W4FA wanted a quick-to-erect directive antenna for 15 meters at his new QTH. However, he wanted an antenna that would also function reasonably well for multiband operation, 80–10 meters. A look into some old handbooks at the local library, plus some of John's experience, provided the answer.

A New Look at Some Classic Wire Antennas

BY JOHN J. SCHULTZ*, W4FA

When I was a young radio amateur, way back when, I often marveled at the elaborate directive, wire-type antennas shown in some amateur handbooks. The antennas had elongated dipole elements, and the antennas had such elements arranged both horizontally and vertically with the elements being fed by a maze of phasing lines. They looked good in the handbooks and provided nice daydreams for a young amateur, but I really duobted their practicability and more or less forgot about them.

However, 40 years later I arrived at my present QTH and thought about an effective antenna system that I could erect before I got into the serious business of putting up a tower and some beams. Delving into some of the old textbooks available at the local library, I found there was indeed a lot of sense in some of the old wire-type antenna ideas. Equally, however, I found that some of the old forms were sheer nonsense in terms of erectability and survivability. Therefore, I had a lot of fun in exercising 40 years of hindsight and trying to extract some old antenna ideas that would be viable today. I think I found some good ideas and would like to present them here.

QTH Background

My present QTH is a ½ acre site with a trapezoidal shape. Nonetheless, some of the tall pines on the property were handy supports for erecting a wire antenna. The first antenna I erected was a simple 80 meter delta loop, as shown in fig. 1, which was strung up between two pine trees. I fed it with 450 ohm ladder line, and using a tuner, it proved to be a remarkably good multiband antenna. I would recommmend it to anyone who has the space available for its erection and who desires just a good, simple multiband antenna.

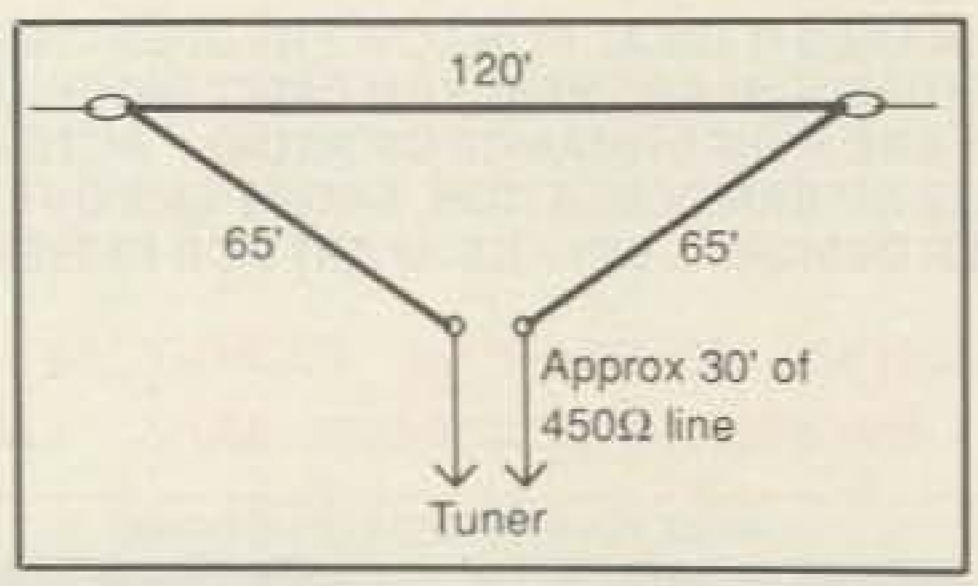


Fig. 1– The delta-loop antenna used initially with very good general results.

