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5-Band Log Periodic Dipole Array

A rotatable log periodic array designed to cover the frequency range from 13 to 30 MHz is pictured in **Fig 19**. This is a large array having a free-space gain that varies from 6.6 to over 6.9 dBi, depending upon the operating portion of the design spectrum. This antenna system was originally described by Peter D. Rhodes, WA4JVE, in Nov 1973 *QST*. A measured radiation pattern for the array appears in **Fig 20**.

The characteristics of this array are:

1) Half-power beamwidth, 43° (14 MHz)
2) Design parameter $\tau = 0.9$
3) Relative element spacing constant $\sigma = 0.05$
4) Boom length, L = 26 feet
5) Longest element $\lambda 1$ = 37 feet 10 inches. (A tabulation

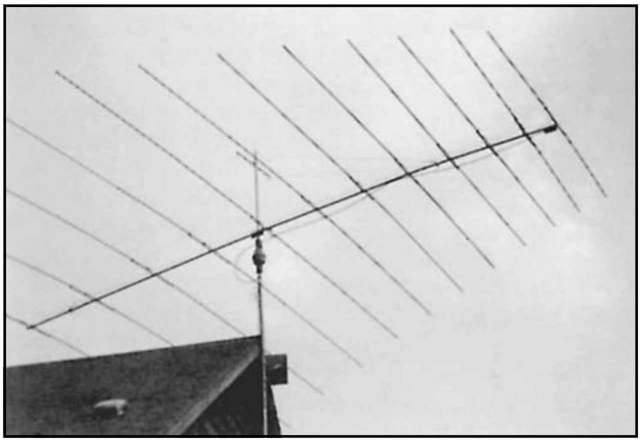

Fig 19—The 13-30 MHz log periodic dipole array.

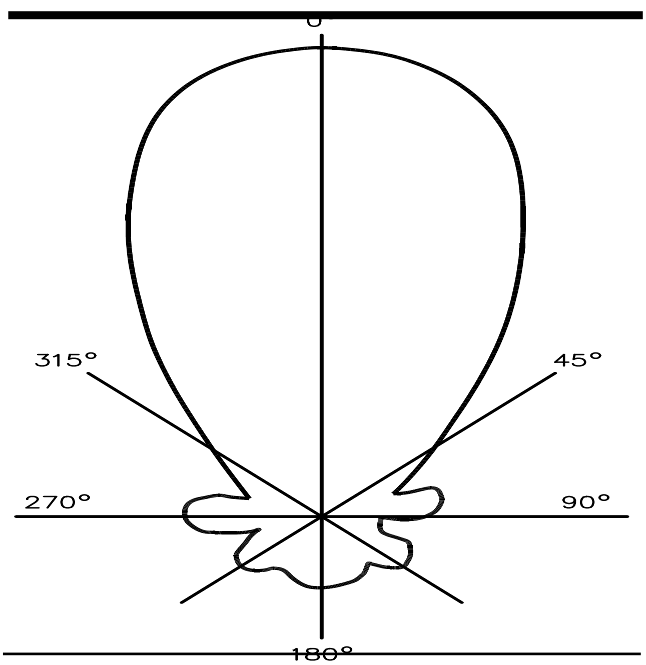

Fig 20—Measured radiation pattern of the 13-30 MHz LPDA. The front-to-back ratio is about 14 dB at 14 MHz and increases to 21 dB at 28 MHz.

Table 3
13-30 MHz LPDA Dimensions, feet

Ele. No.	*Length*	*$d_{n-1,n}$ (spacing)*	*Nearest Resonant*
1	37′ 10.2″	—	
2	34′ 0.7″	3′ 9.4″ = d_{12}	14 MHz
3	30′ 7.9″	3′ 4.9″ = d_{23}	
4	27′ 7.1″	3′ 0.8″ = d_{34}	
5	24′ 10.0″	2′ 9.1″ = d_{45}	18 MHz
6	22′ 4.2″	2′ 5.8″ = d_{56}	21 MHz
7	20′ 1.4″	2′ 2.8″ = d_{67}	
8	18′ 1.2″	2′ 0.1″ = d_{78}	24.9 MHz
9	16′ 3.5″	1′ 9.7″ = d_{89}	28 MHz
10	14′ 7.9″	1′ 7.5″ = $d_{9,10}$	
11	13′ 2.4″	1′ 5.6″ = $d_{10,11}$	
12	11′ 10.5″	1′ 3.8″ = $d_{11,12}$	

