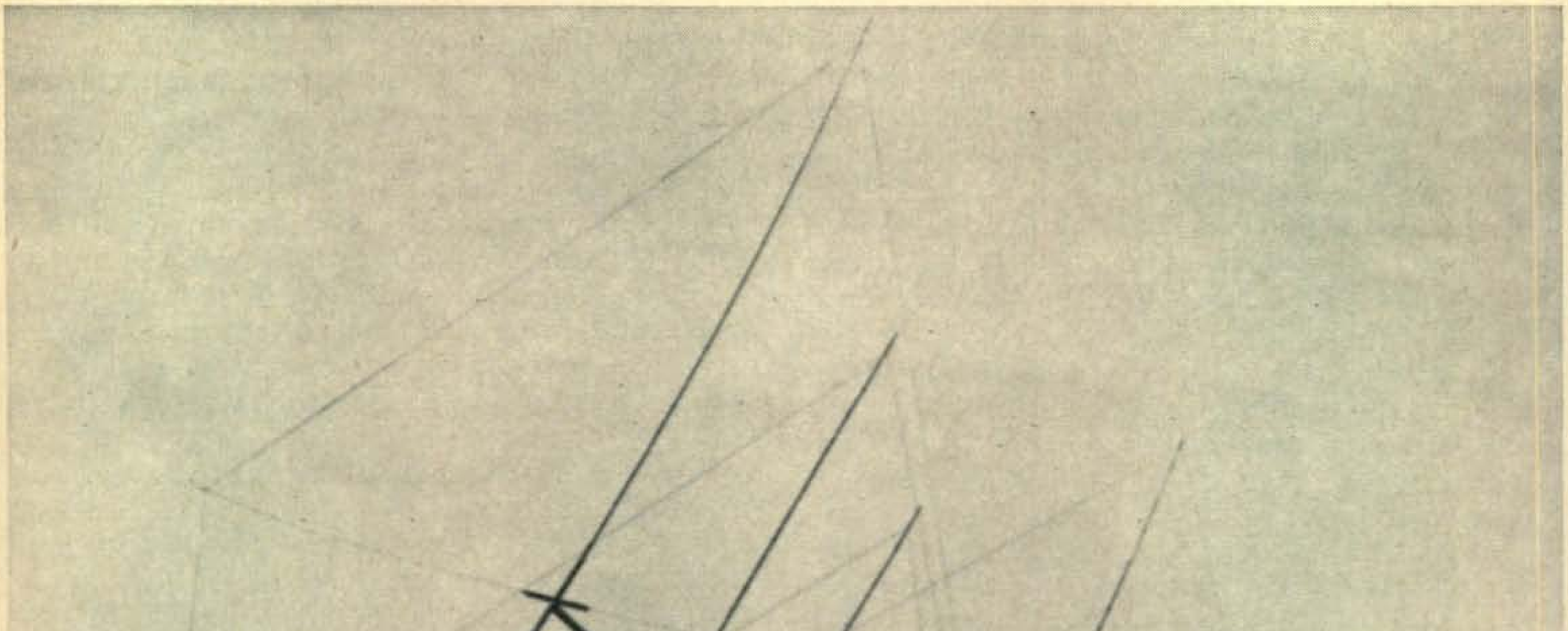


a Three Band Quad

Paul A. Inmon, WØWEP
1850 E. Cairo Street
Springfield, Missouri

For the amateur who likes to work the 10, 15 and 20 meter bands it is a distinct advantage to be able to switch from one band to another with a minimum of effort and time. With the ever increasing number of active hams on these three bands it becomes almost a necessity to have an efficient rotatable antenna array.

For quite a number of years I had been envious of some of my more fortunate fellow hams who could afford to have everything from a stacked Yagi beam array to a Rhombic. Having neither much room on my ordinary city lot nor the finances to have an antenna farm, I decided to quit day-dreaming and go to work on something which would be practical for me.

