Feb. 6, 1945.

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2,368,663

BROAD BAND ANTENNA

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Fig:1.

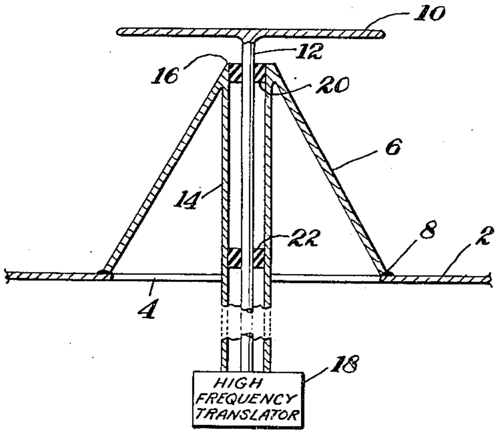


Fig:2.

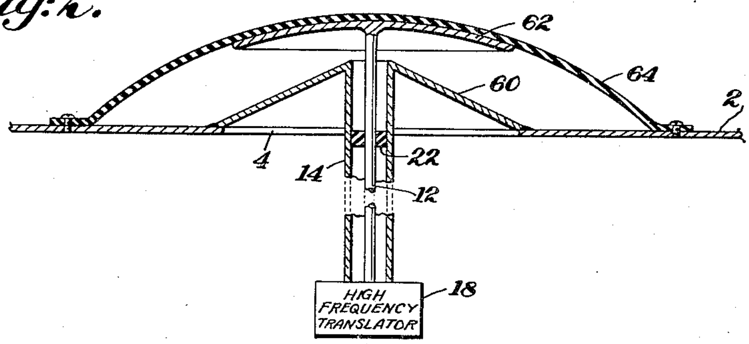
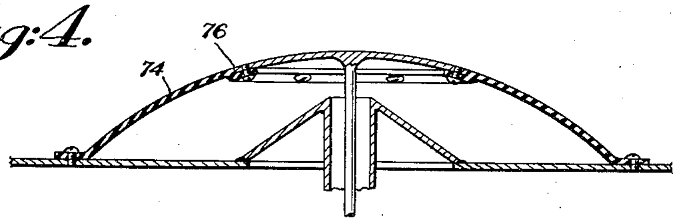


Fig:4.



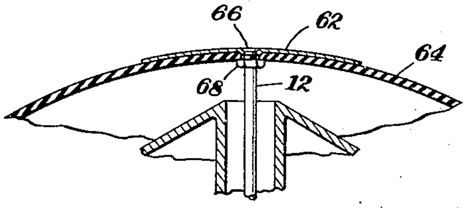


Fig:3.

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BROAD BAND ANTENNA

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8 Claims. (Cl. 250—33)

This invention relates to radio antennas and in particular to broad band antennas for operation at ultra-high frequencies.

In keeping with progress made during the last few years in the development of ultra-high frequency radio technique, and applications thereof to aircraft communication, direction finding, and so forth, it has become necessary to develop special antennas and antenna systems suitable for installation on such aircraft. Flying conditions are such that these antennas must necessarily be small and rigid in their construction and also offer a minimum of wind resistance, in order that the flying efficiency of the aircraft will be unimpaired. In accordance with my invention I have provided a small rigid antenna suitable for mounting on the surface of the fuselage or other component of the airplane structure and in certain embodiments I have also provided a streamlined protecting shield or housing covering or so cooperating with the construction of the antenna system as to greatly reduce wind resistance. This housing preferably takes the form of a "blister" which is only slightly elevated from the normal surface of the aircraft on which it may be installed.

It is therefore an object of my invention to provide an antenna structure of great rigidity.

Another object of my invention is to provide an antenna structure suitable for mounting on aircraft in a manner such that it will produce a very low wind resistance.

Another object of my invention is to provide an antenna structure suitable for operation over a wide frequency band.

