A 40 and 80 METER 8JK BEAM

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WITH THE DECLINE IN SUN-SPOT ACTIVITY as we proceed downward on the sun-spot cycle, 40 and 80 meters are assuming more and more importance as DX bands. Already 10-meter DX openings have become shorter and scarcer, and 20 meters is closed for long periods during night hours. On the other hand, absorption is decreasing, and 40- and 80-meter signals will be better than ever during the next few years. In fact, these will be the only usable bands for DX on many occasions.

With these facts in mind, we gave considerable thought here at W3LOE to the selection of a directive antenna design that would enable us to increase our effective DX signal on these two bands. Practical considerations dictate that an antenna of the dimensions required for these bands have fixed directivity, and it was decided at the outset that the antenna should be bi-directional and oriented so that maximum directivity would be toward Europe and North Africa on one lobe and toward New Zealand and Eastern Australia on the other. These directions include the great majority of the DX activity on 40 and 80. Also, it was felt that maximum utility for DX work would be afforded by an antenna that would give maximum low-angle radiation for a given height. Azimuthal directivity was to be a secondary consideration, and in fact extreme azimuthal directivity was not desired.

The considerations outlined almost automatically dictated the choice of an end-fire type of driven array for our purposes. A long-wire type of antenna—a rhombic, a vee, or long wire itself—was out because of the space it would require. A broadside array would require a greater pole height for a given effective height and would not be readily adaptable to the two-band operation desired. A colinear array alone would give an amount of azimuthal directivity depending upon the number of elements used, but no appreciable gain in low-angle radiation, and these were just the opposite of the desired characteristics.

Although the Kraus, or 8JK as it is popularly called, is a common type of directive array for the higher-frequency bands, where its effectiveness has been thoroughly proved, a question remained as to its performance at the necessarily limited height, in terms of wavelength in the 40- and 80-meter bands, at which we would have to mount it. A statement often made about such antennas is that they must be elevated at least a half wavelength above ground if any appreciable advantage is to be gained. We had made the fortunate acquisition of two used 65-foot poles at a relatively low price from a nearby power company, but it appeared that for 80-meter operation these would provide only about half the desired elevation.

In an attempt to get some approximation of the answer to this question, the vertical field pattern of a single-section 8JK (1/8-wave spacing) for an effective height of 1/4 wavelength above good

