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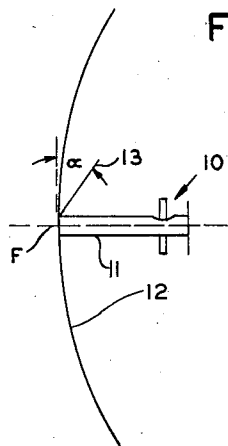


FIG. 1

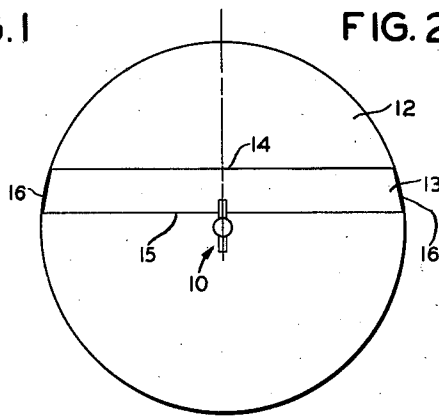


FIG. 2

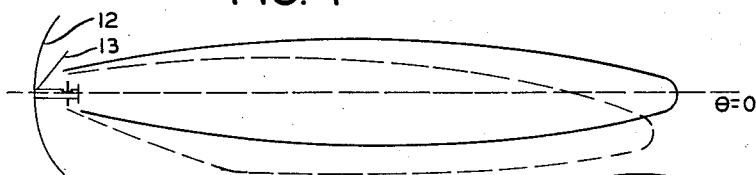


FIG. 4

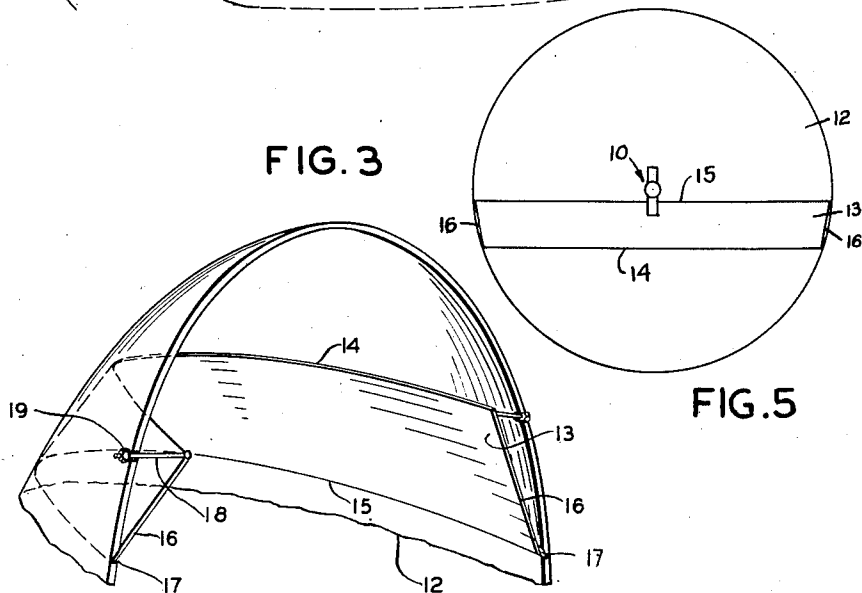


FIG. 3

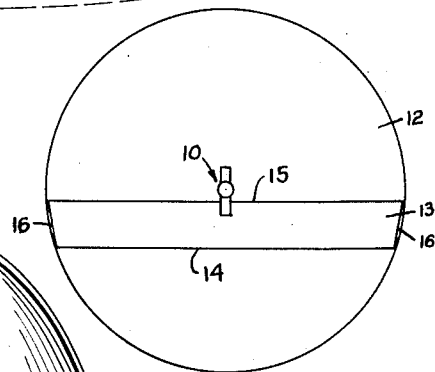


FIG. 5

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This invention relates to antennas for radio object-locating systems and particularly to means for obtaining a radiation pattern closely approximating the relationship $\csc^2 \theta$ in one plane, where θ is the angle measured from the axis of the radiating means.

