A Forty Meter Vertical Beam

BY ROBERT S. DIXON*, W9OKN

This unique "beam" features three fixed verticals that are phased and oriented electrically by a 6 position rotary switch located in the shack. It has a theoretical gain of 5 db over a reference dipole with the added advantage of a null in the back to reduce QRM. Since the separation of the verticals is a quarter wavelength, the installation can be managed in the average back yard.

IN recent months, propagation conditions on the 20, 15 and 10 meter bands have become increasingly poor. This has caused many a DXer to cast fond glances at 40 meters, only to discover that his antenna system was woefully inadequate for DX work on that band.

On the higher bands, a two or three element yagi-type beam is quite common but for 40 meters they become rather unwieldy and quite expensive.

The antenna to be described here has these attractive features:

1) It will fit into the average size yard.
2) It can be built for about $100.00, including all coax, connectors, etc.
3) It has a gain of 5 db, plus the blessing of vertical polarization, giving an extremely low angle of radiation.

Essentially, the idea is this: Three forty meter, vertical ground planes are arranged in an equilateral triangle, such that each one is a quarter wavelength away from the other two. Coax lines are run from each one to the shack, where a six-position rotary switch electrically rotates the beam in steps of 60°, by means of a phase shifting arrangement. If the lot isn't large enough for 3 you might try two.

Principle Of Operation

A top view of the two verticals is shown in fig. 1. Suppose that we feed both A and B with equal lengths of feedline. To an observer on the left, the signal from A seems to have a one-quarter wavelength "head start" on the signal from B, since it is that much closer. Suppose that we now place an extra quarter wavelength of feedline in the line going to A. This causes the signal from A to be delayed one quarter wavelength, so that to an observer on the left the signals from A and B are in phase, and therefore they add up to produce a stronger signal than either A or B would alone.

To an observer on the right, with the original equal-length feedlines, it seems as if the signal from B has a one-quarter wavelength "head start" on the signal from A. If we now insert the extra quarter wavelength of feedline in the line to A again, this delays the signal from A an additional quarter wavelength, so that to an observer on the right the signals from A and B are now one-half wavelength out of phase, and therefore they cancel each other out. The overall directional pattern with this type of an arrangement turns out to be a cardioid as shown in fig. 2.

In this application, three verticals are used, and each has its own equal length feedline running to the shack. There, a switch selects any two and places the extra quarter wavelength of feedline in series with one of them.

*502 Toepfer Avenue, Madison, Wisconsin

Fig. 1—Top view of two verticals separated by ¼ wavelength.

