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QST Issue: Oct 1991
Title: Curtains for You
Author: James Cain, K1TN

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Curtains for You

Big decibels for small dollars.

By James D. Cain, K1TN
Senior Editor

Last February I placed fifth in the US in my entry category in the ARRL International DX Contest with an antenna system that cost less than a hundred dollars and took just two weekends to erect—a classic Sterba curtain.

Several factors brought about my decision to hang two Sterba curtains in the trees:

- Mother Nature, who gave us the warmest December on record;
- A compulsion to store a couple hundred feet of balanced feed line in the air instead of under the car, where inevitably I would run over it;
- The lack of initiative to erect a tower and beam;
- The ARRL CW DX Contest;
- An article by John Schultz, W4FA, in *CQ* Magazine[1] that said, "This classic antenna . . . develops an awful lot of gain for a relatively compact wire antenna."

For seven years I'd been staring up at the 60- to 70-foot trees surrounding my house and thinking about wires, but my results over the years with directional wire arrays had been dismal. Longer ago than I care to admit I had a 500-foot end-fed wire that laid down a good signal on several bands.

[1]Notes appear on p 30.

Trouble was, it had a beamwidth of about three degrees.

Later, I had triband beams and spent a lot of time trying parasitic arrays such as fixed wire Yagis and quads for 40 meters. They refused to work well, though. Usually, when I had a couple of trees to work with, my wire antennas ended up with gain to someplace where penguins outnumber people and hams make expeditions to about once a generation.

I started thinking about Sterba curtains some time before Schultz's article appeared in *CQ*, but he still gets much of the credit for the push I needed. The trees were bare, 10 meters was wide open, and I could get the top of a Sterba up about 45 feet.

A Classic Antenna

If you're interested in a technical explanation of how the Sterba curtain works, see the sidebar "Technical Stuff." It's really a pretty simple antenna.

The ARRL Antenna Book says, in a typical understatement, that the use of Sterba "arrays" by amateurs has been "rather limited."[2] (I prefer "curtain" to "array" because that's precisely what it looks like.) Nevertheless, when I mentioned my project to the boss, Dave Sumner, K1ZZ, he recalled experimenting with a Sterba when he lived in Iowa one summer 20 years ago. (I expect the idea popped into Dave's head after a few days of navigating to work through the Collins Radio antenna farm.)

The Antenna Book notes that the Sterba is a closed loop system for direct current and low-frequency ac, and suggests that "heating currents can be sent through the wires to melt the ice that forms in cold climates." This piece of information led me to suggest to a friend the possibility of plugging the feed line into a house outlet (keeping a fire extinguisher handy by the circuit breaker, of course). But I digress.

It seems that in typical ham style, the Sterba array was in use before it got the name or even before appearing in a scientific paper. The Bell System was using Sterba curtains for its long-distance shortwave telephone circuits on the HF bands at least as early as 1930. E. J. Sterba, who worked at the Bell Telephone Laboratories in New York City, described the array in the July 1931 issue of the *Proceedings of the Institute of Radio Engineers* (starting on page 1184).

Sterba, in an article titled *Theoretical and Practical Aspects of Directional Transmitting Systems*, omitted "details of the mathematical derivations. . . for brevity." Regardless of the brevity, I still couldn't understand the math (which is jam packed

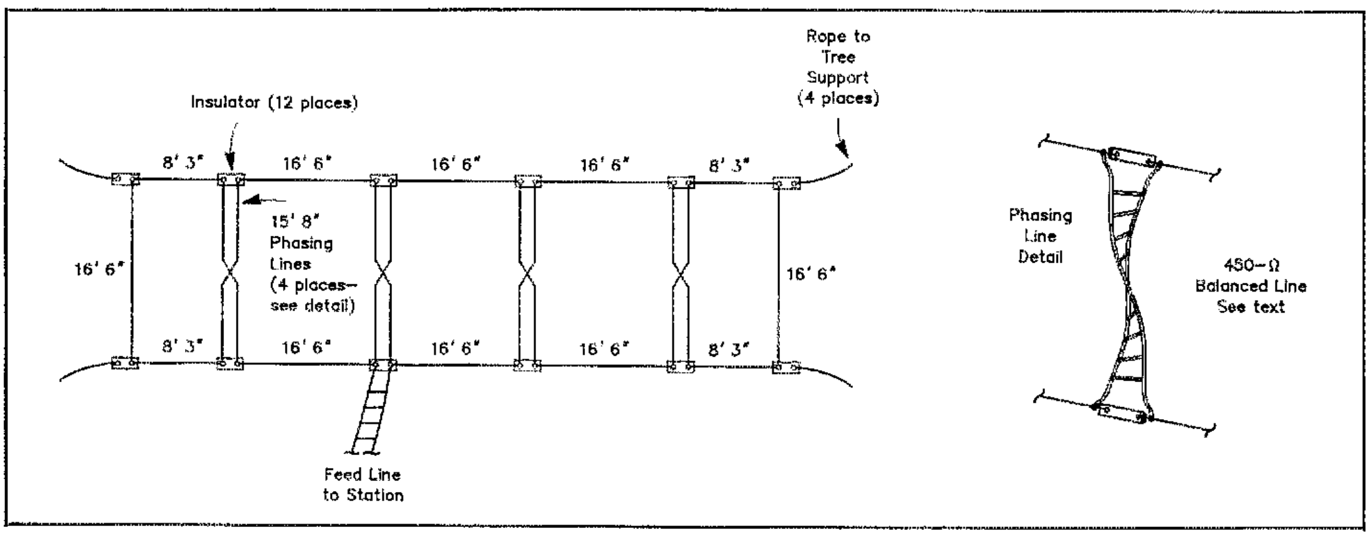


Fig 1—Construction details for an eight-element 10-meter Sterba curtain. Design frequency is 28.4 MHz. Note that the phasing lines are twisted once so that the conductors cross. The inner end of an upper element feeds the outer end of a lower one.

with weird Greek letters) but there, on page 1203, is a diagram of my antennas.