In certain radio object-locating systems, for example, ground search apparatus or low-altitude airborne sets, it is desirable that the distribution of energy in a vertical plane throughout a relatively wide angle be such that the variation of energy density versus the radiation angle is a cosecant-squared function. This provides relatively constant echo strength for targets located on the earth or other surface or at equal altitudes in space regardless of whether the target is distant or close in, and it eliminates the need of tilting the antenna to obtain adequate coverage of the area under observation.

The present invention contemplates an economical and quick method of altering a usual type of parabolic reflector such as a paraboloidal dish to obtain a different type of energy distribution pattern such as a pattern of $\csc^2 \theta$ configuration, preferably having a relatively elongated base line, and with a relatively high gain compensating for less angular coverage.

Accordingly, one of the objects of the present invention is to afford a cosecant-squared radiation pattern by modification of the usual type of paraboloidal reflector.

Another object of the invention is to provide a quick and convenient means of altering a usual paraboloidal reflector without disturbing the original reflecting surface.

Still another object of this invention is to provide a member which is adapted to be attached to at least one portion of a usual type of paraboloidal reflector for presenting a reflecting surface angularly related to that of the paraboloidal surface whereby a beam of energy is adapted to be reflected in a pattern having a modified cosecant-squared configuration.

Other objects and advantages of the invention will become apparent as the description proceeds.

In the drawing:

Fig. 1 is a partially diagrammatic side view of an antenna embodying the reflector according to the invention;

Fig. 2 is a front elevation of the same;

Fig. 3 is an enlarged perspective side view of the upper half of the reflector showing structural features thereof according to one embodiment of the invention;

Fig. 4 is a diagrammatic side view showing the

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radiation patterns produced respectively by the parabolic reflector of Figs. 1 and 2 when used in the conventional manner and in the modified form according to the present invention; and

Fig. 5 is a front elevation view showing another modification of my invention wherein the sheet member is mounted in the lower half of the reflecting surface.

Referring to Figs. 1 and 2 of the drawing, a radiating element or source 10 such as a dipole and parasitic element, fed by a wave guide or coaxial line 11, is constructed and located in a conventional manner for illuminating a reflector 12. Reflector 12 is formed preferably as a paraboloidal surface having its focal point at the apparent center of radiation of the radiation source or element 10. As is well known the reflector 12, as thus far described, is adapted to reflect radiant energy in a pencil type beam characteristically having a distribution pattern relatively narrow both in elevation and azimuth, as indicated by the solid line configuration in Fig. 4.

A member 13, comprising a curved strip or sheet of metal, is adapted to be mounted in front of and to extend substantially horizontally across at least a portion of the upper half of reflector 12. Sheet member 13 has relatively long parallel upper and lower edges 14 and 15 respectively and relatively short side edges 16 which may be sloped or shaped to conform generally with the adjacent edges of reflector 12. The width of strip member 13, that is the distance between edges 14 and 15, is preferably more than a wavelength of the radiant energy.

When it is desired that reflector 12 be modified to obtain a beam of $\csc^2 \theta$ configuration, member 13 is placed in effective position in front of reflector 12. The lower edge 15 of the member is attached to reflector 12 in abutting relation along the surface for substantially the full width thereof and preferably slightly above the vertex or focal line F so that lower edge 15 is in a plane substantially parallel with a horizontal plane through the focal line F. The surface of member 13 is arranged or disposed at an angle α (Fig. 1) to the surface of reflector 12 such that the average spacing between member 13 and reflector 12 is preferably about one-eighth of the wavelength of the radiant energy to obtain the optimum phase relationship between member 13 and reflector 12. Accordingly, the distance between reflector 12 and the upper edge 14 is approximately a quarter of the wavelength of the radiant energy.