Several types of antennas were considered and rejected, not because they were not good, but simply bcause the necessary room was not available. Most of the available space in my back yard was taken up by two large elm trees. For a moment, a chopping axe seemed to be the only solution, but the XYL soon dampened my enthusiasm on that bit of wishful thinking. It was then that I turned to the cubical quad, which is being revived in many parts of the country. This type of antenna is well suited for multi-band construction. Apparently other amateurs seem to share this view also, judging from the interest manifested in dual and tri-band quads. Although the idea for a three band quad was first conceived by the author in the fall of '54, it was not until August, 1955 that the antenna was completed and put into service. Since it offers a number of features that may appeal to the antenna minded ham, it was decided to pass along the details to CQ readers.

In looking over a 20 meter quad, my first impression was of its bulk. Then the thought occurred to me, why not use the available space? By adding additional driven elements and reflectors I would have three cubical quads stacked on one boom, instead of one. The only thing that worried me was the possibility of undesirable reaction due to the close proximity of the elements. It was decided to build and check each element separately and together to see what the results would be. For instance, a 20 meter quad was constructed first and put into service; then the 15 meter elements were installed and checked; after that came the 10 meter section. No difference in performance was noted in any of the quads used. With all the elements securely in place, the antenna worked beautifully.

Fundamentally, the three band quad consists of three radiating elements backed up by three matching parasitic reflectors of the same configuration, as shown in *fig. 1*. Actually these elements are folded dipoles fashioned into square loops, with each side representing one quarter wavelength, making a total of one wavelength around the square loop. The spacing between the driven elements and reflectors is approximately 0.175 wavelength on 14 mc, 0.185 wavelength on 21 mc, and 0.175 wavelength on 29 mc. A slight additional gain on 10 and 15 meters may be obtained by moving the 10 meter reflector to 86″ for 0.20 wavelength, and by moving the 15 meter reflector to 108″ for 0.20 wavelength.

On the air tests showed that the three band quad had an excellent forward gain with a sharp drop-off from front to side. This can be varied by adjusting the shorting bar on the tuning stubs of the reflectors. The position of the shorting bar is adjusted experimentally either for maximum forward gain, maximum front to back ratio, or a compromise between the two as desired. An Antennascope or field strength meter is recommended as an aid in getting the desired results while adjusting the three quads. The theoretical gain, based upon conventional methods of gain calculation for directional arrays, is approximately 8 db over a matched, reasonant half-wave dipole. However, many amateurs have reported measured gains on the order of 10 db, which compares favorably with a 3 or 4 element Yagi type beam.