Sterba diagrammed several wire arrays, including what are now called the "Lazy H" and the "Bruce Array" (also described in Chapter 8 of *The ARRL Antenna Book*). The array we now call the Sterba curtain was the antenna in use at that time at the Bell System's Lawrenceville, New Jersey, facility.

I believe that Bell settled on the Sterba configuration for exactly the same reasons that I find it so compelling: it's easy and cheap to build and to keep up, and it just *looks right*.

A few years later, John Kraus, W8JK, in his classic book *Antennas*, mentioned curtain arrays, and apparently coined the term Sterba curtain. In 1939, the first edition of *The ARRL Antenna Book* noted the Sterba array. Half a century later the information is basically the same.

My favorite line in *The ARRL Antenna Book* is "The system obviously can be extended as far as desired." This was what sent me into the balmy 50-degree December weather, to pace off distances between trees and plot paths to Europe, Asia, and New Zealand.

Preparations

Here are the highly technical and complex set of instructions for erecting your Sterba curtain:

A. Build the antenna.

B. Put it up.

If this seems disarmingly simple, it is. Actually, there is one thing to do before anything else, and that's to determine whether you have the room for this project.

The first Sterba I built, eight elements, is shown in Fig 1. It's roughly 64 feet long—about the same as a 40-meter dipole. You can add or subtract elements, depending on the amount of room you have. As for height, my curtains at 45 feet work great. I suspect they would work with the lower wires as close to the ground as perhaps 10 feet. The literature says the bottom of the array should be a half-wavelength above ground—that's only 16 feet at 28 MHz.

If you are lucky, you will be able to support two curtains at right angles to each other from three trees or other supports.

Materials

Construction materials: antenna wire, balanced feed line, insulators. These are the same materials you need to build a dipole, only you need more for a Sterba array. The suppliers listed in the sidebar "Where to Get the Pieces" have everything you need.

I made a marvelous discovery in the evolution of my curtains. For some time I'd wondered where to get antenna wire these days (without resorting to mail order). I would rather take up another hobby than use the kinky, copper-clad steel stuff available today on every other street corner. You know, the "antenna wire" that comes in 50-foot rolls only, that turns black after a week, and which the store is always out of anyhow.

Then I dropped by the local hardware store and was browsing the wire aisle. Voilà! "#14 solid black 500 feet." I almost had an accident. Finding this wire was for me akin to being the inventor of the internal combustion engine and walking into a dry goods store to find spark plugs for sale.

The other wire needed for this project is balanced feed line. "Open-wire," we used to call it. Don't make your own.

I like the black, plastic-insulated, 450-ohm variety. This is a product I always have figured the manufacturer would discontinue for lack of demand, and I collect it like the proverbial ball of string. Last winter, I helped take down somebody's tower. When I went back in the spring to clean up ("the ice that forms in colder climates"), I unearthed an end of this very same balanced line. Down on hands and knees archaeologist-style, I delicately pulled the line from the dirt and grass. And pulled, and pulled. It was the holy grail of feed lines, nearly 200 feet, all one piece, dirty but definitely serviceable. I hosed off the whole mess and threw it into the washing machine on "heavy load."

Finally, insulators. Since Sterba curtains need a *lot* of insulators (12 for my 8-element array), I decided to make my own. I had some 1.5-inch-wide furring strips (¼-inch-thick wood) lying around, so I cut them into 4-inch-long pieces, drilled two holes in each one, and that was that. These were meant to be very temporary, just to see if a Sterba curtain would work. Of course, there's a lot of pull on these insulators, especially along the top of the antenna, and I estimated they would last about a month.

It was after about two months, actually, that they began failing in a spectacular manner. You will note that the insulators are used where the dipoles attach to the balanced feed line. When an insulator fails, the only thing holding the connections together is the plastic strip making up the spacer for the balanced line. As the wind, the "ice that forms in northern climates"—or whatever causes the failure—persists, the balanced line splits down its length (Fig 2). The curtain loses its poise and things become an ugly mess in a hurry.

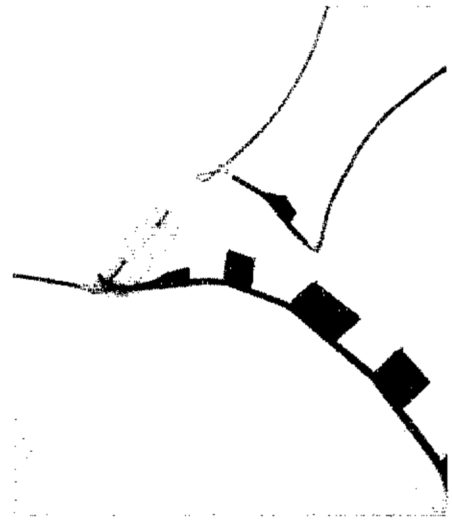


Fig 2—So much for insulators made from furring strips.

