MULIIFREQUENCY COMMON APERTURE MANIFOLD ANTENNA

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1 Claim

ABSTRACT OF THE DISCLOSURE

In this disclosure is described a combination of three antennas as follows: A flat, planar array with a dielectric loaded, slotted, cylindrical wave-guide centrally disposed on a perpendicular to the flat planar array with a dielectric rod radiator extending outwardly from the center of the dielectric-loaded cylinder. If desired, the dielectric rod may be replaced with a dipole placed at an outer edge of the planar array.

Background of the invention

Because of the increased complexity of modern radar systems, especially those used for guidance and target sensing missiles and other ordnance projectiles, it has become increasingly necessary to make maximum use of the limited space available in such projectiles for antenna purposes. In many cases it is necessary for three or more antennas operating in the same or different frequency bands to occupy the very limited space available in such projectiles while operating through the same small diameter aperture. Furthermore, to insure proper operation of the system the electrical characteristics of each of the antennas within the aforementioned limiting area must be maintained and each antenna must be electrically isolated from the other.

In some prior art devices the problem has defied solution, and the designer has been forced to utilize more space and a larger aperture to build a workable system. Of course, the increased size and weight of the antennas and their enclosure can impair the aerodynamic characteristics of the projectile on which they are used. Considerable difficulty has been experienced in designing such systems to have a required electrical isolation and in preventing the radiation patterns from each antenna from interfering with the radiation pattern of the other antennas. Further, in many cases, confining requirements placed on the antennas have impaired their electrical characteristics.

It is, therefore, an object of this invention to provide an antenna system comprising a plurality of individual antennas capable of operating through a small diameter common aperture with no aperture blocking and capable of performing a variety of functions with the antennas having good electrical characteristics.

Another object of this invention is to provide a plural antenna system with the above characteristics requiring little space.

Still another object of this invention is to provide a plural antenna system of simple construction, and to provide one which will add little weight to the system on which it is used.

Summary of the invention

The aforementioned and other objects may be obtained by using the multifrequency common aperture manifold antenna system of my invention. This antenna system comprises a planar array which may be either air-filled or filled with a dielectric, with a cylindrical dielectric-loaded slotted wave-guide mounted in the center of the planar array and perpendicular thereto. A dielectric rod radiator is mounted within and extends from the cylindrical wave-guide and is positioned along the axis of the wave-guide. A dipole may be mounted on one of the outer edges of the planar array replacing a dielectric rod if desired. This unique combination of antennas enables one to operate three functionally separate antennas through a common small diameter aperture with no aperture blocking. Each antenna is electrically isolated from the other and each may operate in either the same or different frequency bands while maintaining the desired electrical characteristics of each antenna.

Brief description of the drawings

FIGURE 1 is an isometric view of the preferred embodiment of the antenna of my invention.
FIGURE 2 is a side view of the cylindrical dielectric-loaded, slotted wave-guide antenna and its radiation pattern used with the antenna system of FIGURE 1.
FIGURE 3a is a side view of the dielectric rod radiator used with the antenna system of FIGURE 1.
FIGURE 3b is a side view of the dielectric rod radiator of FIGURE 3a shown mounted in the dielectric-loaded cylindrical wave-guide.
FIGURE 4 is an isometric view of an alternate embodiment of the antenna system of my invention in which the dielectric rod radiator has been replaced by a dipole placed at the outer edge of the flat planar array.

Description of the preferred embodiments

In FIGURE 1 is shown a preferred embodiment of the multifrequency common aperture manifold antenna 10 of my invention. Antenna 10 is made up of three separate and functionally distinct antennas, flat planar array 11, cylindrical dielectric-loaded slotted wave-guide 12 and dielectric rod radiator 14.

Flat planar array 11 has essentially the characteristics of a parabolic reflector of equivalent aperture. A signal coupled to planar array 11 would be radiated as a plane wavefront in phase over the aperture forming a pattern of high directivity along a line perpendicular to the center of the planar array. Planar array 11, however, is divided into quadrants, each quadrant adapted to receive a signal to be transmitted, by a connector 16, two of which are hidden from view in this figure. As is well known in the art, the quadrants may be selectively energized to vary the radiation pattern from planar array 11. In any case, that pattern will not interfere with the other radiation patterns emanating from antennas 12 and 14.

In FIGURE 2 is shown a side view of the cylindrical dielectric-loaded slotted wave-guide 12 which is shown placed in the center of planar array 11 in FIGURE 1. The cylindrical wave-guide, divided into quadrants, is coupled to a signal to be transmitted by a four-way connector 22, a connector element of which is connected to each quadrant of cylinder 12. The entire slotted cylinder 12 is filled with a silicone fiberglass dielectric 23. The cylindrical dielectric-loaded slotted wave-guide antenna 12 sometimes called a septate antenna is capable of producing a conical beam pattern 20 about the axis of the cylinder without blocking the aperture of the two-dimensional slotted array.

In FIGURE 3a is shown a side view of the dielectric rod radiator 14 which is placed inside the cylindrical wave-guide 12 and positioned along its axis. A dielectric rod will act essentially as a wave-guide containing most of the signal energy within the dielectric material if the rod diameter or cross section is sufficiently large. As the rod is tapered in thickness, appreciable energy is radiated from the sides of the rod. The transition between the radiating and nonradiating condition depends upon the dielectric material, but for a material such as polystyrene...
the power outside a circular dielectric is greater than the power inside the dielectric for diameters less than one-
half wavelength. Dielectric rods act as end-fire antennas and are useful in that they occupy a very small area. The directivity of a dielectric rod antenna is roughly proportional to its length. As can be readily seen, because of its end-fire radiation characteristic, the dielectric rod used in this antenna system will cause no aperture blocking.

In FIGURE 3b dielectric rod 14 is shown mounted in cylindrical wave-guide 12. The rod 14 is supported within wave-guide 12 by hollowing out a sufficient amount of dielectric 23 to conform to the size and shape of rod 14. Rod 14 is excited from cylindrical wave-guide 12 which as well as acting as an antenna, also acts as a circular wave-guide for the signal to be transmitted by dielectric rod 14.

In FIGURE 4 is shown an alternate embodiment of my invention. In this embodiment a dielectric rod radiator is not used but instead an ordinary dipole 28 may be placed at one of the outer edges of flat planar array 11 as shown in the figure. By this means, a hemispherical radiation pattern will be obtained which as in the case of the previously described embodiment will cause no aperture blocking.

While the description of the preferred embodiments of my invention has been directed to its use in ordnance projectiles it will be apparent that it will be useful as well in many other applications where size and small aperture are important. Further, it will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction and arrangement within the scope of the invention as defined in the appended claim.

I claim:

1. A multifrequency common aperture manifold antenna system which permits a plurality of functionally separate antennas to operate through a common small diameter aperture comprising:
   (a) a flat planar array adapted to receive a first signal to be transmitted;
   (b) a dielectric-loaded slotted cylindrical wave-guide mounted in the center of and perpendicular to said planar array, said cylindrical wave-guide being adapted to receive a second signal to be transmitted and to produce a conical radiation pattern from said second signal; and
   (c) a dielectric rod radiator placed within and along the axis of and extending from the top of said cylindrical wave-guide, said dielectric rod being adapted to receive a third signal to be transmitted from said cylindrical wave-guide.

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