Table 4
Materials list: 13-30 MHz LPDA

Material Description	*Quantity*
1) Aluminum tubing—0.047″ wall thickness	
1″—12′ or 6′ lengths	126 lineal feet
7/8″—12′ lengths	96 lineal feet
7/8″—6′ or 12′ lengths	66 lineal feet
3/4″—8′ lengths	16 lineal feet
2) Stainless-steel hose clamps—2″ max	48 ea
3) Stainless-steel hose clamps—1 1/4″ max	26 ea
4) TV type U bolts	14 ea
5) U bolts, galv. type	
5/16″ × 1 1/2″	4 ea
1/4″ × 1″	2 ea
6) 1″ ID polyethylene water-service pipe 160 lb/in.^{2} test, approx. 1 1/4″ OD	20 lineal feet
A) 1 1/4″ × 1 1/4 × 1/8″ aluminum Angle—6' lengths	30 lineal feet
B) 1″ × 1/4″ aluminum bar—6′ lengths	12 lineal feet
7) 1 1/4″ top rail of chain-link fence	26 lineal feet
8) 1:1 toroid balun	1 ea
9) 6-32 × 1″ stainless steel screws	24 ea
6-32 stainless steel nuts	48 ea
#6 solder lugs	24 ea
10) #12 copper feeder wire	60 lineal feet
11A) 12″ × 8″ × 1/4″ aluminum plate	1 ea
B) 6″ × 4″ × 1/4″ aluminum plate	1 ea
12A) 3/4″ galv. Pipe	3 lineal feet
B) 1″ galv. pipe-mast	5 lineal feet
13) Galv. guy wire	50 lineal feet
14) 1/4″ × 2″ turnbuckles	4 ea
15) 1/4″ × 1 1/2″ eye bolts	2 ea
16) TV guy clamps and eye bolts	2 ea