So do it the right way, or maybe even the way I switched to. I bought some ¾-inch-diameter hardwood dowel, cut it into 4-inch-long pieces, drilled holes in it, and then boiled the pieces in ordinary canning wax. I honestly don't know if waxing does any good, but the books have recommended it for at least a century.

I was doing some boiling one afternoon when a friend stopped by and reminded me that you aren't supposed to put the pan of

Where to Get the Pieces

Here's a brief list of suppliers of wire, insulators, feed line, connectors, and other items you'll need for making and installing wire antennas. For a more complete list, see the advertisements in this and other issues of *QST*.

- Radio Shack stores (antenna wire, coaxial cable, ceramic and plastic insulators, connector-sealant tape and other supplies). See 1992 catalog, page 149.
- Davis RF, PO Box 230, Carlisle, MA 01740, tel 508-369-1738 or 800-484-4002, extension 1356 (high-flexibility antenna wire, coaxial cable, several varieties of prefabricated balanced line [and parts to make your own], ceramic insulators, aluminum tubing and other supples). Catalog available.
- Ocean State Electronics, PO Box 1458, Westerly, RI 02891, tel 401-596-3080, fax 401-596-3590 (antenna wire, coaxial cable and connectors, 300-Ω twinlead, insulators). Catalog available.
- Certified Communications, Rte 2, Pittman Rd, Landrum, SC 29356, tel 803-895-4195 (coaxial cable, balanced feed line).
- The Radio Works, PO Box 6159, Portsmouth, VA 23703, tel 804-484-0140, fax 804-483-1873 (antenna wire, coaxial cable and connectors, balanced feed line, baluns, insulators, rope, sealant and other supplies). Catalog available.
- Most major Amateur Radio equipment dealers (Amateur Electronic Supply, Ham Radio Outlet, and other *QST* advertisers) carry parts for wire construction.—*NJ2L*

Technical Stuff

Fig 1 in the accompanying article shows the layout and dimensions for constructing a 10-meter Sterba curtain or Sterba array (either name is appropriate). The construction looks simple enough, but how do all those wires work together to make such a hot antenna? Actually, it's pretty simple. Just consider all the horizontal wires as a series of half-wave dipole sections, and all the vertical wires as phasing lines.

To understand this, let's first consider two parallel half-wave dipoles stacked one above the other, with a separation of ½ wavelength. Let's also feed the two dipoles in phase, for maximum performance in the broadside direction. Fig A shows such an antenna arrangement (ignore the broken lines at the ends of the dipoles for a moment). The feeder brings power to the bottom dipole, and a phasing line carries power from the feeder to the top dipole. Because there is a half wave between the two dipoles, and thus a ½-wavelength phasing line, it takes half an RF cycle for the phasing line to carry power from the system feed point to the top dipole. If the phasing line were simply connected there without twisting, the two dipoles would then be fed 180° out of phase. But we don't want that. Rather, we give the phasing line a half twist, as shown in Fig A. This inverts the 180° phase difference, and the two dipoles are now fed in phase. A simple way to look at it is to consider that the half twist is necessary to compensate for the time delay in the phasing line.

Now we have the two dipoles fed in phase. This means the current in every part of one dipole is identical to that in the same part of the other. And, of course, the voltages in the two dipoles will also correspond. And thus, voltages at the ends of one dipole are identical to those at the corresponding ends of the other. Therefore, we can connect single wires between the ends of the dipoles, as indicated by the broken lines in Fig A, without disrupting the phase.

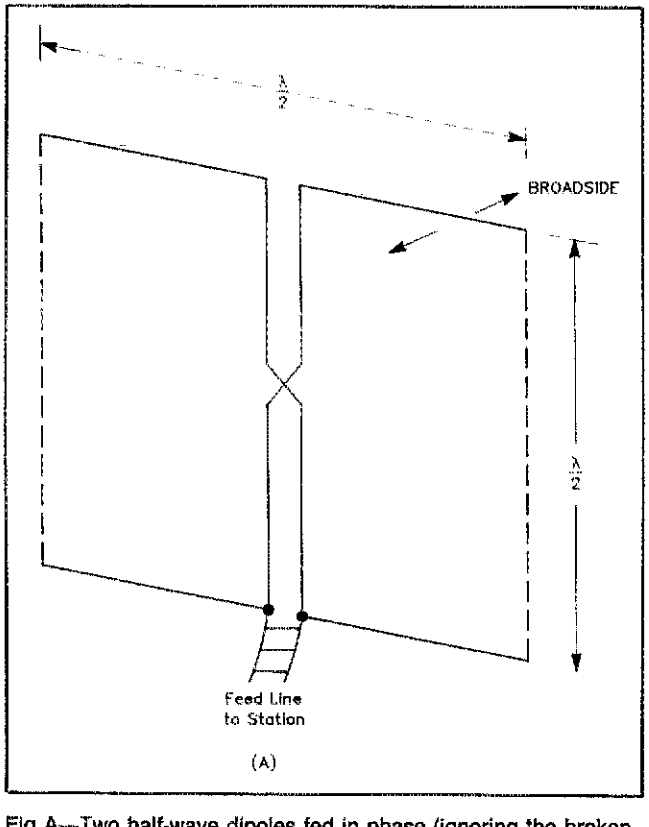


Fig A—Two half-wave dipoles fed in phase (ignoring the broken lines). Adding wires at the ends (broken lines), does not alter the phase and helps to equalize the power radiated from the two elements. This is the basic Sterba antenna section.