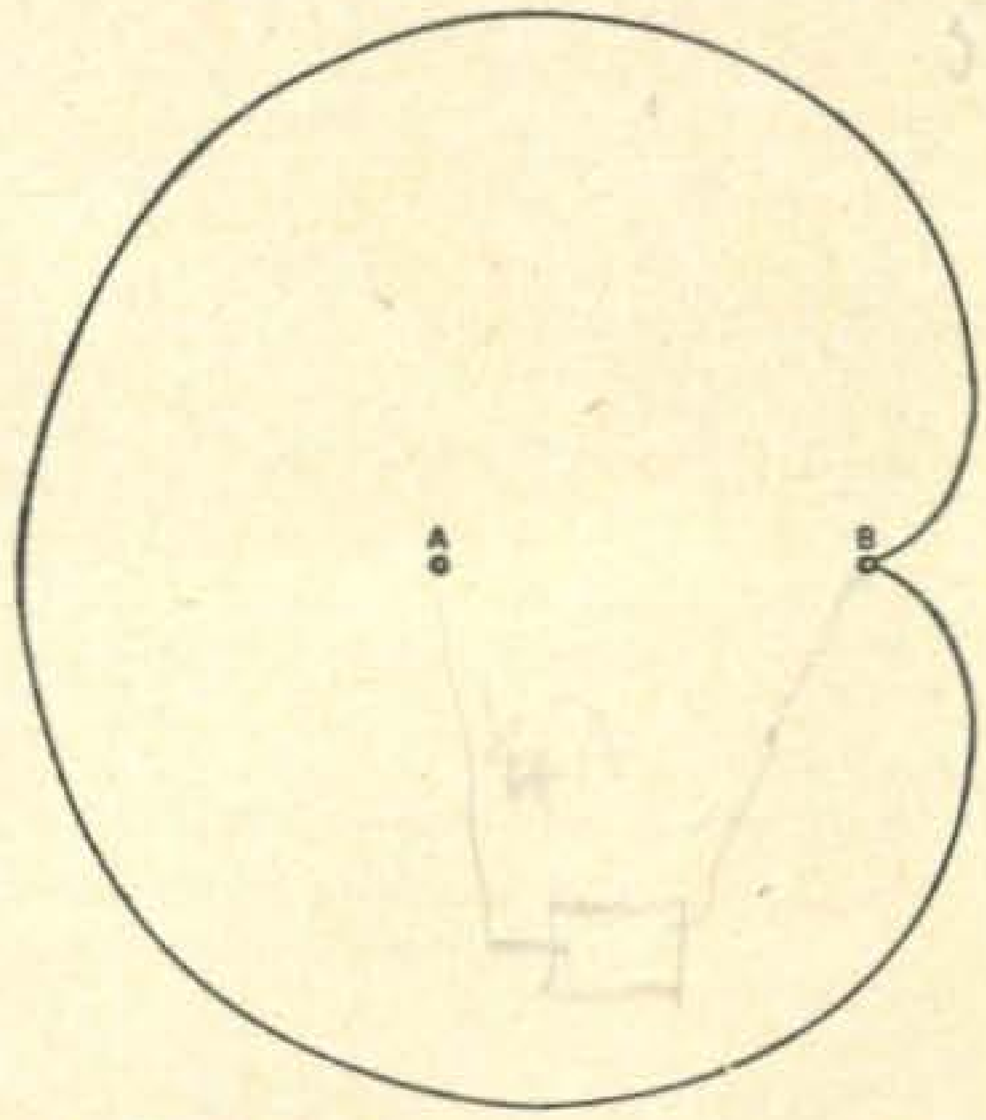


Fig. 2—Cardioid radiation pattern results from the insertion of a ¼ wavelength delay line in series with antenna A.

Switching System

The switching system used is illustrated in fig. 3. The rotary switch, a shorting type, should be housed in a shielded container (large coffee can will also do) and all lines should enter and depart through coax connectors.

The three feed lines to the antennas are of equal length but the 52 ohm line to the switch is fed through 75 ohm matching stubs and an additional ¼ wavelength line for the 90° phasing.

The lengths of the three stubs may be calculated as shown below.

$$\frac{\lambda}{4} = \frac{(246)\ (Veloc.\ Factor)}{Freq.}$$

The velocity factor for regular coax is .66 and .75 for the new polyfoam type.

Matching System

The gamma match method of impedance matching was chosen for two reasons[1]:

[1] Boss, B., "The Gamma-Matched Ground Plane," *QST*, November 1960, page 15.

