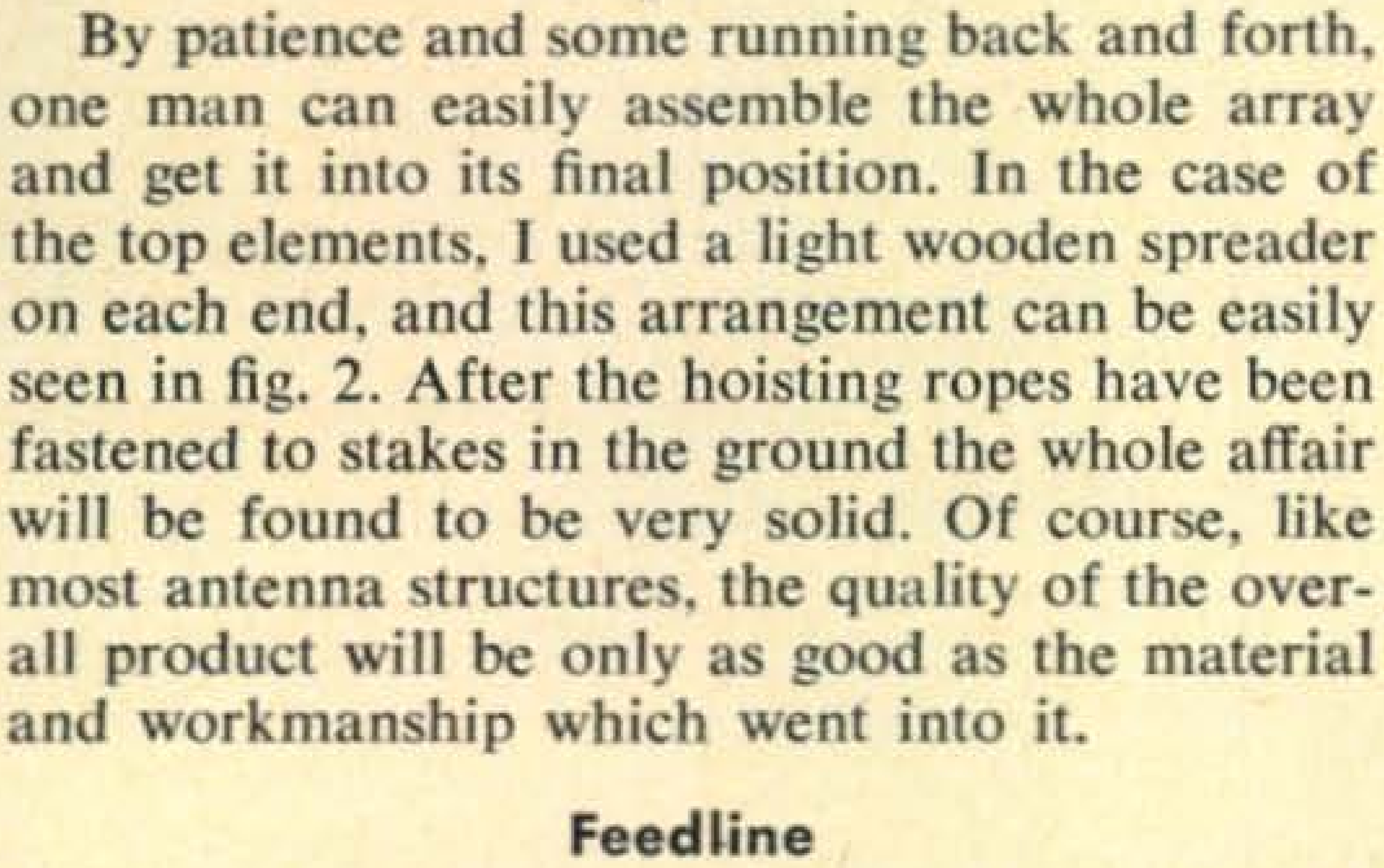

Fig. 4—Method of building the center spacer for the 8JK elements.

