The Case of the Curly Collinear

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Sometimes only a couple of back-to-back questions about the same antenna will spark my interest in it. The curly collinear is just such an antenna. Everyone has seen them mounted on cars, trucks, and SUVs. But apparently, not everyone is familiar with how they work.

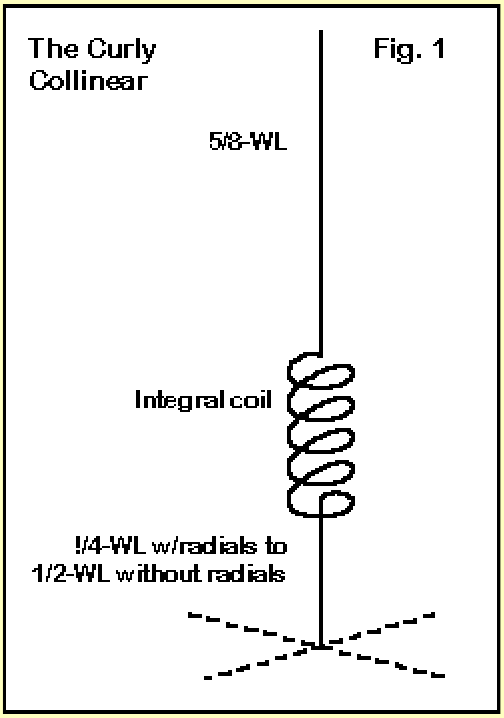

Fig. 1 shows a sketch of a typical curly collinear. The upper section is about 5/8 wavelength. The lower section can be a 1/4-wavelength or 5/8-wavelength monopole--with and without radials in commercial implementations--or even a 1/2-wavelength dipole. Some folks have believed--without looking--that the coil creates a 2-band antenna. However, the coil is actually a method of getting the upper and lower sections in phase, in part, by compensating for the heavy capacitive reactance of the upper 5/8-wavelength section, and in part by separating the two sections to increase the gain.

The beauty of commercial versions of the antenna is that we can fabricate the two vertical sections and the "phasing" coil from a single piece of stainless steel or other suitable antenna material. By removing mechanical connectors along the antenna length, we increase the durability of the antenna. It will survive almost anything except closing the garage door on it.

Having said what the antenna is and having given the core of how it works, I suppose that I could stop here. Had I received only one question about the antenna, I might have quit at this point. But multiple questions got me to wondering. 1. Why do we use these antennas when we can make compact monopoles? 2. What principles of collinear arrays are involved in these antennas? 3. Can I model them adequately--at least adequately enough to show reliably the general trends of performance? Those are enough questions to fill an article.

The Standard Vertical Antennas

The standard antennas used by amateurs for mobile work are the 1/4-wavelength monopole and the 5/8-wavelength monopole, both with radials, along with variations on the 1/2-wavelength dipole. **Fig. 2** shows their relative sizes.

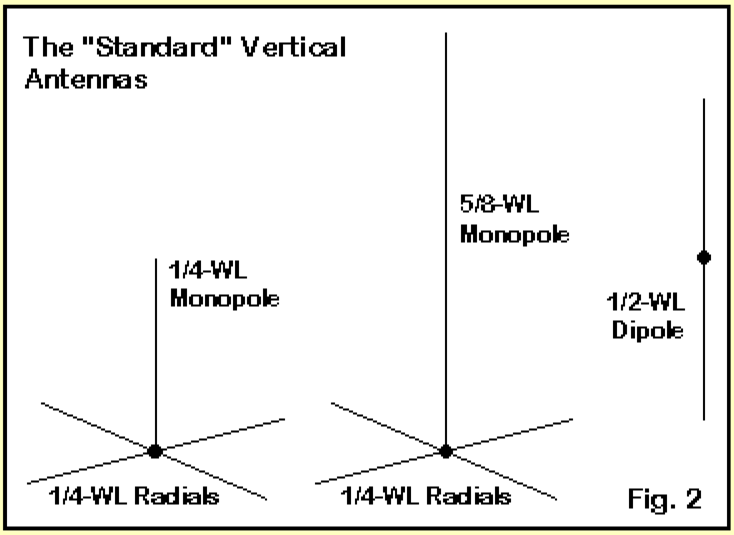

Fig. 2

Some of the monopoles are mag-mount versions that use the vehicle surface in lieu of a radial system. Nonetheless, antennas of each type--whatever the advertising hype--tend to perform similarly, with allowances for the quality of construction and, hence, the losses in the assembly.

To answer our first question of why we might use a vertical collinear array, let's explore the operating characteristics of the standard antennas. We shall use some common characteristics for all of the antennas to be explored. The material will be 1/8" (0.125") diameter aluminum. The operating frequency will be 435 MHz, the center of the 70-cm band. The operating frequency shows why the use of aluminum is harmless; that is, it covers virtually all materials we might use. The diameter is fat enough to reduce differences among materials from silver to stainless steel to a negligible level. As well, the 70-cm band is wide enough so that SWR curves covering the entire band from 420 to 450 MHz give us a useful benchmark.

For each antenna, I shall present a table of dimensions, including the length of any vertical sections and the length of the radials, if used. The table will also include performance data, including a take-off angle. The base height of each antenna will be 60" (2.21 wavelengths) above ground to simulate a small truck or SUV mount. I shall explain any special table entries as they appear. Since the figures are predicated on NEC-4 models of the antennas, I also provide the Average Gain Test (AGT) score for the model in order to establish its reliability. Interestingly, every one of our models will have a score just under 1.0, so the absolute value of the gain correction factor--given as a gain deficit--can be added to the reported gain. The amount is in all cases too small to be range-measured, let alone detected in operation.

Following the tables will be some graphics. One set will include elevation and azimuth plots for the antennas as situated above average ground. Most, but not all, of the azimuth patterns will be boring circles. At least initially, we shall be mostly interested in the elevation patterns, especially as they bear on our first question. We shall also record the 70-cm band SWR curve for each antenna, since most of these antennas find use in the widest portion of the band devoted to FM service.

The 1/4-Wavelength Monopole: Our 1/4-wavelength monopole model is the baseline due to its familiar nature and almost universal use. We have all learned how to make such an antenna with nothing more than a coax connector and a few scraps of house wiring.

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1/4-Wavelength Monopole

Vertical length	**6.75"**	**AGT: 0.959 = -0.18 dB**
Radial length	**6.35"**	

Gain: 4.63 dBi TO angle: 5.2 deg. Feed Z: 24.6 - j 0.5 Ohms

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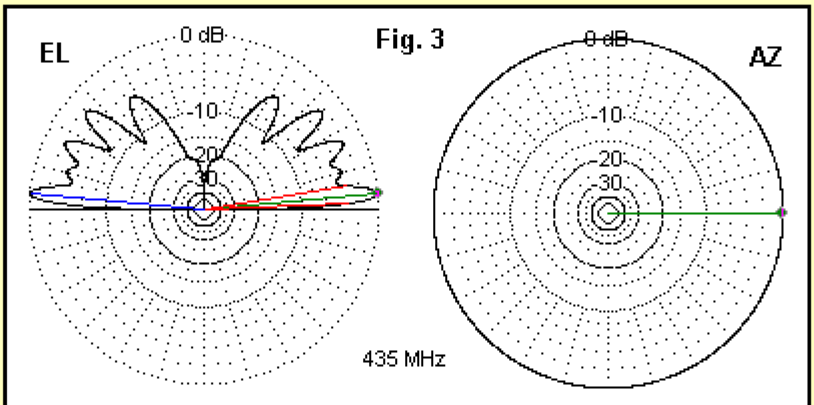