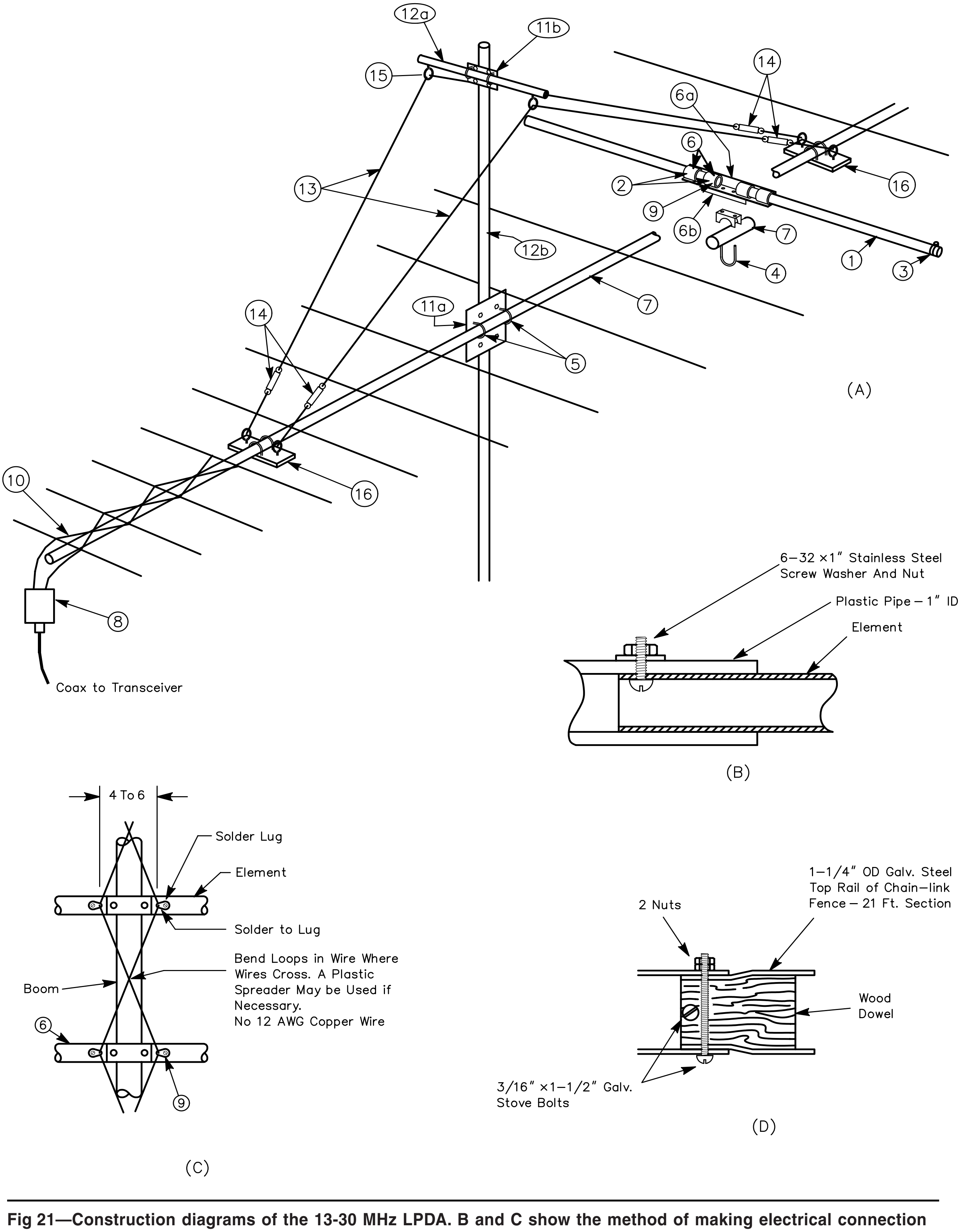

Fig 21—Construction diagrams of the 13-30 MHz LPDA. B and C show the method of making electrical connection between the phase-line and each half-element. D shows how the boom sections are joined.

Table 5
Element Material Requirements: 13-30 MHz LPDA

Ele. No.	*1″ Tubing Len.*	*Qty*	*7/8″ Tubing Len.*	*Qty*	*3/4″ Tubing Len.*	*Qty*	*1 1/4″ Angle Len.*	*1″ Bar Len.*
1	6′	2	6′	2	8′	2	3′	1′
2	6′	2	12′	2	—	—	3′	1′
3	6′	2	12′	2	—	—	3′	1′
4	6′	2	8.5′	2	—	—	3′	1′
5	6′	2	7′	2	—	—	3′	1′
6	6′	2	6′	2	—	—	3′	1′
7	6′	2	5′	2	—	—	2′	1′
8	6′	2	3.5′	2	—	—	2′	1′
9	6′	2	2.5′	2	—	—	2′	1′
10	3′	2	5′	2	—	—	2′	1′
11	3′	2	4′	2	—	—	2′	1′
12	3′	2	4′	2	—	—	2′	1′

of element lengths and spacings appears in **Table 3**.)
6) Total weight, 116 pounds
7) Wind-load area, 10.7 square feet
8) Required input impedance (mean resistance), R_0 = 72 Ω, Z_t = 6-inch jumper #18 wire
9) Average characteristic dipole impedance, Z_{AV}: 337.8 Ω
10) Impedance of the feeder, Z_0: 117.1 Ω
11) Feeder: #12 wire, close spaced
12) With a 1:1 toroid balun at the input terminals and a 72-Ω coax feed line, the maximum SWR is 1.4:1.

The mechanical assembly uses materials readily available from most local hardware stores or aluminum supply houses. The materials needed are given in **Table 4**. In the construction diagram, **Fig 21**, the materials are referenced by their respective material list numbers. The photograph shows the overall construction, and the drawings show the details. **Table 5** gives the required tubing lengths to construct the elements.

Experimenters may wish to improve the performance of the array at both the upper and lower frequency ends of the design spectrum so that it more closely approaches the performance in the middle of the design frequency range. The most apt general technique for raising both the gain and the front-to-back ratio at the frequency extremes would be to circularize τ as described earlier in this chapter. However, other techniques may also be applied.

The following material was extracted from earlier editions. Figure and Equation sequence references are those from the 21st edition of *The ARRL Antenna Book*

The Telerana

The Telerana (Spanish for *spider web*) is a rotatable log periodic antenna that is lightweight, easy to construct and relatively inexpensive to build. Designed to cover 12.1 to 30 MHz, it was co-designed by George Smith, W4AEO, and Ansyl Eckols, YV5DLT, and first described by Eckols in *QST* for Jul 1981. Some of the design parameters are as follow.
1) τ = 0.9
2) σ = 0.05
3) Gain = 4.5 to 5.5 dBi (free-space) depending upon frequency
4) Feed arrangement: 400-Ω feeder line with 4:1 balun, fed with 52-Ω coax. The SWR is 1.5:1 or less in all amateur bands.

