May 31, 1960

S. ZISLER

2,939,143

WIDE BAND DIPOLE ANTENNA

Filed Oct. 4, 1954

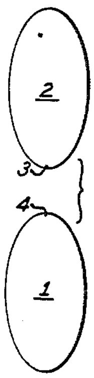

Fig. 1

Fig. 2

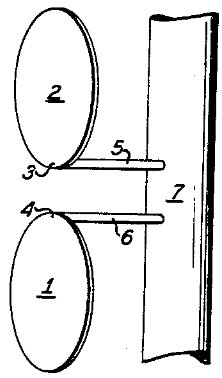

Fig. 3

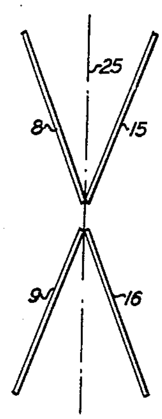

Fig. 4

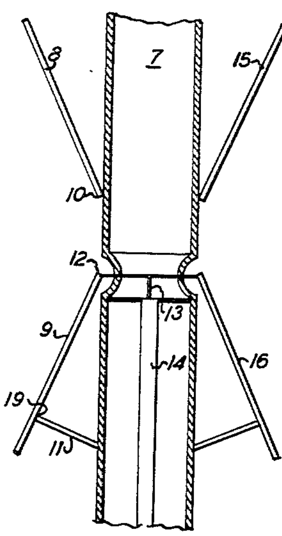

Fig. 5

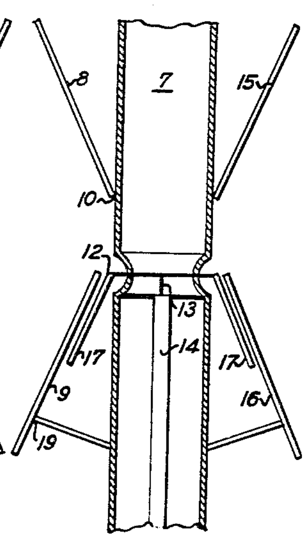

Fig. 6

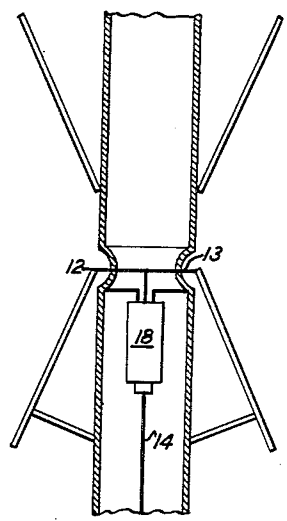

Fig. 7

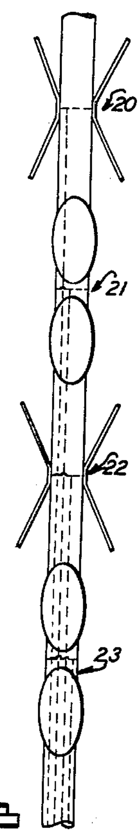

Fig. 8

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WIDE BAND DIPOLE ANTENNA

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1 Claim. (Cl. 343—800)

It has already been proposed to use antennas including two circular or elliptic discs positioned advantageously above each other in a common plane and fed respectively through the points of said discs which are nearest each other. My invention has for its object improvements in such antennas.

My invention is based on the fact that the radiating properties such as the width of the frequency transmission band and the radiation pattern are practically unmodified when two pair of discs, disposed symmetrically with reference to their bearing mast, are employed; the discs of each pair are slightly inclined with reference to each other so that they may be symmetrical with reference to a plane perpendicular to the axis of the mast.

According to a further feature of my invention the said discs are secured to a metal mast with the upper discs of each pair in direct electric connection with the mast. The ends of the coaxial cable feeding them are connected respectively with the lower discs and with the mast at the point of connection between the mast and the upper discs.