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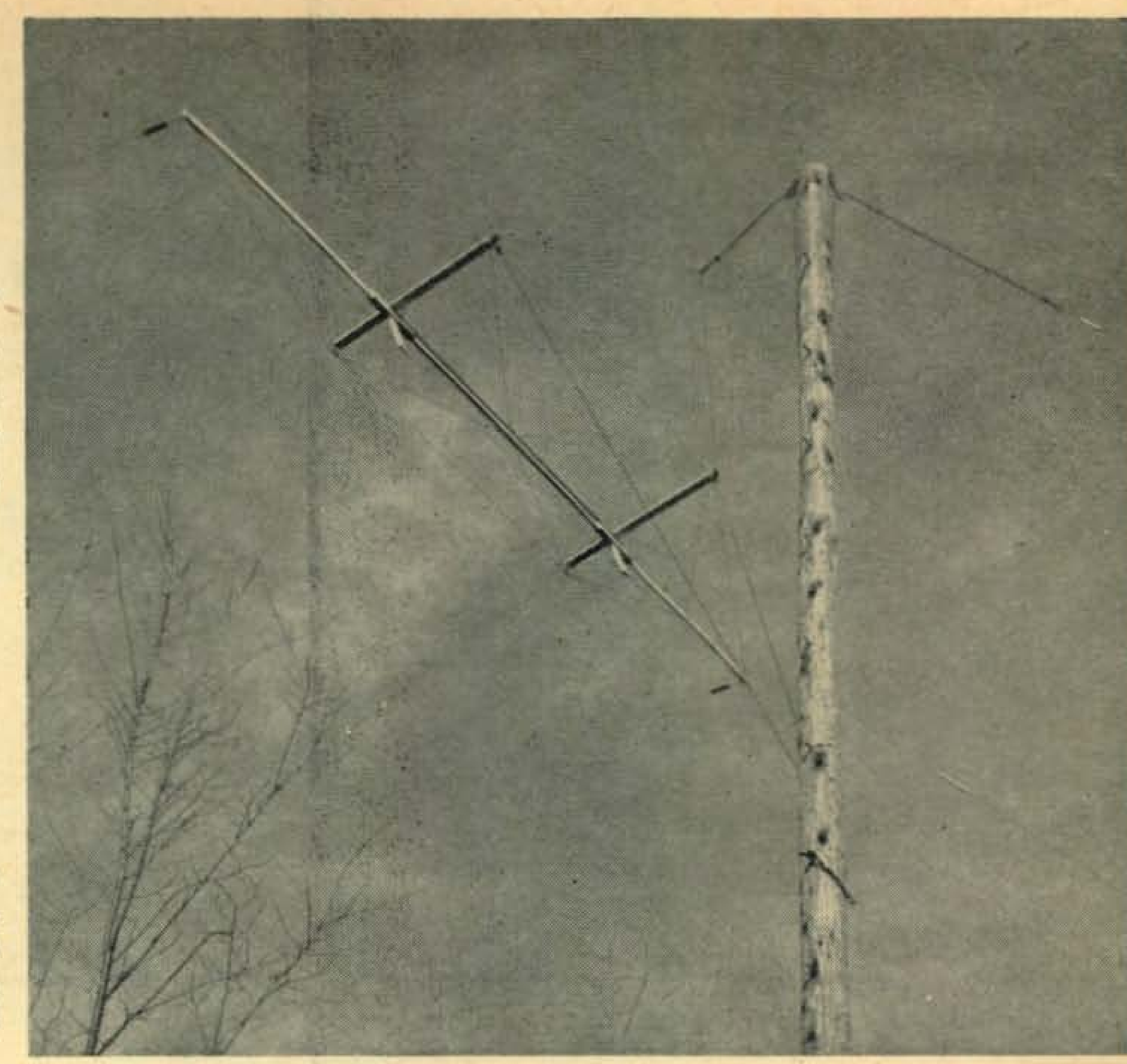
OVERALL VIEW:
An overall view of the 40 and 80-meter 8JK. The short pole in the center is the transmission line pole. Here the individual feeder sections from the radiating elements join the main feeder, which extends to the right of the picture. One of the feeder sections is transposed at the paralleling point.

An effective beam for the lower frequency bands is an interesting challenge. W3LOE's successful answer has been a big factor in his high scores during recent DX contests.



CLOSE-UP OF SPREADER:

The general construction of the spreaders is shown in this photo. Raising the antenna into position by means of the rope and pulley arrangement shown is a two-man job!

earth was plotted and compared with the pattern for a half-wave dipole at the same elevation. The results are shown in Fig. 1. At first glance, the 8JK doesn't appear to offer much advantage, but close inspection of the patterns reveals a gain on the order of 4 to 4.5 db for the 8JK at all riadiation angles up to slightly over 20 degrees. Above 35 degrees the field of the single dipole exceeds that of the 8JK, the latter dropping off fairly rapidly above this figure. It was thought, however, that this might be a point in favor of the 8JK for DX work, since high-angle QRM from nearby stations would be reduced. Also, it was thought that the high-angle energy of the single dipole, traveling over more hops and arriving at the distant point somewhat more attenuated than the low-angle energy, might produce a signal with greater interference fading there, the result being a less "solid-sounding" signal than would be delivered by the 8JK with its greatly suppressed high-angle radiation. This appears to be the case in actual practice, because reports of DX stations on comparisons between the 8JK and a half-wave dipole at the same elevation often indicate considerably more than the theoretical gain—possibly some of this difference is caused by the psychological effect of the more steady signals reported for the 8JK.