The array consists of 13 dipole elements, properly spaced and transposed, along an open wire feeder having an impedance of approximately 400 Ω. See **Figs 22** and **23**. The array is fed at the forward (smallest) end with a 4:1 balun and RG-8 cable placed inside the front arm and leading to the transmitter. An alternative feed method is to use open wire or ordinary TV ribbon and a tuner, eliminating the balun.

The frame that supports the array (**Fig 24**) consists of four 15-foot fiberglass vaulting poles slipped over short nipples at the hub, appearing like wheel spokes (**Fig 25**). Instead of being mounted directly into the fiberglass, the hub mounts into short metal tubing sleeves that are inserted into the ends of each arm to prevent crushing and splitting the fiberglass. The necessary holes are drilled to receive the wires and nylon.

A shopping list is provided in **Table 6**. The center hub is made from a 1 1/4-inch galvanized four-outlet cross or X and four 8-inch nipples (Fig 25). A 1-inch diameter X may be used alternatively, depending on the diameter of the fiberglass. A hole is drilled in the bottom of the hub to allow the cable to be passed through after welding the hub to the rotator mounting stub.

All four arms of the array must be 15 feet long. They should be strong and springy to maintain the tautness of the array. If vaulting poles are used, try to obtain all of them with identical strength ratings.

The forward spreader should be approximately 14.8 feet long. It can be much lighter than the four main arms, but must be strong enough to keep the lines rigid.