These and other objects of the invention will be best understood and appreciated from the following description of different embodiments thereof, described for purposes of illustration and shown in the accompanying drawing in which:

Fig. 1 is a cross-sectional view of an antenna structure according to one embodiment of my invention;

Fig. 2 is a cross-sectional view of an antenna structure in accordance with a second embodiment of my invention.

Fig. 3 is a modification of the antenna structure shown in Fig. 2; and

Fig. 4 is a further modification of the antenna structure shown in Fig. 2.

Several forms of broad band antennas for operation at ultra-high frequencies are known in the prior art. In general, a characteristic feature of a broad band antenna lies in the fact that the antenna impedance is substantially constant over a wide frequency band. One way of obtaining this substantially constant impedance is to so devise the antenna structure that the energy flowing in the antenna encounters no abrupt change of impedance as it passes along the antenna and is radiated into space. One known form of broad band antenna having the above described characteristics consists of two conical surfaces of revolution positioned so as to have a common axis and having their apexes adjacent each other. This form of antenna is difficult to construct unless bracing members are employed to support the bases of the cones forming the antenna. These structural supports are usually positioned in the field of the radiated energy and unless formed of low-loss insulating material tend to absorb energy. Furthermore, if a structure of this type were employed as an aircraft antenna for example, it would introduce such great wind resistance as to be impractical.

In accordance with my invention, I retain one of the conical elements of an antenna such as above described but for the other conical element I substitute a disk which may be either flat or slightly concave. The disk may be either round, square, or of other configuration, but because of symmetry the round form is preferred.

Referring now to Fig. 1, I have illustrated an antenna structure which would be suitable for use on an airplane. For example, the reference character **2** may represent a portion of the surface of a fuselage. In general, however, and without reference to where the antenna may be mounted, this surface may be formed of either a conducting or insulating material depending upon the band of frequencies for which the antenna is to be employed, as will be described presently.

The surface **2** may extend over a considerable area and although preferably substantially flat, it need not be necessarily so. Over a hole **4** in the surface **2** is mounted a conical antenna element **6**. If the surface **2** is of metal, the element **6** may be welded thereto at the point **8**. Other forms of mounting could obviously be employed. If the surface **2** is of insulating material, many forms of mounting could be devised by those skilled in this art but since the manner of mounting forms no part of my invention, no details or description thereof are given.

The antenna element **10** consists of a round disk mounted on the end of a rod **12**, for example, by welding. The rod **12** forms the inner conductor of a concentric conductor transmission line, the outer conductor **14** of which, is connected to the apex **16** of the conical element **6**.

The transmission line extends to a distant point where it may be connected to either a transmitter or to a receiver or both, shown in Fig. 1 as a high frequency translator 18. Insulating members 20 and 22 space the transmission line conductors and also rigidly support the inner conductor 12, which in turn, rigidly supports the disk 10. The impedance of the transmission line is such that it matches the impedance of the antenna system comprising the elements 10 and 6. If the antenna is employed for transmitting purposes, the high frequency waves, upon reaching the end of the transmission line, diverge and travel toward the outer extremities of the antenna elements from which point they spread into space in the form of radiation as is well understood in the art.

Referring to Fig. 2 I have illustrated another embodiment of my invention similar in most respects to the embodiment shown in Fig. 1, but wherein the antenna structure is completely shielded so as to reduce wind resistance to a minimum. The cone shaped antenna element 60 has a larger base in proportion to its height, than the element 6 shown in Fig. 1 for the purpose of reducing the overall height of the antenna. The manner in which the cone is attached to the surface 2 may be similar to that described above as in connection with Fig. 1.

The antenna element 62 is somewhat mushroom-shaped so as to conform to the inner surface of a concavo-convex shield 64 which is of non-conducting material. The purpose of the shield is to reduce wind resistance to a minimum. The antenna element 62 may be in the form of a metal disk or it may be sputtered or otherwise deposited on the inner or outer surface of the shield 64.

