

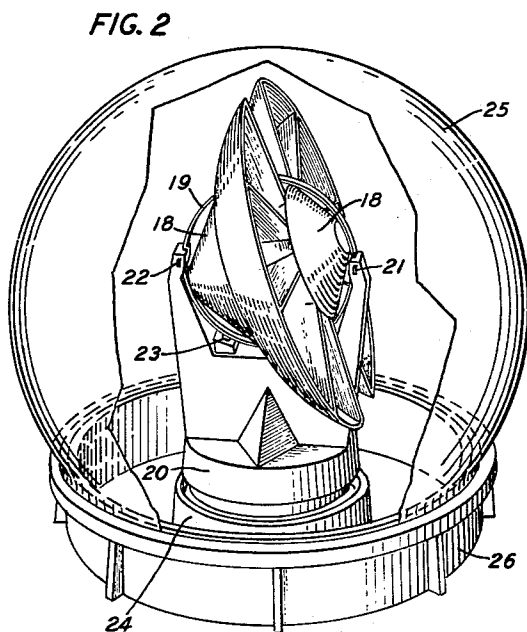
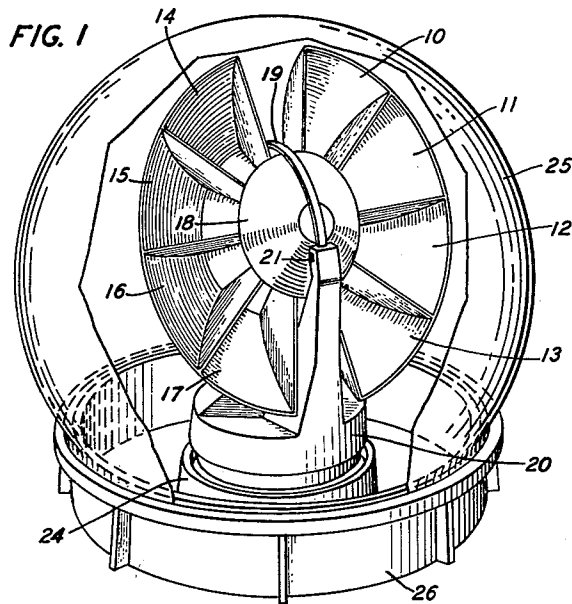
March 9, 1965

A. R. SMITH ETAL

3,173,144

SPLIT ANTENNA ARRAY ROTATABLE ON BEARINGS MOUNTED IN SPLIT

Filed March 15, 1963



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3,173,144 SPLIT ANTENNA ARRAY ROTATABLE ON BEARINGS MOUNTED IN SPLIT

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Filed Mar. 15, 1963, Ser. No. 265,418
4 Claims. (Cl. 343-762)

This invention relates to antenna systems and in particular to arrays of directional antennas.

Parabolic-reflector antennas have been widely used because they possess certain desirable electrical and mechanical features. They have, for example, relatively high gain characteristics and physical symmetries that are desirable from manufacturing and operating viewpoints. Unfortunately, however, they have far side lobe to main lobe sensitivity ratios which sometimes cause extraneous signals appearing within the far side lobes to produce undesirable effects. (The expression "far side lobes," as used in this specification, is an expression of art meaning that the side lobes referred to subtend a relatively large angle with respect to the main or primary lobe.) The signals appearing in these side lobes are particularly objectionable when using recently developed low-noise high-gain receivers to receive weak signals.

Antennas which have lower far side lobe to main lobe sensitivity ratios than those of parabolic-reflector antennas are horn-reflector antennas. Horn-reflector antennas also have low-loss feed lines and substantially uniform and highly efficient transmission characteristics over relatively wide frequency and ambient temperature ranges. They have, therefore, been used to advantage with low-noise high-gain receivers to receive relatively weak signals. (Several types of horn-reflector antennas are disclosed in the literature. See, for example, U.S. Patent 2,416,675, issued to Beck and Friis on March 4, 1947; U.S. Patent 2,817,837, issued to Dale and Friis on December 24, 1957; and "A Horn-Reflector Antenna for Space Communications" by Crawford, Hogg and Hunt, beginning on page 1095 in the July 1961 issue of the Bell System Technical Journal.)

