A Shortened ZL-Special Beam

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The antenna described here is not the "non plus ultra" in amateur beam arrays, but it has some features which make it very advantageous in certain locations. The gain with this 2 element ZL-special beam is 7 *db,* a little better than a 2 element parasitic beam, but not quite as good as a 3 element parasitic beam.

This article is not written for those who already have good results with their rotary beams, cubical quads, V beams, or what have you. It is written for those who think they cannot put up a "rotary", because of its weight, cost, size, etc.

I have often been asked; "Why do you use a 'ZL-special' and not a parasitic type beam antenna"? To answer this, I first must say a few words about my QTH. Our house stands right on the main street here and is over 85 feet high. The roof is so steep that one cannot work on it, unless he is a tiler or a member of the Fire Department. Therefore, the only possibility here to install any antenna is to work inside the roof with some tiles removed. It is quite impossible to put up a rotary-beam with aluminum tubing, heavy boom, etc. Even if the mechanical problems were solved, adjustment of the beam would be impossible, as the concrete and iron of the building severely detunes the beam from any pre-set value.

During the period of 1949 to 1956, I tried many antennas such as ground-plane, vertical dipole, longwires, horizontal dipole, and various others in my attic. The results always were poor, although the vertical dipole did work fairly well, but my DX signal reports were not more than average. I lacked the "punch"!

That was the situation when I first saw the 10 meter beam of DL1CX, and at once recognized that this is the answer to my antenna problems! The beam consisted of four bamboo poles and a handful of 300 ohm twin-lead. The whole thing did not weigh more than two pounds. Ten meters was just opening, and I could see it working like a charm. DL1CX had previously used a ground-plane antenna, and he told me the difference in performance was remarkable!

Two weeks later, I also had up a beam, and I regretted I had not done this years before. I built the "ZL-special" for 21 *mc*; this always having been my favorite band. My power never exceeded 100 watts in the two years I have now used this beam, I have worked a lot more DX (and a lot easier, too) than ever before. In fact, the antenna proved so excellent that only a few minor changes were made since I first put it up. However, it was found some time later, that the lengths of the elements could be shortened to ⅜ wavelength instead of the usual ½ wavelength. Further details are as follows . . .

First I shall describe the type with the normal antenna lengths, and then the type with the shortened elements.

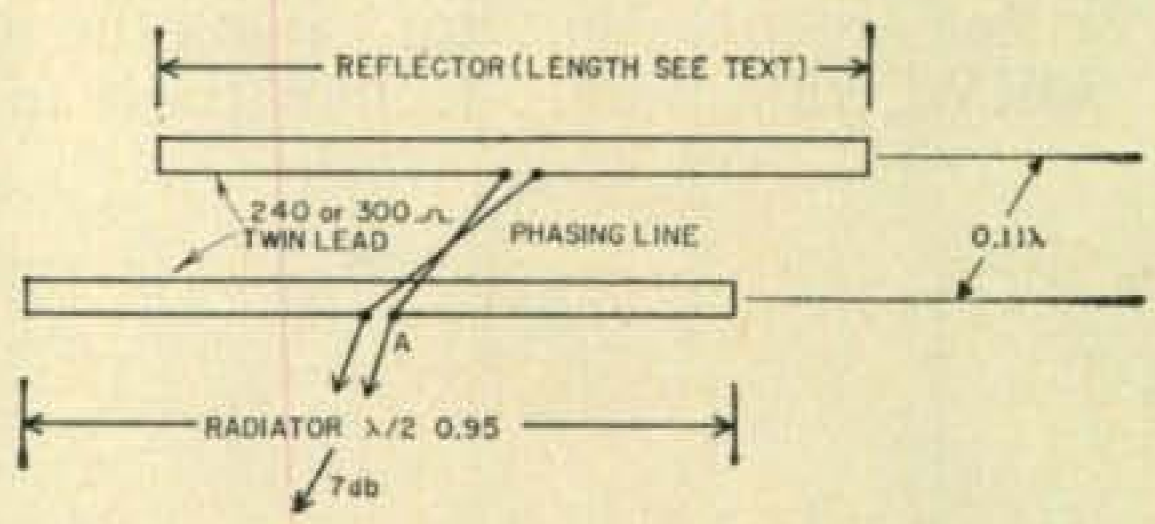

Fig. 1—ZL Special with normal length elements. The elements and phasing line are made of 300 ohm line.