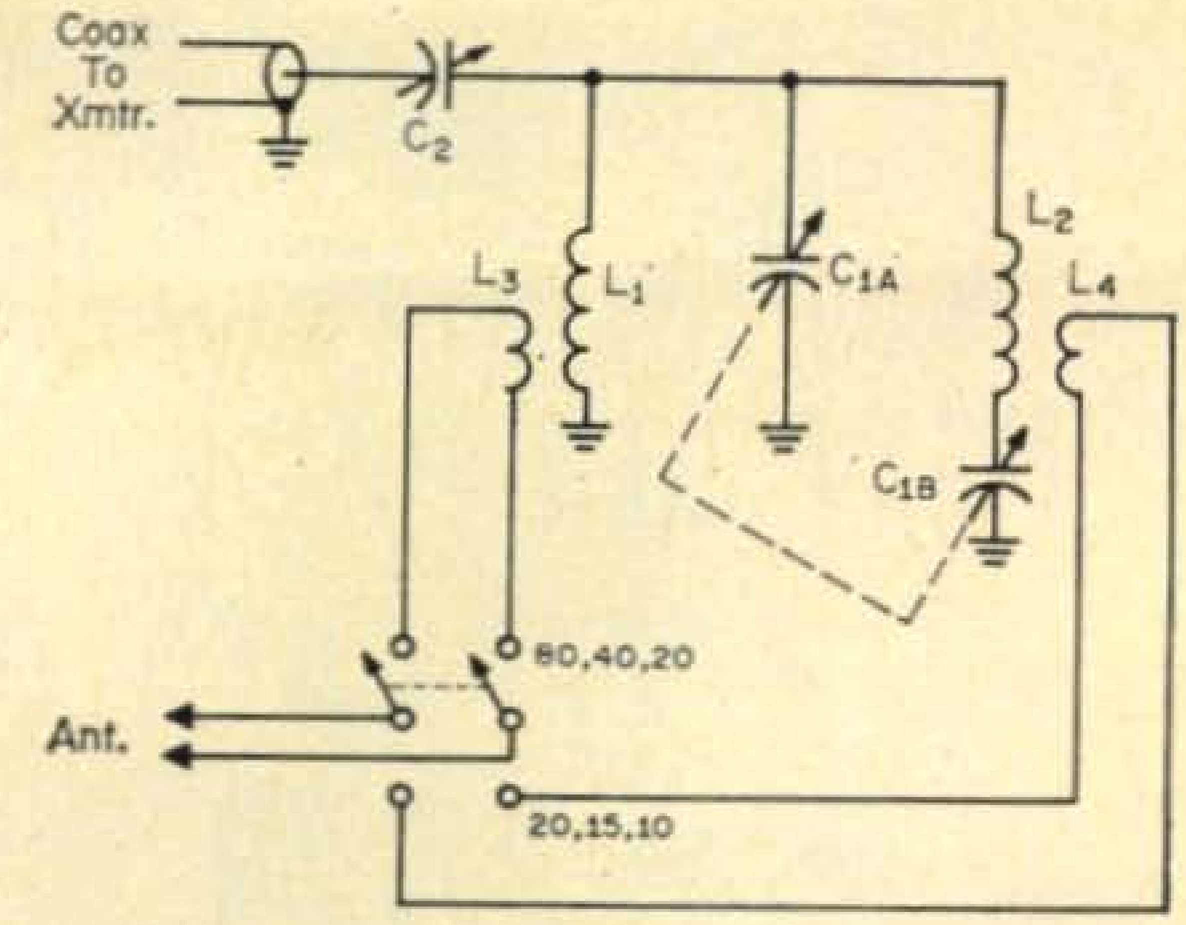

Fig. 5—Circuit of the tuner used with the 8JK array. The coils are wound on ceramic forms taken from an old BC-375 tuning unit. The coax series capacitor is taken from the v.f.o. section of a TA-12 transmitter and C_{1A} and B is a unit with spacing large enough to handle the power of the transmitetr used.