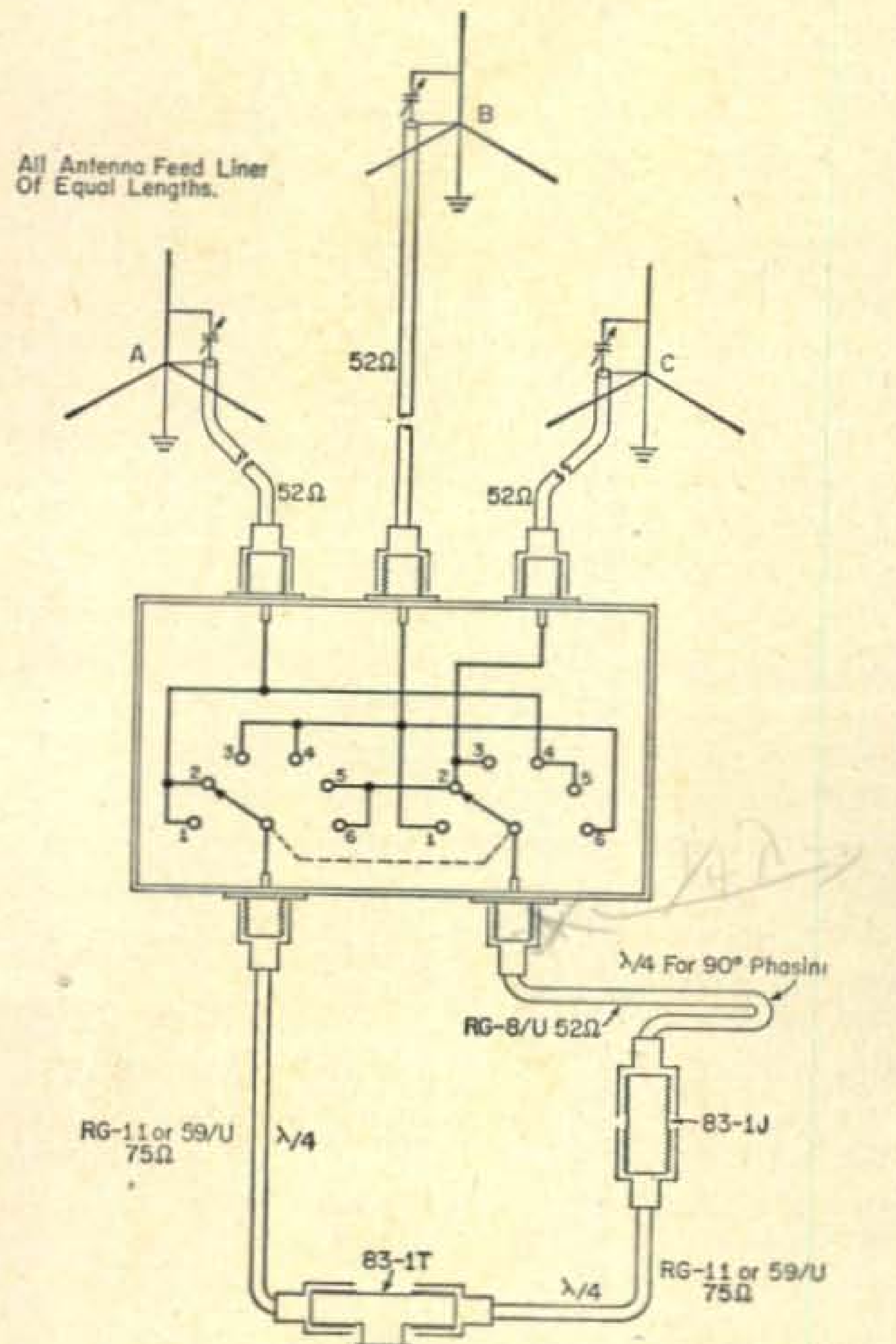


Fig. 3—Pictorial diagram of the antenna switching arrangement. Matching stubs and phasing line lengths may be calculated as explained in the text. The lettered antennas correspond to those in fig. 4. The selector switch may be a Centralab JV-9004 mounted in a 7 × 5 × 3" Minibox.

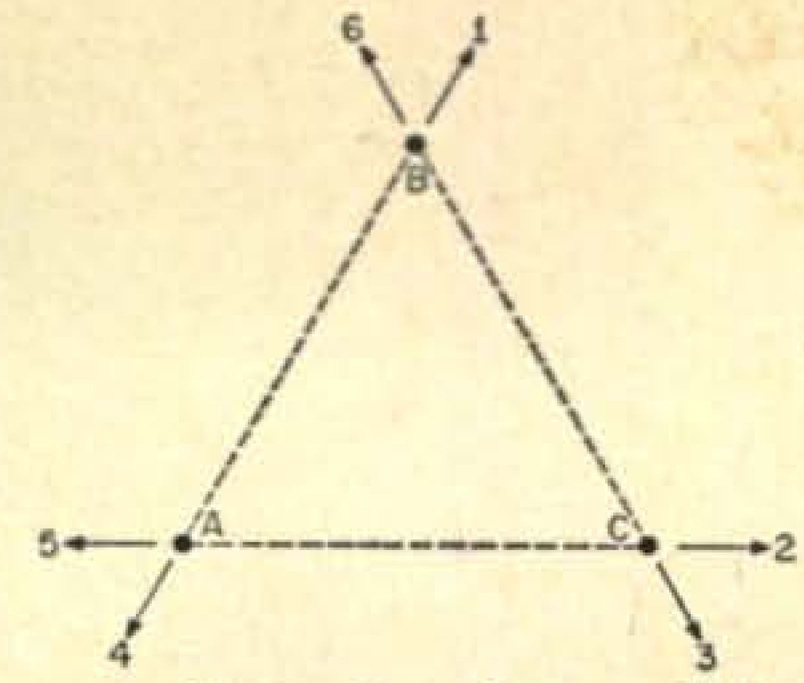


Fig. 4—Diagram illustrating the equilateral triangle configuration made by the three vertical elements of the 40 meter beam. Numbers indicate directions of fire as selected by the rotary switch.

