the K2GNC Giza beam

A novel approach to directional antennas

If you happen to be looking for something simple and inexpensive in a beam antenna, take a look at this one. I haven't determined if this is a new concept, but it may be some time before anyone comes up with a design that performs better. What is it? The Giza beam — a lightweight, low-cost, rugged, directional array that almost anyone can make in an evening from junk-box parts.

I've tried just about every beam over the past 45 years. The design shown in **fig. 1** is easy to build and erect and provides plenty of punch. It's a modification of the conventional delta-loop wire beam (**fig. 2**).

In the Giza design, I removed the upper boom (**fig. 2**) and brought the apexes of the two loops together, which I fastened to the top of the supporting mast. There was no obvious difference in the antenna's operation. Front-to-back ratio seemed the same, it tuned up just as well, and the signal reports remained good. One major structural member had been removed and a more rigid, lighter-weight array with a lower center-of-gravity resulted. Its pyramidal shape and firm, solid construction reminded me of the great pyramids of Giza in Egypt, so it seemed appropriate to name it the K2GNC Giza beam.

a practical 15-meter beam

A bit of shopping brought together all the parts for a functional 15-meter Giza beam. I bought two straight, knot-free, furring strips for about $1.00. I used some No. 18 (1.0-mm) stranded, plastic-covered hookup wire for the elements. Lightweight TV mast sections provided the main supporting member. A few hose clamps, a scrap piece of plywood, and a few miscellaneous small items rounded out the bill of materials.

construction

Fig. 1 shows construction details with dimensions given for 10-, 15-, and 20-meter beams.

Making the four wooden spreaders, the main structural members, requires the most consideration. These were ripped from the two furring strips as shown in **fig. 3**. Painting or varnishing the wood will help preserve its shape and give it a professional appearance. The spreaders may be made of many

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materials, including bamboo, fiberglass, metal tubing, or thin plastic pipe.

The mounting plate (**fig. 4**) for the spreaders was made from exterior-grade plywood. It can be any convenient size, or you can use dimensions shown (**fig. 4**). Drill or saw a hole into the center slightly larger than the mast you're using, then drill some holes through it at the proper places for the spreader hinge wires. Any stiff, strong wire may be used for the hinges; there are no strong mechanical forces on them. (A heavy wire coat-hanger is a good choice.)

To assemble, lay the parts out flat. Run short lengths of the hinge wire into the spreader holes, bend them, run them through the holes in the mounting plate, then twist the ends together to hold them in place.

Mount the four corner braces on the top and bottom of the spreader mounting plate using bolts, lock washers, and nuts. Space the braces so that the vertical mast fits snugly between them.

Wrap lengths of stiff, insulated wire around the tip of each spreader and twist together tightly, leaving the ends pointing upward. These wires will hold the corners of the triangular loops.

The spacer cords (**fig. 1**) are lengths of nylon cord or fish line tied securely between the spreader tips. They should separate the lower sides of the loops by the distance shown. To form the loops, cut two lengths of plastic-covered, stranded hookup wire to the length shown in the table of dimensions in **fig. 1**.

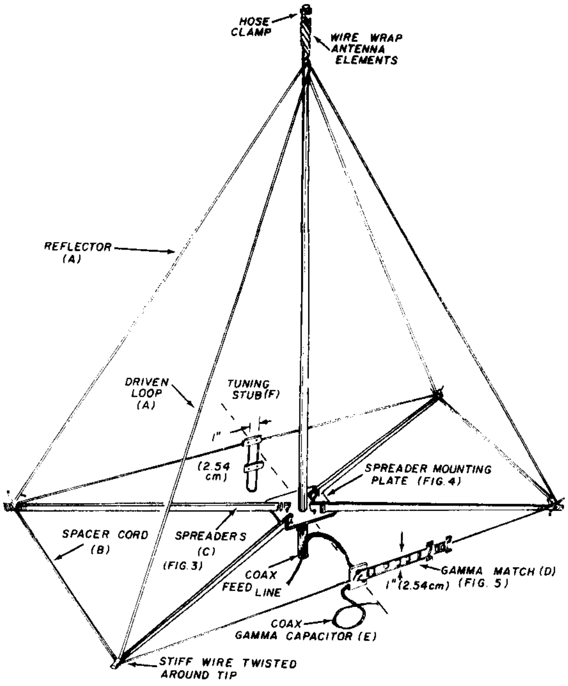
You don't have to use insulated wire for the loops. Bare wire, if used, need only be insulated at the spreader tips where the voltage is high. I used plastic-covered hookup wire because it's readily available, quite strong, and doesn't kink during assembly. Mark the *exact* center of both loops.