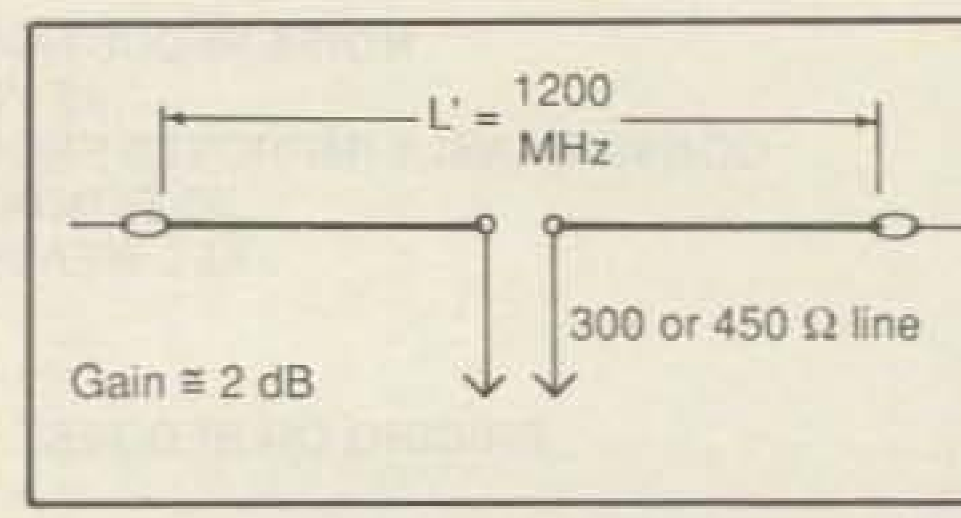


Fig. 2– Classic Double Extended Zepp fed with balanced line to permit operation on most HF bands using a tuner.

This antenna will put out an excellent signal over the 80–10 meter range, using a tuner, although its directivity will change from band to band. Phasing lines could be introduced to control the directivity, but I decided to avoid that compli-

