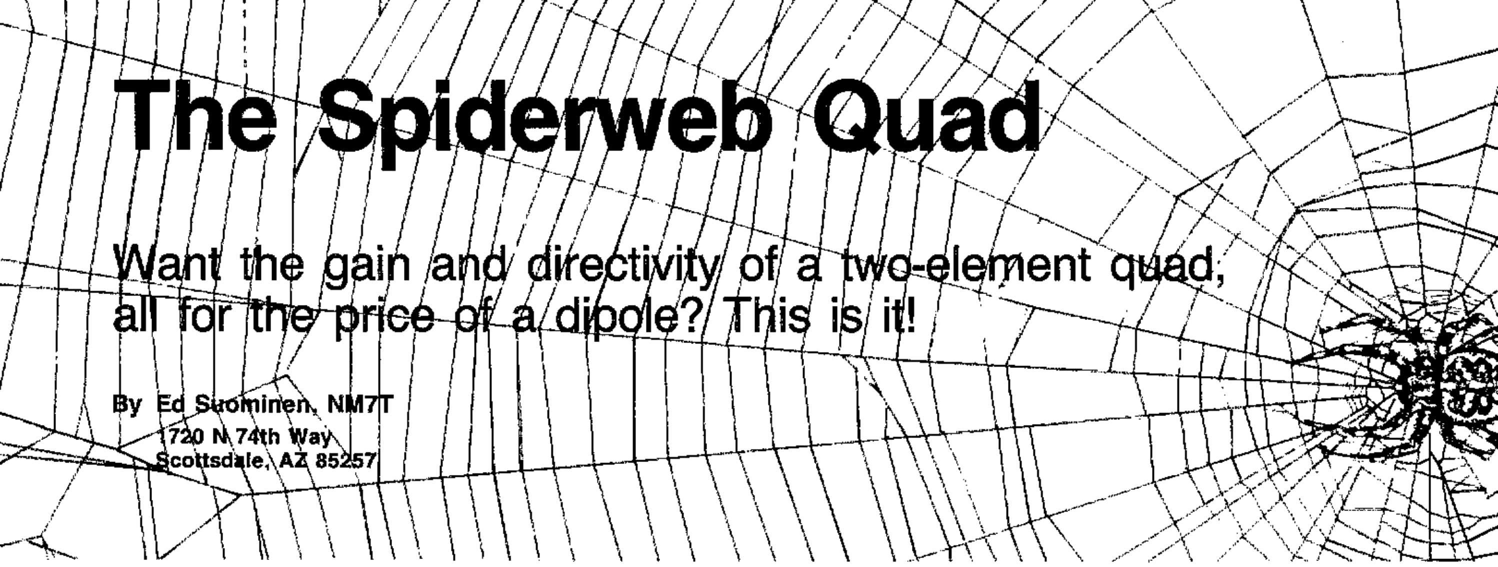

The Spiderweb Quad

Want the gain and directivity of a two-element quad, all for the price of a dipole? This is it!

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A few months ago, I became fascinated with the world "down under": New Zealand, Australia and the South Pacific. I wanted to contact hams living there, and learn about that part of the world. I was frustrated, though, listening through QRN and QRM for their signals on my inverted V at 35 feet. I needed a beam to cut through the mess on 20 meters, but my tiny bank account put the traditional aluminum "skyhook" out of my reach.

Looking at a great-circle map of the world centered on the western US, I saw that a fixed beam would easily cover the areas that I wanted to work. A decent front-to-back ratio and low-angle radiation pattern would cut out most of my noise and stateside QRM, bringing the elusive Pacific DX out of the mud.

I needed a good DX antenna that I could throw together out of wire and rope, and hang between two available supports in a fixed direction. I needed gain and a good directive pattern, but I didn't want the headaches of tuning a tricky gamma or T-match. Most importantly, I couldn't spend much money. After visions of all sorts of strange antenna designs floated through my head, I settled on the idea of a fixed, two-element quad.

The Spiderweb Quad Design

The Spiderweb Quad (shown in Fig 1) is made up of two full-wavelength rectangular loops suspended between two supports. The top corners of the loops hang from a pair of insulating spreaders that keep the elements spaced correctly with respect to each other. The loops are held tight at the bottom corners by small ropes leading to ground stakes. The entire antenna, wire elements, supporting ropes and lines, is an easily built version of a widely respected DX antenna.