Although horn-reflector antennas have electrical characteristics which are superior in some applications to those of parabolic-reflector antennas, they have mechanical characteristics which result in more severe construction and operating requirements. They, for example, are larger than and lack the symmetry of comparable parabolic-reflector antennas. These two characteristics produce a number of undesirable results. Firstly, horn-reflector antennas require the use of stronger, which generally means heavier, structural elements. Secondly, the heavier structures in turn require larger and stronger mounting foundations. Thirdly, the heavier and larger structures have greater moments of inertia which require higher powered mechanical steering mechanisms. Fourthly, when radomes are required, the larger structures require larger radomes. Although these more severe construction and operating requirements have been successfully met in present day large horn-reflector antenna installations, they have resulted in large expenditures of time and money. It would, therefore, be advantageous to have antenna arrangements having mechanical characteristics similar to, or better, than those of parabolic-reflector antennas and electrical characteristics similar to those of horn-reflector antennas.

An antenna arrangement which includes this advantageous combination of characteristics, along with additional mechanical features, forms the principal subject matter of patent application Serial No. 265,386 filed on even date herewith by J. S. Cook and J. N. Hines. In one

of its broader aspects, the Cook et al. arrangement comprises a plurality of horn-reflector antennas arranged to form at least a portion of a substantially circular array with the apexes of the antennas at substantially the center of the array and the apertures of the antennas directed in substantially the same direction. The apexes are connected to an electrical coupler unit which in turn is connected to at least one transmission line. When used for receiving purposes, the coupler unit combines received signals for transmission over a transmission line to a receiver. On the other hand, when used for transmitting purposes, energy received from a transmitter is divided substantially equally between the horn-reflector antennas by the coupler units.

Although the invention disclosed in the previously mentioned Cook et al. application provides in an antenna installation an advantageous combination of electrical and mechanical characteristics, it would be desirable to further reduce the weight, moment of inertia and size of such an installation.

An object of the present invention is to further reduce the weight, moment of inertia and size of an antenna installation utilizing an antenna arrangement of the type forming the subject matter of the previously mentioned Cook et al. patent application.

In accordance with the present invention in one of its broader aspects, a horn-reflector antenna arrangement embodying the Cook et al. invention is divided into two equal sections with the sections secured to respective sides of a vertical circularly shaped member, such as a ring member, so that the plane of the circular antenna array is substantially normal to that of the circular member. The center of gravity of the resulting structure is substantially over the center of a mounting base supporting the circular member. The circular member is rotatably supported by the mounting base so that the radiation pattern of the antennas may be changed in an elevational sense. The mounting base also permits the circular member and antennas to be rotated in a horizontal plane so that the radiation pattern of the antennas may be changed in an azimuthal sense.

The present invention provides several additional advantageous mechanical characteristics in antenna installations embodying the Cook et al. invention. Firstly, because the resulting center of gravity of the combination of the horn-reflector antennas and circular member is substantially over the center of the mounting base, the moment arm of the structure is a minimum. Secondly, because the horn-reflector antennas are divided into two groups and secured to either side of the circular member, relatively lighter weight structural elements may be used in forming the antennas. Thirdly, the circular member has an inherent structural strength because of its continuous nature which permits lighter weight structural elements to be used to support the antenna arrangement on the mounting base. Fourthly, the overall installation is more compact. These characteristics in turn permit the overall weight of the structure to be reduced, thus reducing the supporting requirements of the mounting base. Furthermore, providing a minimum moment arm and reducing the overall weight reduces the moment of inertia which in turn reduces the requirements on the mechanical driving means. In addition, the more compact nature of the overall installation permits a smaller radome to be used when a radome is required.