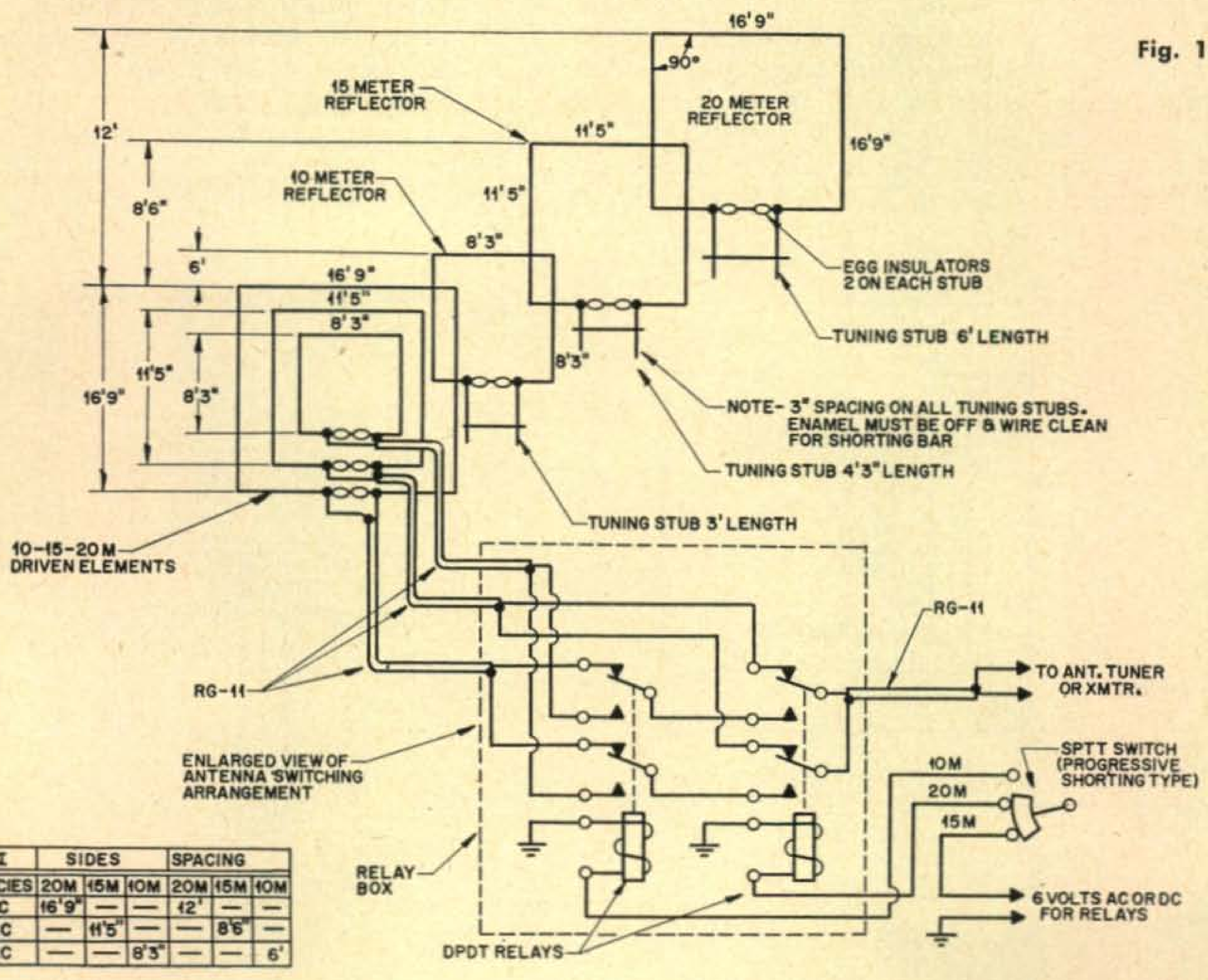


Fig. 1

TABLE I	SIDES			SPACING		
FREQUENCIES	20M	15M	10M	20M	15M	10M
14,150 KC	16'9"	—	—	12'	—	—
21,200 KC	—	11'5"	—	—	8'6"	—
29,000 KC	—	—	8'3"	—	—	6'

In addition to its gain, the three band quad has other features worthy of consideration. RG-11/U 75 ohm coax is used on the driven elements in a simple direct hook-up. No line balance converters or phase inverting sections are needed. The standing wave ratio is low, which is desirable for reducing TVI. The antenna also has a low angle of radiation—desirable for DX. Because of its simple construction it is easy to build and adjust. It is a full size beam with no loading coils to absorb power, yet the boom is only 12 feet long as compared to a 20-foot Yagi boom, hence it occupies less space in rotating. Best of all, the antenna is bandswitching for 10, 15 and 20 meters and costs only about $20.00 to build, depending on locality and the amount of material already on hand. Mine cost $5.60, how can you beat that?

Construction

All of the material used in the construction of the three band quad is readily obtainable in most localities. Once the material has been accumulated, actual work may begin.

The boom is a 12-foot section of 1½″ x 1½″ square aluminum tubing with a ⅜″ 1½″ x 48″ aluminum reinforcing bar, *fig 2*.