The vertical pattern for operation of the array on 7 mc was also plotted. On this band it becomes a double-section quarter-wave spaced 8JK (two by two colinear end-fire array). The effective height was assumed to be a half wavelength, and the comparison antenna was a half-wave dipole at the same height. The two patterns are compared in Fig. 2. In this case the superiority of the 8JK is quite marked, a gain of well over 5 db being provided at all angles up to slightly over 20 degrees. The horizontal pattern is slightly sharper than that for 80-meter operation, but it is still over 40 degrees wide between half-power points, where

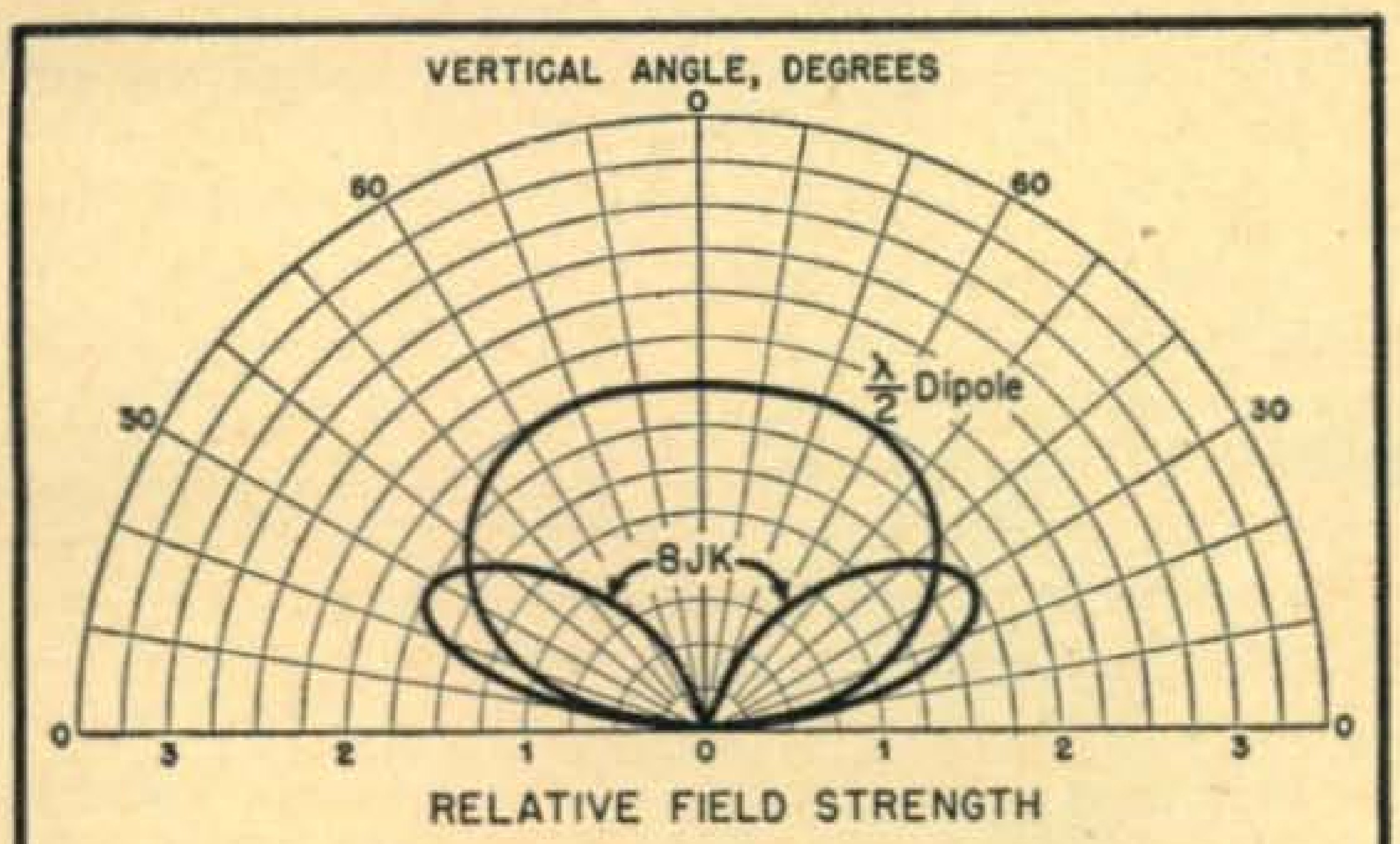


Fig. 1. Comparative vertical radiation patterns of single-section 8JK, 1/8 wave spacing, and 1/2 wave dipole, both at an effective height of 1/4 wavelength above ground.