A properly tuned two-element quad gives excellent gain and directivity, and a single-band version is easier to build and tune than a Yagi. The quad works well across a wide bandwidth, and has an impedance very close to 50 Ω; no matching network is required.

The two supports available to hold up my creation are a pair of two-by-fours nailed to my roof, and a galvanized pipe. Since this limited the height of the top edge of the loops to 20 feet, I decided to make the antenna vertically polarized. If the antenna was horizontally polarized, the current nodes would be on the top and

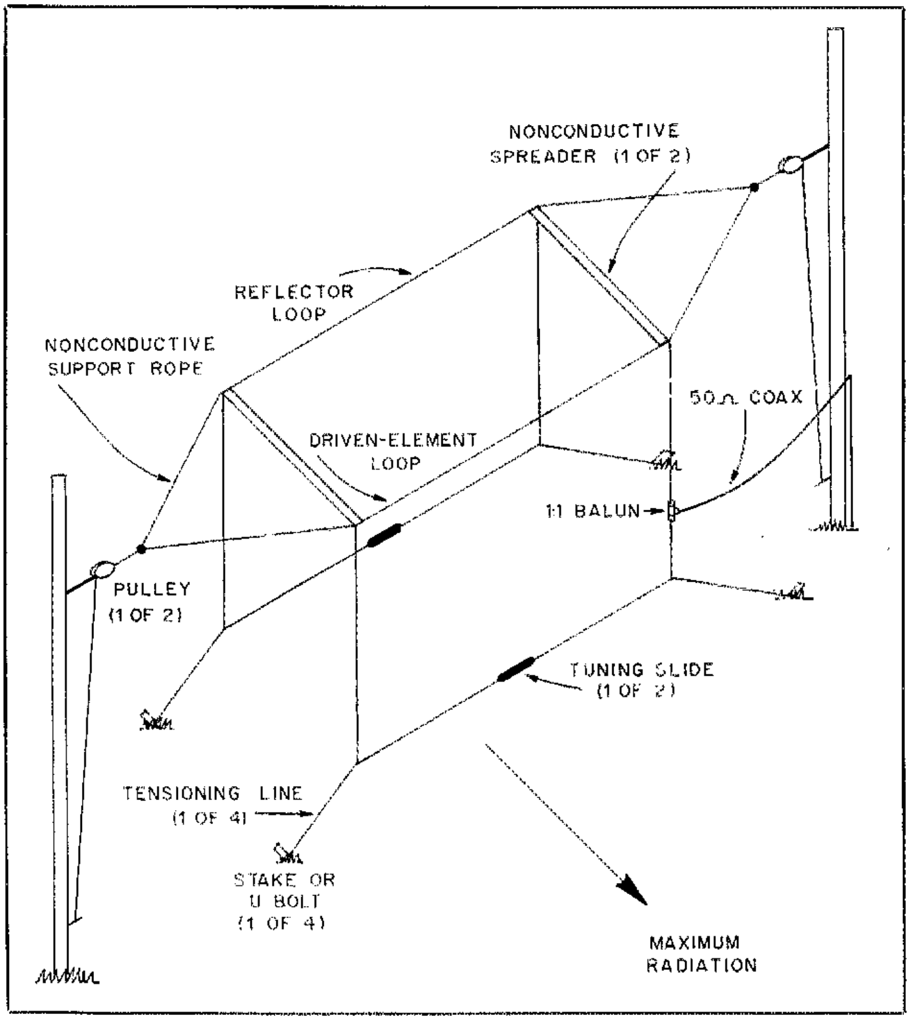

Fig 1—Pictorial diagram of the Spiderweb Quad. The spreaders can be any lightweight, insulating material—bamboo or fiberglass are best. The driven element can be tuned for resonance by adjusting the overlap at the bottom center of the loop. The overlap at the bottom of the reflector can be tuned for best front-to-back ratio or forward gain.

bottom sides of the loops, and most of my RF would go to heating up weeds. The vertical legs of a vertically polarized quad do the radiating (radiation from the horizontal legs is mostly canceled). Vertical elements radiate well at low angles even when they're close to the ground. See Figs 2 and 3.[1]

The Spiderweb Quad elements are rectangular because the low height of the supports leaves little space for the vertical sides of the loops. I wanted the bottom sides to hang at least 4 feet off the ground, but couldn't get the top sides higher than about 17 feet because of the unavoidable droop in the supporting ropes. This left me with only 13 feet for each vertical side of the loops—quite a bit less than a quarter of the total loop length for 14 MHz. Flattening the loops any farther than this wouldn't help the antenna's performance, but this shape is necessary from a constructional standpoint.

