Nov. 15, 1955 | G. J. YEVICK | 2,724,054

PILLBOX ANTENNA

Filed Jan. 5, 1946

FIG. 1

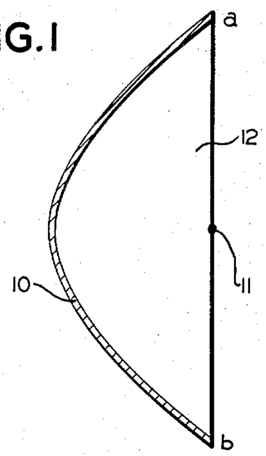


FIG. 2

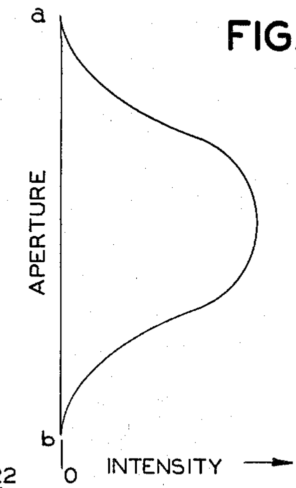


FIG. 3

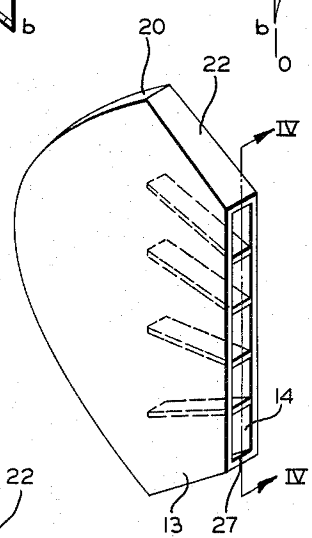


FIG. 4

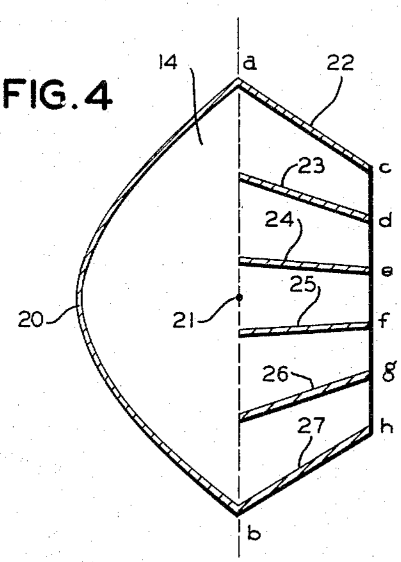
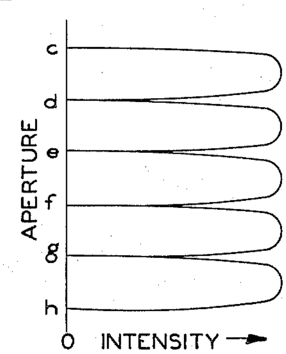


FIG. 5



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PILLBOX ANTENNA

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5 Claims. (Cl. 250—33.65)

This invention relates to an antenna, and more particularly to a means for controlling the energy distribution across the aperture of an antenna.

The power gain, with respect to an isotropic radiator, of an antenna excited with electromagnetic energy is at absolute maximum and the beam width of the diffraction pattern is at absolute minimum when the energy is distributed uniformly across the aperture of the antenna.

In the case of a pillbox antenna, which consists of a short parabolic cylinder closed at its ends by parallel plates and excited by a point source of energy at its focus, the space attenuation effects, diffraction pattern of the primary feed and other effects produce a distribution of energy across the aperture which is non-uniform and similar in form to a Gauss Error Curve. This tapered distribution of energy across the aperture results in a decreased power gain and an increased diffraction pattern beam width over that which would be obtained if the aperture were uniformly excited.

It is an object of this invention to provide a means for controlling the energy distribution across the aperture of an antenna.

It is another object of this invention to provide an antenna having a substantially uniform distribution of energy across the aperture thereof.

It is a further object of this invention to modify a pillbox antenna to obtain a uniform distribution of energy across the aperture thereof.

These and other objects will be more apparent upon consideration of the following description together with the accompanying drawings, in which:

Fig. 1 is a sectional view of a pillbox antenna;

Fig. 2 is a typical graph of the distribution of energy across the aperture of a pillbox antenna such as is shown in Fig. 1;

Fig. 3 is an oblique view of an embodiment of this invention;

Fig. 4 is a sectional view along line IV—IV of Fig. 3, the plane of the section being parallel to the broad walls of the pillbox; and,

Fig. 5 is a graph of the distribution of energy across the aperture of the antenna shown in Figs. 3 and 4.