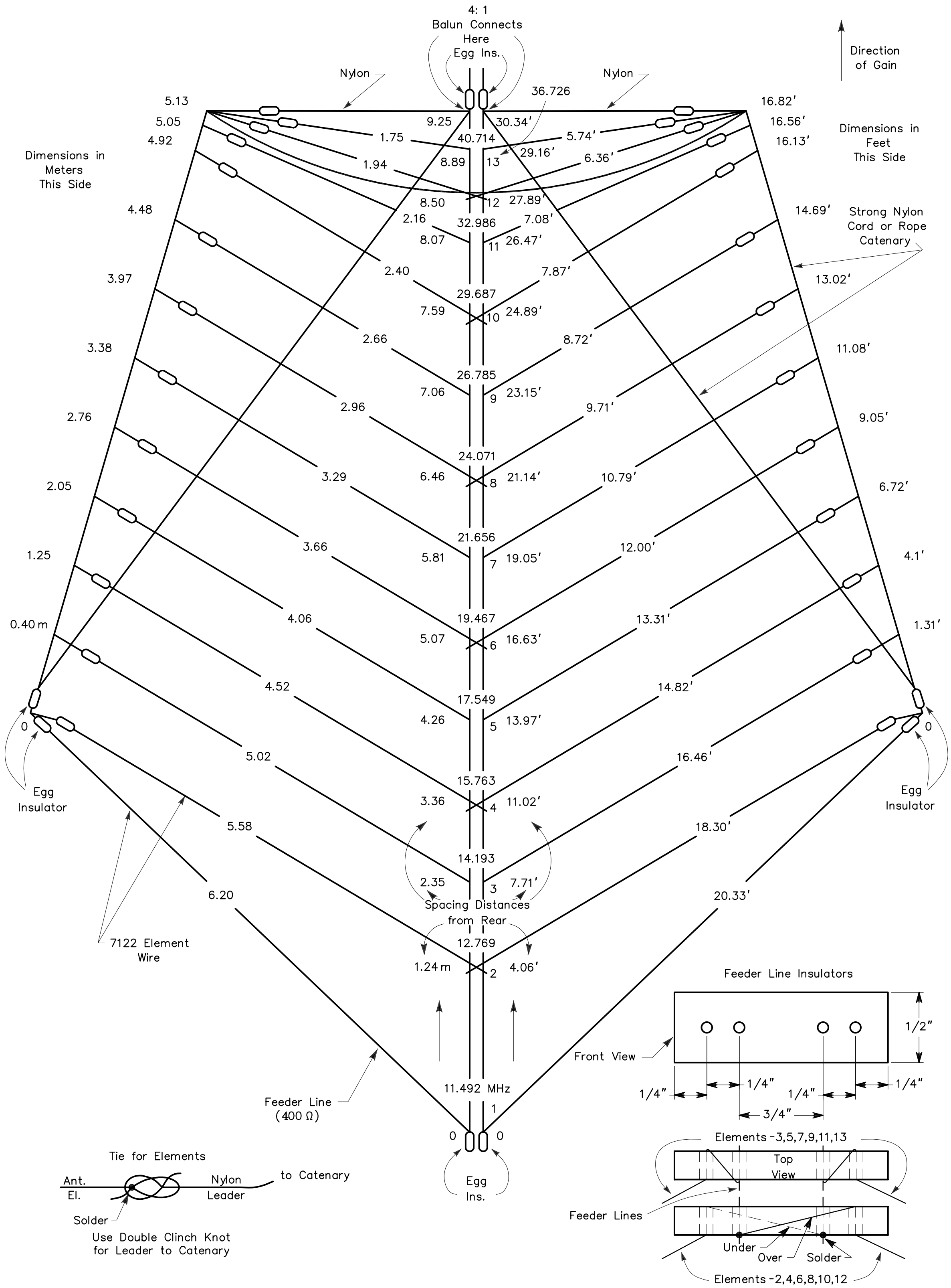

Fig 22—The overall configuration of the spider web antenna. Nylon monofilament line is used from the ends of the elements to the nylon cords. Use nylon line to tie every point where lines cross. The forward fiberglass feeder lies on the feeder line and is tied to it. Both metric and English measurements are shown, except for the illustration of the feed-line insulator. Use soft-drawn copper or stranded wire for elements 2 through 12. Element 1 should use 7/22 flexible wire or #14 AWG Copperweld.

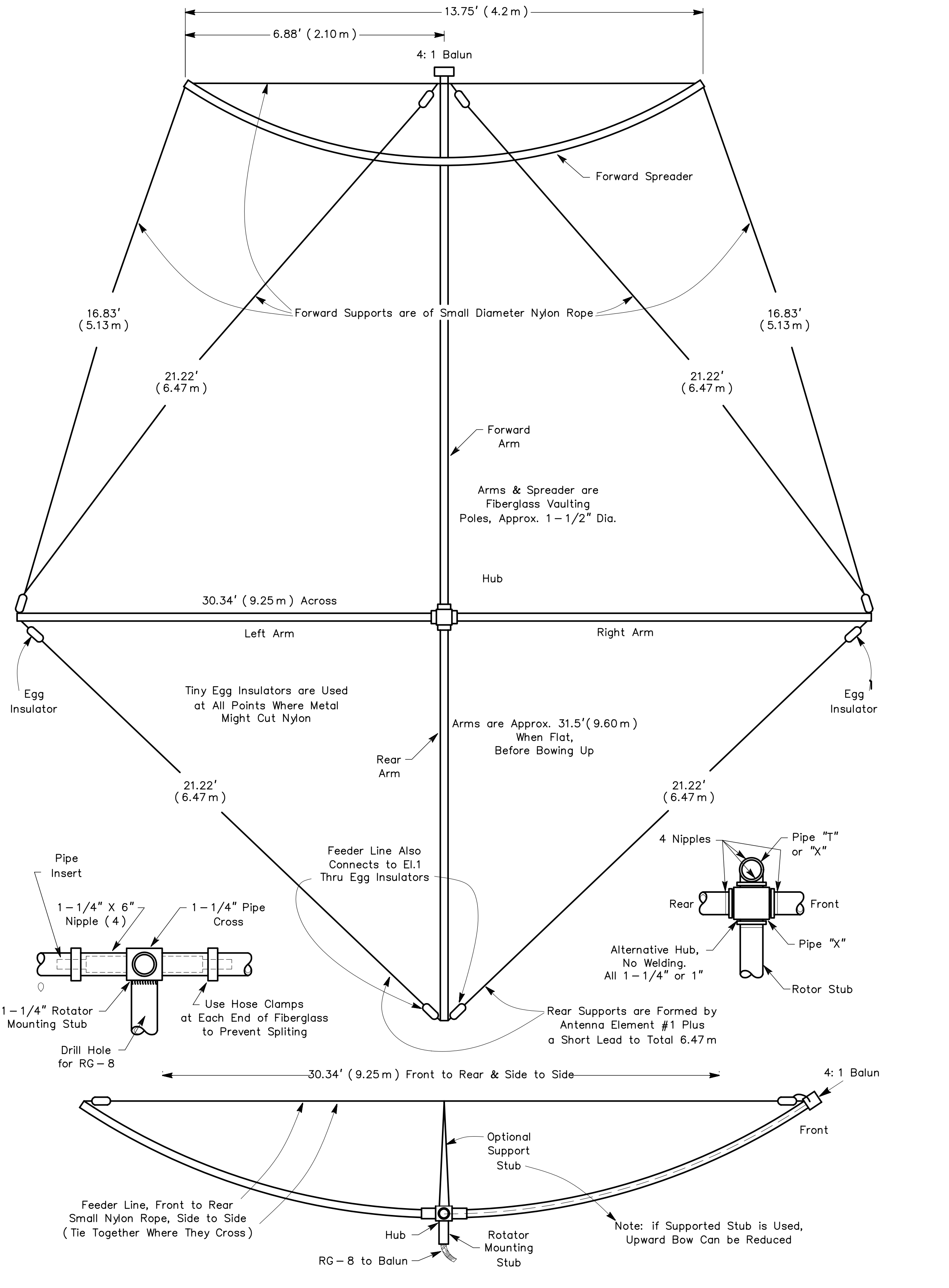

Fig 23—The frame construction of the spider web antenna. Two different hub arrangements are illustrated.