Figure 1 shows the ZL-special with normal length of the elements. Radiator, reflector, and phasing section are made of 300 ohm twin-lead. Be sure to cross the phasing-section, as the reflector must be driven 135 degrees out of phase against the radiating element. For a maximum forward gain of 7 *db*, the reflector should be 6% longer than the driven element; this gives a F/B ratio of 25 *db*. As usual with beam antennas, the points of maximum forward gain and F/B do not coincide. The F/B ratio curve has a maximum with a reflector length of 10% longer.

The feed impedance at point "A" (fig. 1) (center of driven element) is approximately 80 to 90 ohms, depending on the height of the antenna above ground. I used 75 ohm twin-lead for the transmission line and it gave me a low SWR over the entire band. Of course any other type of transmission line can be used as well, it only being realized that the antenna offers a balanced resistive load of some 85 ohms. While not quite correct from the theoretical view-point, the antenna can also be fed with 72 ohm coaxial-line without using a balun or line-balance converter.

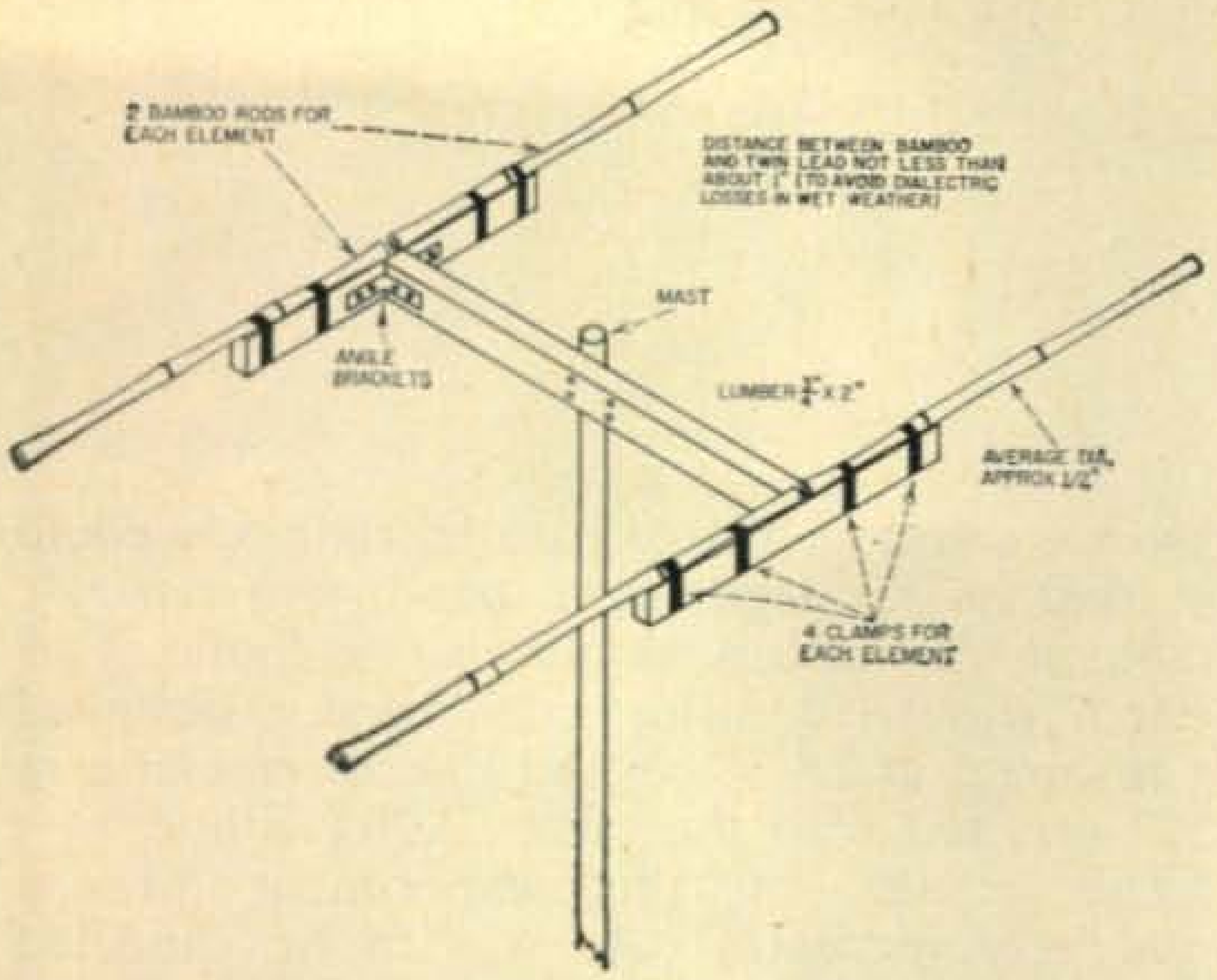

Fig. 2—Construction of the framework carrying the twin-lead antenna.