These wires actually carry power to the upper dipole, helping to equalize the power radiated from the lower and upper dipoles. Currents reaching the ends of the lower dipole no longer are reflected back toward the feed point, but instead continue up the vertical wires to the upper dipole. In this way, these single wires may also be considered as phasing lines. So considering the broken lines as representing wires, what you have in Fig A is your basic Sterba antenna section. It contains two half-wave elements.

Extending the Array

It has already been said, "The system obviously can be extended as far as desired." Actually, the antenna of Fig A by itself, with the vertical end wires, will do a very respectable job, but extending the array provides even better performance. This is done by adding more Fig A Sterba sections, simply stringing them together end to end.

Fig B shows a Sterba array containing two sections (four half-wave elements). Note that the added section, to the right in the drawing, is not fed independently. Instead, the single vertical wires are not installed at the junction of the two half-wave sections; the added section receives power through its direct connection to the dipole ends of the original section. This is possible because the currents in all the dipole elements of the array are flowing in phase, as indicated by the arrows in the drawing. Logically, an extended array should be fed as near the center as possible, to preserve symmetry and thereby maintain current balance in the feeder. The system may also be fed by opening and feeding a corner. This is sometimes done at a bottom corner with coaxial line and a toroidal step-up transformer. For either type of feed, the feed-point impedance is in the order of a few hundred ohms.

So now you can see that Fig 1 in the accompanying article is really nothing more than several Fig A sections connected in series—four such sections, to be exact. So the author properly refers to this antenna as having eight elements; each is a half wave in length.

Radiation Pattern and Gain

What kind of a radiation pattern and gain does the Sterba array have? Fig C shows the results of an analysis using a computer program based on *MININEC*, which performs calculations using a method of moments. The theoretical gain is approximately 8.1 dBd, and the 3-dB beamwidth is

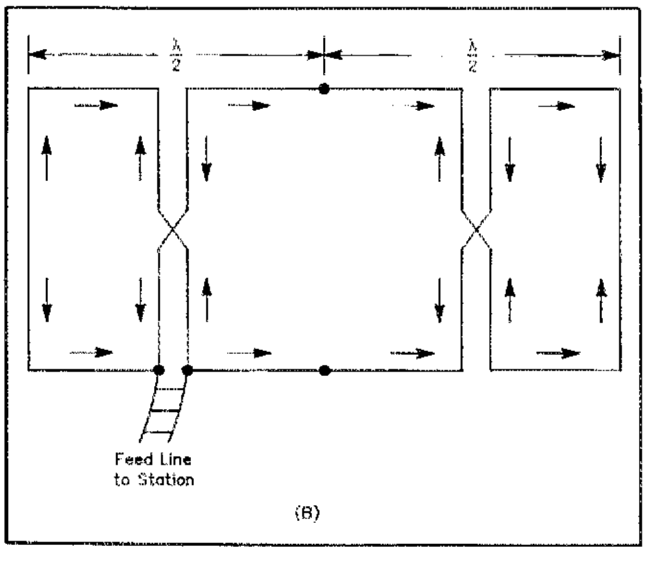


Fig B—A simple 4-element Sterba array containing two sections as shown in Fig A. The arrows show the direction of current flow throughout the array at a given instant. Radiation from the vertical wires tends to cancel, while that from the horizontal wires reinforces.

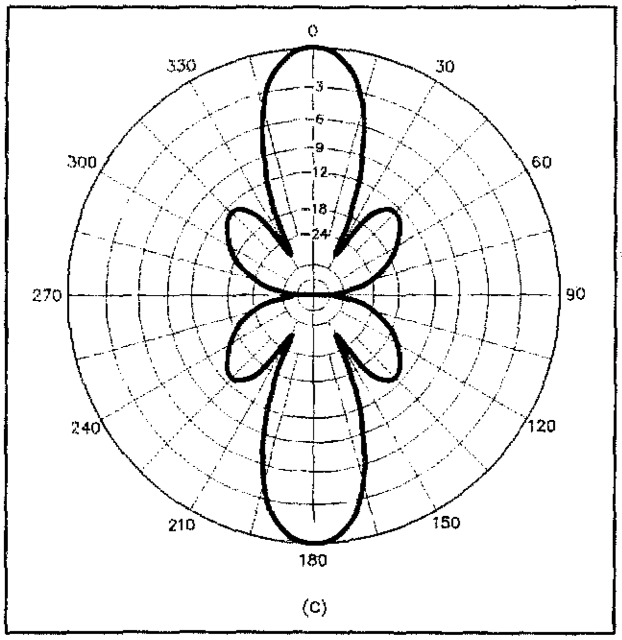


Fig C—Azimuth radiation pattern for the antenna of Fig 1, obtained from computer calculations using a *MININEC*-based program. The plane of the antenna is along the 90-270° line.

24°. Only the horizontal wires and the two vertical end wires were included in the computer model, so this is not a totally accurate analysis. In the real world, the beamwidth will likely be somewhat greater, the gain somewhat less, and the nulls of the pattern filled in slightly. Radiation from the interior phasing lines will contribute to these effects.