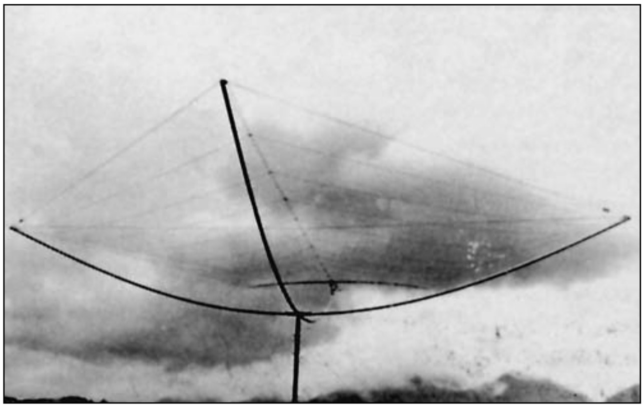

Fig 24—Although the spider web antenna resembles a rotatable clothes line, it is much larger, as indicated by Figs 22 and 23. However, the antenna can be lifted by hand.

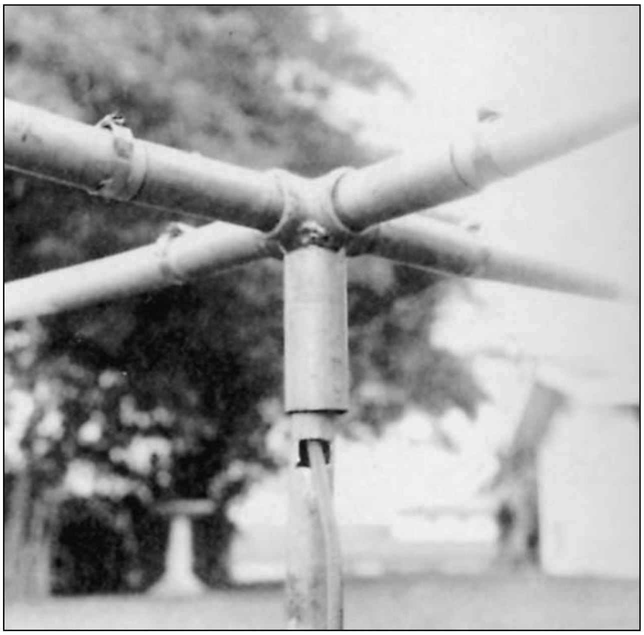

Fig 25—The simple arrangement of the spider web antenna hub. See Fig 23 and the text for details.

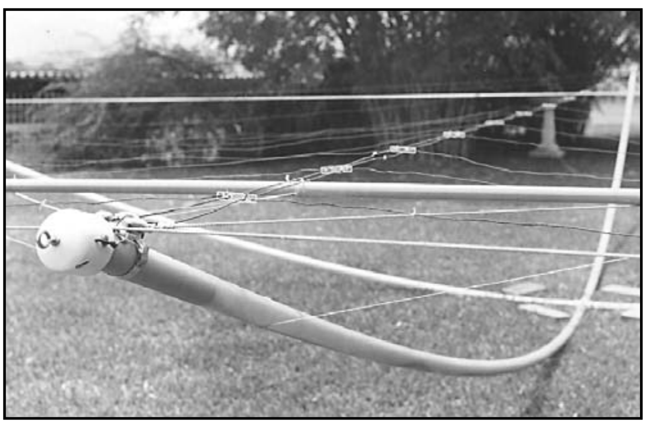

Fig 26—The elements, balun, transmission line and main bow of the spider web antenna.