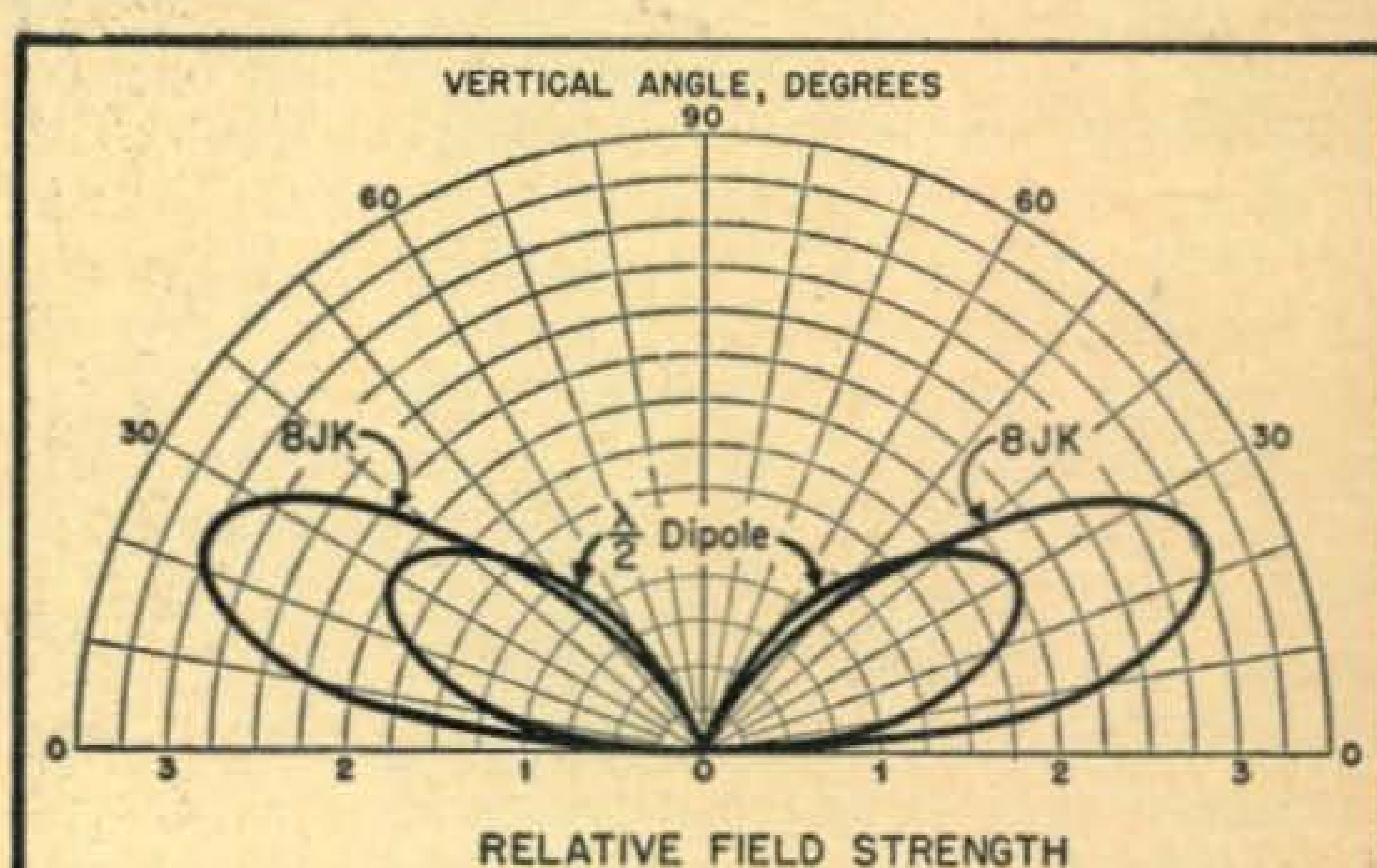


Fig. 2. Comparative vertical radiation patterns of double-section 8JK, 1/4 wave spacing, and 1/2 wave dipole, both at an effective height of 1/2 wavelength above ground.

