

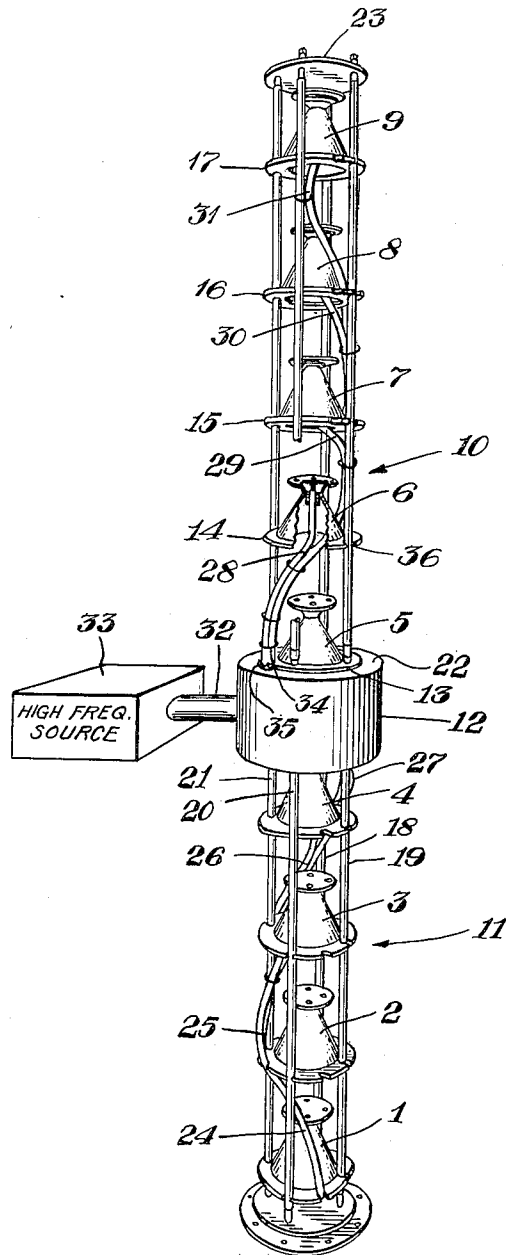
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ANTENNA ARRAY

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ANTENNA ARRAY

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This invention relates to an arrangement of feeder lines for an antenna array and in particular to the arrangement of feeder lines to the individual antennas of a stacked double surface antenna array.

An antenna of the type comprising two elements such as discs, cones or similar elements with surfaces arranged to have a peripheral opening in the plane of radiation has been used. Such antennas are generally omni-directional with a polarization perpendicular to the surfaces at the opening. For convenience, these antennas will be herein referred to as double surface dipoles or dipole antennas. A coaxial line feeding such an antenna is arranged so that the outer conductor connects to the lower element and the inner conductor extends to connect with the upper element. When such antennas are stacked one above the other to form a vertical stacked array, each antenna is fed by separate coaxial transmission lines. Concentric lines coaxially aligned with the common axis of the antennas have been proposed for feeding such arrays. With such a feed the line becomes very cumbersome if a considerable number of antennas are used. Moreover, it is difficult to supply each antenna with high frequency energy of the same power and phase. To avoid this, the antennas may be fed by a separate coaxial line of the same size. The feeder lines are then mounted on the outside of the array instead of axially inside the array. However, with the feeder lines on the outside of the array instead of axially inside the array, the symmetry of the radiation pattern is disturbed by reflection or re-radiation of the radiated energy from the lines. This effect is the greater because of the vertical polarization of the radiated energy and the vertical arrangement of the feeder lines.

It is an object of my invention to arrange the externally mounted feeder lines to the individual double surface dipoles of a stacked array to minimize the distortion of the radiation pattern of the array caused by the feeder lines.

In accordance with my invention the symmetry of the radiation pattern of the array is disturbed to a minimum amount by binding the feeder lines together in a single cable and spirally winding the cable around the array so that the cable cuts across the opening between the two surfaces of each antenna only once and in a different sector of the azimuth from the other antennas. Each feeder line is terminated at a respective antenna.

The groupings of the cables reduces the effect of the cable due to reflection and the spiralling

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of the cable distributes the effect of the cable on the radiation pattern at different azimuths.

For a better understanding of my invention reference is made to the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims. The single figure of the drawing illustrates an embodiment of my invention for the feeding of a double surface dipole array wherein one surface comprises a disc and the other surface is a cone and is known as the disc-cone type.

Referring to the drawing, the antenna array comprises nine antennas of the disc-cone type, 1, 2, 3, 4, 5, 6, 7, 8 and 9, vertically stacked. The array is separated into an upper section 10 of antennas 5, 6, 7, 8, 9, and a lower section 11 of antennas 1, 2, 3 and 4 by the junction box housing 12 which may contain an impedance matching transformer and the extra lengths of cable.

Since the upper and lower sections are substantially the same, it will be necessary only to describe the upper section to illustrate the embodiment of my invention.

In the upper section the antennas 5, 6, 7, 8 and 9 are rigidly mounted on the flat insulator rings at 13, 14, 15, 16 and 17. The insulator rings are rigidly fastened at spaced points to four vertical poles 18, 19, 20 and 21 that are rigidly mounted in the top plate 22 of the junction box housing 12. A top plate 23 at the upper end of the section is rigidly fastened to the four poles to hold them in proper relationship to one another.

