Aug. 9, 1949. L. J. CHU 2,478,241

FLAT BEAM ANTENNA

Filed July 9, 1945

FIG. 1

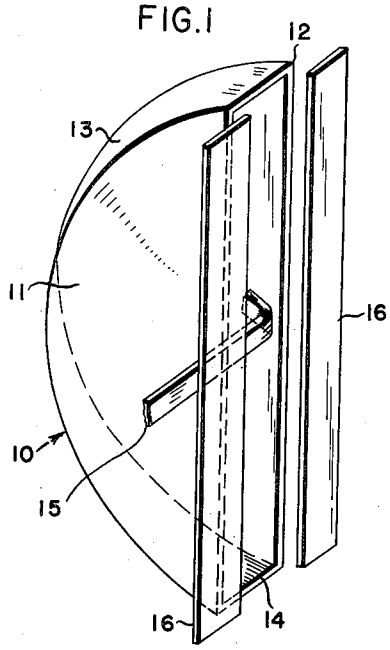


FIG. 2

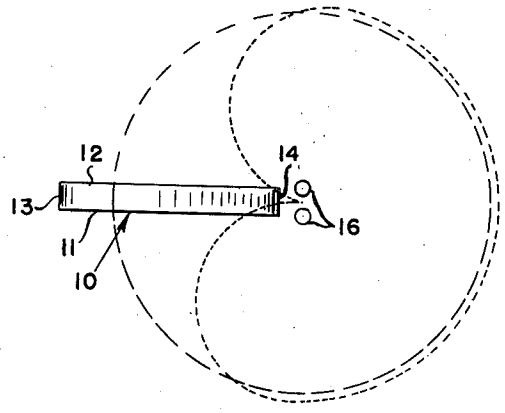
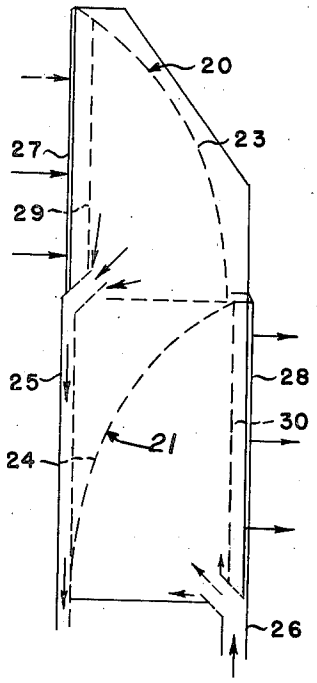


FIG. 3



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Patented Aug. 9, 1949

2,478,241

UNITED STATES PATENT OFFICE

2,478,241

FLAT BEAM ANTENNA

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Application July 9, 1945, Serial No. 604,019

3 Claims. (Cl. 250—33.65)

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This invention relates to antennas and more particularly to antennas having sharp directivity in one plane. Such antennas have many useful applications such as for use in radio beacon systems for radiating or intercepting electromagnetic waves of energy.

It is an object of the present invention to provide an antenna having sharp directivity in one plane and a uniform 360° coverage in a plane perpendicular to the first plane without rotation of the antenna itself.

It is another object of the invention to provide, in an antenna having sharp directivity in a vertical plane, means for affording a uniform 360° coverage in azimuth.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following description, taken in connection with the accompanying drawings.

In the accompanying drawings:

Fig. 1 is a perspective view of one embodiment of the antenna according to the invention.

Fig. 2 is a partly diagrammatic top plan view of the antenna in Fig. 1 showing on a smaller scale a modification thereof and the radiation patterns produced; and

Fig. 3 is a vertical side sectional view of another embodiment of the antenna according to the invention.

By way of example and to simplify illustration, the invention is herein described, according to a preferred embodiment, as applied to an antenna having a pill-box type feed or radiating element. A pill-box radiating element comprises a parabolic cylindrical reflecting surface, of small axial dimension, mounted between plane parallel metallic walls or plates which serve to enclose the ends of the parabolic cylinder. The spacing between the plates and consequently the axial dimension is preferably less than half the wavelength of the feed energy. Th pill-box type radiator is particularly suitable for obtaining a narrow radiation pattern in one plane; e. g., in the vertical plane when the pill-box is oriented with the axis of the cylinder horizontal. However, it is to be understood that the invention is not limited to the use of a pill-box type feed as it is contemplated to use any suitable source for radiating energy in a pattern which is sharply directive in one, and preferably a vertical, plane.

Referring now to Fig. 1, there is shown a pill-box type radiating element 10 comprising parallel plates 11 and 12 closing the ends of a parabolic reflecting cylinder 13 and affording a rectangular

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opening, aperture or mouth 14. Energy for exciting pill-box 10 may be fed thereto by any desired means such as by wave guide 15 entering mouth 14. Pill-box 10 may be supported in any suitable manner so that the plane of mouth 14 is preferably vertical, or in other words, with the axis of cylinder 13 in a horizontal plane. As thus far described, pill-box 10 is adapted to radiate energy in a beam pattern which is relatively narrow in a vertical plane and has a configuration in the horizontal plane similar to that shown in dotted lines in Fig. 2.