Fig. 1 illustrates in section a conventional pillbox type antenna comprising essentially a short, conductive parabolic cylinder enclosed between two conductive side walls, one of which, **12** is illustrated. The feed for a pillbox is usually a point source radiator, such as an electromagnetic horn, positioned at the focus **11** of the parabola **10**. Energy radiated from this point source and reflected by parabola **10** produces an energy distribution across the substantially rectangular antenna aperture *ab* of the type illustrated in Fig. 2, wherein the field intensity is plotted as a function of distance along the aperture. The non-uniform distribution has the disadvantages previously mentioned.

An embodiment of the modified pillbox radiator incorporating the principles of the present invention is shown in Figs. 3 and 4. The structure of this antenna

comprises a parabolic cylinder **20**, corresponding to parabola **10** in Fig. 1, enclosed between two flat conductive side walls **13** and **14** having generally the shape of the side walls of the pillbox shown in Fig. 1 with the substantially trapezoidal extension as shown. The external structure is completed by the conductive side plates **22** and **27**. The aperture *ch* of the antenna is rectangular and is shorter than aperture *ab* of the parabolic pillbox.

The antenna is energized by a point source radiator positioned at point **21**, the focus of parabola **20**. Energy reflected from the parabola **20** produces, in accordance with the principles discussed in connection with Fig. 1, an energy distribution along the axis *ab* of Fig. 4 similar to that shown in Fig. 2.

Strips **23**, **24**, **25** and **26** of conducting material such as metal are positioned between aperture *ab* and aperture *ch* and between end plates **22** and **27** in such a way that the total energy intercepted between any pair of adjacent strips along the line *ab* is equal to that intercepted between any other pair. Since each channel between adjacent strips carries the same amount of energy, the energy distribution across aperture *ch* will be substantially uniform, as shown in Fig. 5.

The relative phases of energy arriving at aperture *ch* through each channel can be controlled by changing the spacing between the strips in the plane parallel to the side walls when the energy of the point source radiator is so polarized that the electric component of the field is normal to the side walls, thereby changing the phase velocity of the energy. The resulting effect of such a modification is that of changing the electrical path length through the channel. It is usually desirable that the energy appearing across the aperture be in-phase (a plane wave) along a line parallel to the aperture.

Since certain changes may be made in the above described article and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense, and therefore, that the invention is to be limited only by the prior art and the spirit of the appended claims.

What is claimed is:

1. An antenna comprising, a reflector having a first aperture, a source of electromagnetic radiation positioned with respect to said reflector so as to radiate energy in the direction of said reflector, a member disposed across said aperture and forming a second aperture displaced from said first aperture in a direction away from said reflector, means partitioning said member into a plurality of converging channels, each of said channels having first and second ends and communicating with said first aperture at said first end and with said second aperture at said second end, said second aperture being smaller than said reflector aperture whereby the energy distribution across said second aperture is changed with respect to energy distribution across said reflector aperture.

2. An antenna comprising, a parabolic pillbox reflector, said pillbox reflector having a rectangular aperture, the plane of said aperture being in a plane parallel to the directrix plane of the parabolic cylinder of said pillbox reflector and including the focal line of said parabolic cylinder, a source of electromagnetic energy disposed at said focal line, a hollow extension conductively integral with said pillbox reflector, said extension being formed with a first aperture at one end coinciding with the aperture of said pillbox reflector and with a second aperture at the other end, said second aperture of said extension being rectangular and of smaller area than the aperture of said pillbox reflector, and a plurality of conductive strips disposed in said extension and extending from the

aperture of said pillbox reflector to said second aperture of said extension, said strips being positioned to form a plurality of convergent channels within said extension for equal energy flow through said channels, said strips also being positioned parallel to the electric vector of the radiation to be radiated by said reflector.

3. An antenna comprising, a parabolic pillbox reflector, said parabolic pillbox reflector having a rectangular aperture in a plane parallel to the directrix plane of the parabolic cylinder of said reflector and including the focal line of said parabolic cylinder, and a conductive extension member secured to said reflector at the sides of said aperture, said conductive extension member being formed with a plurality of channels in juxtaposition in a plane perpendicular to the axial plane of said parabolic cylinder, each of said channels having a first aperture communicating with said reflector aperture, each of said channels having a second aperture in a plane parallel to said directrix plane and displaced from said aperture in a direction away from said reflector, said second apertures having equal areas, said first apertures having areas adapting said channels for interception of equal amounts of energy at said reflector aperture.

4. Apparatus as in claim 9, wherein the combined area of said second apertures of said channels is smaller than the area of said pillbox reflector aperture.

5. Apparatus as in claim 9, wherein said channels are disposed symmetrically with respect to the axial plane including said focal line and perpendicular to said directrix plane and the combined area of said second apertures is smaller than the area of said pillbox reflector aperture.

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