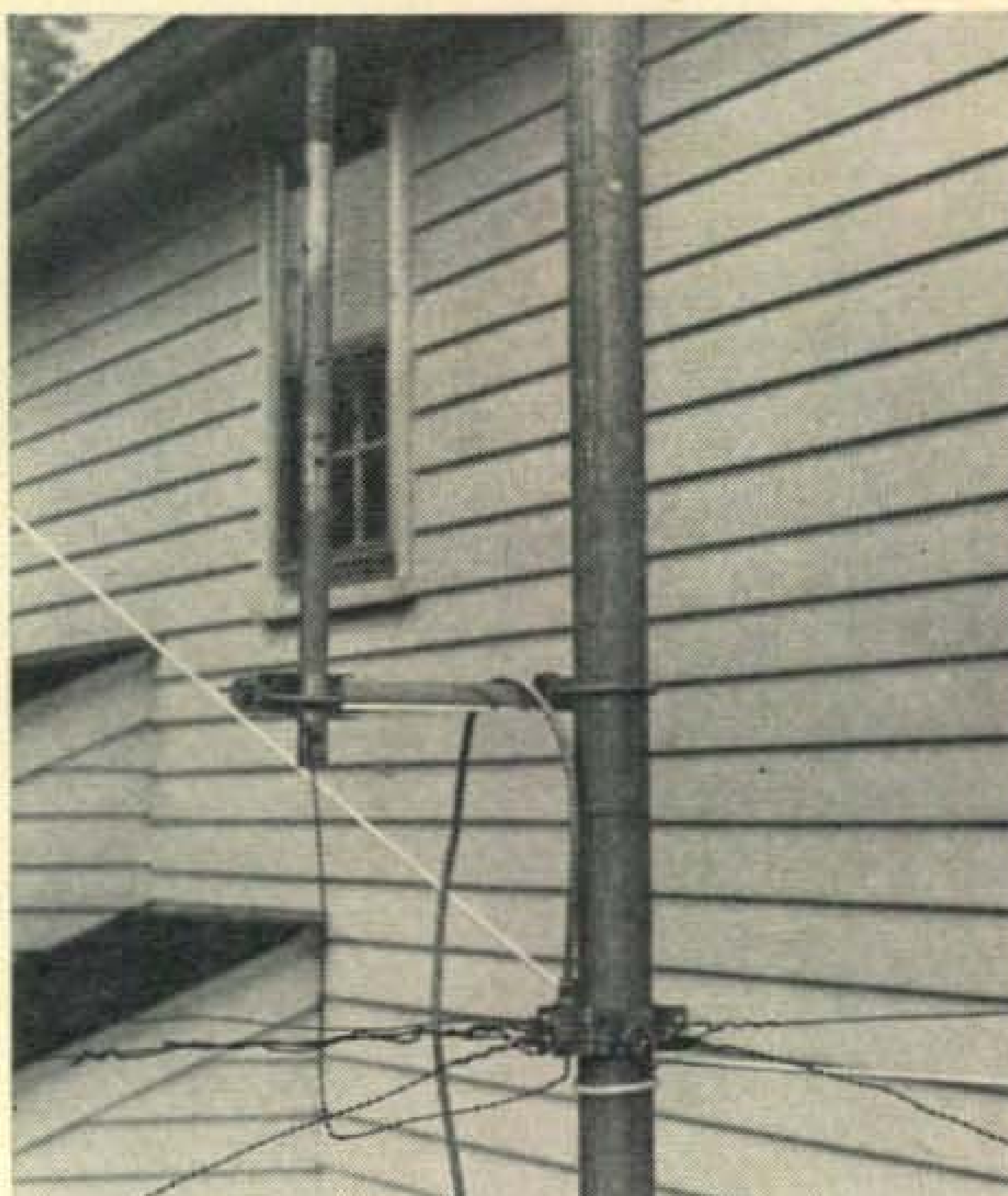
1) Its great versatility permits the use of a wide variety of coaxial lines.