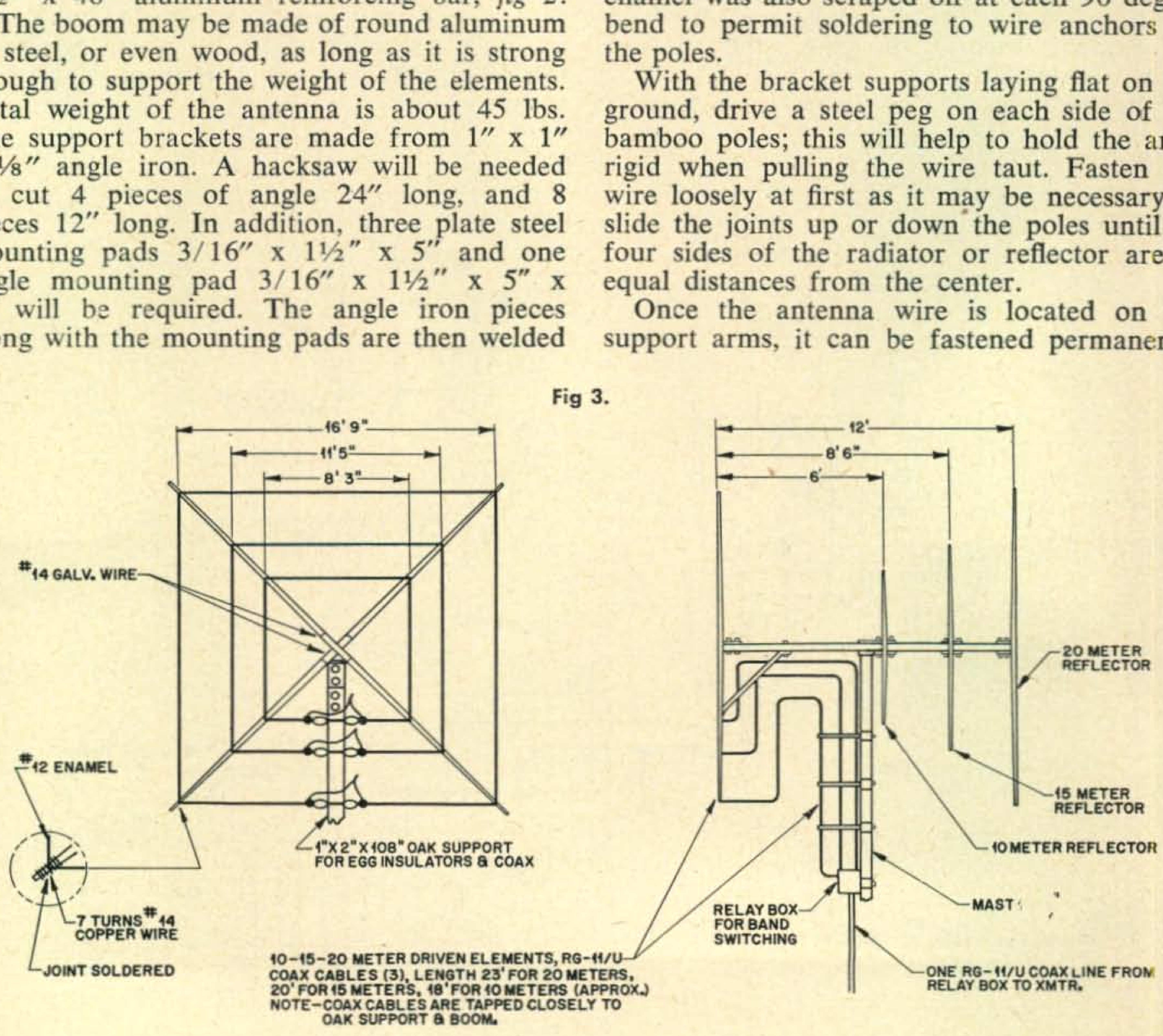
The boom may be made of round aluminum or steel, or even wood, as long as it is strong enough to support the weight of the elements. Total weight of the antenna is about 45 lbs. The support brackets are made from 1″ x 1″ x ⅛″ angle iron. A hacksaw will be needed to cut 4 pieces of angle 24″ long, and 8 pieces 12″ long. In addition, three plate steel mounting pads 3/16″ x 1½″ x 5″ and one angle mounting pad 3/16″ x 1½″ x 5″ x 5″ will be required. The angle iron pieces along with the mounting pads are then welded together as shown also in *fig 2*. Four complete support brackets will be needed to hold the sixteen bamboo poles used in the construction of the three band quad. In selecting the bamboo fishing poles it is suggested that those imported from Japan be used since they seem to be superior to the American variety. They should be straight, free from splits, and about 18 to 20 feet long. Since the poles are longer than necessary, they may be cut to their approximate length as follows: eight 13 feet long, four 9 feet long, and four 7 feet long. Be sure to cut the surplus off of the small end of the poles. Later, after the arms are mounted in the bracket supports and the antenna wire is fastened in place, an additional amount may be cut off the end of the poles to make the antenna more compact and neater. Before mounting the arms, however, the butt end of each bamboo pole should be wrapped with a layer of friction tape for protection against the wire used in securing the arms to the brackets. Each bamboo pole is then given two coats of spar varnish to weather-proof it.