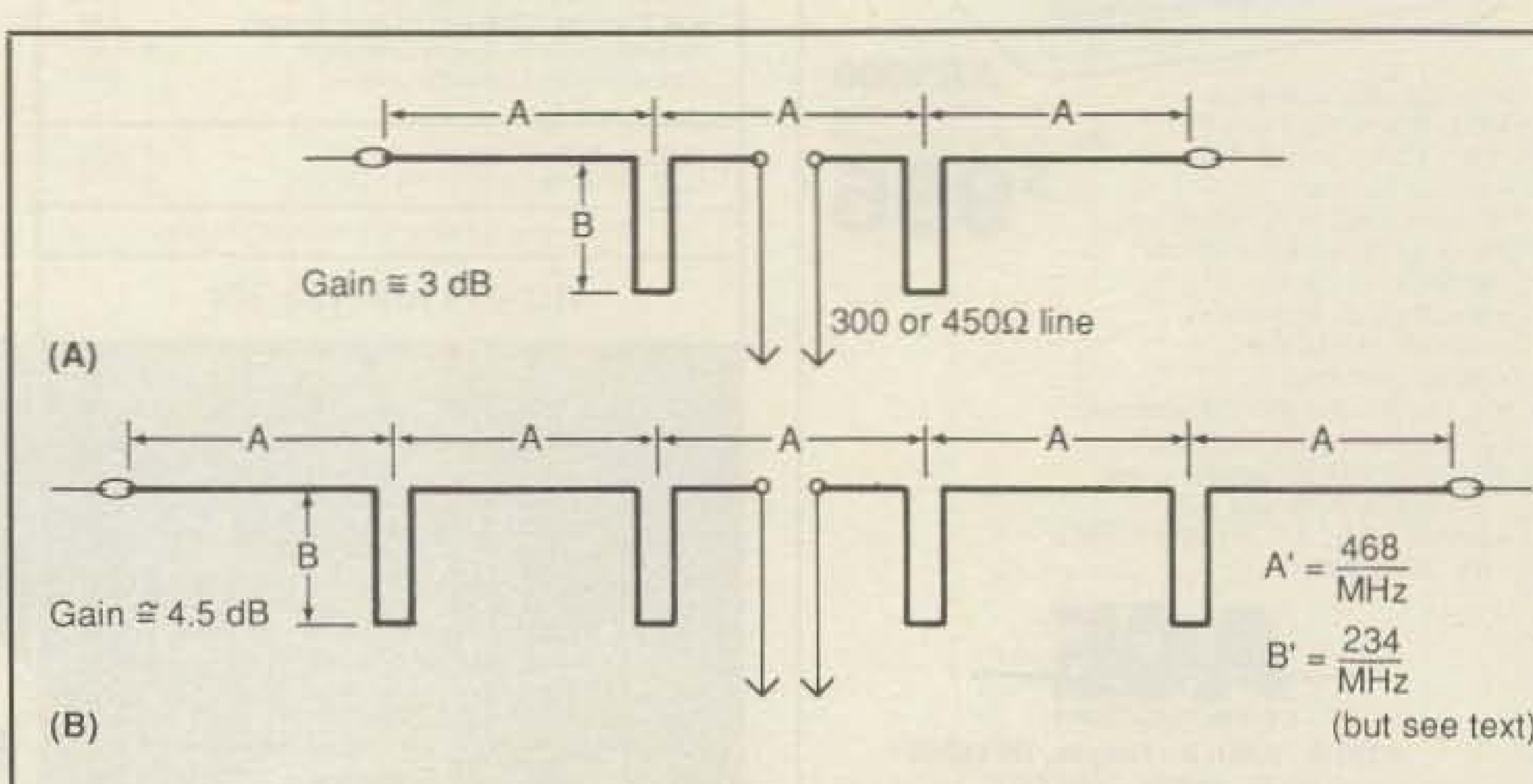
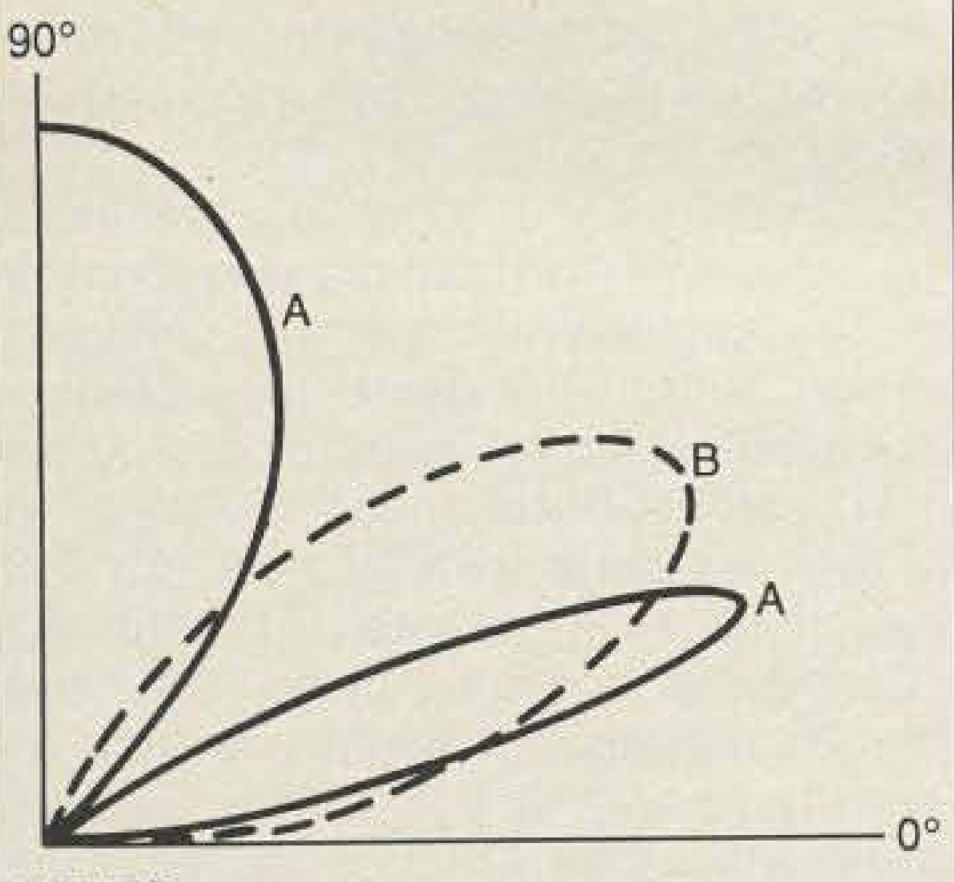


Fig. 3– Simple collinear array antennas built up by phasing dipole elements.