Also, it will handle with ease the impedance variations of the verticals caused by different radial arrangements and by nearby objects, such as trees, houses, etc.

2) It greatly simplifies the mechanical construction of the verticals by eliminating the need for any base insulator.

This method is used as follows: On each tower, at a point one-quarter wavelength down from the top end we connect the radials and the outer conductor of the coax to the tower. This makes that point a voltage minimum point and hence if we were to connect the center conductor here also, the coax would see zero impedance. The top of the tower, however, has become a voltage maximum, and if the center conductor were to be connected there, the coax would then see a very high impedance. What we want is something in the 50-70 ohm range, so we use a movable clamp to fasten the center conductor to the tower somewhere in between the top and the radials.

But consider what we actually have connected to the coax now. We have one big



View of the lower portion of the Gamma match. One side of the SO-239 connector for the feedline is shaped to fit the contour of the mast.

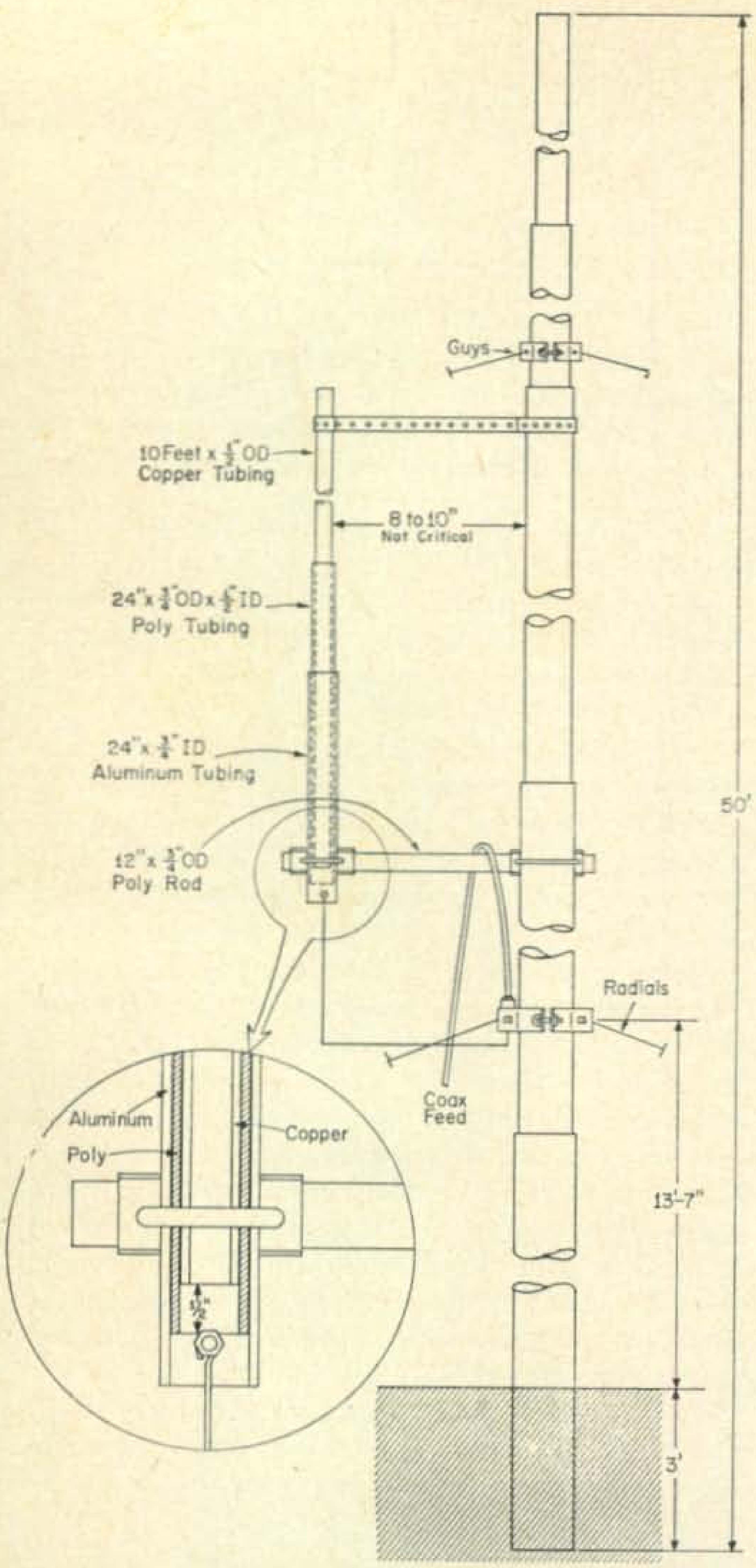


Fig. 5—Construction details of one of the three 40 meter quarter-wave verticals. The top clamp of the Gamma match is made of perforated soft iron ribbon. Note that the Gamma match capacitor insulator is made from two standard 12" lengths of poly tubing.