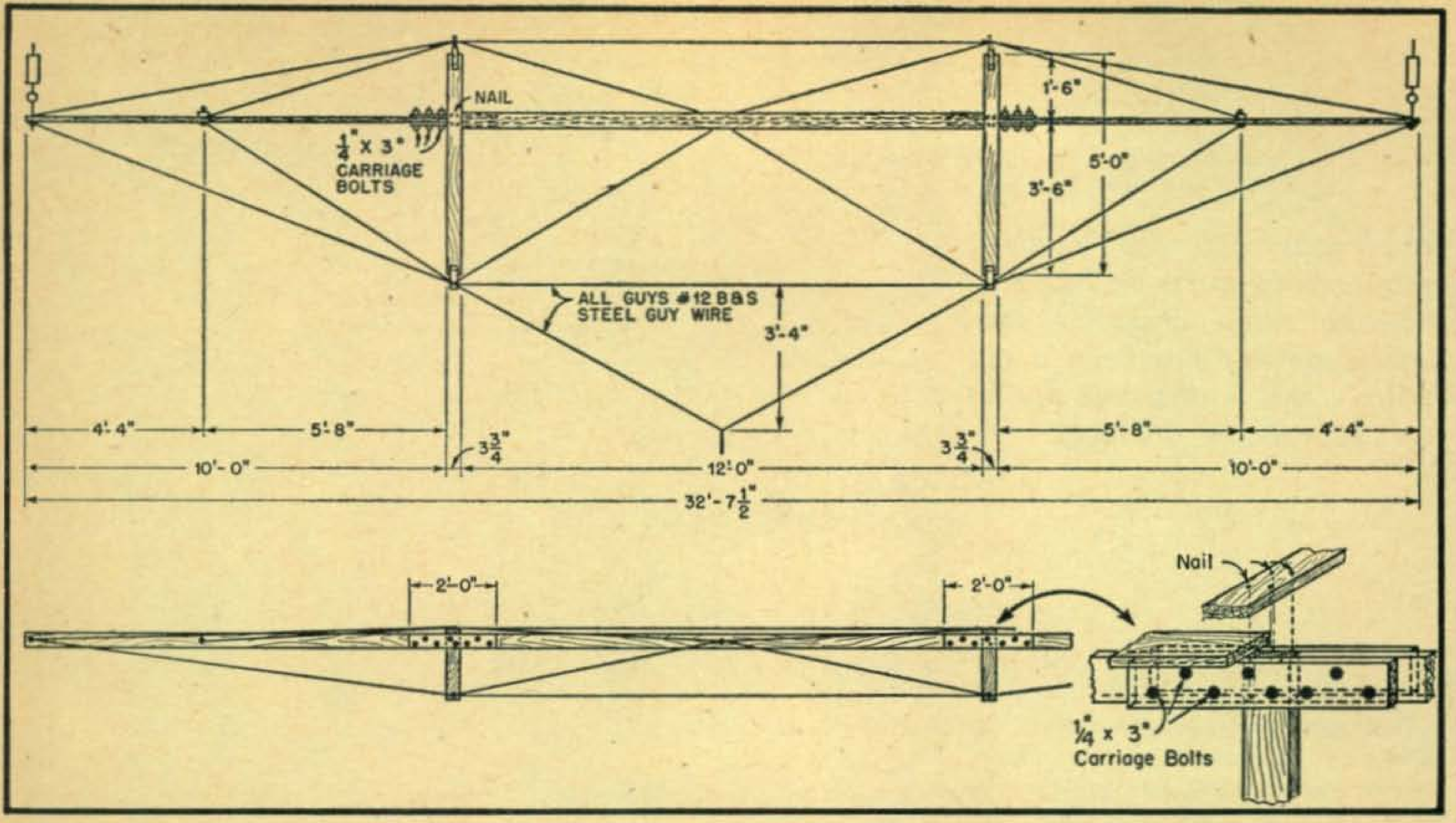


Fig. 3. Details of spreader construction. All the wood members are 1 x 4 white pine, and all guy wires are No. 12 B & S steel.