Fig. 3

Elevation and Azimuth Plots of 1/4-WL Monopole

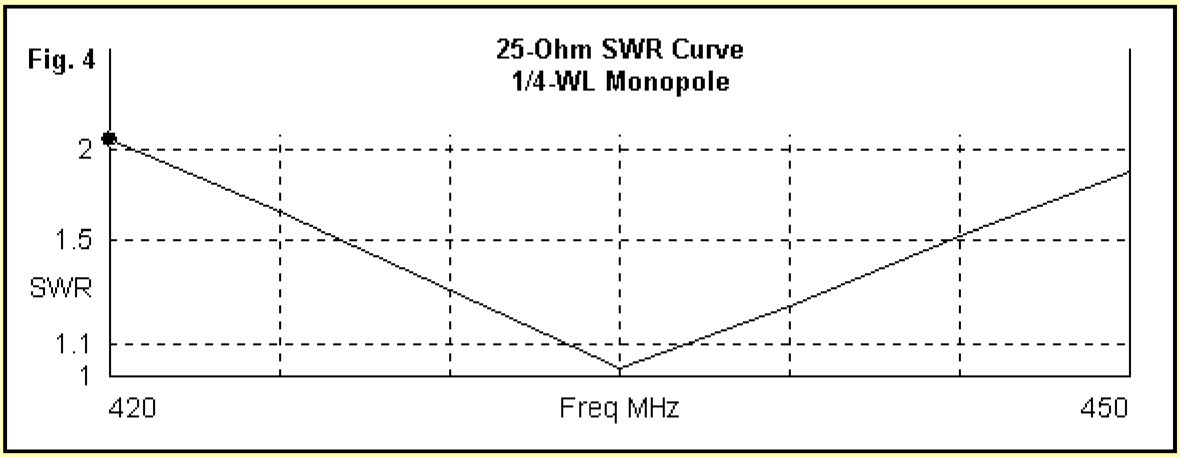

Fig. 4

25-Ohm SWR Curve
1/4-WL Monopole

The quarter-wavelength monopole has a low main lobe, but it places most of its energy in much higher and relatively useless lobes. The elevation pattern in **Fig. 3** displays this property clearly. The 25-Ohm SWR curve in **Fig. 4** tells us that with a simple matching section or system, we can cover virtually the entire 70-cm band with under 2:1 SWR. We may droop the radials to raise the impedance closer to 50 Ohms to directly match our coax feedline.

The 5/8-Wavelength Monopole: The popularity of the 5/8-wavelength monopole arose initially from advertising hype of a 3 dB improvement based on the theoretical capabilities of the antenna. Unfortunately, over real ground of any sort, the antenna does not achieve its theoretical potential. This becomes clear in both the tabular and graphic data. In urban mobile use, the 5/8-wavelength monopole sometimes shows superiority over its short cousin because the maximum current region is higher and may be above the level of surrounding vehicles.

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5/8-Wavelength Monopole

Vertical length	**17.00**	**AGT: 0.951 = -0.22 dB**
Radial length	**6.35"**	

Gain: 4.76 dBi TO angle: 4.8 deg. Feed Z: 77.8 - j 215 Ohms

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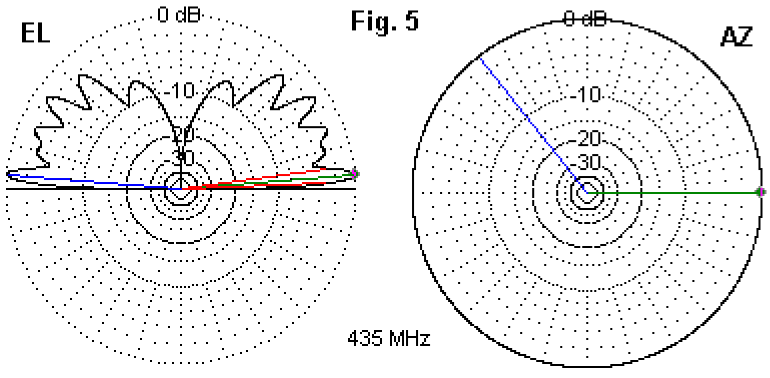
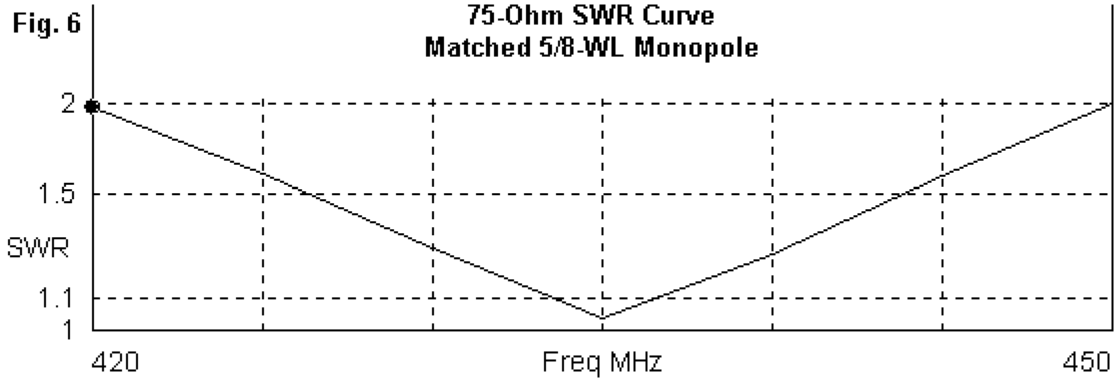
Fig. 5



Elevation and Azimuth Plots of 5/8-WL Monopole

Fig. 6



As shown in **Fig. 5**, the lobe structure of the 5/8-wavelength monopole is only slightly different than the corresponding lobe structure of the 1/4-wavelength monopole. Considerable energy heads upward at angles beyond usefulness for most VHF and UHF mobile purposes. The SWR curve in **Fig. 6** used a simple inductive load to compensate for the high capacitive reactance. The resulting matched 75-Ohm SWR curve then turns out to be as broad as the corresponding 25-Ohm curve for the short monopole.

The 1/2-Wavelength Dipole: Despite complexities of feeding a vertical dipole for mobile or portable use, it remains a standard antenna type and requires coverage with our monopoles. So we shall include it for reference. Of course, it uses no radial system.