matching section

The gamma match (**fig. 5**) can be made from a length of 450-ohm line or two lengths of bare No. 16 wire. A variable capacitor is usually used for adjusting the match to the feed line. However, there's an old trick of using a length of RG-58/U or RG-59/U coax in its place because it's convenient and doesn't require a waterproof housing. These cables provide capacitances of about 30 pF and 20 pF per foot respectively. They will withstand full legal power at this low-voltage point. In fact, for low-power use, it may be more convenient to use two- or three-wire shielded microphone cable, which has a greater capacitance.

Connect the inner conductors together at the end and use them for one side of the capacitor. The shield is the other side.

Remove a length of wire from the end of one loop and replace it with the gamma match section of that



Amateur band, meters	loop length A, ft (meters)	spacing B, ft (meters)	spreader length C, ft (meters)	gamma match D, inches (cm)	gamma capacitor E,* inches (cm)	stub length F, inches (cm)
10	35.8 (10.8)	4.5 (1.37)	6 (1.83)	24 (60)	28 (70)	10 (25)
15	47.0 (14.3)	6.0 (1.83)	8.0 (2.44)	32 (80)	36 (90)	16 (40)
20	71.6 (21.9)	9.0 (2.74)	12.0 (3.66)	48 (120)	48 (120)	28 (70)

*Length of RG-58/U coax cable before trimming.

fig. 1. Design of the Giza beam with dimensions for the three high-frequency bands. Simplicity and readily available parts make this antenna a definite candidate for the homebrewer.

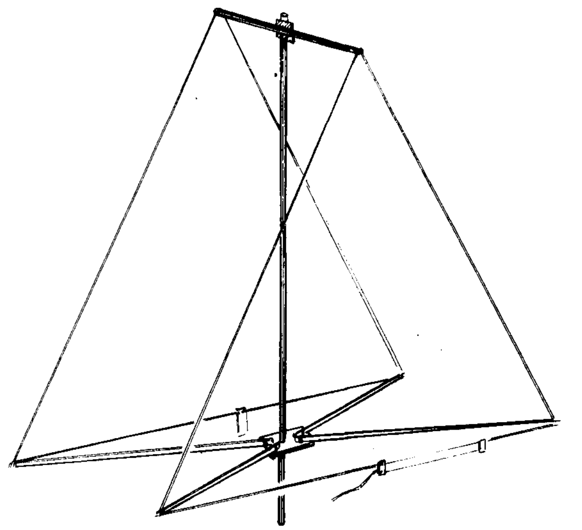


fig. 2. The conventional delta-loop wire beam. The top boom is eliminated in the Giza design, which results in a more rigid structure.