Antenna Construction

Bamboo rods carry the twin-lead elements. Figure 2 shows the construction. The twin-lead is fastened with cord to the bamboo rods. However, there should be at least one inch between the bamboo and the twin lead to avoid dielectric losses when the rods are wet or covered with snow. For 21 *mc* the beam is light enough to be turned by nearly any TV rotator.

Shortened Elements

Before putting up this original beam, I told the family I would soon have something on the roof, "not much larger than a TV-antenna", and it would hardly be seen from the street. I need not go into details, but I assure you the shock was considerable, when I had the antenna up and it took me several days to convince the family and my neighbors that any other antenna would probably cause severe TVI !!!! It even surprised me how far one could see the thin bamboo rods.

It was therefore out of the question that I could use a full-size 14 *mc* ZL-special in this

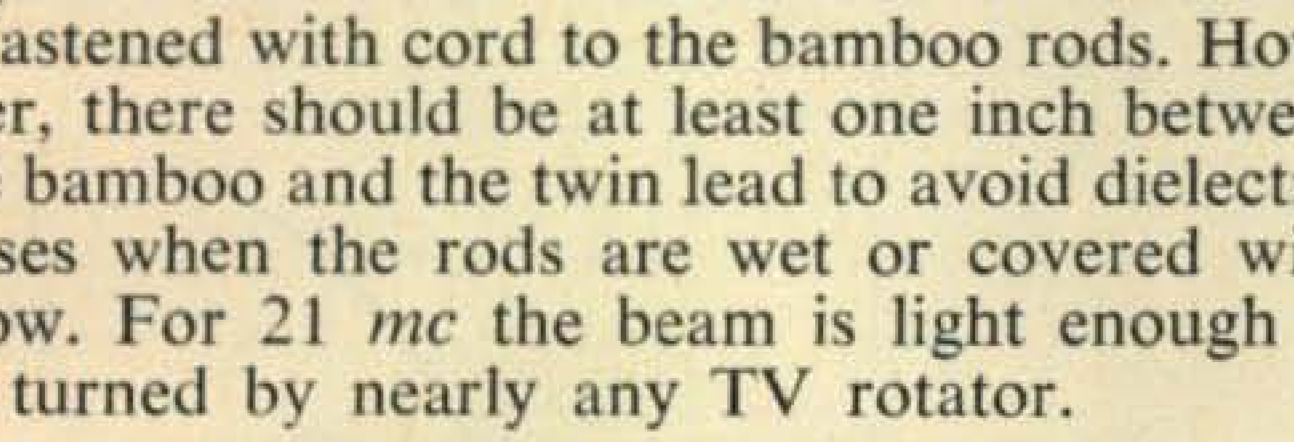

Fig. 3—3/8 wavelength version replacing the usual 1/2 or 5/8 antenna.

QTH. It was taken into consideration there are many miniature beams on the market with their aluminum elements and coils, and their sacrifice in antenna gain and bandwidth. Giving the problem some thought, it was recalled there is a type of a folded dipole which only needs to be 3/8 wavelength long, instead of the usual 4/8 or 1/2 wavelength which possibly could be used. (Figure 3). In other words, such a dipole for 14 *mc* only needed the length for 21 *mc* and, that without using coils or some fancy tricks.