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1/2-Wavelength Dipole

Vertical length 12.70 AGT: 0.999 = -0.00 dB
Radial length -----

Gain: 5.43 dBi TO angle: 5.0 deg. Feed Z: 72.1 + j 0.4 Ohms

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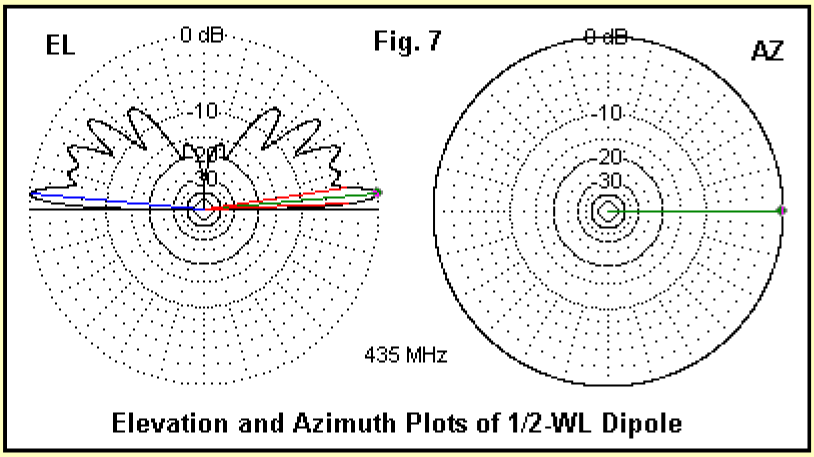
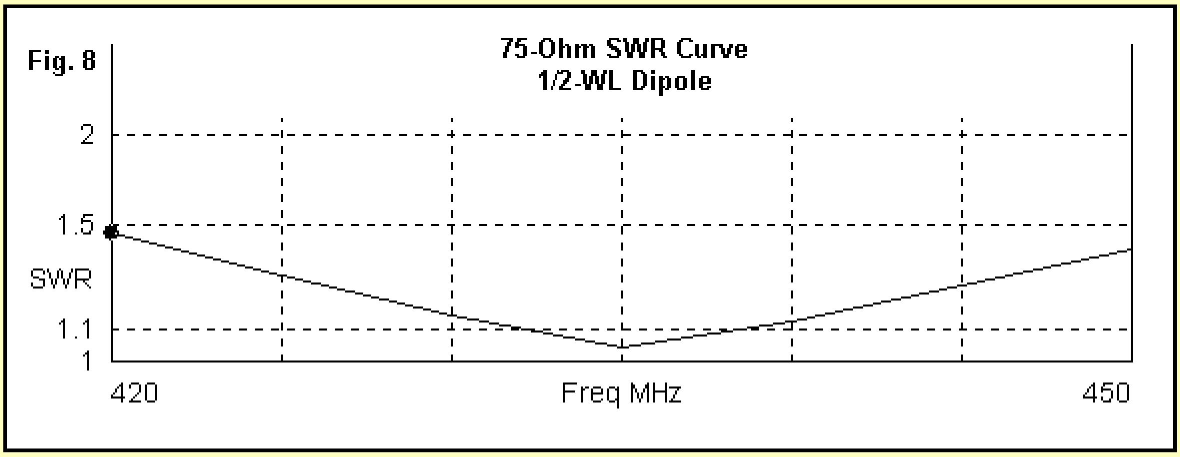


Elevation and Azimuth Plots of 1/2-WL Dipole



The dipole shows a small improvement over the monopoles, but likely insufficient to warrant any special efforts required for the feedpoint and the cable to prevent the occurrence of common mode currents. As the elevation pattern in **Fig. 7** shows, the upper lobes are a bit weaker than those of the monopoles, but still filled with largely wasted energy. One clear advantage of the dipole appears in **Fig. 8**. The 75-Ohm SWR curve shows a maximum SWR at the band edges of about 1.5:1.

The sum of our brief review of standard antenna types amounts to this: they all exhibit wasted energy at high elevation angles. If we could recover some of that energy and re-direct it at a low elevation angle, we might improve the performance of our vertical antennas, whether or not in mobile service. And that is where the collinear array enters the picture.

The Traditional Collinear Array

Essential background on the collinear array appears in Chapter 8 of the current (19th) edition of *The ARRL Antenna Book* (pages 8-35 to 8-39), written by Rudy Severns, N6LF. The original home for the collinear array was the HF region, where one might piece together a number of horizontal 1/2-wavelength wires, end-to-end. The key to obtaining gain is to operate them in phase, and the natural link between sections was the 1/4-wavelength shorted stub or phasing section.

Adaptation to VHF vertical applications in the 1960s was initially simplistic. The horizontal wires were center-fed. If we cut the array in half and stood it vertically (with help to prevent the wire array from sagging), we might obtain gain. Unfortunately, as I learned from copying a magazine design in the 1970s, the so-called phasing section was not a simple matter at all, as most of my radiation went skyward and my trusty house-wire monopole regularly outperformed the rudimentary collinear array.

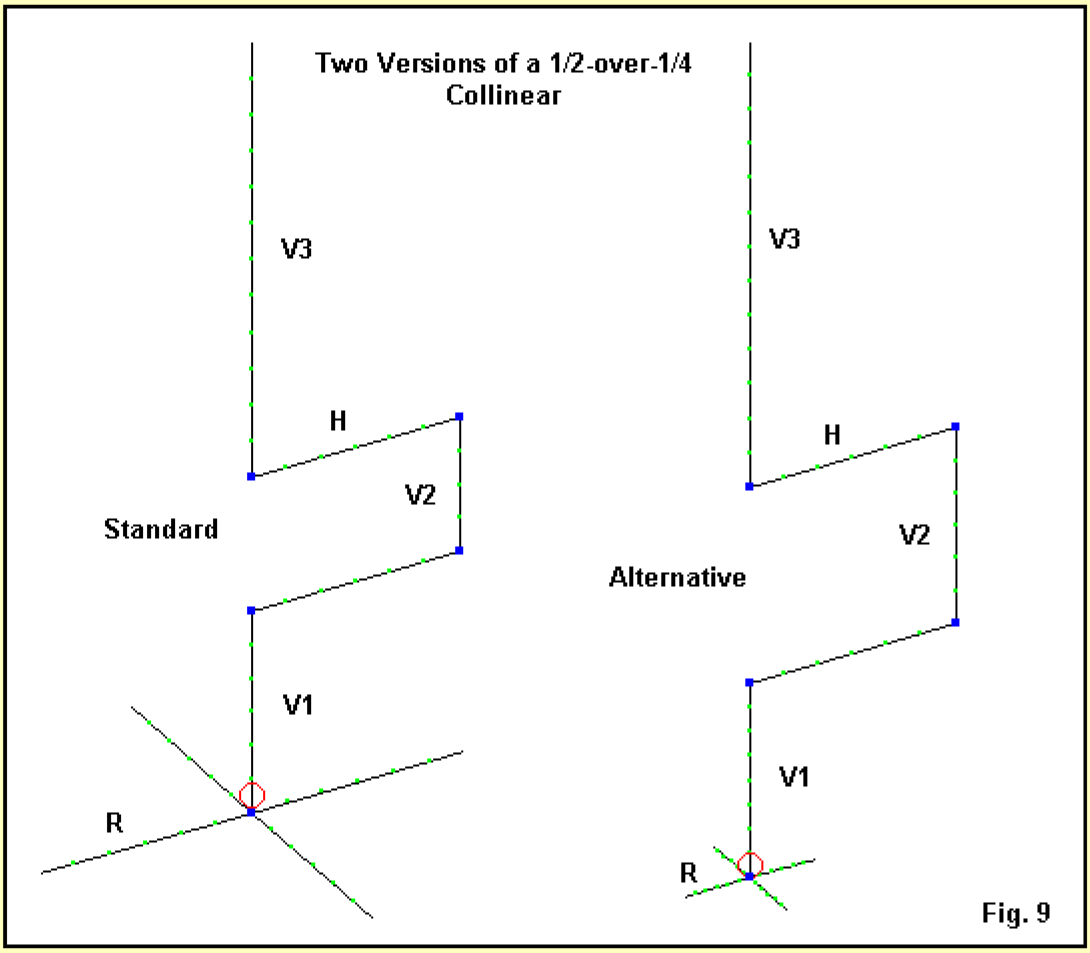
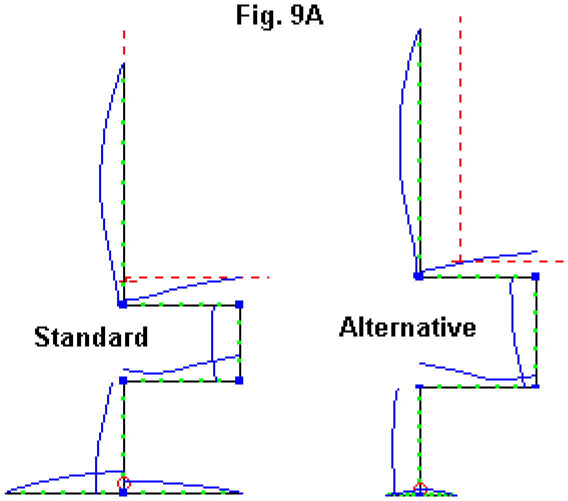