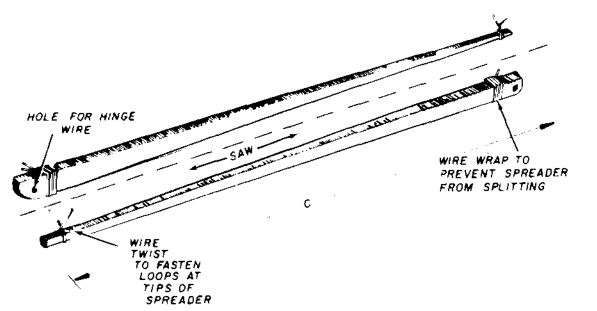


fig. 3. Two spreaders are made from one furring strip.

length. Attach the loop ends to the appropriate plastic insulator of the gamma match and the tuning stub. Secure the lower sides of the two loops loosely to the spreader tips with the stiff wires on each tip. Meanwhile keep the insulators centered and the two lengths equal. Pull the wires taut so that no slack exists in the spacer cords, then firmly twist the stiff wire so that the loop wires will not slip through.

final assembly

Secure the midpoint of each loop to the mast top with a hose clamp and place the mast in the center hole of the mounting plate. It doesn't matter whether the wire is actually grounded to the mast or not. Allow the spreader assembly to fall into a place on the mast where the spreaders are horizontal. Use hose clamps around the corner braces and tighten the mounting plate to the mast. Your Giza beam is now assembled.

tune up

The array is tuned in the conventional manner. However, I suggest that it be tuned to the low-frequency end of the band first for reasons to be explained.

First, adjust the reflector stub for best front-to-back ratio using your receiver and a strong, distant signal. Then position the gamma match slider to a point that provides lowest SWR. Once this point is found, adjust the gamma coax capacitor by snipping off short lengths from its end. At the same time, readjust the gamma match slider. An SWR near 1:1 should be easily obtained.

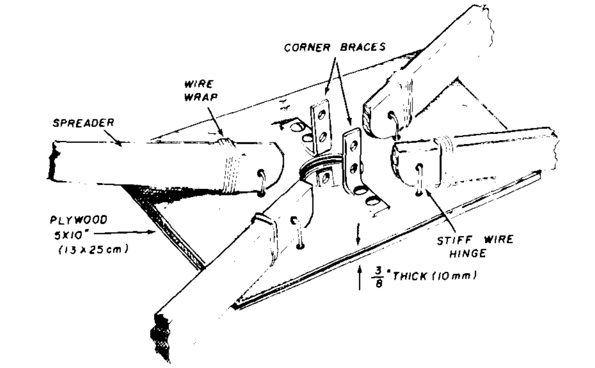


fig. 4. Details of the spreader mounting plate.

To prevent the coax from shorting at the end, remove a very short length of the outer insulation and the shield; then seal both ends of the coax with rubber cement, or tape them tightly to prevent water from creeping into the shield. Attach your coax feed line and you're ready to go on the air at the low end of the band.

a new twist

When it comes to peaking the antenna at a specific

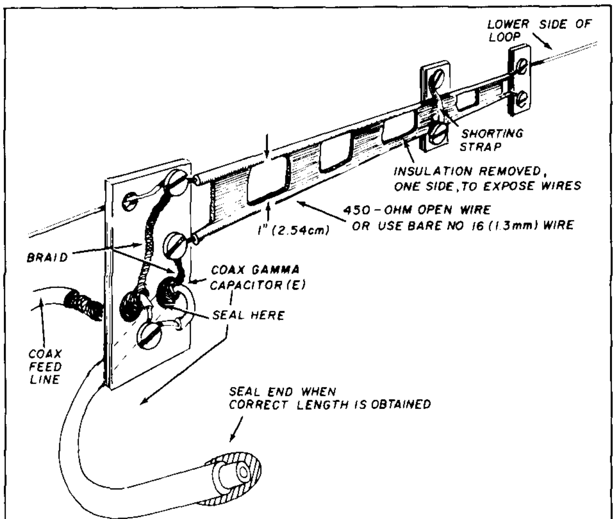


fig. 5. Gamma-match assembly.

frequency in the band, the K2GNC Giza beam has no equal. This operation was discovered by mistake: Once, while making some adjustments, the resonant frequency mysteriously shifted a considerable amount. After some investigation I observed that the spreader section had twisted around the mast while the mast stood still. This action caused the wire at the top of both loops to wrap around the mast. The loop lengths had shortened, thus increasing the resonant frequency. The SWR held at 1:1.