Whatever the case, you can be sure of one thing—a Sterba curtain works, and it works very well! I can vouch for that based on personal experience. Many years ago I was at a field site doing work on a propagation study. We had a 1200-ft-long rhombic antenna we used on occasion for 22-MHz communications with our net control station, roughly 5000 miles away. It was a time in the sunspot cycle when conditions were terrible, requiring a superb antenna. But the rhombic was dedicated for use in transmitting data most of the time, and that left us in need of a good antenna for point-to-point communications. We found a high dipole to be almost useless. In desperation, we hung a 12-element Sterba curtain between the side supports of the rhombic. Its upper bay was 70 feet (1½ wavelengths) above ground. The Sterba design came right out of *The ARRL Antenna Book*, but the book didn't give much of a clue about how it would perform. However, its performance was truly amazing, almost the same as the rhombic! And that for only a few hundred feet of wire, some rolls of open-wire line, and some insulators. You bet a Sterba curtain works!—*Jerry Hall, K1TD*

wax directly on the stove top. So Switch to Safety and use a double-boiler. I didn't think to try microwaving the wax.

Build the Antenna

Now build your Sterba curtain. You can assemble a curtain in a garage or basement, but I don't recommend it. Ever try to relocate a spider web?

Rus Healy, NJ2L, covered a lot of construction tips for wire antennas in his *magnum opus* on dipoles.[3] You might want to review those articles before starting on your curtain.

Dimensions for an eight-element, 10-meter Sterba are shown in Fig 1. Measure one dipole, then cut all the others to the same length. Remember to leave enough extra wire to wrap around the insulators. Do the same for the phasing lines. Although the phasing lines are also ½ electrical wavelength, they're physically shorter than the dipoles to account for the velocity factor of the 450-ohm balanced feed line (about 0.95 for the line I used).

It's a good idea to consider soldering the connections, too. Since you probably will be building this in the dead of winter, think about measuring all the dipoles and phasing lines inside, tinning all the wires, then moving outside for assembly. On really cold days even giant electric soldering irons strain—those nifty little butane-powered irons that you can buy at Radio Shack and elsewhere are a good alternative.

These antennas are not critical in terms of dimensions. Although I did measure the dipole elements carefully in the beginning, each time I replaced an "insulator" I lost about six inches of dipole length. I also somehow ended up with a couple of phasing lines perhaps as much as two inches too long. I'm sure there is a limit to how much of this you can get away with, but Sterba curtains seem to be very forgiving.

Put It Up

Let's assume you are using trees for supports. Much has been written on this subject. Methods suggested for getting ropes into trees include, of course, climbing them. I rule out this method because you want to get the rope as high in the tree as possible, which means up in the tiny branches where you can't climb.

Mechanical methods described over the decades run from bow-and-arrow to slingshot[4] to catapult. I know for a fact that none of these methods work because I have never tried them.

I went to a fishing supply store and bought some 6-pound-test line and a handful of sinkers. Then I bought a ball of small nylon twine. The big expense was for hundreds of feet of polypropylene rope (that, despite rumors, will last quite a while holding wire antennas).

I used the horseshoe-pitching method, swinging about three feet of the fishing line until I got the right momentum, then letting go. There's an art to this, and if you can't master it, use a slingshot or some other method.

The fishing line disappears once you reel it out onto the ground. It can easily become a hopeless bird's nest of knots and will break at the slightest provocation. I lost several sinkers and a lot of the fishing line on unsuccessful launch attempts, but the beauty of the stuff is that it's invisible up there in the trees and it's cheap.

The spectacle of a grown man or woman flinging fishing sinkers into trees can invite a visit by the attendants in white coats, so it might be prudent to do this when the neighbors are gone.

Now use the fishing line (you already know this) to pull up the nylon twine, then pull up your sturdy rope. You can reuse the twine to tie off the lower corners of your Sterba (see below). In the spring your lawn mower will easily locate the lost fishing line.

Keep in mind that in time the motion of the branches may saw through your big rope (or the tree may be hurt). Every few months you can reposition your curtain (and the ropes). I, of course, accomplished this by lowering my curtains several times to replace those furring strips.

Just as a clean car runs better, so a straight and level curtain works better. When you pull your curtain into position you will be overjoyed to see everything fall neatly into place. These are very elegant, graceful arrays. And the real beauty is that you can pull on all four corners. You can play with ropes and tension until all is shipshape.

Even if your top supports are at different heights, your curtain will find its own spot and level off nicely. I found the most rewarding part of putting up my curtains was being able to fine-tune them for esthetics. I absolutely will *not* climb a tower to reposition one Yagi element that is a degree off level, but readjusting ropes is easy and effective.

Feeding the Array

You'll need an antenna tuner that can handle balanced line. The Sterba is a beautifully symmetrical, electrically balanced antenna that tunes like a dream, and one setting of your antenna tuner covers at least a hundred kilohertz.

You can feed a Sterba with coaxial cable if you use an appropriate impedance transformer, but I don't recommend it. For the price of the coax you probably can buy or build an antenna tuner, and with coax you lose the ability to use the Sterba on other bands (more on this later).

I was fortunate to have two antenna tuners available, one for each Sterba. One tuner *could* be used with two Sterbas; you would need a way of switching the feeders to the two antennas (are double-pole, double-throw knife switches still made?). You also would want to make the Sterbas electrically identical so the tuner wouldn't have to be readjusted.

First Impressions

I started out with an eight-element Sterba aimed broadside at about 70/250 degrees (remember, Sterbas are bidirectional). It cooked from the moment I put power to it, the first contact being with ZD8LII on December 21 at 1250Z (a "band opener"). Three days later I tried it on 24 MHz—tuned up just like it did on 10 meters and blew a hole in the 12-meter band.