Fig. 9 shows two different kinds of designs that we might terms fundamental. The standard design uses a ¼-wavelength monopole topped by a 1/2-wavelength section. The monopole requires standard length radials. However, the phasing section is perhaps the most surprising feature. It is too wide from the top wire to the bottom wire to view as a transmission line stub, even though the horizontal dimension is about ¼-wavelength. Its vertical width contributes to the radiation, and the horizontal sections of the flag-like section also influence the pattern. The spacing between the lower and upper sections is necessary to obtain maximum gain in the lowest elevation lobe of the pattern.

The alternative design is based on the fact that we can feed a dipole--of which the monopole with a set of radials is a variation--anywhere along the dipole length as an off-center-fed antenna. Hence, we may reduce the radial lengths to the point where just the mounting base will suffice for that service. The remaining dimensions will change to yield both the desired pattern and the feedpoint impedance.

In vertical use, then, the collinear array has additional properties besides contributing to broadside gain. Elevation angle and feedpoint impedance are also matters of concern, since we normally operate these antennas with coaxial cable and no antenna tuner. The combination of functions, focused in the phasing section of the array, yield a pattern of current distribution quite unlike the idealized patterns we sometimes see in texts.

Fig. 9A



Current Magnitude Distribution in Two Versions of a 1/2-over-1/4 Wavelength Section Collinear

Fig. 9A shows the current magnitude distribution on the two variant designs that we shall individually examine. Ideally, we might expect the current magnitude curve in the vertical portion of the phasing section to be symmetrical, with descending currents along the horizontal wires. Quite another pattern appears in reality such that the entire system lacks balance. Even the upper half-wavelength does not have its peak at the center, but somewhere above that point. Such patterns are typical of phasing sections in vertical arrays, and we saw similar patterns in various J-pole designs. (See "Some J-Poles That I Have Known", Parts 1-4, ../vhf/jp1.html.)

The two designs sketched in the graphics are only two of many possible designs for a fundamental 1/2-over-1/4 wavelength collinear vertical array. My interest in these stems from my desire to know if one can adequately model a collinear array. In flag-phase-section form, they are perhaps the simplest to model and among the most tedious to tweak on the way to optimizing the pattern. Both designs are geared toward a 100-Ohm feedpoint impedance, with the idea of using a quarter-wavelength 70-75-Ohm matching section on the way to a 50-Ohm main feedline. In each dimension table, we shall encounter 3 vertical lengths, as designated in **Fig. 9**. As well, we shall note the horizontal length of the phasing flag.

The Standard "Flag" 1/2-Over-1/4 Collinear Array: We might easily build the standard design from a 35.4" length of 1/8" rod, assuming that we can make good, sharp bends and that our modeled design translates into a physical antenna having the same dimensions. One advantage held by commercial makers is that they can run through many prototypes on the way to final factory fabrication. The average backyard builder must find alternative uses for failed 1-wire versions if he is to not feel guilty for wasting the aluminum rod.

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Standard 1/2-Over-1/4 Collinear Array

V3 length	**13.0"**
V2 length	**4.0"**
V1 length	**6.0"**
Horizontal length	**6.2"**
Radial length	**6.35"**

AGT: 0.951 = -0.22 dB

Max. Gain: 7.33 dBi Gain Differential: 2.17 dB Mean Gain: 6.25 dBi
TO angle: 4.8 deg. Feed Z: 96.8 + j 0.4 Ohms

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The pattern for the standard flag collinear array is a broad oval with over 2-dB difference between maximum and minimum gain levels. The tabulated data provides one measure of the imbalance. The current distribution in **Fig. 9A** goes a long way toward showing the source of the non-circular pattern, with unbalanced current levels everywhere on the structure, especially in the radials and the phasing wires.

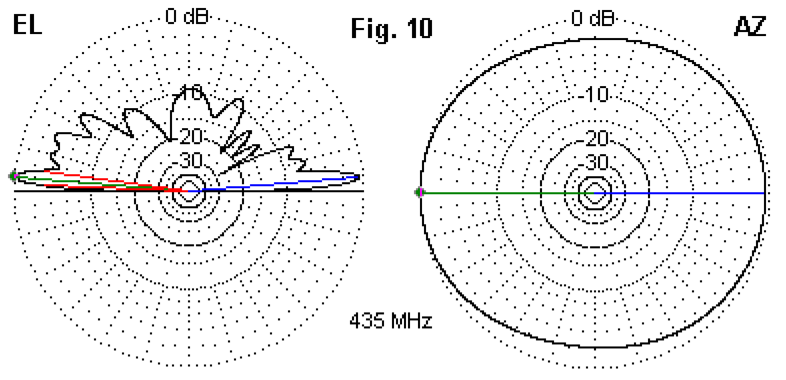

Fig. 10

Elevation and Azimuth Plots of Standard 1/2-over-1/4 Collinear

Both the elevation and the azimuth patterns in **Fig. 10** are interesting as they reveal the results of the current imbalance. The azimuth pattern is not only non-circular, but as well shows a slight egg-shaping to the oval. The elevation pattern, taken along the axis of maximum gain, shows considerable dissimilarity in the lobe structures on each side of the vertical assembly.

The Alternative "Flag" 1/2-Over-1/4 Collinear Array: The alternative structure provides a partial correction to the misshapen azimuth pattern provided by the standard model. Although the phasing wires appear to have a greater imbalance than on the standard design, the very short radials have a much more equal set of currents. However, the short radials require that the upper section of the antenna use about 38.3" of rod, an inconvenient length for the home builder who tries to get something useful from every 6' length of rod purchased from mail order houses or home centers.

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Alternative 1/2-Over-1/4 Collinear Array

V3 length	**13.7"**	**AGT: 0.958 = -0.19 dB**
V2 length	**6.0"**	
V1 length	**6.0"**	
Horizontal length	**6.3"**	
Radial length	**2.0"**	

Max. Gain: 7.48 dBi Gain Differential: 1.36 dB Mean Gain: 6.80 dBi
TO angle: 4.7 deg. Feed Z: 116.4 - j 3.2 Ohms

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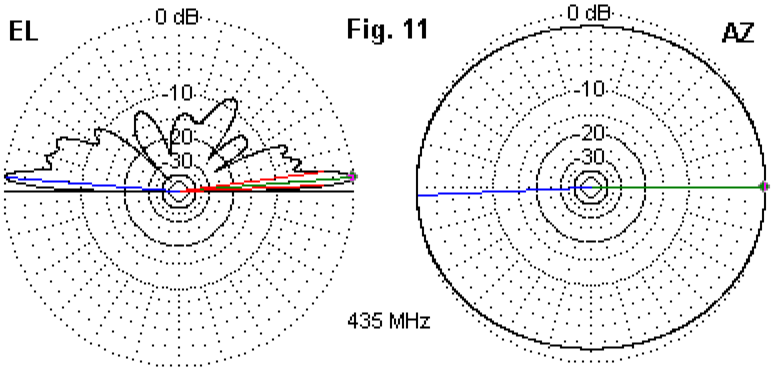
The ovalization of the azimuth pattern, shown in **Fig. 11**, is only a little more than half that of the standard design. However, the elevation pattern shows as much imbalance left and right of the vertical center line as did the corresponding pattern for the standard design.