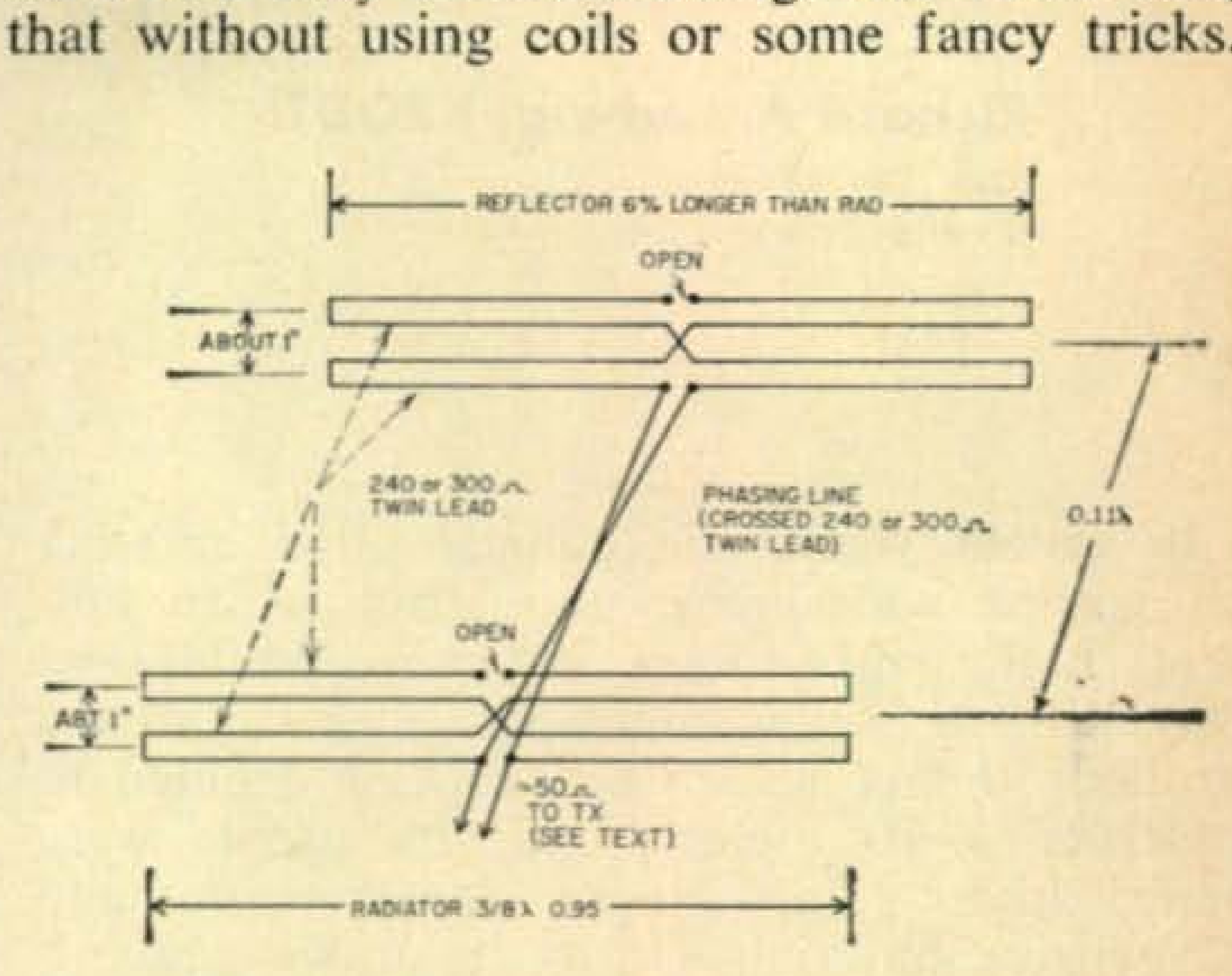

Fig. 4—The shortened ZL Special. This particular antenna was constructed for 29.6 mc.

The impedance at the feed point is 230 ohms, which is rather close to the 280 ohms of a "normal" folded dipole. The next step was to apply this to the ZL-special. To test this shortened array (fig. 4) I built one for 29 *mc* and checked it against the 3 element parasitic beam of a local DL4 friend. The antenna at once loaded well with a low SWR, from 28 to 29.6 *mc*. This shortened ZL-special was placed about 15 feet from the 3 element beam and switching was so arranged that antennas could be changed in seconds. In 90% of the QSO's, reports indicated that both antennas produced the same signal-strength.

Only the F/B ratio of the 3 element beam was better, though that of the ZL-special was between 15 to 20 db. Since the reflector was 6% longer than the radiator, the F/B ratio probably could have been improved if the reflector was made some 10 to 12% longer than the radiator. Unfortunately, the inclement weather at the time of the experiments prevented trying this. The antenna was fed with 52 ohm coaxial-line and this gave a low SWR. No balun was used to transform the unbalanced transmission line to the balanced feed point. All details of the mechanical construction, are the same as shown in fig. 2.

There is however one disadvantage with all the ZL-special beams; they can be used only on one band. There might be a way to apply one of the many 3 band rotary-beam techniques to this system also, but it would probably be complicated.

As I have said, while this article has not been written for those already enjoying the many advantages of a rotary-beam, it might give an answer to those who still don't know what Hamlet said: To beam or not to beam, that is the question! ■