C_1—350 mmf per section.
C_2—400 mmf.
L_1—11t #12, 2" o.d., 2¾" long.
L_2—5½t #12, 2" o.d., 1¼" long.
L_3—6t #12, 2½" o.d., 1½" long.
$_4$—5t #12, 2½" o.d., 1¼" long.

Johnson "Match-Box" type, but can also be made up very cheaply out of junkbox components. Many satisfactory designs have been shown in magazines and handbooks, but I personally have had excellent success with the all-band tuner shown in the ARRL antenna handbook, and diagrammed in figure 5. The procedure for setting up the tuner is given in any handbook, and since the vast majority of transmitters today are of the pi-network output type, an s.w.r. meter should be considered an absolute necessity for initial tuning up. Once the proper setting for the capacitors are found, a pair of dials can be added and the various band settings carefully marked. Then the s.w.r. meter can be removed or, if borrowed, can be returned to its owner. With this tuner, it is readily possible to get the s.w.r. in the coax link line down to a 1:1 ratio or very close to it. However, considering the variables involved, two capacitors in the pi-network and two more in the tuner, the initial tune-up can easily be a slow and frustrating experience. It may be necessary to experiment with the length of the feedline though this should not normally be tried until one is absolutely sure the tuner will not operate properly.

Performance

After tuning the array up on 20, 15 and 10 meters, and finding results to be very satisfactory, I tried an experimental tune-up on 40 meters. To my surprise, the array tuned very well indeed, and a few minutes later I was having a chat with 5N2JKO in Nigeria, which is quite an acceptable test of any antenna on 40 meters. It also proved very satisfactory for working into Europe and South America so operation on 40 should be considered as an excellent bonus. As a matter of fact the tuner will load the antenna on 80 meters but all I used it for on this band was local rag-chewing so how it would be for DX is questionable.

Having no equipment for accurate gain measurements, the best that I could do was consider all the published data I could find on the 8JK then make some allowances for element length, height, etc. However, it seems likely the gain would be about 6 db. Regardless of actual figures, I found the antenna gave really excellent performance, and certainly left little to be desired. There is the problem of fixed directivity of course, but the lobes are not extremely sharp and in actual practice it is capable of good results even off the ends. The small disadvantages are outweighed by obvious good features of low cost and multi-band operation with good efficiency. If the band is even barely open, this antenna will make itself heard.

Inverted Vees

In actual fact, the antenna is designed only for 20, 15 and 10 and operation on 40 or 80 is not really normal, even though in my own case I found it could be done with good results. However, just to be sure, I completed the "farm" by using the two masts as the supporting point for an inverted Vee for both 80 and 40. Using one mast for each antenna not only provides good physical separation, but also provides an extra set of guys for the mast itself. The inverted Vee is well known and the construction is very simple. I used separate feed lines made of RG-59/U coax (72 ohm) because this line is considerably cheaper than the heavy RG-8 or RG-11, and is quite adequate for medium power transmitters. A saving could be accomplished by mounting both antennas on one mast, and feeding them in parallel with one piece of coax. However, I do not personally favor this arrangement because of the ease with which the second harmonic of 80 meters can be transmitted by the 40 meter antenna unless some sort of harmonic trap or tuning network is employed.

The final result is an all-band set-up which will be very efficient and at the same time be just about as low cost as a reasonably good antenna farm could be.

Perhaps it might be well to point out that a simpler arrangement can be made by using only one section of the 8JK. The masts will be the same basic construction, but could be lower, and the feedline would be connected to the mid-point of the transposed line between the elements. The same tuning network can be used, and results will be very good, though, of course, there will not be quite as much gain or directivity. ■