Fig. 11

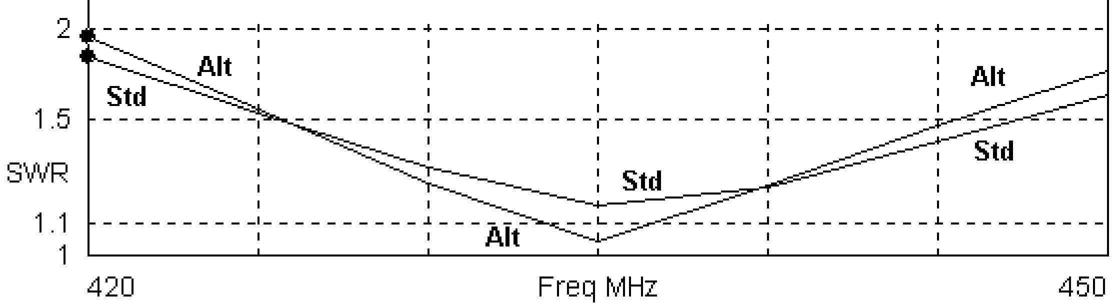


Elevation & Azimuth Plots of Alternate 1/2-over-1/4 Collinear

In practice, there is not much to choose between the two designs. The SWR curves in **Fig. 12**--based on a reference impedance of 112 Ohms, an idealized value for a 75-Ohm quarter-wave matching section--show that either design will cover the entire 70-cm band, if only barely within the 2:1 standard so often used for SWR values.

Fig. 12

112-Ohm SWR Curves
Standard and Alternate 1/2-over-1/4 Collinears



The question with which we are faced is how to make a collinear array with a truly circular pattern.

Folding the Phasing Section of a Traditional 1/2-Over-1/4 Collinear Array

One early measure taken to prevent harm to the flag-like phasing section of a traditional 1/2-over-1/4 wavelength collinear array was to fold the section around the central vertical elements. To see what this measure might do to and for the collinear arrays that we have just examined, I revised the models in the general shape shown in **Fig. 13**.

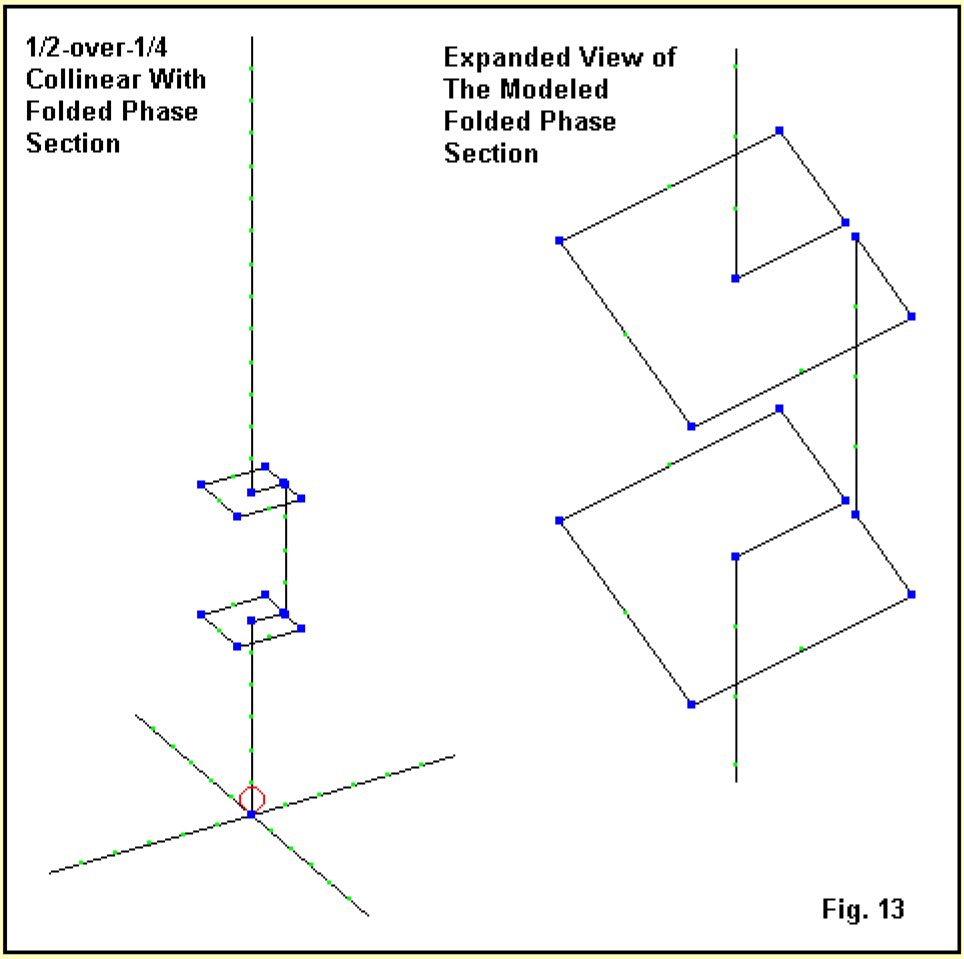


Fig. 13

The key difference in the new models is the squared fold-around phasing section. The section is 2" on a side, with a spacing of 1" from the central vertical sections. Due to the diameter of the wires (0.125"), I terminated the section 0.15" short of closing the gap. Hence, the total horizontal length of the phasing section is 8.85", and with one model, further revisions of dimensions proved necessary to bring it into line with respect to pattern shape, gain, and feedpoint impedance.

The Standard 1/2-Over-1/4 Collinear Array with a Fold-Around Phasing Section: The standard collinear array required only a slight lengthening of the top vertical section to bring it into usable shape, as shown by the tabulated information.

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Standard 1/2-Over-1/4 Collinear Array

V3 length	**14.2"**	**AGT: 0.953 = -0.21 dB**
V2 length	**4.0"**	
V1 length	**6.0"**	
Horizontal length	**8.85"**	
Radial length	**6.35"**	

Max. Gain: 7.08 dBi Gain Differential: 0.33 dB Mean Gain: 6.75 dBi
TO angle: 4.7 deg. Feed Z: 97.7 + j 5.0 Ohms

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The top vertical section grew by 1.2", and the mean gain of the array also grew a bit. The non-circularity of the pattern is down to only 0.33 dB, a value with which virtually any user can live. Equally apparent in the patterns in **Fig. 14** is the much better balance in the elevation lobes left and right of the vertical center line. As well, there appears to be an overall decrease in the high angle radiation levels.

The Alternative 1/2-Over-1/4 Collinear Array with a Fold-Around Phasing Section: The alternative basic collinear array also benefits from the fold-around phasing section. However, as the following tabulated data shows, its dimensions show a much larger departure from the initial dimensions. It is likely that some of these variations might have been avoided by using a slightly larger set of outer dimensions for the phasing section. As previously noted, there is no single design maneuver one must use in arriving at a useful--or at least plausible--array design.