Building the Spiderweb Quad

I wasn't terribly excited about the idea of wrestling with 60-foot coils of springy Copperweld, and I wanted a conductor that was strong, light and stiff. I bought 150 feet of bare no. 14 copper wire at a local hardware store, and I cut it into two lengths for the driven element and reflector. Because I can easily tune the elements from ground level after putting up the antenna, I didn't concern myself with exact loop lengths. A few inches of extra loop length could be removed later.

The ends of both loops are connected at the midpoints of the bottom legs for easy tuning. The driven element is fed at the midpoint of one vertical side with 50-Ω coaxial cable and a 1:1 balun. The distance from the connection point of the loop to the feed point is a quarter of the total loop length. Once the loops were formed, I measured the four sides and bent the corners sharply at the guy line attachment points. Although the left, right, and bottom-side lengths aren't critical, the length of the top of the reflector and driven element loops must be the same. That's because these two lengths support the elements from between the spreaders, and a difference between them would make the antenna lopsided.

Supporting a single-loop antenna is a simple matter of hanging the loop from its top corners. Because the Spiderweb Quad has two elements, and because there are only two available supports, a spreader system is needed to lead the top corners of each side to a single rope. To do this, I used two pieces of 1- × 1-inch wood molding as insulating spreaders, and two lengths of lightweight rope, as shown in Fig 4.

The spreaders should be made of material that is light, stiff and a good electrical insulator. Although the wood molding does the job for me, there are quite a few materials that would do much better. If the pole is long enough to separate the elements by 0.15 λ, and is light and strong enough not to bend or break, it will work. My wood spreaders bend into fascinating shapes after a good rain, so I don't recommend using molding. Fiberglass or bamboo are better choices for spreaders.

Once the spreaders were hanging nicely from their ends, I began attaching the loops to the top corners of the spreaders. I wound the wire at each corner around the ends of the spreaders several times to hold it in place, as shown in Fig 5. I attached the top left corners of both elements to the left spreader, and the right corners to the right spreader. After this was finished, I attached the end of the feed line to the balun, and led the coax horizontally to one of the supports.

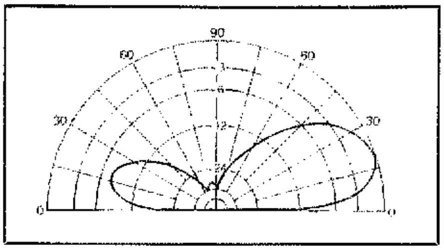

Fig 2—Elevation-plane radiation pattern of the 20-meter Spiderweb Quad shown in Fig 1.

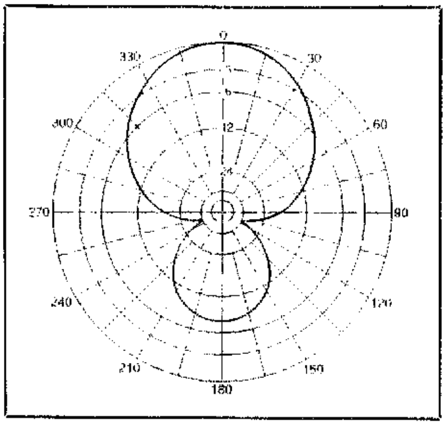

Fig 3—Azimuth-plane radiation pattern of the 20-meter Spiderweb Quad shown in Fig 1.

Table 1

Dimensions for Spiderweb Quads for the 80- through 10-meter Ham Bands

Band (MHz)	*Driven element loop length (ft)*	*Reflector loop length (ft)*	*Loop spacing (ft)*
3.5	283	290	42
3.8	258	264	38
7	143	146	21
10	100	102	15
14	72	73.5	10
21	48	49	7
24	41	42	6
28	36	37	5