*302 Glasgow Lane, Greenville, NC 27858



NOTES:
A = Dual lobes of dipole $^3/_4\lambda$ above ground.
B = Single lobe of vertical stacked array, highest element $^3/_4\lambda$ above ground and lower element $^1/_4\lambda$ above ground.
Lobes illustrate approximate vertical directivity, they will vary according to ground conditions.

Fig. 4– Not always well appreciated is the idea that phased-array or Yagi antennas in most cases have vertical directivity very different from that of a dipole.

cation. What I really was after was an antenna that would have some defined directivity on 15 meters, but that could also be used as a general-purpose multiband antenna by feeding it with balanced line and using a tuner. I wanted the antenna to be directive in directions at right angles to the plane of my existing delta loop (coming in and going out the page as you look at fig. 1).

Collinear Antennas

The simplest antenna form I could find that would do what I desired was a so-called collinear array. Collinear arrays are nothing more than extended dipoles, except that steps are taken to keep the directivity at right angles to the plane of the antenna. If you start to elongate a regular ½λ dipole, the directivity remains at right angles to the plane of the antenna just about to the point where the dimensions of the Double Extended Zepp (fig. 2) are reached. The antenna has a gain of about 2 dB and is, I suppose, about the simplest "gain" type wire antenna that can be erected. Its feed-point impedance is complex, but it can be easily fed with 300 or 450 balanced line using a tuner. If cut for 15 meters, its flat-top length of about 57 feet will allow it to operate on any band from 80–10 meters. On bands above 15 meters its directivity will split into a cloverleaf pattern, while on bands below 15 meters the directivity will be about the same as a ½λ dipole.

If you keep elongating the antenna beyond the Double Zepp dimensions and wish the directivity to remain as stated, you have to introduce phasing sections. The reason for this is explained in detail in classic antenna textbooks, although rarely in the simplified amateur radio antenna books available today. It's probably not all that important anyway, as long as you accept the idea. Fig. 3 shows the idea for an antenna which has flat-top lengths of 1½ and 2½λ. The quarter-wave vertical phasing sections can be constructed of classic, homebrew open-wire line (#14 or smaller spaced 4 to 6 inches), but I doubt if anyone would want to go through that fuss when KW-type 300 ohm line or 450 ohm ladder line is available. If either of the two latter lines are aer used, the length derived from the formula shown in fig. 3 has to be multiplied by the velocity factor of the line used. Typically, it's around 0.95, but you should get an exact figure from the supplier. Radio Works (Box 6159, Portsmouth, VA 23703) stocks both types of line, and they offer a free catalog with lots of antenna materials.

The gain of the antenna does not increase dramatically as the antenna is elongated, but it's very inexpensive gain. For instance, I erected the antenna form of fig. 3(B). The theoretical gain of 4.5 dB is noticeable, and the cost of all of the wire for the flat-top and phasing lines was something on the order of $10 for a 15 meter antenna! Theoretically, you could expand the antenna endlessly to build up the gain, but I haven't found any references in antenna literature as to how far the scheme would be practical. I rather doubt that it would make any sense to expand the antenna much beyond twice the size shown in fig. 3(B). There is bound to be some measurement error when you cut the antenna wire and phasing lines, and I suspect that it will, in a practical sense, limit the gain potential of the antenna. Nonetheless, considering cost and the simplicity of construction, the old collinear antenna (also called Franklin array) is rather hard to equal.