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Alternative 1/2-Over-1/4 Collinear Array

V3 length	**14.4"**	**AGT: 0.968 = -0.14 dB**
V2 length	**6.0"**	
V1 length	**7.6"**	
Horizontal length	**8.85"**	
Radial length	**2.0"**	

Max. Gain: 7.75 dBi Gain Differential: 0.20 dB Mean Gain: 7.65 dBi
TO angle: 4.5 deg. Feed Z: 111.7 - j 5.8 Ohms

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Lengthening both vertical sections yields a small increment of overall gain improvement, with a reduction in gain differential to only 0.2 dB. The patterns in **Fig. 15** show the results. Indeed, the alternative 1/2-over-1/4 wavelength array shows the best performance achieved so far in this modeling exercise.

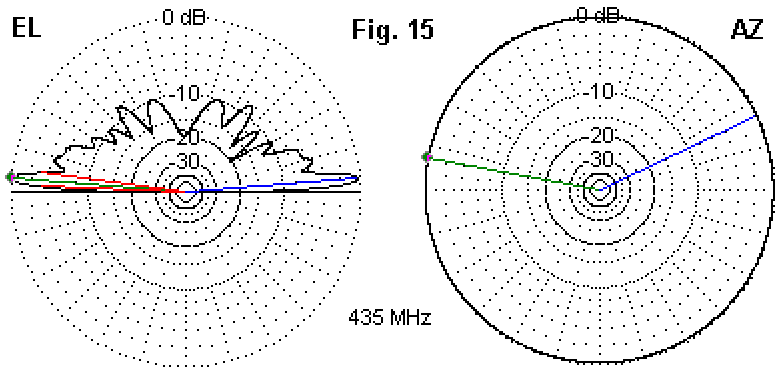


Fig. 15

El. & Az. Plots: Alternate 1/2-over-1/4 Collinear-Modified

The SWR curves in **Fig. 16** uses a 100-Ohm reference impedance to more closely correspond to the results we might obtain using a 70-Ohm quarter-wavelength matching section for our main 50-Ohm feedline. A 112-Ohm reference would have reversed the positions of the lines on the graph.

With either standard, we can observe one significant effect of using a fold-around phasing section for the array: the 2:1 SWR bandwidth has undergone significant narrowing in the process.

Throughout this section, I have called the middle part of the array simply a "phasing section." Perhaps it is not excessive repetition to note once more that the section does more than establish correct phasing between the two main vertical portions of the antenna. It also separates the sections to increase overall low-angle gain and works with the lengths of the two central sections to establish a usable feedpoint impedance.

The traditional collinear array is a fairly complex structure to construct. Field adjustment suggests separate pieces for the sections, but durability for mobile or heavy-weather uses suggest one-piece construction. The search for a workable solution to this conundrum--at least as we approach the GHz range of frequencies--resulted in the ubiquitous curly collinear.

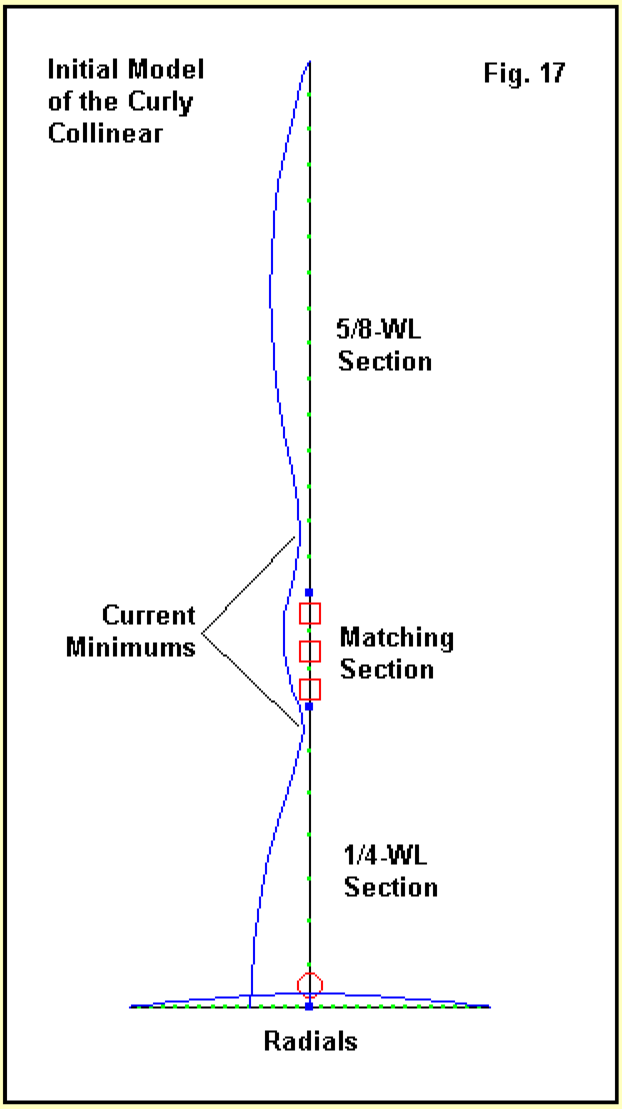
Finally, the Curly 5/8-Over-1/4 Wavelength Collinear Array

The curly collinear, sketched in **Fig. 1**, takes a different approach to placing a 1/2-wavelength element above the base element. By extending the element to about 5/8 wavelength, it yields an impedance at the lower end that has a resistive component below 100 Ohms and a capacitive reactance that can run from -200 to -300 Ohms, depending upon the precise length selected.

If we add an inductor to the lower end of the upper linear section, we can do several things. First, we can compensate for the capacitive reactance of the 5/8-wavelength section. Second, we can use the length of the inductor to effect a physical separation of an eighth wavelength or more between the upper and lower sections to enhance the array gain. Third, we can match the entire array to a desired impedance, depending upon the design of the lower section.

The lower section in the trial models is about 1/4 wavelength. Using slightly short radials (relative to 1/4 wavelength), we can extend the lower section, and then add a bit more so that the reactance at the top end of the section is also capacitive. The inductor then provides compensation for that reactance as well. The net required inductance is sufficient to require a coil long enough to provide something close to optimal spacing without lowering the inductor Q too much.

The Initial Model of the 5/8-Over-1/4 Collinear Array: **Fig. 17** shows the outline of my initial model of the curly collinear. It shows the current magnitude distribution along the antenna, as well as marking the sections of the antenna. The current minimums noted on the sketch show the results of selecting section lengths that create the conditions suited to the use of an inductor as a separator, as a matching coil, and as a means of keeping the two sections in phase.



My initial phasing section consisted of NEC loads, both R-X and later R-L-C types. I loaded each segment of the 3-segment wire in the section with 1/3 of the total load to reflect the fact that a coil filling the total space of the wire would act similarly. The following tabulated data shows the total reactance and inductance at 435 MHz. I arbitrarily chose a Q of 300 for the inductor.