Wrap the wires around the pole by twisting the spreader assembly under controlled conditions. I tried it and got just what I wanted — an antenna that can be set mechanically to any desired frequency in the band.

Loosen the hose clamps on the spreader mounting plate and, with the transmitter on the desired frequency, rotate the spreader assembly until you get 1:1 SWR.

Once you've made one of these little giants and tried it out, you'll want to try some variations. A number of them are obvious. Wrapping the apex of the loops around the pole is only one way of accomplishing a resonant-frequency shift. The loop wires could be pulled down into the mast pole by a wire going up through the pole. They could be fastened to a yoke and pulled through a ring at the top of the mast down the outside of the mast. Combining these ideas with flexible spreaders or ones that are hinged at the central mounting plate could bring about some broad frequency variations. You may even encompass another band, especially one of the newly acquired bands.

A triband Giza would give many pluses. Using the usual feed methods for three-band quads, a few additional loops going from the mast to appropriate places on the spreaders would result in a more rigid structure than a single bander. A two-band model, already constructed, has proved this to be true.

A super lightweight, 20-meter Giza has been built using element-size aluminum for the mast and thin-walled, small-diameter aluminum tubing for the spreaders. These spreaders were tipped with lengths of plastic rod and insulated from each other. The mast, in this case, extended far enough below the spreader mounting plate for thin nylon rope guys to be run between it and the tips of the spreaders. This design resulted in an extra strong array that has withstood some pretty heavy winds. Mounting the antenna on the rotor was easy.

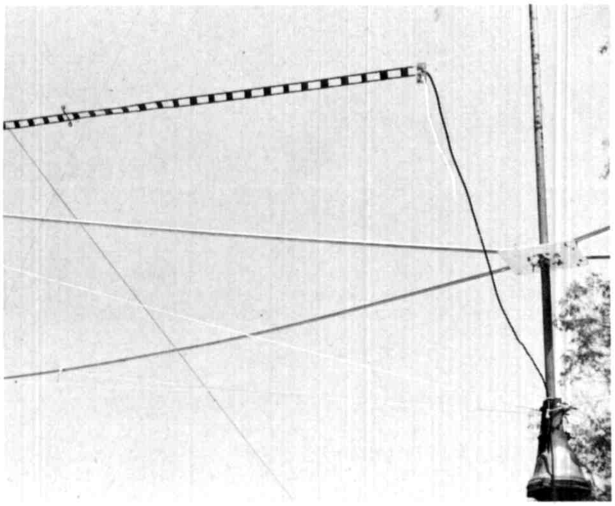
For portable operation or Field Day, what else but a Giza, pre-assembled, folded up umbrella-fashion, and stowed in the trunk or on the car roof? Be watchful that the loop wires don't get tangled with each other. (Perhaps it will help to first check with your nearest skydiver friend on how he packs a parachute.)

The small size and light construction should encourage more beams for 40, 80, and who knows, 160 meters. The same is true regarding the new bands when they become available.

Those who shy away from mounting a big Yagi on the roof because of the wife or the neighbors, or who otherwise want to be inconspicuous as hams, can use No. 22 electric fence wire for the loops. With almost invisible wires, the Giza looks like an fm ground plane to the untrained eye. (Don't ask me who ever saw a ground plane with a rotor on it.)

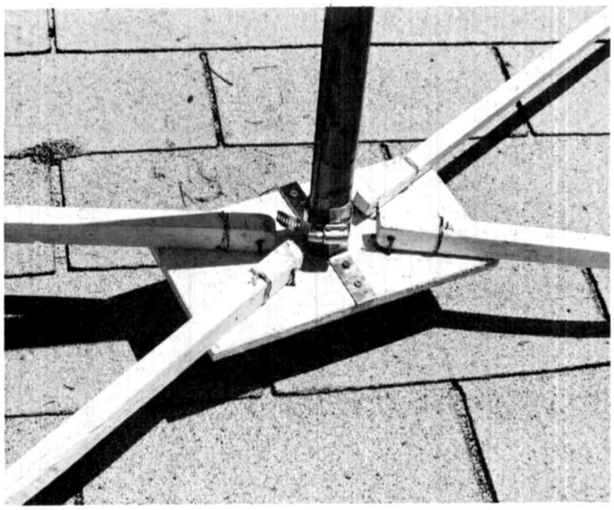
does it work?