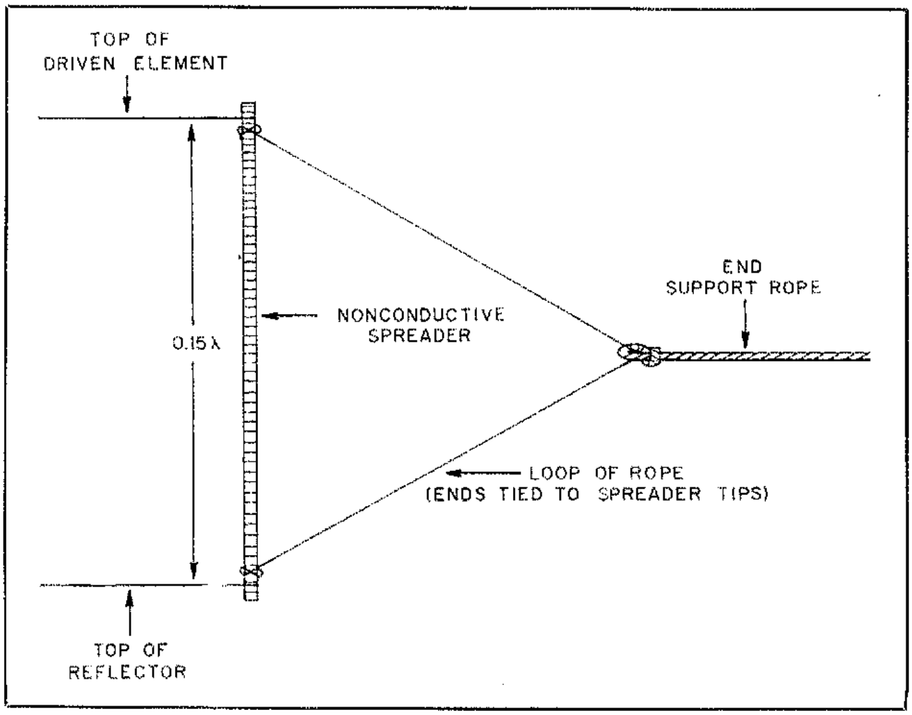

Fig 4—Top view of the spreaders and support ropes used in building the Spiderweb Quad.

[1]The radiation patterns shown in Figs 2 and 3 were produced at ARRL HQ using the MININEC antenna-modeling program (and other software developed at HQ) on an IBM® PC. Ed Suominen's 20-meter version of the Spiderweb Quad (shown in Fig 1) was modeled over average ground (conductivity: 5 mS/m; dielectric constant: 13), but the effects of obstructions (buildings, trees and so on) were not taken into account.