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Initial Model of 5/8-Over-1/4 Collinear Array

V3 length 14.7" AGT: 0.972 = -0.12 dB
V2 length 3.15"
V1 length 8.25"
Radial length 5.0"
V2 Total Load: R = 1 Ohms Xl = 300 Ohms L = 0.33 uH

Max. Gain: 7.26 dBi TO angle: 4.6 deg. Feed Z: 50.4 - j 1.9 Ohms

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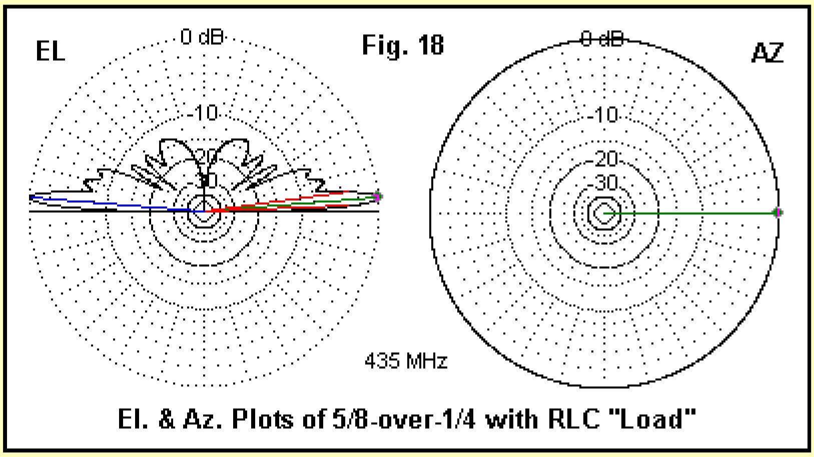
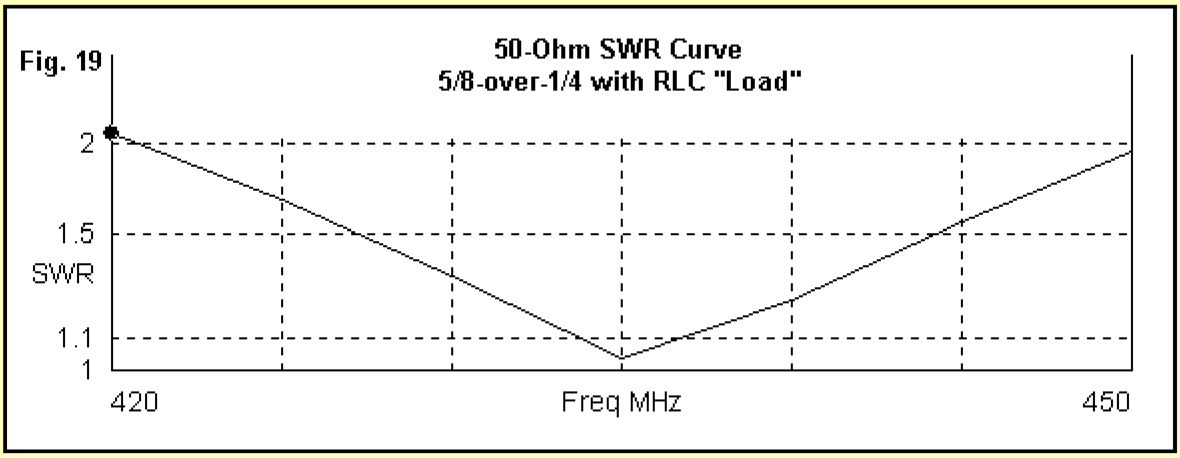
The performance of the initial model of the curly collinear--with non-radiating loads rather than a physically modeled coil--shows that the design is practical. As revealed in **Fig. 18**, the azimuth pattern is circular, since there are no bent wires in the array except for the symmetrical radials. The elevation pattern shows a considerable reduction in high-angle radiation compared to the monopoles and the dipole which we originally set up as standards of comparison. The gain falls well within the range of values that we obtained for traditional collinear designs.



El. & Az. Plots of 5/8-over-1/4 with RLC "Load"

The 50-Ohm SWR curve for the array shows--in **Fig. 19**--that the antenna should cover just about all of the 70-cm band.

Fig. 19



50-Ohm SWR Curve
5/8-over-1/4 with RLC "Load"

Two questions regarding antenna performance remained after tweaking the initial model to the shape shown in the tables and graphics. First, with a physical radiating coil, will the high-angle radiation remain at the low level shown in **Fig. 18**? Second, would the operating passband remain as wide as shown in **Fig. 19** with a physical coil? Finally, of course, a modeling question remained: could I model a physical coil and still have a model that would have an AGT close to 1.0?

The Model of the 5/8-Over-1/4 Collinear Array Using a Physical Coil: To ensure that I kept the turns of the physically modeled coil sufficiently separated, I increased the spacing between the upper and lower section to about 4". I then modeled a physical coil with a pitch of 0.8" per turn or 1.25 turns per inch. The coil used an octagonal shape so that each wire in each turn would not be excessively different in length than the segment lengths used in the vertical wires above and below the coil.

Including the leads from the vertical wires to the coil ends, the resulting 5-turn coil has a calculated inductance of about 0.29 uH. The deficiency, relative to the 0.33-uH NEC coil simulation, required that I lengthen the upper section somewhat to reduce the capacitive reactance for which the coil provides compensation. To achieve close to a 50-Ohm feedpoint impedance, I also had to lengthen each radial by an inch. **Fig. 20** shows an outline of the final model, along with an expanded view of the coil section.

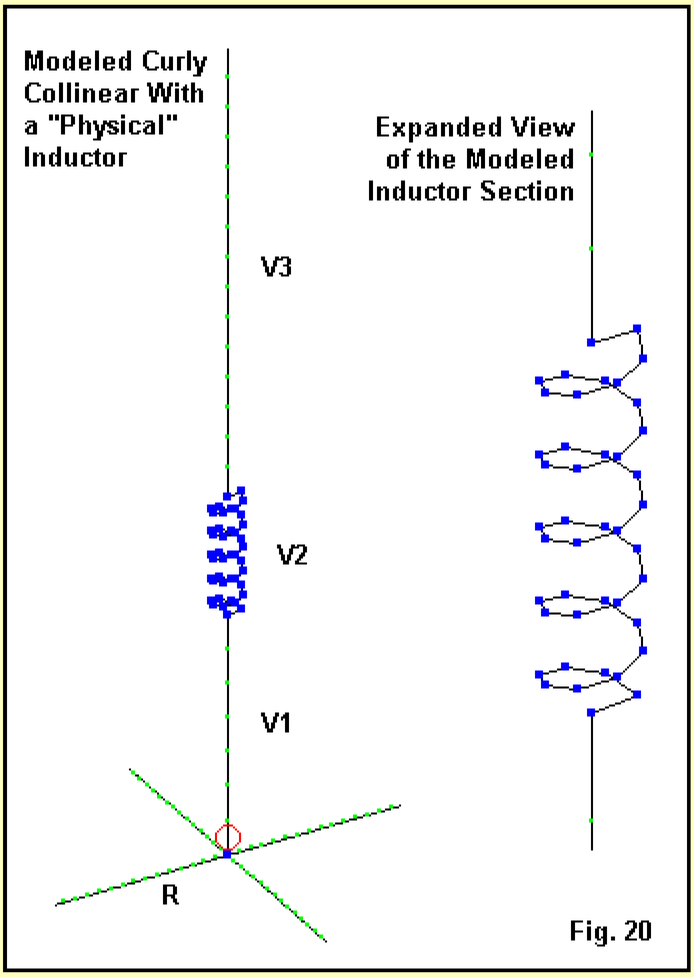


Fig. 20

The resulting model shows the same type of current distribution as the initial model. The current minimums occur within the straight sections of the array. However, the coil--both as a radiating element and as a longer physical separator between the two vertical sections--does alter performance somewhat.

. . . .