Further features and advantages of my invention will be disclosed hereinafter in a description of the preferred embodiment of my invention, reference being made to accompanying drawings, wherein:

Figs. 1 to 4 are explanatory diagrams;

Fig. 5 shows a first embodiment of my invention;

Fig. 6 illustrates a second embodiment showing a modified manner of feeding the lower discs;

Fig. 7 illustrates a further modification of the said feeding means;

Fig. 8 shows a radiating system including a plurality of disc arrangements of the above type mounted on a common mast.

In Figs. 1 and 2, illustrating in front and side views the conventional antenna of the type referred to, 1 and 2 designate the two discs, assumed to be elliptic, the high frequency voltage being applied between two points 3 and 4 of the discs which face each other. It is a known fact that such an antenna has an input impedance which is substantially constant throughout a wide band of frequencies. If the plane containing the discs 1 and 2 is vertical, the polarization obtained is also vertical. To attain this result, it is essential to feed the antenna symmetrically, therefore, it has already been proposed to secure two discs at the ends of corresponding supports secured to a mast. Fig. 3 shows in perspective, such an arrangement, wherein the discs 1 and 2 are secured through their points 3 and 4, serving for electrical connection, to the carriers 5 and 6 which are in their turn secured to the mast 7. In this case, the carriers 5 and 6 may include a balanced unit generally termed in an abbreviated manner "balun" while the feed is provided through a coaxial cable extending inside the mast 7. Now, experience has shown that the omnidirectional pattern produced by the radiation of the discs considered alone is detrimentally affected by the presence of the mast 7 if

the latter is made of metal, or by the presence of the outer conductor of the coaxial cable if the mast is made of dielectric material; consequently, the resulting pattern is no longer omnidirectional, thus reducing the advantageous properties of the radiating system.

My invention has for its object the removal of this drawback by resorting to a combination of radiating discs secured to a metal mast. The combination has the same advantageous radiating properties as the discs of Figs. 1 and 2 considered alone, i.e., without mast or coaxial cable interference.

The arrangement thus obtained is illustrated in Fig. 4 showing two pairs of discs, the first pair including the discs 8–9 and the second pair including the discs 15–16 while the axis of the mast is illustrated in dotted lines at 25. It is apparent that the pair of discs 15–16 is arranged symmetrically of the pair 8–9 with reference to the plane passing through the said axis 25 perpendicularly to the plane of the figure. Furthermore, the two discs 8–9 or 15–16 of each pair are arranged symmetrically with reference to each other to either side of a plane perpendicular to the axis 25.

Fig. 5 shows a practical embodiment including a metal mast 7 with a first pair of discs 8 and 9 contained in planes perpendicular to the plane of the figure. Their traces in the plane of the figure, as illustrated, slope slightly in opposite directions with reference to the axis of the mast. The discs 8–9 are either circular or elliptical in shape. The upper disc 8 is secured through its base 10 to the mast 7, an electrical connection between the disc 8 and the mast at said point 10. According to Fig. 6, the lower disc 9 is secured to the mast by means of a metal strut 11. The part 12 of the lower disc 9 nearest the mast 7, instead of being connected to the mast 7 is connected to the inner conductor 13 of the coaxial cable 14, extending within the mast 7 via suitable openings in the mast's wall. The point 19 at which the lower disc 9 is secured to the metal strut 11 is located at such a distance from the end of the disc that it cannot produce any substantial disturbance in the operation of the radiating system. In particular, the location of point 19 and the length of the strut 11 are selected so that the part of the lower disc 9 between the points 12 and 19, and the part of the mast 7 between the point 12 and the strut 11, form with the strut 11, a quarter wave trap for the average operating frequency.

As already mentioned, I position at the same height on the mast, instead of a single system of discs 8–9, two systems 8–9 and 15–16 which are located and fed symmetrically with reference to the plane of symmetry, perpendicular to the plane of the figure and passing through the axis of the mast 7. This arrangement allows, furthermore, coupling in a sufficiently loose manner the mast with reference to the two systems of discs 8–9 and 15–16 with a view to cutting out any action of the metal mast on the radiation. I obtain thus a very rigid and simple structure which is provided with all the desired radiating properties.