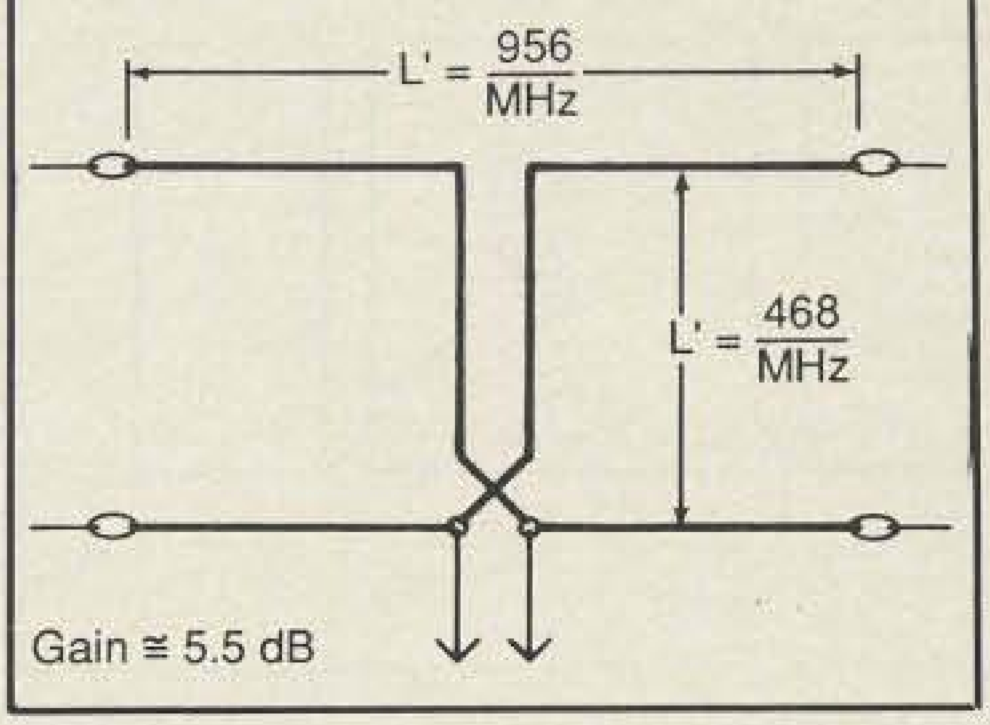


Fig. 5– The classic Lazy H antenna.