In a couple of weeks I was starting to think seriously about a single-band 10-meter effort in the ARRL CW DX Contest in February. Around Christmas, a ham friend from Austin came to visit. After plying him with a couple of Wild Turkeys, I dragged him out into the balmy 40-degree weather to observe another fishing line/sinker session, into the two trees I had scoped out for a north-south Sterba.

I built the second Sterba one evening that week, finishing up after dark, soldering by flashlight. The first contact on that antenna was with HH2PV in Haiti, followed by a string of Asian stations. This was a monumental occasion; I now had two aerials at right angles to each other (give or take 30 degrees).

The effect was astounding. Unlike a unidirectional Yagi or quad that takes time to rotate (forever, if you stumble across a station you *really* want to work), I could instantly switch to any of four directions. A Japanese station inaudible on the east/west array was S9-plus on the other array, and so on.

The evening of January 29 I logged BV2DA, BY4RB, and BZ4SAA, along with a slew of Asiatic Soviet stations. The next night saw HL2DIT, HL1XP, and VS6CT. This is great stuff, on any band, with any kind of aerial. I moved several of these stations down to 12 meters and worked them there, too.

But the best was yet to come.

With the contest just two weeks away, I lowered the east/west Sterba curtain and added four more dipole elements, making it about 90 feet long. I managed to reorient it to about 60/240 degrees, still some 20 degrees off optimum for Europe, but better than before. When you begin making antennas bigger at this level, the differences are difficult to discern. But the antenna was a lot *bigger*, giving me a psychological boost.

On the other hand, the 10-degree reorientation seemed to pay off. I did better into Scandinavia, and 4K2/UV3CC on Franz Josef Land gave me an S9 + 30-dB report.

These antennas seem to have very broad patterns (in two directions, of course). That's good, because neither of my Sterbas is optimally oriented to hit the high-population areas of Europe and Japan. The north/south antenna, at 5/185 degrees, from my Connecticut location, is about 20 degrees off for Japan and most of South America. You can't move the trees....

I believe these antennas have all the advantages noted for cubical quads—namely, they are quiet, and are great listening antennas because of their large capture areas. The 12-element Sterba has just over 200 feet of "active" wire (not counting the phasing lines) in it. Sterbas have the disadvantage of picking up signals off the back. But if there is one HF band where this is not often a problem, it's 10 meters.

A side benefit of the Sterbas has been their terrific performance on 12 meters; their patterns aren't as "textbook" there (they are 20 percent too small) but I break pileups with ease. Not many people have gain antennas on 12 meters yet.

My curtains will accept power on every amateur band from 1.8 to 28 MHz. They seem to have a little bit of gain on 20, 17 and 15 meters, but it's hard to tell where. Below 14 MHz they get out about as well as the traditional 135-ft center-fed flattop.

The Ultimate Test

In the days before the contest, I began listening to the band every morning, noting the appearance of the first Europeans. Ditto in the evening for Japanese stations on the other curtain.

I operated the contest using my curtains and a 600-watt amplifier. In the end, my score was good for fifth place in the single-band 10-meter (CW) category. Stations who beat me used stacked Yagi arrays. Although I had higher contact totals than several of the multi-transmitter stations, I lost the contest on multipliers (number of different DXCC countries). It is obvious that my curtain antennas have deep nulls off their ends. I worked only one African station, J52US, over the north pole late at night. I also worked almost nothing in the Pacific, another null in my system.

What I needed was a third Sterba or a small rotary Yagi or quad to "fill in the gaps." In early June I found the initiative to put up 60 feet of tower and a three-element triband beam. Thanks to the usual lousy summertime conditions there has been little opportunity to compare antennas. On a couple of sporadic-E openings to Europe, the tribander and Sterba were neck-and-neck. Into Central and South America, sometimes one or the other is significantly better. On summertime sporadic-E openings down the East Coast, the tribander almost always is a little better than the north/south Sterba for stations in the Carolinas, Georgia and Florida.

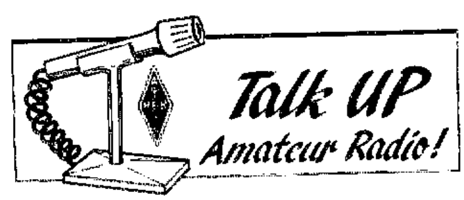
If the Sterbas are about as good as a beam, why not go with the beam? My two Sterbas cost less than a hundred dollars and are virtually invisible. A tribander on a 60-foot tower will cost a lot more and definitely is not neighbor-friendly. On the other hand, the Sterbas have reminded me of what amazing performers small tribanders are, considering their design limitations.

Here's an experiment for someone to try—a Sterba made for midway between 15 and 10 meters; that is, for 12.5 meters. I know it would work beautifully on 24 MHz, and suspect it also would rival a tribander on 10 and 15.

These arrays are so simple to build and erect, perhaps I'll try. Then again, why don't you?

Notes

[1] J. Schultz, "A New Look at Some Classic Wire Antennas," *CQ*, Jan 1991, pp 32-34.
[2] J. Hall, Ed., *The ARRL Antenna Book*, 16th ed, pp 8-41 and 8-42.
[3] R. Healy, "Antenna Here is a Dipole," *QST*, Jun 1991, pp 23-26 and "Feeding Dipole Antennas," *QST*, Jul 1991, pp 22-24.
[4] W. Calvert, "The EZY Launcher," *QST*, Jun 1991, pp 34-35.