Experience has shown that the horizontal radiating pattern of the system illustrated in Fig. 5 is circular with an allowance of one decibel in either direction. Furthermore, the frequency band is broad and the input impedance which is practically constant throughout the frequency band, is, furthermore, independent of the length of the mast, which proves that the latter does not act on the radiation.

Fig. 6 illustrates a modified means for feeding the two pairs of discs of Fig. 5, the said modifications allowing a still further increase in the width of the frequency band and also improving the radiation properties within the said band. This is obtained in the apparatus of Fig. 6

by a compensating circuit provided by feeding the lower discs **9** and **16** from the inner conductor of the coaxial cable through a compensating line including a continuation **17** of the inner conductor of the coaxial cable extending in parallel with and at a small distance from the disc **9** in register with the inner surface of the latter, i.e. as illustrated in Fig. 6 between the disc **9** and the mast.

The compensating circuit includes this extension or conductor **17**, the outer end of which is insulated, and the surface of the disc **9** facing the said conductor. It will be readily ascertained that the discs are fed in this case exactly as if the inner conductor of the coaxial cable were connected with the point **12** through said compensating line, which latter has an electric length equal to one quarter wave length. It will be remarked that the sectional conductor **17** may be located to the side of the disc **9** which is opposed to that referred to in the description of Fig. 6, i.e. in register with the outer surface of the disc. The results obtained are the same in both cases.

In the case illustrated in Fig. 7, the discs **8** and **9** are fed through the point **12** as in the case of Fig. 5, but a transformer circuit **18** is provided inside the mast and inserted between the coaxial cable **14** and the point **12** through which the discs are fed. It should be noted that the two circuit arrangements of Figs. 6 and 7 are related.

I have described hereinabove embodiments incorporating discs arranged symmetrically with reference to each other. This condition is, however, not critical. I may use for the discs **8–9** and **15–16** shapes which are different and not necessarily elliptic or circular. By varying the shape of the discs great adaptibility is provided for obtaining the desired curve of input impedances plotted against frequencies.

I have already mentioned that the radiating arrangements according to my invention are particularly well adapted for the assembly of a plurality of radiating systems on a common central mast.

Accordingly, Fig. 8 illustrates diagrammatically such an assembly including four superposed radiating systems constituted each by two pairs of discs. Each elementary system shown at **20–21–22–23** conforms with the embodiments illustrated in Figs. 5, 6 or 7. It is apparent that the planes of symmetry of the systems **20** and **22** are set angularly in the same direction with reference to the mast while the planes of symmetry of the systems **21** and **23** are also arranged in the same angular direction, perpendicular to that corresponding to the first systems **20** and **22**. This relative arrangement of the disc systems improves the pattern of the whole antenna assembly in a horizontal plane, provided the different systems **20** to **23** are fed through a common coaxial cable with a same high frequency wave.

I may also operate the assembly illustrated in Fig. 8 by feeding independently each of the systems **20** to **23** by a different coaxial cable fed by a different wave, each wave serving for the transmission of a signal independent of all other signals transmitted by other waves. In this case, it is obviously possible to give any arbitrary angular setting to the different systems **20** to **23** without it being compelled to select any particular distribution for these angular settings.

What I claim is:

A wide band antenna comprising a metal mast; two pairs of discs arranged symmetrically with reference to a plane perpendicular to the axis of the said metal mast and assuming equal slopes differing from zero with reference to the said axis, the said pairs being arranged symmetrically to either side of a plane parallel to and including said axis, means for connecting electrically the upper disc of each pair with said metal mast, a coaxial cable extending longitudinally inside said metal mast and comprising an inner conductor and an outer conductor connected with said metal mast and leads connected with the inner conductor of the coaxial cable and extending outwardly of said metal mast to form each a member parallel with the lower disc of the corresponding pair at a small distance therefrom to provide a compensating electric connection between the said lower disc and the inner conductor of the cable.

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