the gain is 3 db down from maximum. From our location, this provides complete coverage of Europe and a healthy slice of North Africa, the opposite lobe being aimed at New Zealand and still providing a small gain toward Eastern Australia.

It was concluded, therefore, that an 80-meter 8JK with eighth-wave spacing, operated as such on 80 but as a double-section 8JK with quarter-wave spacing on 40, would come closer to meeting our original specifications than any other basic type of directive array.

A practical problem that immediately presented itself was the means of getting the required spacing between the elements. No more poles were available at bargain prices; so it was obvious that some sort of spreader arrangement would have to be used. It was realized that spreaders long enough to give eighth-wave spacing (35 feet) at 3.5 mc would be no mean structures if they were to support themselves alone, not to mention the additional strain of supporting the antenna elements and the feed lines when they were pulled up taut. The spreaders finally designed give a spacing of a little over 32 feet, slightly less than an eighth wavelength, but the elements are pulled apart several feet at the center to give an average spacing close to the desired 35 feet. This probably broadens the horizontal pattern slightly, but this is considered to be no disadvantage.

Mechanical Details

The design and construction of spreaders of these dimensions provide an opportunity for the exercise of considerable ingenuity, not to mention the application of plenty of the principles of structural engineering if you are versed in them, which this writer definitely is not. For this reason, the spreaders used are not described in the following paragraphs with the intention of implying that they are the best design for the purpose. However, they have stood some severe windstorms and ice loads over the past year, and they are undoubtedly better than the first spreaders we tried, one of which collapsed with a resounding crash the first time the antenna was pulled taut.

The construction of the spreaders finally used is shown in the accompanying photographs and the drawing, Fig. 3. Clear, straight-grained white pine was used for all the structural members. The guys are of No. 12 B & S solid steel guy wire. The main boom consists of a 12-foot "T" section made up of two 12-foot 1 x 4's, spliced at each end to a 10-foot 1 x 4 extension. The splices include the top ends of the two vertical struts. The horizontal struts are nailed on above the center of the splice.

The guys are dead-ended with Nicopress dead-end splicing sleeves. A small block and tackle assembly with a pair of "come-alongs" was used to give the guys a small amount of initial tension before the sleeves were crimped with a Nicopress crimping tool. In the absence of this type of equipment, the use of ordinary twisted dead-ends with a turnbuckle at the center of each of the main guys would no doubt have been a satisfactory method of construction.

All the wood members were given a primer coat before assembly, and the completed spreaders were given a final coat of outside white house paint.

The radiators are No. 12 Copperweld wire. Copperweld is required because of the tension to which the elements are subjected. The elements are cut for resonance at 3525 kc (132 feet), making the resonant frequency of the individual halves of each radiator approximately 7100 kc for 7-mc operation. However, the directivity pattern does not depend critically upon the lengths of the elements, and the directivity is good for operation over the entire width of both bands.

Each radiator is fed at the center with 70 feet of 600-ohm open-wire line. These feed lines are brought away from the radiators at an angle which causes them to pull the centers of the radiators apart by several feet, as shown in Fig. 4, to compensate for the fact that the spreaders are slightly less than an eighth wave long. The lines are held in tension in this position by six-inch spools, made of a piece of broomstick with a knob insulator at each end, at a height of about 15 feet from the ground. Each spool is attached to a guy wire which is dead-ended to a stake in the ground. The feed lines double back to a short transmission line pole directly below the center of the antenna, where they are paralleled (with the proper transposition in one of them) and attached to the main feeder. The latter is also a 600-ohm open-wire line, which in our case is 212 feet long.