Strays

I would like to get in touch with...

☐ anyone who has a complete schematic for a Tandy 4000 computer. Robert Fevery, ON6FY, 7, Waterpolder, B9992 Middelburg, Belgium.

☐ anyone with documentation on a Kikusui Electronics Corp (KEC) model 536A oscilloscope. Jim Yex, WB3CQA, 2189 Lancelot Dr, N Huntingdon, PA 15642.

8) The Executive Committee discussed, without formal action, ARRL cooperation with industry to promote Amateur Radio.

9) On motion of Mr. Mendelsohn, the names of 82 newly elected Life Members were recognized, and the Executive Vice President was directed to list their names in *QST*.

10) On motion of Mr. Butler, the following clubs were declared affiliated:

Category I

Blackhawk DX & Contest Club, Rockford, IL
Florida Amateur Radio Society, Largo, FL
Kentucky Contest Group, Harlan, KY
Left Coast Contest Club, Marysville, WA
Lone Star DX Association, Garland, TX
Mid-Columbia ARC, Goldendale, WA
Northern Lake County ARC, Lindenhurst, IL
Palm Beach ARS, Lantana, FL
Pasco County Local Area Network, Bayonet Point, FL
Patriot DX Association, Pride's Crossing, MA
Quad City Amateur Television Club, Long Grove, IA
Southeast Louisiana ARC, Hammond, LA
Troy Amateur Radio Association, Green Island, NY
U.H.F. Associates, West Covina, CA
Underground Discharge ARC, North Plainfield, NJ
Yavapi Amateur Radio Club, Prescott, AZ

Category III

Inter-Lakes High School ARC, Meredith, NH
Lake Washington Technical College ARC, Kirkland, WA
University School ARC, Shaker Heights, OH

The following clubs have been affiliated by mail vote of the Executive Committee since the previous meeting:

Category I

Burleson Amateur Radio Society, Alvarado, TX
East Pasco ARS, Dade City, FL
Eastern Amateur Radio Service, Watermill, NY
Hercules Amateur Radio Club, Hercules, CA
Houston Amateur Radio Helpline, Houston, TX
Jonesboro Area Amateur Radio Operators, Hodge, LA
Pasco Hills DX Association, Zephyrhills, FL
Pearl River County ARC, Inc., Picayune, MS
Porterville Amateur Repeater Assn., Inc, Porterville, CA
Southeastern CT Radio Amateur Mobile System, Groton, CT
Voice of Aladdin ARC, Columbus, OH
Amateur Communications Society, Inc., San Rafael, CA
Batesville Area ARC, Batesville, AR
Great Dismal Swamp DX Association, Virginia Beach, VA
Middle Georgia Radio Association, Warner Robins, GA
Pine State ARC, Old Town, ME
Radio Amateurs of Northern Vermont, South Burlington, VT
Sam's Point ARC, Montgomery, NY
Satellite Communications Research Group, Wallingford, CT
Southwestern React ARC, San Diego, CA
Sweetwater Douglas County ARC, Douglasville, GA

Category II

Mobile Amateur Radio Awards Club, Inc., Rochester, MN

Category III

Easton High School ARC, Easton, MD
Henry Ford Community College ARC, Dearborn, MI
University ARC, (University of Alabama), Tuscaloosa, AL
University of Pittsburgh Panther ARC, Pittsburgh, PA
Watertown High School ARC, Watertown, CT

Category IV

Amateur Radio Council of Arizona, Phoenix, AZ

11) Convention matters.

11.1) On motion of Mr. Butler, the holding of the following ARRL conventions was approved:

Northern Florida Section, March 13-15, 1992, Orlando, Florida
International DX, April 10-12, 1992, Visalia, California
North Carolina State, April 12, 1992, Raleigh, North Carolina
West Gulf Division, June 5-7, 1992, Arlington, Texas
Tennessee State, June 6, 1992, Knoxville, Tennessee
Hudson Division, June 6, 1992, Teaneck, New Jersey
Northwestern Division, June 12-14, 1992, Seaside, Oregon
Missouri State, August 1-2, 1992, Springfield, Missouri
Texas State, August 7-9, 1992, Austin, Texas

The following conventions have been approved by mail vote of the Executive Committee since the previous meeting:

New England DX, November 9, 1991, Framingham, MA
South Texas Section, November 8-10, 1991, Houston, TX
Delta Division, April 4-5, 1992, North Little Rock, AR
Atlantic Division/NY State, May 15-17, 1992, Rochester, NY
Midwest Division, May 22-23, 1992, South Sioux City, NE
Georgia State, June 19-20, 1992, Albany, GA
Central Division, July 11-12, 1992, Indianapolis, IN
Southeastern Division, July 17-18, 1993, Atlanta, GA
Southwestern Division, September 17-19, 1993, Ventura, CA

11.2) As host director, Mr. Heyn reported on preparations being made for the 1992 ARRL National Convention in Los Angeles, and for publication sales by staff at the ARRL booth at the convention.

12) Other business

12.1) The Committee discussed the presentation made earlier in the day by Mr. Loughmiller. On motion of Mr. Mendelsohn, it was voted that the League shall conduct a direct mailing to members seeking voluntary contributions in support of the Phase 3D program with a goal of raising $300,000 from ARRL members by the end of 1992, as requested by AMSAT-NA.

12.2) Contest log-checking procedures. On motion of Mr. Butler, it was voted that a letter regarding perceived inequities be referred to the Membership Services Committee.