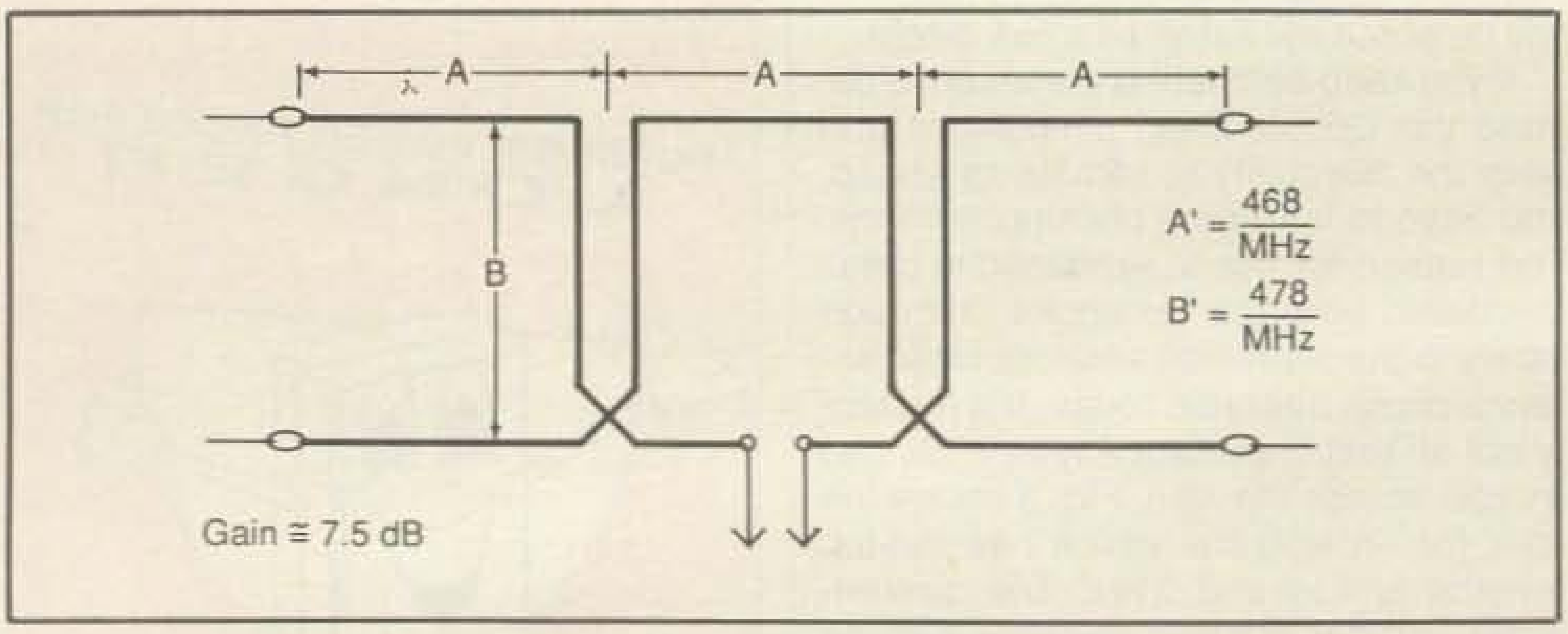


Fig. 6– Another classic—the Six-Shooter array.

Complex Collinear Arrays

As you might imagine, and as can be fortified if you research some old antenna handbooks, many proposals were put forth to take a basic collinear antenna and stack it above another such antenna, or to phase two spaced collinear antennas in the horizontal plane, or to develop a combination array having both vertically stacked and horizontally spaced elements. I suppose various such complex arrays were actually constructed and probably worked quite well, but I suspest such antennas were also short-lived due to their mechanical complexity and weather susceptibility.

The one thing that did make sense to me when I took a look at complex collinear arrays was the idea of simple vertical stacking. A simple collinear array achieves gain, as it is made longer, by concentrating the radiation from the antenna in the horizontal plane. For example, a simple ½λ dipole elevated about ½λ above ground has its vertical radiation lobe at about 30 degrees from the ground surface. No matter how long a single collinear array might be made, the vertical directivity does not change. If the single-element collinear array is elevated ½λ above the ground, its main radiation lobe is going to be about 30 degrees from the ground surface regardless of the length of the antenna. Unfortunately, if the antenna is a certain heights, even rather high ones in terms of wavelength, a good deal of radiation can take place at high angles, which is great for short-skip but hardly useful for DX. For a given antenna height, vertical stacking is not quite as effective in getting radiation concentrated at the lower angles as is the idea of horizontally spaced elements.