In laying out the radiator and reflector loops, *fig 1*, the No. 12 enameled wire was measured and marked by bending the wire to a 90 degree angle at quarterwave intervals. The enamel was also scraped off at each 90 degree bend to permit soldering to wire anchors on the poles.

With the bracket supports laying flat on the ground, drive a steel peg on each side of the bamboo poles; this will help to hold the arms rigid when pulling the wire taut. Fasten the wire loosely at first as it may be necessary to slide the joints up or down the poles until all four sides of the radiator or reflector are at equal distances from the center.

Once the antenna wire is located on the support arms, it can be fastened permanently

Fig 3.



where it touches by drilling a small hole in the bamboo poles on each side of the wire. The holes are used to anchor about seven turns of No. 14 tinned copper wire (bare) as a means of holding the antenna in place. The next step is to install two "egg" insulators at the bottom of each element in the center to the loose ends of the antenna wire. These are then tied together 3″ apart. When the driven elements and the reflectors are completed, they are mounted on the boom with 5/16″ x 2¼″ machine bolts. By all means use lock washers under the nuts.

The whole assembly can then be mounted on an 1¼″ pipe mast by means of a pipe flange and bracket. Notice in the assembly drawing *fig. 3*, that the antenna is mounted slightly off center to counter-balance the weight, and also to provide clearance for the 10 meter reflector. Each driven element is equipped with a short length of RG-11/U coax cable which goes to the relay assembly mounted in a metal box on the mast. The size of the relay box is 4″ wide, by 3″ deep, by 6″ long. A 1½″ x 3½″ slot is cut in the top end of the box, and a 1½″ x 1½″ slot is cut in the bottom end. These are cut for the purpose of insulating the chassis receptacles from the metal box. Three type SO-239 coax chassis fittings are mounted on a polystyrene strip to accommodate the three feed lines from the driven elements. This insulated strip is then secured to the top of the box by means of 6-32 x ¾″ machine screws. One SO-239 coax chassis fitting is similarly arranged and secured to the bottom of the relay box to take care of the coax line from the transmitter. Only one RG-11/U transmission line is needed from the relay box to the transmitter as a result of the switching arrangement.

Antenna switching is accomplished through the use of two low voltage DPDT relays and one SPTT progressive shorting switch. This is a very simple arrangement and permits the operator to choose the antenna desired by rotating the progressive shorting switch to any one of three positions, see *fig 1*.