12.3) The Executive Vice President was requested to circulate to the Board copies of all agreements with other organizations to which the ARRL is a party.

12.4) The Executive Vice President was requested to review the means by which accurate information regarding breaking news can be more effectively communicated to members, and to present recommendations to the Board.

There being no further business, the meeting was adjourned at 5:59 P.M.

Respectfully submitted,
David Sumner, K1ZZ
Secretary

LIFE MEMBERS ELECTED 10/26/91

Jonelle L. Allen, KQ4P; Ricky D. Beach, N8KKO; Andrew W. Bonnot, KF5QR; Pieter F. Borsboom, KC4VDE; D. Craig Boyer, WE5I; Mark E. Brown, WA3GON; John W. Buchignani, KA3VBY; Leonard A. Buonaiuto, KE2LE; David R. Burgess, WA2TVS; Margaret D. Burgess, KB2BRR; Jonathan Canfield, N1DYM; Elmer D. Carter, WB4ZAT; John P. Chapman, WA1K; G. Warren Coleman, WD4NIT; Greer W. Craig, AA5HN; William L. D'Agostino, WB1DMK; Kasandra L. De Graff, KC6ZMY; Alan W. Dietrich, KB6JES; Jerry V. DiTrolio; Charles W. McElwee, K3QMK; Bill Fairchild, WO2V; Dave Farnsworth, WJ2O; Henry Fehrmann, N4EDQ; John Robert Finch, NØLGY; Keith A. Gleason, WD4PQZ; Donald B. Gouin, K1CMM; Chris Gramlich, N2EBT; Jerry Greathouse, AA5QW; Norman Hanson, WØRSD; Berlin L. Harshbarger, N8QAL; Frederick G. Heffner, W1CKV; Karl Hess, WF5A; John Homme, N6RUI; Douglas S. Howard, KG5OA; John H. Huber, N8FYL; David M. Ihle, WB5MSB; John D. Inscor, N4WGE; Michael Wayne Invergo, N4MUJ; Timothy Isom, WD9HDQ; A. William Jaacks, NQ2W; Marilyn J. Jackson, KD4O; David D. Johnson, WB6QMO; John T. Ju, N6VBH; James L. Kerr, K8KJ; Richard A. Kuhljuergen, KAØYAP; Lorin R. Lammers, N6HIQ; John S. Landry, WA2JGE; Robert O. Landry, WB2AVC; Denton K. Larson, WBØZUR; James T. Lee, KN4FW; John Leekley, Jr., WB9SMM; James D. Lent, N1HGM; Carol D. Lewin, KC6ECO; James E. Lewin, WD6FET; Martin J. Lynch, KA1LXG; Bill Machia, N3HTJ; Dan Magro, KV6I; Larry Makoski, N2ELW; Gene Marshall, AA6IY; John McClain, N3HUH; Dave Messinger, N4QPM; Wilton P. Myerson, NH6D; Scott H. Nolte, N6CUV; Robert L. Norton, KUØP; Alfonso M. Paolantonio, NN1U; Willie E. Pruitt, KC4IYU; Franklin Radatz, KF8BJ; Rolf Ramseyer, WB2DPF; Bob R. Russell, WB5NMB; John A. Schell, KD3KX; Alfred A. Schwarz, ND2K; Helmut K. Seike; Luke E. Sheridan, NB3V; Joel S. Sitko, N9GBA; Richard D. Sizemore, WX9P; Barton A. Smith, N6HDN; William T. Spurgeon, KAØINS; Wayne M. Sutherland, NQ7Q; John A. Teipen, WXØQ; Robert E. Weissman, NV1D; Vernon M. Wells, WC4C; Stephen W. Wessels, AAØAI; Frederick M. Whitaker, WA2GZW; Walter W. Wilson, N6VYB; David S. Worcester, AF1L; Stephen W. Worden, NN3M.

Feedback

☐ The text description of the current flow in a Sterba array is in error in October 1991 *QST* (the sidebar "Technical Stuff," pp 28-29 accompanying "Curtains for You"). The text wrongly states that adding single vertical wires at the ends of the two dipoles in Fig A does not disrupt the current flow. Actually, adding these wires shifts the current loops or maxima by ¼ λ, to the corners of the square. The nodes or minima exist at the feed points, as shown in Fig 4 here. The phasing diagram of Fig B in "Technical Stuff" is correct. Phase-reversal points for current are not shown there, but exist where the phasing lines are attached (four places) and at the centers of the vertical end wires. Thanks to the many readers who pointed out this error.—*Jerry Hall, K1TD, Associate Technical Editor*

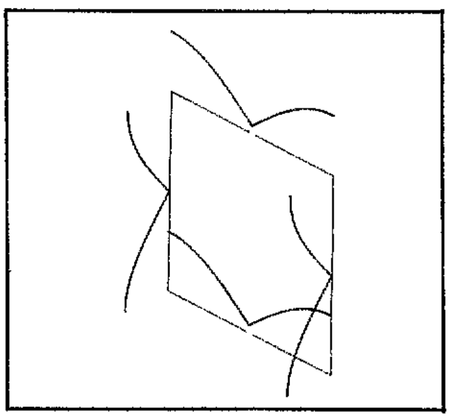


Fig 4—Amplitude of current flow in the basic Sterba section, Fig A, p 28 of October 1991 *QST*. This drawing omits the phasing line for clarity. The gain of this array is approximately 6.54 dBi. *(Array calculations performed with* MN.)