Other objects and features of the invention will become apparent from a study of the following detailed description of a specific illustrated embodiment.

In the drawings:

FIGS. 1 and 2 are two views of an embodiment of the invention.

The embodiment of FIGS. 1 and 2 includes a first group

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of horn-reflector antennas 10 through 13 and a second group of horn-reflector antennas 14 through 17. The antennas are affixed to a hub member 18 to form a substantially circular array with the antenna apexes at substantially the center of the array, the antenna apertures directed in substantially the same direction and the groups displaced to respective sides of a diameter of the array. Hub member 18 is in turn affixed to a vertical ring member 19.

Ring member 19 is supported in a vertical position by an upper base member 20. In particular, ring member 19 is supported in upper base member 20 by roller bearings mounted in upper base member 20 at points 21, 22, and 23 so that the radiation pattern of the antenna array may be changed in an elevational sense.

Upper base member 20 is rotatably mounted on a lower base member 24 so that the radiation pattern of the antenna array may be changed in an azimuthal sense.

The antenna array and its supporting structure are enclosed by a radome 25. Radome 25 is secured at its base to a cylindrically shaped wall 26.

Drive mechanisms enclosed within base members 20 and 24 are used for rotating ring member 19 with respect to upper base member 20 and upper base member 20 with respect to lower base member 24. In accordance with a feature of the invention, the relatively low moment of inertia and the well balanced natures of embodiments of the invention permit, in many embodiments, a relatively inexpensive friction type of coupling (instead of a gear type of coupling) to be used with the driving mechanisms.

The embodiment shown in FIGS. 1 and 2 is illustrated in a fixed site application. Embodiments also lend themselves advantageously to mobile applications. Their relatively light weight, good balance and compact nature permit them to be transported easily and put into operation with a minimum of supporting structure in addition to that afforded by the transporting vehicle.

Although only one embodiment of the invention has been illustrated and described in detail, it is to be understood that other embodiments may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A mount for a plurality of horn-reflector antennas, said mount comprising
 - a circularly shaped member,
 - means located at least at three places on the periphery of said circularly shaped member and rotatably supporting said circularly shaped member in a vertical plane,
 - means securing one-half of said antennas to one side of

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said circularly shaped member and the other half of said antennas to the other side of said circularly shaped member with said antennas forming at least a portion of a substantially circular array with their apexes directed towards the center of the array, their apertures directed in substantially the same direction, the plane of said array substantially normal to that of said circularly shaped member and the combined center of gravity of said antennas and said circularly shaped member substantially directly above the center of said supporting means, and

mechanical driving means connected between said circularly shaped member and said means rotatably supporting said circularly shaped member to change the rotational position of said circularly shaped member.

2. A mount in accordance with claim 1 in which said circularly shaped member comprises a ring member.

3. A mount for a plurality of horn-reflector antennas, said mount comprising

- a base member having at least three sets of bearings for receiving and supporting at its periphery a circularly shaped member in a vertical plane,

- a circularly shaped member supported in a vertical plane by said base member bearings,

- means securing a group of one-half of said antennas to one side of said circularly shaped member and the remaining antennas to the other side of said circularly shaped member with said antennas forming at least a portion of a substantially circular array with the apexes of said antennas at substantially the center of said array, the apertures of said antennas directed in substantially the same direction, the plane of said array substantially normal to that of said circularly shaped member and the combined center of gravity of said antennas and said circularly shaped member substantially directly above the center of said supporting means, and

- mechanical driving means connected between said circularly shaped member and said base member to change the rotational position of said circularly shaped member.

4. A mount in accordance with claim 3 in which said circularly shaped member comprises a ring member.

References Cited in the file of this patent

UNITED STATES PATENTS

2,426,183	Deloraine et al. _____	Aug. 26, 1947
2,480,829	Barrow et al. _____	Sept. 6, 1949
2,530,890	Mattke _____	Nov. 21, 1950
2,814,038	Miller _____	Nov. 19, 1957