Performance

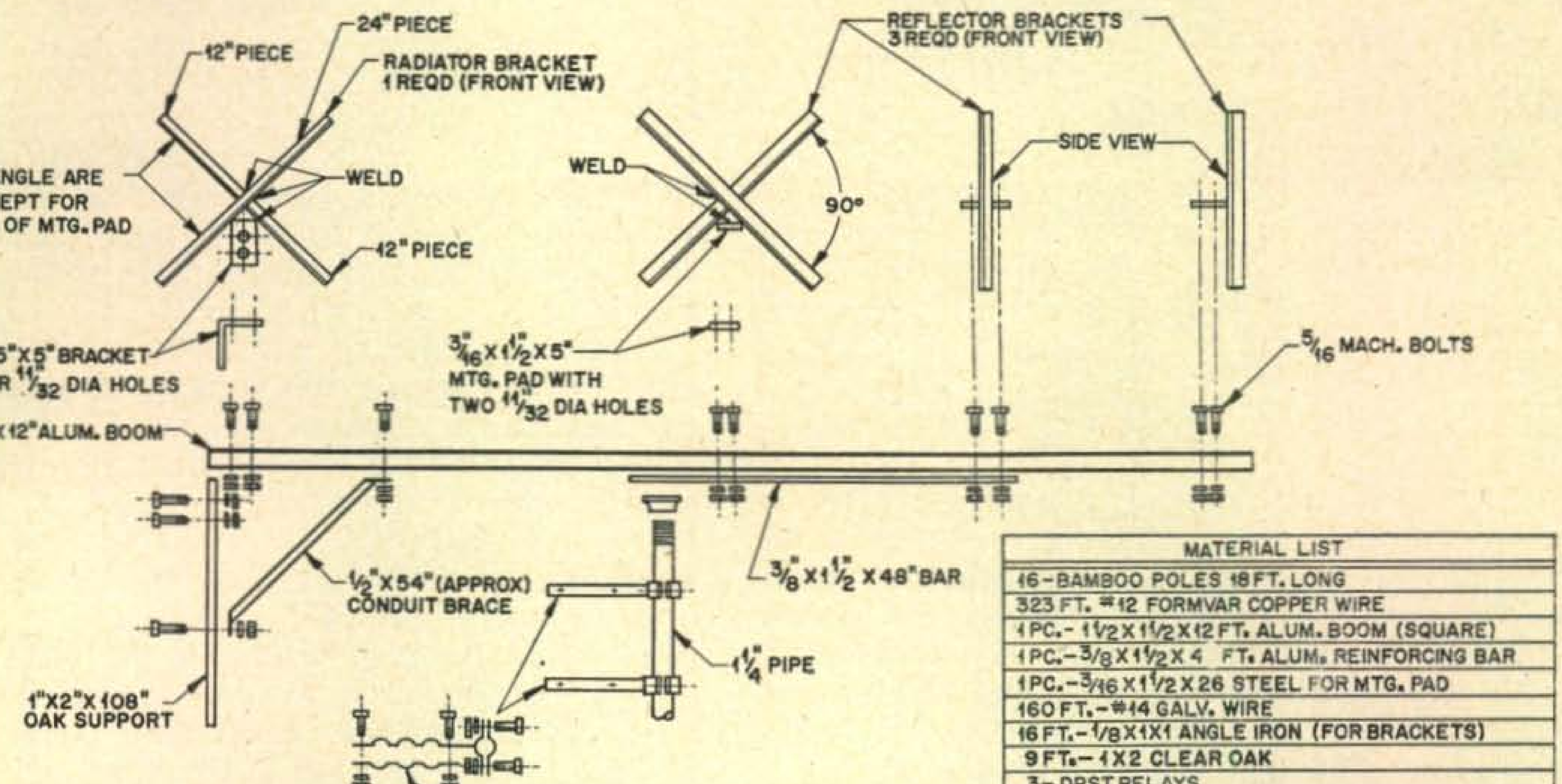
In spite of the antennas' frail appearance it has turned out to be rather rugged. As a matter of fact I accidentally dropped it when I was about 20 feet up on the tower. To my surprise, it bounced around on the ground like a "giant" spider with no damage resulting.

After eighteen months of usage in all kinds of weather, the three band quad continues to give a good account of itself. Results have been extremely gratifying. Signal reports on all three bands have been averaging well above an S9. On 15 meters, the band I prefer, WAC was worked easily. Best signal reports on DX from oversea contacts was 40 over S9 on both 10 and 15 meters, and 20 over on twenty meters. Contacts were made on phone with a power input of 140 watts.

While there is nothing spectacular in these results, they do prove that the three band quad merits more than just a passing glance. For the amateur who is saddled with the problem of space and finances, why not try a three band quad. From the many inquiries received and the interest manifested, it would seem to be a worth-while project, besides offering possibilities to the experimenter.

In conclusion, I would like to express my thanks to the Southwest Missouri Amateur Radio Club for their interest and encouragement in the design of this beam. ■

Fig 2. The parts list should read 2 DPDT relays and 1 SPST switch, not 3 and 3 as shown.



MATERIAL LIST
16-BAMBOO POLES 18 FT. LONG
323 FT. #12 FORMVAR COPPER WIRE
1 PC.-1½X1½X12 FT. ALUM. BOOM (SQUARE)
1 PC.-3/8X1½X4 FT. ALUM. REINFORCING BAR
1 PC.-3/16X1½X26 STEEL FOR MTG. PAD
160 FT.-#14 GALV. WIRE
16 FT.-1/8X1X1 ANGLE IRON (FOR BRACKETS)
9 FT.-1X2 CLEAR OAK
3-DPST RELAYS
3-SPST SWITCHES
1 QT.-SPAR VARNISH
MISC.-BOLTS, NUTS, WASHERS, COAX, WIRE, ETC.