It will be noted that the 70-foot feeder sections to the individual radiators are approximately a half wave in length for 7-mc operation. The resultant impedance presented to the main feeder at the point where they are paralleled is half the impedance directly at the feed points of the radiators. Although this impedance is somewhat higher than that required to match the 600-ohm line properly, it is predominantly resistive, and the resulting standing wave ratio on the main feeder is not unduly high over the 7-mc band.

In the 3.5 mc band, the input impedance of the individual radiators is quite low, and the 70-foot feeder sections are a quarter wave in length. As a result, the impedance presented to the main feed line at the paralleling point is a very high resistance, and the SWR is correspondingly high (estimated at about 30 to 1). However, the loss in the feeder is estimated to be well below 1 db at this frequency, in spite of the high SWR, and it was not considered worth the sizable additional investment to make the 70-foot feeder sections of close-spaced tubing, as is done in the Johnson "Q" antenna, in order to reduce the SWR in the main feeder. This might have been done if the feeder had been more than several hundred feet long, but the mechanical problems of supporting such matching sections might have been somewhat formidable.

On both 7 and 3.5 mc, a conventional antenna tuner is used to match the transmitter to the load presented by the feeder. The construction and adjustment of such tuners is described in all the handbooks and antenna manuals. Because the feeder is an integral multiple of a quarter wave long on both bands, it is not necessary to employ reactance compensation in the tuner.

Results

This is the inevitable close of every antenna story—a report on the results obtained. This writer attaches no significance whatever to such closing

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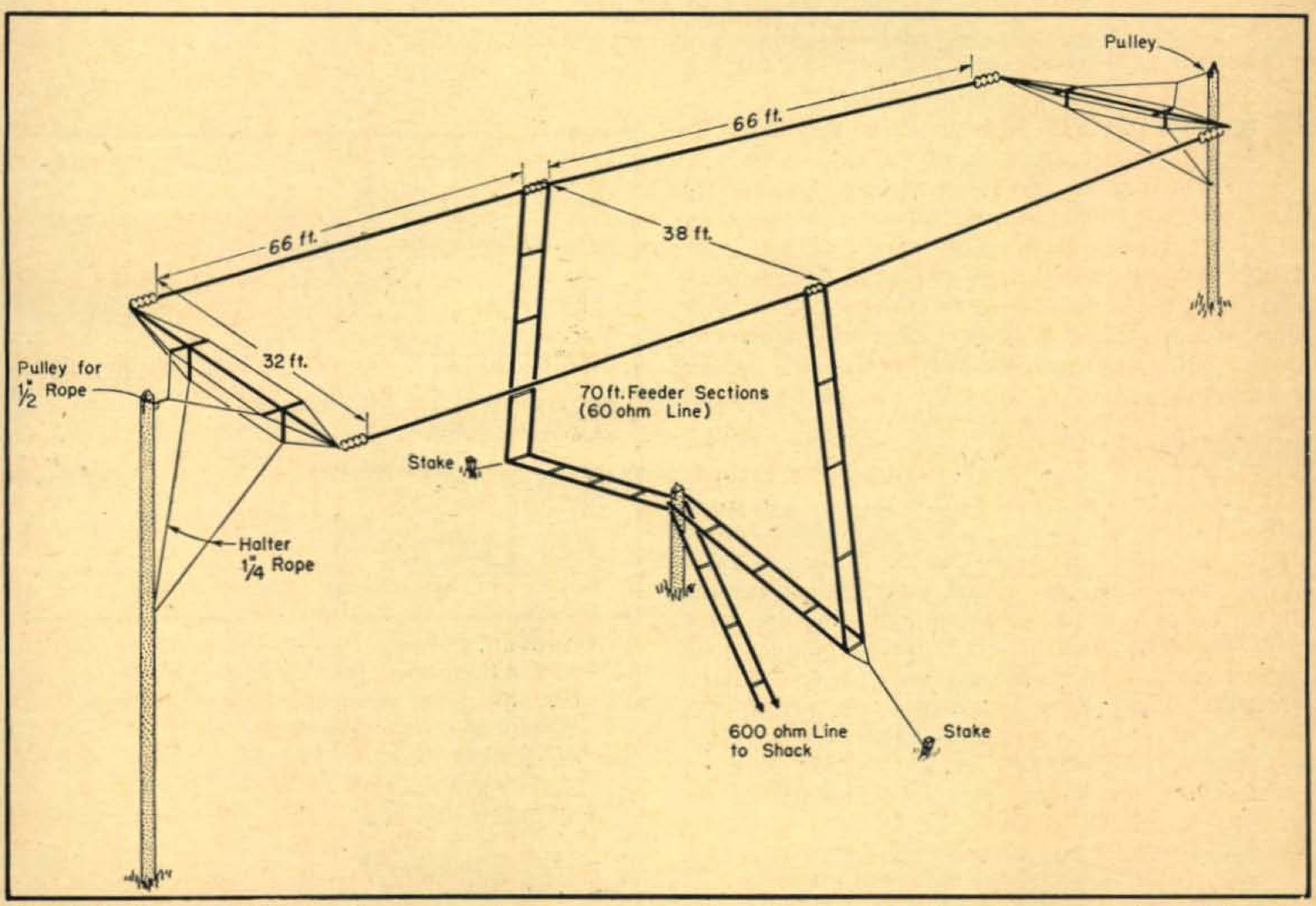