The antennas 1, 2, 3, 4, 6, 7, 8 and 9 are connected in parallel by the flexible coaxial feeder lines 24, 25, 26, 27, 28, 29, 30 and 31 to the transmission line 32 in the junction box housing 12. For cophasal energization of the antennas the feeder lines are all made equal in length, the extra lengths which are not extended for the nearer antennas, being contained within the junction box housing. The lengths of feeders may be chosen to provide other phasing of the energization. The feeder line connecting the antenna 5 to the transmission line 32 is in the junction box housing 12 and is not shown. The transmission line 32 connects the feeder lines of the disc-cones to a high frequency energy source 33.

The feeder lines 28, 29, 30 and 31 are bound together by bands of string 34 and extend out of the junction box housing 12 through the hole 35 positioned between the poles 20 and 21 and in line with the periphery of the insulator 13. They are spirally wound around the array and fastened to pole 20 at a point near the succeeding insulator 14. The feed line 28 separated from the other

lines 29, 30, and 31 at this point and connects to antenna 6 as shown.

The remaining lines 29, 30 and 31 are continued to be spirally wound around the array and fastened to the succeeding pole 19 at a point near the insulator 15. The lines are held in position by notch 36 in insulator ring 14. Line 29 separates from lines 30 and 31 and connects to antenna 7 in the same manner as line 29 connects to antenna 6. The remaining lines 30 and 31 are spirally wound in a similar manner connecting to antenna 8 and 9 respectively.

In this embodiment of the invention it is seen that the portion of the cable between the junction box housing 12 and the antenna 7 affects the radiation from between the disc and cone of antenna 5 in an azimuth between poles 20 and 21. The portion of the cable between insulators 14 and 15 affects the radiation from antenna 7 in an azimuth between poles 18 and 19 or substantially 90° from the disturbance in the radiation pattern of antenna 6. Each succeeding antenna is affected in the succeeding quadrant so that the unaffected radiation from four of the antenna will minimize the distortion of the radiation of one of the antenna. Thereby the radiation pattern over the entire azimuth will be affected a minimum amount.

With the antenna array separated into two sections the feeder lines can be grouped into two separate cables thereby reducing the size of the cable to further reduce the disturbance of the symmetry of the radiation pattern. Considering the lower section, the feeder lines 24, 25, 26 and 27 of the lower section of the array are spirally wound in a similar manner and so that the radiation pattern of only two of the antenna of the entire array are affected in the same quadrant. The antennas 2, 2, 3 and 4 are connected to the feeder lines 24, 25, 26 and 27 respectively in the same manner that the antennas of the upper section are connected to the feeder lines. The cables 24, 25, 26 and 27 extend past antenna 4. The feeder line 27 branches from the cable below the antenna 4 and connects to the antenna. Similarly, the other feeder lines extend past the respective antenna and connect to the antenna from underneath.

While in the example illustrated the main feeder 32 is shown coming in normal to the antenna junction box housing it is clear that for other structures this may not be preferred. Should the antenna be mounted on a mast, for example, the feeder 32 may be brought up the mast and positioned spirally about the lower antenna portions in the same manner as the cables as shown. In this case it is preferable that the same pitch and path be followed by the main cables and the feeder lines.

While I have indicated the preferred embodiment of my invention, it is apparent that my invention is by no means limited to the exact form illustrated, but that many variations may be made in the particular structure used without departing from the scope of my invention as set forth in the appended claims.

What is claimed is:

1. In an array of double surface dipoles mounted vertically above one another and spaced a given distance from one another, a feeder system for said dipoles comprising a cable mounted at one end of at least a portion of said array, said cable having the same number of lines as antennas in said portion and being in the form of a spiral arranged about the outer peripheries of said antennas and cutting across the opening of each antenna once and in different sectors of the azimuth, each line of said cable being branched from said cable at a respective antenna and coupled thereto.

2. In an array of double surface dipoles mounted vertically above one another and spaced a given distance from one another, a feeder system for said dipoles comprising a cable mounted at one end of at least a portion of said array, said cable having the same number of lines as antennas in said portion and being in the form of a spiral symmetrically advanced about the outer peripheries of said antennas from said end and cutting across the openings of the antennas in symmetrically arranged sectors of the azimuth, each line of said cable being branched from said cable at a respective antenna and coupled thereto.

3. An array according to claim 1 wherein each line is a coaxial line.

4. An array according to claim 3 wherein the outer conductor of each line is coupled to the center of one of said surfaces and the inner conductor extends beyond said one surface and connects to the other surface.

5. An array according to claim 1 wherein each of said double surface dipoles comprises a disc surface and a cone surface, said disc surface being positioned above the apex of the cone surface and normal to the axis of the cone surface.

6. In an array of double surface dipoles mounted vertically above one another and spaced a given distance from one another, a feeding system for said dipoles comprising two cables mounted in an intermediated position and being in the form of spirals arranged about the outer peripheries of separate portions of said array in opposite directions from said central position, each cable having the same number of lines as antennas in each respective separate portion, each line of said cables being branched from said cables at a respective antenna and coupled thereto.

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