Fig. 3 illustrates a modification of the structure shown in Fig. 2 wherein the metal disk 62 is fastened to the outside surface of the shield 64. In this case it is necessary for the conductor 12 to pass through the shield where it may be fastened to the disk in some suitable manner such as shown in Fig. 3 as a clamping arrangement consisting of a head 66 and a nut 68. Should the disk 62 be formed by sputtering metal on the shield, the clamping arrangement could be as shown in Fig. 3, or the head 66 could be made flush with the outer surface of the shield and the metal of the disk sputtered thereon. It is preferable that the element 62 be on the concave side of the shield rather than on the outer or convex side since the shield thereby offers a mechanical protection to the antenna element.

As above stated the surface 2 may be of either metal or insulating material. If of metal, the surface acts as an extension of the cone shaped antenna element and electrically it has the effect of lowering the band of frequencies over which an antenna of a given size and shape would operate. In other words when constructing an antenna in accordance with my invention, the effect of the surface 2 must be considered. If the surface is normally of insulating material and it is desired that an antenna structure be provided having a band width lower than it would normally be with an insulating surface, an artificial conducting surface placed over the insulating surface, could be provided. The extent to which this surface extends beyond the base of the cone determines in some degree the position of the frequency band. The greater the extension, the lower the band frequencies.

In Fig. 4 I have illustrated a modification of the manner in which the disk-shaped antenna element may be fastened to or mounted on the non-conducting shield. In this figure the shield 74 does not extend completely over the disk-shaped antenna element, but joins the periphery of the disk at 76 where it may be attached thereto by screws, threads, rivets or other fastening means.

While I have described above the principles of my invention in connection with specific apparatus and particular modifications thereof, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of my invention as set forth in the objects of my invention and the accompanying claims.

I claim:

1. A broad band antenna comprising means defining an extended conducting surface, a substantially conical antenna element supported on said surface and conductively connected thereto, said surface extending substantially perpendicular to the axis of said conical element, a disk-shaped antenna element, said disk-shaped element being positioned adjacent the apex of said conical element, and a coaxial transmission line passing through said surface defining means and said conical element, the inner conductor of said line being arranged to support said disk-shaped element and the outer conductor of the line being connected to the apex of said conical element.

2. A broad band antenna in accordance with claim 1 and further comprising a non-conducting shield extending between said disk-shaped element and said surface.

3. A broad band antenna in accordance with claim 1 and further comprising a streamlined non-conducting shield extending between said disk-shaped element and said surface, and means for supporting said disk-shaped element from said shield.

4. A broad band antenna comprising means defining an extended conducting surface, a substantially conical antenna element supported on said surface and conductively connected thereto, a non-conducting streamlined shield mounted on said surface and extending over said conical element, a disk-shaped element mounted on said shield, said disk-shaped element being positioned adjacent the apex of said conical member, and a transmission line comprising an inner and an outer conductor passing through said surface and said conical element, said inner conductor being connected to said disk-shaped element and said outer conductor being connected to said conical element at said apex.

5. A broad band antenna in accordance with claim 4 wherein said disk-shaped element comprises a metal deposit on a surface of said shield.

6. An antenna construction comprising a pair of cooperating antenna elements, and a wind shield housing the antenna elements at least in part to present therewith an outer substantially convexed surface, one of the antenna elements being disk-shaped with one side thereof being convex, and said shield being concave-convex with the concave side thereof arranged adjacent the convex surface of said disk-shaped element.

7. An antenna construction comprising a pair of cooperating antenna elements, and a wind shield housing the antenna elements at least in part to present therewith an outer substantially convexed surface, one of the antenna elements being disk-shaped and the shield being annular,

and means connecting the inner edge of said shield to the edge of said disk-shaped element.

8. An antenna construction for use on aircraft and other devices where it is desirable to maintain wind resistance at a minimum comprising a conical antenna element to be disposed with the base thereof on the outer surface of the aircraft, a disk-shaped antenna element positioned adjacent the apex of the conical element, and a concavo-convex wind shield housing the antenna elements at least in part and forming with the surface of the aircraft the appearance of a "blister", said disk-shaped antenna element having one side thereof convex, with the concave side of the shield arranged adjacent thereto.

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