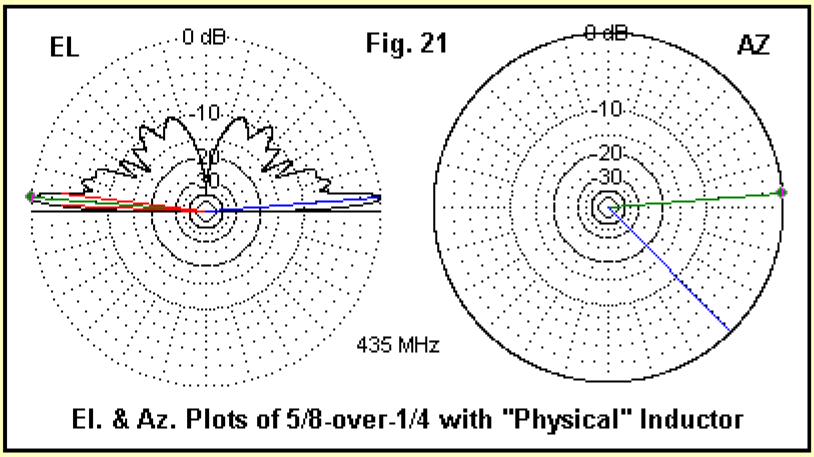
Model of 5/8-Over-1/4 Collinear Array with a Physical Inductor

V3 length 15.4" AGT: 0.964 = -0.16 dB
V2 length 4.05"
V1 length 8.25"
Radial length 6.0"
Inductor: 5 turns, 1" diameter, 4.05" total length, 1/2" leads

Max. Gain: 7.55 dBi TO angle: 4.5 deg. Feed Z: 47.8 + j 0.8 Ohms

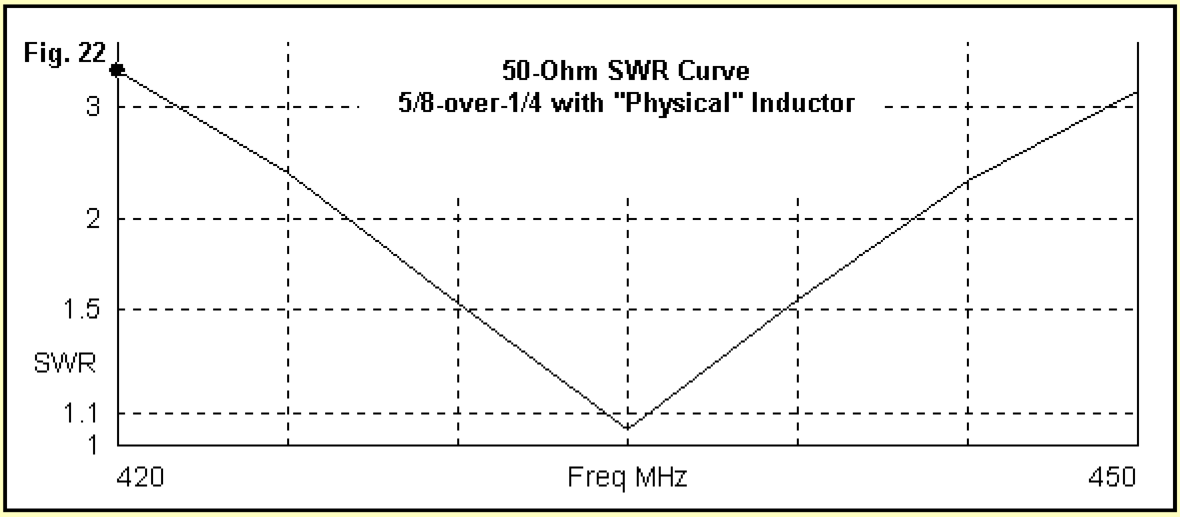
. . . .

Despite concerns over the effects of the coil upon the adequacy rating of the model, the 0.964 AGT value falls very much within the range of values obtained by the entire set of models used in this exercise. The added separation between the vertical array sections is the most likely source of the half-dB increase in gain at the lowest angle. However, it is likely that the coil structure contributes to both the gain and to higher angle radiation, as shown in the elevation plot in **Fig. 21**. (Compare elevation plots in **Fig. 21** with those in **Fig. 18**.)



El. & Az. Plots of 5/8-over-1/4 with "Physical" Inductor

It would also appear that the coil, when physically modeled, shows a higher effective Q than the assumed value of 300 used in the initial model. The 2:1 50-Ohm SWR bandwidth of the model shrinks to about 20 MHz, as shown in **Fig. 22**.



50-Ohm SWR Curve
5/8-over-1/4 with "Physical" Inductor

Establishing an actual coil Q would be a daunting task, since the conditions under which the coil operates do not fit classical inductor theory, which presumes a constant current throughout the coil turns. In fact, the current distribution changes from one modeled coil wire section to the next. Hence, the effective Q is best estimated from the coil's effect on operating bandwidth. Rather than quantifying on the basis of the SWR curves, we may simply note that the bandwidth narrows considerably with a physically modeled coil in place of the idealized NEC load simulations.

The end result, nonetheless, is a highly effective collinear array. As we noted at the start, for frequencies at least twice our 70-cm test frequency, the design of curly collinears shows many variations, including no-radial versions. Most have an integrated total structure so that the only weak point is at the junction of the collinear and its base.

Conclusion

We have largely answered the questions with which we started this exploration. The collinear array provides a significant gain increase over the normal standard antennas used for omni-directional vertically polarized service in the UHF region of the spectrum. It does so by reducing high-angle radiation and increasing the gain in the lowest elevation lobe. Hence, the collinear array fulfills the promise originally made but ineffectively kept by the simple 5/8-wavelength monopole.

We have also seen that developing a collinear array is not a simple matter, especially when we vertically orient the antenna and play it against a presumed ground plane. What some view simplistically as a quarter-wavelength matching "stub" turns out to be a somewhat complex section of the antenna, even if the wire structure seems simple. The current distribution within the section--especially as it effects a physical separation between the main radiating portions of the array--has both phasing and matching functions, with the latter one important when we wish to arrive at a working feedpoint impedance.

The 5/8-over-1/4 wavelength collinear design actually simplifies both the electrical and physical design requirements by providing capacitive reactance at the coil ends for compensation by the inductive reactance in the coil. For a coil of "ball-park" inductance (and inductive reactance at the design frequency), we may adjust the lengths of the vertical sections (and the radials, if used) to obtain a relatively high performance collinear array with a desired feedpoint impedance.

Moreover, NEC-4 appears well suited to modeling the entire structure so long as we use the same diameter wire throughout. Indeed, modeling the coil section rather than using NEC non-radiating loads appears to present a more realistic view of the antenna's potential performance. However, careful modeling of the coil is essential to sustaining close to an ideal AGT rating for the model.

For the 70-cm band, it is likely that backyard builders would employ separate upper and lower sections, with a stiff insulating section between to support an inductor. Such an array would permit considerable experimentation on the road to perfecting a design. However, the 3-part curly collinear has 2 main areas of caution. One of them is electrical: sustaining as close as possible to lossless junctions between adjacent sections. The second concern is mechanical: creating a structure that will stand up to the rigors of its working environment. These two concerns are likely the reasons that we do not see many amateur band versions of the curly collinear--at least, not at 70 cm and lower.

Whether or not we actually build a curly collinear, understanding its operation and its place within the general spectrum of collinear designs is a worthy enterprise. These notes have only scratched the surface of what we may learn about collinears, and the ideas involved in their workings may prove useful in other antenna design work.

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