It is desired to obtain a radiation pattern which is uniform in the horizontal plane through 360° in azimuth substantially as indicated by the dashed line in Fig. 2. This may be achieved according to this invention by providing means for reflecting part of the energy generally in a direction opposite to the direction of the main portion of the energy radiated from pill-box 10. Such reflecting means according to the invention may comprise bar, strip, or rod members 16 of metal or any other suitable electrically conductive material positioned in front of and spaced from mouth 18 in such manner that they partly cover mouth 18.

There are preferably two members 16 which may be rectangular bars as shown in Fig. 1, or rods having a circular cross section as shown in Fig. 2. The two members 16 are arranged preferably in spaced parallel relation with their longitudinal axes substantially parallel to the plane at mouth 14. Bars or rods 16 are mounted in any suitable manner so that preferably their longitudinal axes lie in the planes of plates 11 and 12 and the planes of the plates 11 and 12 bisect them lengthwise. With this arrangement, part of the energy radiating from pill-box 10 passes between the bars or rods 16 while the remaining energy is reflected by bars or rods 16 backwardly in a direction generally opposite to that of energy passing between the bars or rods 16. Thus energy from pill-box 10 is radiated in a pattern which is relatively narrow in a vertical plane and which is substantially uniform through 360° in azimuth.

In Fig. 3 there is illustrated an arrangement which embodies a modification of the invention and which has been found particularly suitable for use as a beacon type antenna. Instead of a full pill-box radiating element as described with reference to Figs. 1 and 2 and which may be used for both transmitting and receiving energy, the modification shown in Fig. 3 comprises two half pill-box radiators 20 and 21 having semi-parabolic cylindrical reflecting surfaces 23 and 24, re-

spectively, and fed by wave guides 25 and 26. As shown, radiators 20 and 21 are arranged one above the other so that one radiator, for example lower radiator 21, may be used for transmitting energy while the other radiator 20 may be used for receiving energy. Radiators 20 and 21 are provided with reflecting bars or rods 27 and 28 disposed in front of the respective radiators 20 and 21 in a manner similar to that described with reference to Figs. 1 and 2. It will be understood that inasmuch as both radiators 20 and 21 are adapted to radiate or receive energy in or from any azimuthal direction, it is of no consequence in which direction the energy is adapted to be directed from and to reflecting surfaces 23 and 24. The arrangement of Fig. 3 in which the respective mouths 29 and 30 of radiators 20 and 21 open in opposite directions is advantageous, however, in permitting the waveguide 25, for transmitting energy to or from the upper pill-box 20, to be carried at the rear of the lower pill-box 21, thus avoiding interference with the field of the latter.

While there has been described what is at present considered the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention.

What is claimed is:

1. In an antenna including a radiator having two spaced parallel plates enclosing the ends of a parabolic cylindrical reflecting surface and means for feeding energy to said radiator, said radiator being positioned with the planes of said plates vertical and adapted to radiate energy in a beam pattern which is narrow in the vertical plane, reflecting means comprising a pair of spaced parallel bars of electrically conductive material positioned in front of and spaced from the mouth of said radiator, each bar having its longitudinal axis lying in the plane of one of said plates, said bars being adapted to intercept and reflect a portion of the energy radiated by said radiator in a direction substantially opposite to that normally directed by said radiator, whereby a radiation pattern which is substantially uniform through 360° in azimuth is produced.

2. A beacon antenna structure comprising two radiators, each having a semi-parabolic cylindrical reflecting surface mounted between a pair of plane parallel metallic plates enclosing the ends of said surface, said radiators being mounted one above the other with their respective mouths positioned in opposing directions, wave transmission means entering the mouth of one of said radiators for conveying wave energy thereto, wave transmission means entering the mouth of said other radiator for deriving wave energy therefrom, and a pair of reflecting members disposed symmetrically before the mouth of each of said radiators in spaced relation therewith, said members acting to intercept and reflect a portion of radiant energy, whereby one of said radiators is adapted to receive radiant energy in a substantially omni-directional configuration in azimuth, and the other of said radiators is adapted to radiate energy in a substantially omni-directional configuration in azimuth.

3. An antenna comprising a radiator having a pair of spaced parallel plates enclosing the ends of a parabolic cylindrical reflecting surface, an open ended wave guide entering into the mouth of said radiator for conveying energy thereto, means to position said radiator with said plates in a vertical plane, whereby said radiator projects radiant energy in a beam pattern which is narrow in a vertical plane, and reflecting means including a pair of spaced parallel conductor rods disposed before the mouth of said radiator in spaced relation thereto, each rod having its longitudinal axis lying in the plane of one of said plates, said rods acting to intercept and reflect a portion of the energy emitted by said radiator in a direction substantially opposed to that normally directed by said radiator, whereby a radiation pattern which is substantially uniform through 360° is produced.

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