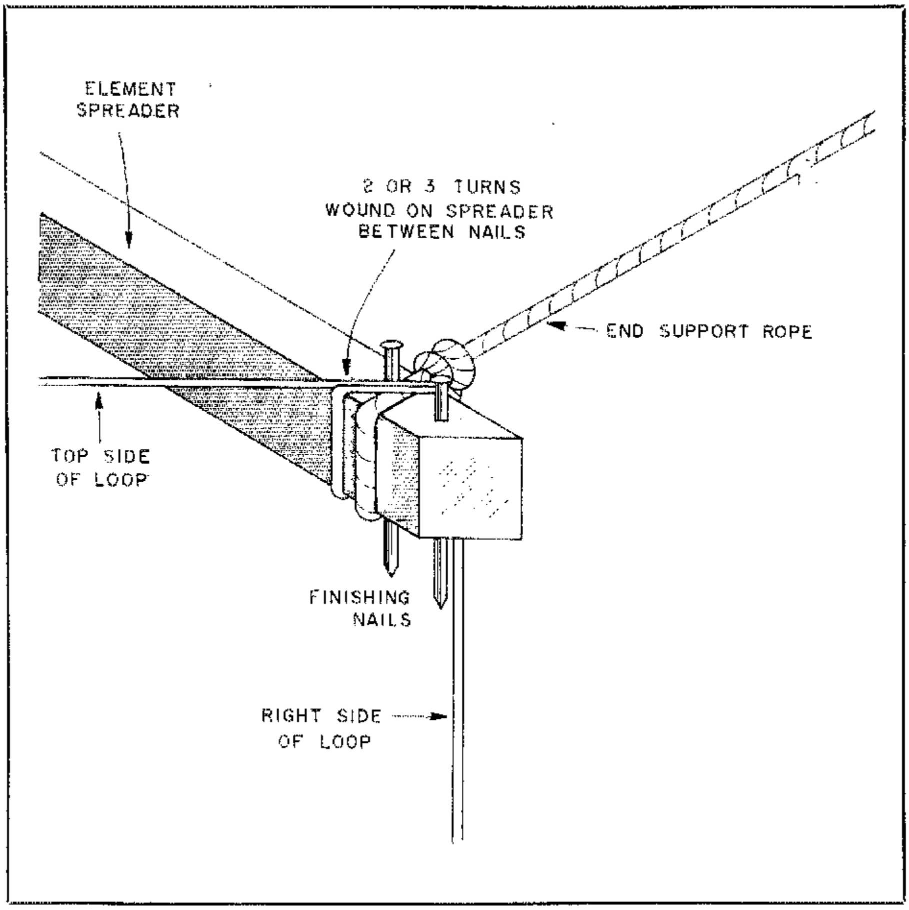

Fig 5—Detail of the spreader tips on the author's version of the Spiderweb Quad. The spreader material used is 1- × 1-inch wood molding (see text). Two finishing nails driven through the molding keep the loops and support ropes positioned correctly on the spreaders.

I used a pulley at each support to raise the antenna. I tied off the rope from one pulley, and raised the antenna with the other. Having two pulleys allowed me to position the antenna exactly where I wanted it between the supports.

Once the antenna is hanging from the spreaders, stake the bottom corners to keep the elements shaped properly. Otherwise, the loops will droop. I ran fishing line at about 45° from the bottom corners of the loops to ground stakes (I used U bolts for the ground stakes).

Summary

After operating with the Spiderweb Quad for a few months, I've found that the antenna does what I had hoped. I hear the accents of stations in Australia, New Zealand, Hawaii and other areas in the South Pacific. The old days of fighting to hear these stations through the Greater Podunk Ragchew net are over. Most signals I don't want to hear are off the main lobe of the antenna, down in the noise. The Spiderweb Quad has worked as well for me as any tribander perched on an expensive tower. DX stations no longer seem to have trouble hearing my puny 100-W signal—they actually come back to my calls and engage in enjoyable QSOs!

Ed Suominen has been a licensed ham since age 14—he earned his Novice ticket in 1983. Ed's Amateur Radio interests include antenna design, satellite operation, VHF and EME communications, digital modes and teaching licensing classes. His first love is low-band CW operation.

A Relative RF Ammeter for Open-Wire Lines

(continued from page 17)

measurements at levels higher than 5 W: Hazardous voltages may be present on the exposed feeder and ammeter wires under such conditions. Even at low power levels, don't apply RF power to the feed line while clamping or unclamping the device. (This prevents RF "bites" *and* reduces the potential for QRM by allowing test transmissions to be shorter.)

But I Want to Calibrate It...

As described so far, the RF ammeter is more of an indicator than a measuring device because it is not calibrated in electrical units. Yes, it *is* possible to calibrate the ammeter, but this usually won't be of much value in practice because open-wire line is often used under conditions of high SWR. (Although you can calculate and measure the impedance of open-wire line, the feeder current varies along the line when the SWR is not 1 to 1. This means that even if you calibrate the device to National Bureau of Standards accuracy, you'd probably end up making relative measurements anyway!)

When a high impedance voltmeter is used as an indicator in the circuit shown in Fig 1A, the ammeter's output voltage drops off linearly with frequency. (I measured this by using a Hewlett-Packard HP 8116A function generator as a signal source and a Fluke 77 digital multimeter as an indicator. The ammeter output voltage varied from 0.65 to 0.39 V over the 1.8- to 30-MHz range.)

Conclusion

This simple RF ammeter can be further refined, of course; its low parts count makes experimentation easy because there are few variables to deal with. Built as described here, though, the ammeter performs well enough to be useful and simply enough to be fun. Besides, if the RF ammeter helps you clear up a case of feeder-imbalance-related interference, you may not have to use split ferrite cores for their intended purpose: eliminating RFI!

Notes

[1]Balanced, open-wire transmission line can be built with two or four wires. Two-wire open line is assumed throughout this article because it is used much more widely by hams than the four-wire type.

[2]Available from Amidon Associates, 12033 Otsego St, N Hollywood, CA 91607, tel 818-760-4429. Palomar Engineers stocks a split core (the FSB-1/4) of the same ID, OD and ferrite material as the Amidon part; the FSB-1/4 appears to differ from the 2X-43-251 only in that it is 1/8 inch shorter than the Amidon core. The Palomar core will probably work well in the ammeter, although this has not been tried. Contact Palomar Engineers, PO Box 455, Escondido, CA 92025, tel 619-747-3343, for information.

[3]For suitable techniques, see Dennis Kennedy, "Build It Yourself—With Plastic," *QST*, Aug 1988, pp 30-34.