loop of conductor connected between the inner and outer conductors of the coax. This amounts to quite a large and undesirable inductance, which must be tuned out by using a variable capacitor in the lead running from the center conductor of the coax up to the movable clamp. The capacitor is made up of two concentric telescoping tubes with polystyrene tubing dielectric between them[2]. This type of capacitor is used to obtain long term stability and weatherability. The construction of the gamma match is shown in fig. 5.

Construction

The towers are held up by two sets of guys—the radials at the 14 foot level and by a non-conducting set at the 27 foot level as shown in fig. 5. The latter guys must be non-conducting so that they will not interfere with the radiation properties of the antenna. The radials are fastened to the tower with TV guy connectors, and the upper guys with one of the guy rings furnished with the tower.

Raise the towers one section at a time using only the upper guys, and after all three are secured install the radials and gamma matching sections. When you are laying out your radial system, keep these two things in mind:

1) You are trying to approximate a conducting sheet extending about a quarter wavelength out from each tower, therefore use as many radials as practical.

2) Any currents that flow in the radials will flow either toward or away from the tower, therefore no interconnecting wires between the radials are necessary.

Place a coax connector between one of the bolts of the guy connector and the mast, on each tower. Wrap the ground lead around each radial two or three times, and solder. Fasten the center conductor lead to a bolt through the bottom of the outer tube of the gamma capacitor.

Tuning And Adjustment

Put an s.w.r. bridge in one of the coax lines near the transmitter end. Place the movable clamp about eight feet from the bottom of the gamma rod, and set the capacitor about three-fourths of the way in. With the aid of a helper at the transmitter, adjust the capacitor for minimum s.w.r. (with the power off while adjusting!) and note this result. Then raise the movable clamp a few inches and readjust the capacitor. If the minimum s.w.r. is now lower than before you are moving the clamp in the right direction. If not, the clamp must be moved the other way. Continue on in this fashion, each time adjusting the capacitor for minimum s.w.r. If your measurements indicate that the clamp must go higher than the upper end of the gamma rod, move the entire capacitor assembly higher up the mast and proceed as before.

If no combination of adjustments produces an s.w.r. of less than 1.2 to 1 try raising or lowering the guy anchor a few inches. This will effectively change the length of the antenna. Then repeat the adjustment procedure. Do not be surprised if the position of the clamps on different towers are not the same, since various radial arrangements and nearby objects will affect each tower differently.

After all three are tuned independently, feed them two at a time with the switching arrangement, and again measure the s.w.r. in each of the three lines. It will probably be a few tenths higher than it was before, but a very small adjustment on each one will return the s.w.r. to its previous low value. It should be possible to maintain an s.w.r. of better than 1.2 to 1 over at least 150 kilocycles.

[*Continued on page 106*]

[2] Reynolds, F., "Simple Gamma-Match Construction," *QST*, July 1957, page 30.

Vertical Beam *[from page 54]*

Results

The theoretical gain of this antenna is 5 db over a dipole with the additional advantage of a null in the back to reduce QRM. However, it has a very low angle of radiation which gives it a further advantage over a horizontal dipole for DX work. In fact, comparison tests made between my ninety watts to the beam and a local station running a kilowatt to a dipole, with stations in the favored direction of his dipole, indicate that our signal strengths are about equal at distances greater than 1000 miles. This would indicate that for DX work one could expect a 10 db improvement in signal strength over a horizontal dipole.

On receiving, those "locals" in the 300-700 mile range no longer have such ear-shattering signal strengths, and the QRN from distant electrical storms is noticeably reduced.