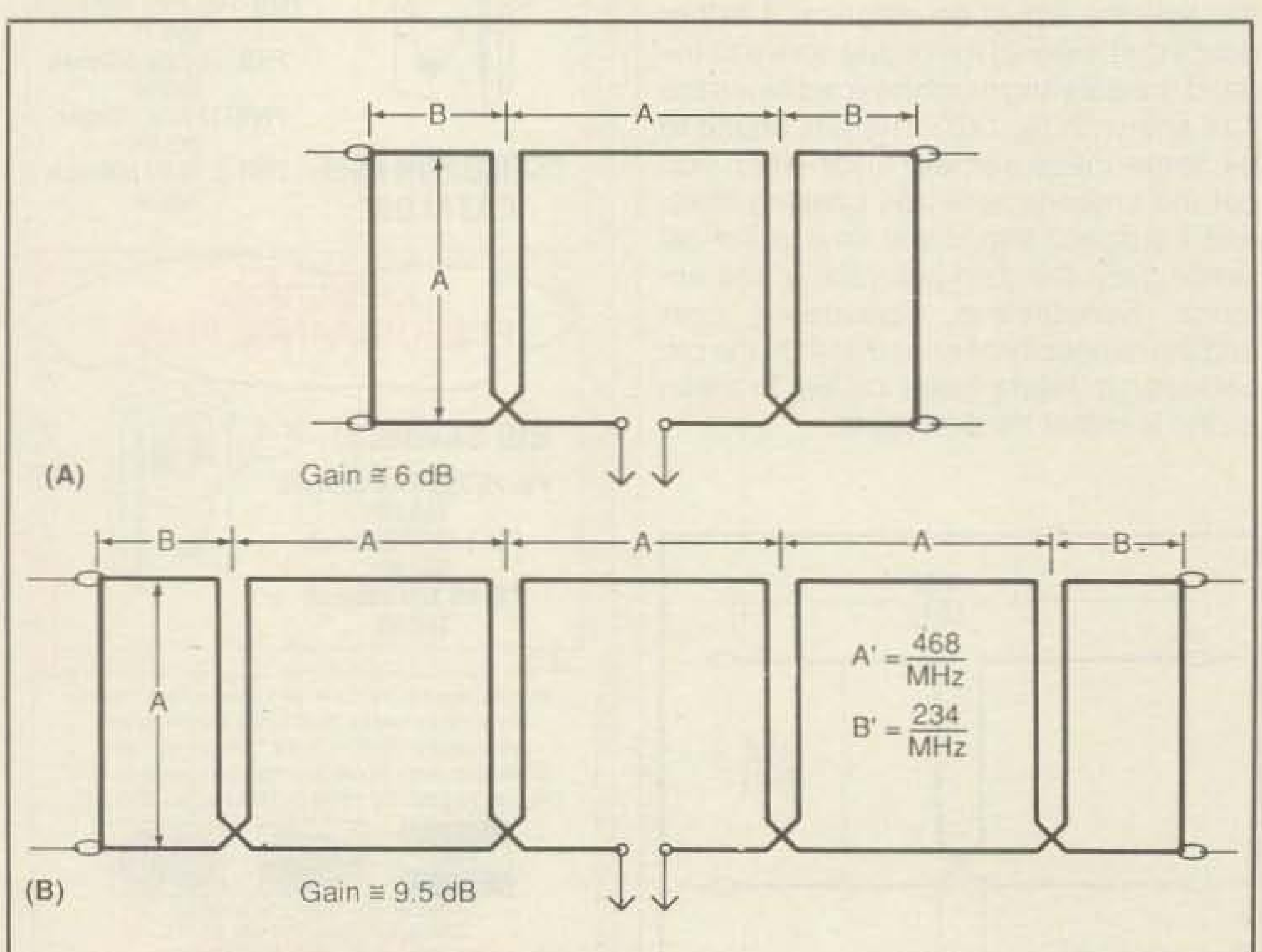


Fig. 7– Two examples of Sterba curtains. On a materials cost to effective DX gain basis they probably cannot be equalled. They differ only in size, and hence gain.

However, from a constructional viewpoint, when considering wire-type antennas, vertical stacking is by far the easiest way to go.

I don't think that too many amateurs appreciate the vertical-plane directivity change that takes place when a vertically stacked antenna is used. For instance, take a look at fig. 4. The horizontal dipole at ¾λ elevation has a good "DX lobe" at 20 degrees but a fairly useless (for DX) major lobe at 90 degrees. The stacked antenna has one lobe at slightly more than 20 degrees, *but* all of the vertical directivity (power, if you will) is concentrated in that lobe. Although it's out of the scope of this article, if you consider Yagi also along with fig. 4 and compare its pattern against that of the dipole, you will find that the 90 degree lobe shrinks tremendously, while the 20 degree lobe expands. That's why the Yagi "plays" so well for DX, along with its other attributes.

There are many classic stacked arrays, the granddaddy of which is probably the Lazy H, as shown in fig. 5. For a wire-type antenna it's not all that large, but it will deliver a respectable 5.5 dB gain. My next favorite is a sort of expanded Lazy H, dubbed the Six-Shooter and shown in fig. 6. By making the antenna only ½λ longer than the Lazy H, you pick up almost 2 dB of additional gain. Both antennas are fairly easy to construct if you imagine the upper and lower elements as being each one run of antenna wire broken up as necessary by insulators. The vertical phasing lines can be 450 ohm ladder line, and it doesn't matter where the twist in each line is located as long as it is there.

Another stacked array with which I have had great success in the past is the Sterba curtain. This classic antenna (used by AT&T for overseas telephone service in the 1930s) is just a touch more difficult to contruct than the preceding antennas because of the closed ends, but it develops an awful lot of gain for a relatively compact wire antenna. Two examples of Sterbas are shown in fig. 7.

Summary

For which form did I settle after initially trying the fig. 3(B) collinear? The Sterba curtain of fig. 7(B). It provides excellent DX gain on 15 meters and certainly works out extremely well on all bands from 80–10 meters. I constructed the antenna using #18 copper-clad wire and black-colored 450 ohm ladder line having #18 copperweld conducters (both items available form Radio Works). The antenna is certainly inconspicious, although the ladder-line phasing sections seem to be suspended in space. Until I get the beams erected, I must admit that I'm hooked again on wire-type antennas. CQ