Fig. 4. Radiator and feeder dimensions of the antenna. A ½ inch rope and pulley arrangement is used to raise the spreader into position and to provide tension on the antenna elements.

Lawton-Ft. Sill ARC is all ready for several thousand messages to be originated at the annual Easter Pageant on March 25; watch for the W5s in this area for traffic on the above-mentioned date and help the club to clear the hook quickly; mobiles, portables, telephone ops and sundry handymen are lined up for the event; the club bulletin queries: "Are there any amateurs in Deleware?" . . . Schenectady ARA has its 1951 officers in *W2GYV*, pres.; *UKA*, v.pres.; *ZHI*, sec., and *YIK*, treas.

YL

(from page 35)

"Finally, I will mention my other hobbies. Amateur radio is, of course, my chief hobby. But as the second one comes music. I play the piano and my favorite composer is Beethoven. I am very much interested in all kinds of sports—in winter I love skiing and in summer swimming. I also like very much to dance. And last, I love all sorts of travel, but first and foremost by ships. So I know that sooner or later I will go to sea, and naturally as a radio operator. But in the meantime you'll hear me from this small QTH where I'll be fishing for DX."

40 & 80 METER 8JK

(from page 19)

paragraphs in many antenna articles which state that such a situation was worked and the report was this or that. The only worthwhile criterion of performance is a comparison of one antenna with another under identical conditions, that is, a test in which a quick change is made several times between antennas, with a distant station listening and giving comparative reports. At the time this antenna was erected, we had available a 3.5 mc center-fed half-wave antenna at approximately the same height as the 8JK. This antenna became two half waves in phase on 7 mc, with maximum directivity in the same directions as the 8JK. Also available was a center-fed half-wave antenna for 7 mc, at an elevation of about 45 feet. Comparative tests were made with a number of DX stations among the three antennas on 7 mc and between the 8JK and the half-wave job on 3.5 mc. On 3.5 mc, the reports from Europe and from New Zealand in nearly every case gave the 8JK at least one "S" point over the half wave, sometimes more. G5VG and ZB1AR reported the 8JK three "S" points better than the half wave! On 7 mc a particularly interesting series of tests was run with F3NB, who gave the 8JK S-8/9, the two half waves in phase S-7, and the 7-mc dipole S-5 with heavy QSB. We were receiving F3NB a solid S-7 with the 8JK, but when we stood by to listen after changing to the dipole we had to switch quickly back to the 8JK in order to get his report, because his signal was so weak and thin we could hardly be sure he was there in the QRM.

The payoff on this antenna, however, was the way in which it performed in the 1950 ARRL