So far, the simple construction and light weight of the antenna have been extolled. Now, what happens when rf goes into it? How does it work? There is an inclination to reply, "Try it, you'll like it." However, that answer will not satisfy many.



Twenty-meter Giza beam uses 450-ohm, parallel wire line for gamma match. Insulation is stripped from one side of line at left end of line for adjustable shorting strap. Microphone cable at feed line input terminal serves as gamma capacitor. Nylon guy lines from aluminum spreader tips to rotor make structure rigid.

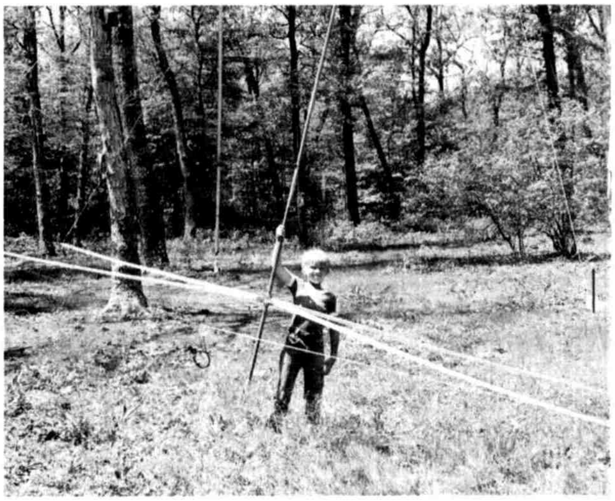
Without an accurate means of measuring forward gain, one way to determine performance is to get front-to-back readings. So, with the 20-meter array at a height of only 30 feet (9 meters), readings were gathered from many sources both in the U.S. and foreign countries. The readings averaged around 30 dB. Some readings went as high as 35 dB. Off the sides the reports were about 35 dB lower than off the front. One report said the signal disappeared off both the side and the back when it was 35 dB on the front.



Stiff wire hinges secure spreaders to central spreader mounting plate. Corner braces and hose clamps fasten mounting plate to vertical pole. Wire wraps on spreaders prevent wood from splitting.

This all compares favorably with most other good, normal-sized beams. It is probably better than other beams when they are operating off their resonant frequency.

Performance off the front made my heart leap many times. Signal reports rarely, if ever, have any real technical merit, so to say that RST 599 or 599FB was a common report from DX stations is insignificant. However, using the Giza on 20 meter phone has, for the first time, given me 100 percent contacts one time after another, and 20 meters is where you separate the men beams from the boy beams.



Author's second-generation harmonic, Brett, shows off lightweight (7-1/2-pound, 3.4-kg), sturdy construction of 15-meter Giza beam.

Running barefoot with a beam at 30 feet (9 meters) just cannot, of course, compare with the real professional, uppercrust gang and their five elements at 150 feet (46 meters). But when this antenna gets its dander up in the air, fully charged with a linear, it should hold its own with any array of comparable size.

conclusion

There is still much work to be done. What happens when you change the spacing between elements? What is optimum? Can a third or fourth element be added? This remains to be seen. But at this station it is very unlikely that I will ever go back to making a quad, Yagi, or conventional delta loop again. This one does the job so much more easily.

Thanks to my ever-loving wife, Roz, who has put up with a yard full of wires and poles these many years of our happy married life. Also, thanks to all those hams who gave reports at various headings, and my daughter, Lee, who so willingly typed this article.

ham radio