Table 6
Shopping List for the Telerana

1—1 1/4-inch galvanized, 4-outlet cross or X.
4—8-inch nipples.
4—15-foot long arms. Vaulting poles suggested. These must be strong and all of the same strength (150 lb) or better.
1—Spreader, 14.8 foot long (must not be metal).
1—4:1 balun unless open-wire or TV cable is used.
12—Feed-line insulators made from Plexiglas or fiberglass.
36—Small egg insulators.
328 feet copper wire for elements; flexible 7/22 is suggested.
65.6 feet (20 m) #14 Copperweld wire for interelement feed line.
164 feet (50 m) strong 1/8-inch dia cord.
1—Roll of nylon monofilament fishing line, 50 lb test or better.
4—Metal tubing inserts go into the ends of the fiberglass arms.
2—Fiberglass fishing-rod blanks.
4—Hose clamps.

If tapered, the spreader should have the same measurements from the center to each end. *Do not use metal for this spreader*.

Building the frame for the array is the first construction step. Once the frame is prepared, then everything else can be built onto it. Begin by assembling the hub and the four arms, letting them lie flat on the ground with the rotator stub inserted in a hole in the ground. The tip-to-tip length should be about 31.5 feet each way. A hose clamp is used at each end of the arms to prevent splitting. Place the metal inserts in the outer ends of the arms, with 1 inch protruding. The mounting holes should have been drilled at this point. If the egg insulators and nylon cords are mounted to these tube inserts, the whole antenna can be disassembled simply by bending up the arms and pulling out the inserts with everything still attached.

Choose the arm to be at the front end. Mount two egg insulators at the front and rear to accommodate the inter-element feeder. These insulators should be as close as possible to the ends.

At each end of the cross-arm on top, install a small pulley and string nylon cord across and back. Tighten the cord until the upward bow reaches 3 feet above the hub. All cords will require retightening after the first few days because of stretching. The cross-arm can be laid on its side while preparing the feeder line. For the front-to-rear bowstring it is important to use a wire that will not stretch, such as #14 Copperweld. This bowstring is actually the inter-element transmission line. See **Fig 26**.

Secure the rear ends of the feeder to the two rear insulators, soldering the wrap. Before securing the fronts, slip the 12 insulators onto the two feed lines. A rope can be used temporarily to form the bow and to aid in mounting the feeder line. The end-to-end length of the feeder

Improving the Telerana

In *The ARRL Antenna Compendium, Vol 4*, Markus Hansen, VE7CA, described how he modified the Telerana to improve the front-to-back ratio on 20 and 15 meters. In addition, he added a trapped 30/40-meter dipole that functions as a top truss system to stabilize the modified Telerana in strong uprising winds that otherwise could turn the antenna into an "inside-out umbrella."

Fig A shows the layout for the modified Telerana, and Table A lists the lengths and spacings for the #14 wire elements. Note that VE7CA used tuning stubs to tweak the 15 and 20-meter reflector wires for best rearward pattern. The construction techniques used by VE7CA are the same as for the original Telerana. Fig B shows a side view of the additional 40/30-meter-dipole truss sytem.

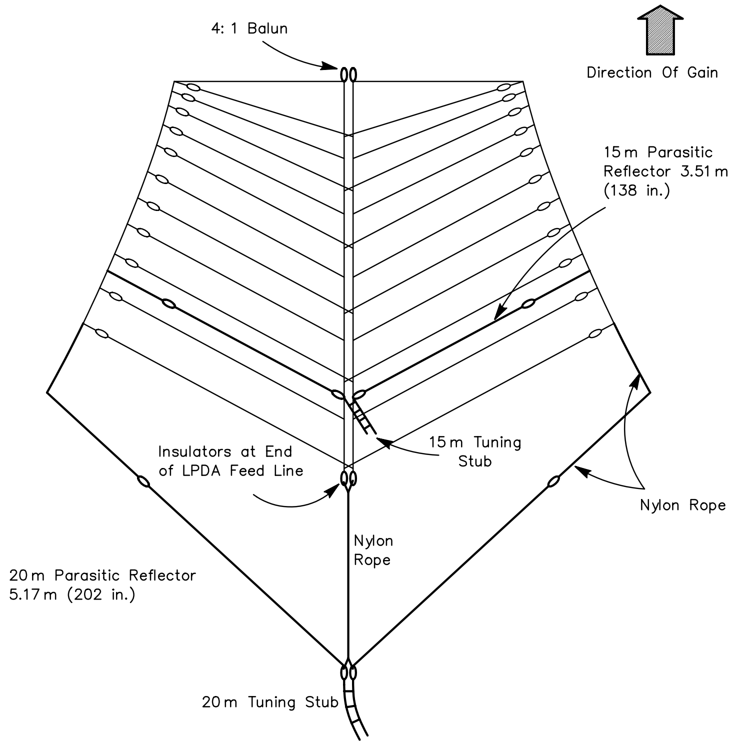

Fig A—Physical layout of modified Telerana with 20 and 15-meter reflectors added (in place of first two elements in original Telerana). Note the tuning stubs for the added reflectors.