Member 13 may be secured in the effective posi-

tion as described above in any suitable manner. For example, notches 17 (Fig. 3) may be provided in the edges of reflector 12 for receiving the end portions of the lower edge 15 of member 13, or, if desired, a groove may be provided in the surface of reflector 12 to receive the lower edge 15 of strip member 13. Also a bar or arm 18 may be secured to each of the upper corners of member 13 with the free ends thereof provided with clamps or threads for engagement with apertures or slots 19 in the adjacent edge portions of reflector 12. It will be apparent that member 13 as described is adapted to be quickly and conveniently placed in position to modify or alter the effective shape of reflector 12 as desired.

It will be seen that when member 13 is placed in the aforesaid position, it serves to modify the reflecting surface of the upper half of reflector 12 while the lower half of reflector 12 remains a parabolic surface. Thus, member 13 effectively forms the upper portion of modified reflector 12 and tends to concentrate the radiation downwardly while the lower half of reflector 12 tends to concentrate the radiation ahead of reflector 12. The combination of these effects is such as to produce the type of radiation pattern indicated in broken lines in Fig. 3 which closely approximates the relation $\csc^2 \theta$, where θ is the radiation angle measured from the radiation axis $\theta=0$. It will be appreciated that a circular or PPI type scan to which the present invention may be applied, may be accomplished by rotation of the antenna about a vertical axis in a well known manner. Distant objects located in the area which is being scanned are subjected to radiant energy by a portion of the radiation field having relatively greater intensity than that portion of the radiation field which impinges upon objects closer in, whereby substantial uniformity in the strength of received signals is achieved. It will be appreciated that modifications in the shape and angular relation of sheet member 13 can be made, if desired, to alter the cosecant-squared pattern.

While the above description has disclosed that the sheet member 13 is placed above the vertex or focal line of the reflector, it will be understood that the sheet member 13 may also be located below the vertex as shown in Fig. 5. In this latter position member 13 tends to concentrate the radiation in an upward direction and thus the reflector may produce an upwardly directed beam of $\csc^2 \theta$ configuration.

Various other modifications and improvements may be made within the scope of the present invention and therefore it is not desired that the invention be limited to the precise details set forth herein.

What is claimed is:

1. An antenna comprising a paraboloidal reflector, a radiating means disposed at the focal point thereof, and a sheet-like arcuate member mounted in front of the reflecting surface, said sheet-like member having relatively long parallel upper and lower edges and relatively short side edges, said member having its lower edge attached along the full width of said reflector in a line slightly above and substantially parallel to a horizontal plane through the axis of said reflector and said upper edge being spaced from said reflector one-quarter of the wavelength of the radiant energy, whereby said sheet-like member is angularly related to the adjacent portion of said reflector and affords a modified reflecting surface in conjunction with the lower half of said reflector for producing a radiation pattern which varies as the square of the cosecant of the angle measured from the radiation axis of the antenna.

2. An antenna comprising a paraboloidal reflector, a radiant energy transducer disposed at the focal point thereof, and a sheet-like arcuate member mounted in front of the reflecting surface for modifying the radiation pattern emanating therefrom to produce a cosecant squared beam, said member having relatively long parallel upper and lower edges and relatively short side edges, one of said parallel edges abutting said reflecting surface for substantially the full width thereof, and the other of said parallel edges being spaced a predetermined distance from said reflecting surface.

3. An antenna as claimed in claim 2, wherein the abutting edge of said sheet-like member is the lower parallel edge.

4. An antenna as claimed in claim 2, wherein the average spacing between said member and said reflecting surface is one-eighth of the wavelength of the radiant energy.

5. An antenna as claimed in claim 2, wherein the spacing between the upper and lower parallel edges of said sheet-like member is at least a wavelength of the radiant energy.

6. An antenna as claimed in claim 2, wherein said member is mounted in front of a portion of the lower half of said reflecting surface.

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