Using this beam, I have had no difficulty working WAC on 40 meter c.w., and Australian and New Zealander stations can be worked, at will, in the early morning hours up until about 7:00 A.M. local time. ■

DX *[from page 69]*

DX contest. W4KVX gave a talk along with a photographic tour of the production of his *DX Magazine.* Those of you who do not subscribe to Don's weekly DX bulletin do not know what you are missing. I would suggest that you drop Don a note and ask him for a sample copy.

Last but not least on the DX program was K6BX, Clif Evans, of CHC fame. I am sure Clif will go into more detail of his Dayton observations in his column. The first USA-CA certificates were presented by our infamous Editor at the main banquet. The main speaker at the banquet was WØTSN, former president of ARRL.

The above is only a short outline of the happenings at the Dayton Hamvention. Space as well as discretion does not permit more elaboration of the formal and informal proceedings at the Convention, however, as I have said many times before, if it is at all possible to make it, we will be looking for you next year.

QSLs and QTHs

The following is a quote from a letter from Bill, VE7ZM, thanks to the Western Washington DX Association.

"I am *not* QSL manager for the Soviet boys, but act only as distributor for the cards they send me. So far, *all* cards from the following have been sent to me and have gone out to those who have sent envelopes. (Many are still on hand unclaimed and due to so many errors which only I can get corrected, will remain here until claimed.):

UA3FE/UAØ & UAØKYA (s.s.b. only-Zone 23); UA3AT/UAØ, UAØBP/UAØ, UO5PK, UQ2AN/UG6, UQ2AN/UD6, UH8DA, UG6-KAA (s.s.b.), UA2AO, UM8KAA (s.s.b.).

"I will receive all cards from UA3CR/UA1: UAØKAR (s.s.b. only) and UA3CR/UAØ. A few cards have been received from UAØBP (Zone 18); and UF6FB. If anyone sends an envelope and I do *not* return it at once, it means there is either no card here or a wrong one is here and the only way I can correct it is to apply to Moscow for it and this takes time.

"I am QSL Manager for the following and have logs for all on hand through March 15th, 1962. ZB1A, TA3GI, HP9FC/VQ8, HS2A; VK8OW, KH6EDY (Op. Jim Hunt) and KC6CG."

With the difficulty of obtaining cards from some of the "U" stations, it certainly is a lot of work on Bill's part. A very nice pat on the back was given Bill, VE7ZM and Bill W7PHO by Leo, UA3CR in a fine article concerning s.s.b. in the Soviet Union in a recent issue of the *Sidebander.*

W8MXY was an operator at the XU6GRL in 1946-47 and can assist in QSLs if anyone still requires a card.

SM5AIO is handling the QSLs for the late SM5BUG/9Q5.

The following is from GW2DUR's QSL manager, George KØRDP: "I am now QSL manager for GW2DUR. Two batches of logs have been received from him, including only those specific and recent requests for QSLs. To prevent confusion, I'll repeat that logs I now have from Noel include only those contacts making recent request for a card, in spite of the fact that the contact may have been an old one. The Logs include contacts made as far back as 1948, but (again) only include contacts for which recent requests for cards has been made. I guess I have the point across now.

"Since the logs now on hand include some well over 400 requests, some cooperation would be very much appreciated. If anyone, DX or W/K, VE have worked GW2DUR in the period preceding April 1, 1962, back to 1948, and have made a recent request for a QSL directly to GW2DUR, they are probably on the logs I have. If these stations would kindly send s.a.s.e. it would substantially lighten my work load. If the boys sending in s.a.s.e. are not on my log copies, I'll forward their request to Noel and they will subsequently receive a card. In any case, s.a.s.e. or not, all stations on the logs now on hand will eventually receive a card but help would be appreciated."

73, Urb, W2DEC

QTH and QSL Managers

BY1PK Box 427, Peking, China.
CP5EZ Box 930, Cochabamba, Bolivia.
DU1EH 638 D. Santiago, Sampaloc, Manila, Philippines.
EA8BA via W4MXL
EL5E Larry Hendricks, c/o Assembly of God Mission, Cape Palmas, Liberia.
EL6E via VE4CX
ex-EP2BK Bob Snyder, Box 502, Springfield, Missouri.
FB8YY via F9AH
FK8AX H. Lesuer, B. P. 541, Noumea, New Caledonia.
FW8AS VK/ZL via VK3-AHO others via W4ANE.

[Continued on page 110]