Table A
Element Lengths and Spacings, in Inches

Element Number	*1/2 Element Length (inches)*	*Total Distance (inches)*
R1	202.0	0.0
L1	210.1	102.0
L2	191.2	140.7
R2	138.0	158.3
L3	174.0	175.9
L4	158.3	207.9
L5	144.1	237.0
L6	131.1	261.5
L7	119.3	285.6
L8	108.6	307.6
L9	98.8	327.6
L10	89.9	345.8
L11	82.4	364.5

Note: the reflector lengths do not include the length of the tuning stubs.

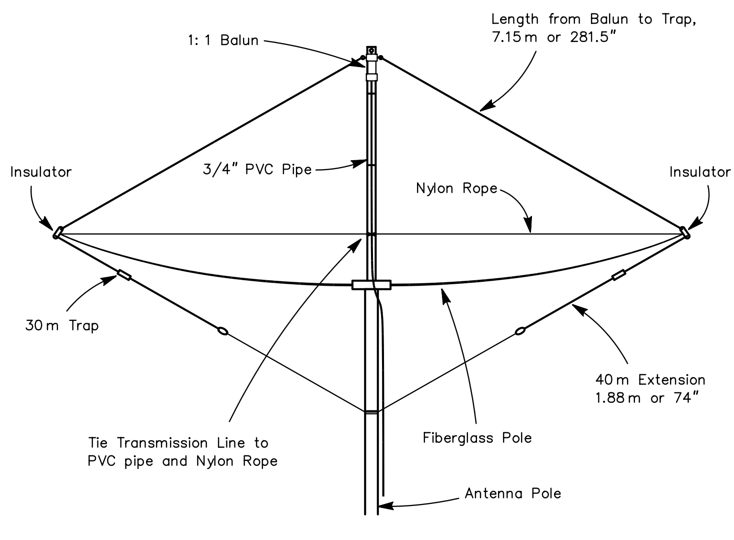

Fig B—Side view of 30/40-meter addition to the modified Telerana, using 3/4-inch PVC pipe as a vertical stabilizer and support for the 30/40-meter trapped dipole.

should be 30.24 feet.

Now lift both bows to their upright position and tie the feeder line and the cross-arm bowstring together where they cross, directly over and approximately 3 feet above the hub.

The next step is to install the number 1 rear element from the rear egg insulators to the right and left cross-arms using other egg insulators to provide the proper element length. Be sure to solder the element halves to the transmission line. Complete this portion of the construction by installing the nylon cord catenaries from the front arm to the cross-arm tips. Use egg insulators where needed to prevent cutting the nylon cords.

When preparing the fiberglass forward spreader, keep in mind that it should be 14.75 feet long before bowing and is approximately 13.75 feet across when bowed. Secure the center of the bowstring to the end of the front arm. Lay the spreader on top of the feed line, then tie the feeder to the spreader with nylon fish line. String the catenary from the spreader tips to the cross-arm tips.

At this point of assembly, prepare antenna elements 2 through 13. There will be two segments for each element. At the outer tip make a small loop and solder the wrap. The loop will be for the nylon leader. Measure the length plus 0.4 inch for wrapping and soldering the element segment to the feeder. Seven-strand #22 antenna wire is suggested for the element wires. Slide the feed-line insulators to their proper position and secure them temporarily.

The drawings show the necessary transposition scheme. Each element half of elements 1, 3, 5, 7, 9, 11 and 13 is connected to its own side of the feeder, while elements 2, 4, 6, 8, 10 and 12 cross over to the opposite side of the transmission line.

There are four holes in each of the transmission-line insulators (see Fig 22). The inner holes are for the transmission line, and the outer ones are for the elements. Since the array elements are slanted forward, they should pass through the insulator from front to back, then back over the insulator to the front side and be soldered to the transmission line. The small drawings of Fig 22 show the details of the element transpositions.

Everywhere that lines cross, tie them together with nylon line, including all copper-nylon and nylon-nylon junctions. Careful tying makes the array much more rigid. However, all elements should be mounted loosely before you try to align the whole thing. Tightening any line or element affects all the others. There will be plenty of walking back and forth before the array is aligned properly. Expect the array to be firm but not extremely taut.