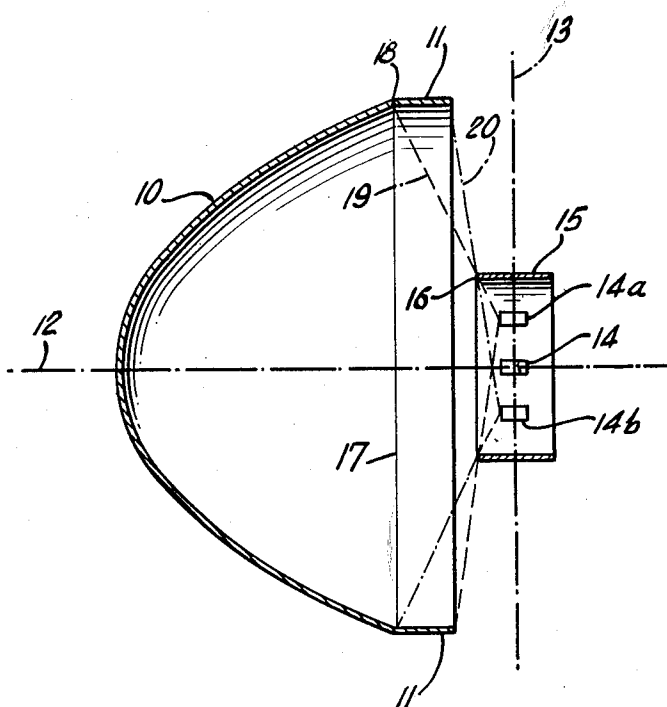


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PLURAL HORNS AT FOCUS OF PARABOLIC REFLECTOR WITH  
SHIELDS TO REDUCE SPILLOVER AND SIDE LOBES  
Filed Feb. 14, 1963

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3,176,301

## PLURAL HORNS AT FOCUS OF PARABOLIC REFLECTOR WITH SHIELDS TO REDUCE SPILLOVER AND SIDE LOBES

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8 Claims. (Cl. 343-782)

This invention relates to antenna systems for the radiation of ultra-high frequency electromagnetic energy and more particularly to an antenna shielding arrangement as applied to generally parabolic reflectors for the directive and efficient propagation of such electromagnetic energy.

Present day antenna systems of the parabolic reflector variety as used with, for example, radar, perform quite satisfactorily in their ability to track and locate distant targets. The solid angle subtended by the radiated beam of these antennas is sufficiently small so as to permit their use in tracking what is now considered a distant target. If one were, however, to draw a plot of the energy radiated from these antennas certain discontinuities would appear. These side lobes as they are referred to indicate that not only is a certain percentage of the radiated energy wasted but that the solid subtended angle is considerably widened. Although these difficulties are presently only of a minor nature in view of the limited distance between the target and the antenna, they become quite appreciable when celestial targets are considered. Testing of various antenna systems has revealed that extensive difficulties exist in attempting to attain the necessary accuracy in moon tracking. It has been determined that a large part of this difficulty is due to spillover lobes of the antenna. That is, the distortion of the solid angle through which the active antenna radiator is able to view the surrounding terrain directly and to accept energy from such terrain. This is a common fault of paraboloidal antennas and it results in the reception and transmission of energy from or toward directions where such transmission or reception is unwanted or spurious.

It is therefore an object of this invention to provide an inexpensive, simple, efficient shielding arrangement for an antenna system to minimize the spillover lobes normally attendant in such antennas.

An additional object is to provide shielding for parabolic antenna systems and to improve the operation of the same, which may also be applied to existing antennas with a minimum of expense.

Other objects and advantages will appear from the following description of an example of the invention, and the novel features will be particularly pointed out in the appended claims.

The single figure of an illustrated embodiment of this invention shows a metallic reflector 10 shaped generally in a paraboloid which type reflectors are well known in the art. The leading or forward portion 11 of the reflector 10 is distorted from the generally parabolic shape of the central portion of reflector and assumes a cylindrical configuration. The same arrangement may be obtained by extending the leading reflector edge or by affixing to a parabolic antenna a cylindrical co-extensive strip. This extension or shield constitutes only a small or minor portion of the antenna surface as compared with the parabolic portion and under certain installation conditions, its forward length is limited as, for example, by the radome where clearance is required. The reflector shield is substantially coaxial with respect to the reflector axis 12.

Disposed in front of the reflector and in the focal plane 13 thereof is the active element of the antenna which in

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this particular embodiment is made up of four feed horns 14. The horns are symmetrically arranged about the focus of the reflector so that two are in the vertical plane on opposite sides of the axis while the other two are similarly arranged in the horizontal. The horns are positioned at the vertices of a square with the reflector axis at the center and are equidistant therefrom. The energy emitted by the horns is directed toward the reflector as also is the energy impinging on the reflector directed thereby toward the horns. Although the supporting structure for the reflector 10 and for the horns has not been illustrated, these structures are well known and presently used in the art.

Disposed symmetrically about the axis 12 and enclosing the feed horns is a cylindrical metallic shield 15. Since it is essential that the surface of the reflector 11 viewed by the horns be kept to a maximum and the spillover a minimum, the dimensions of this shield 15 must be properly proportioned to obtain superior results. In order to determine these dimensional parameters, namely, the diameter of the cylindrical shield and the location of its leading edge 16, a pair of projection lines are drawn from one pair of opposite feed horns. One line is drawn from any of the feed horns, in this case, for example, horn 14a, to the closest point 18 thereto along the boundary 17 between portion 11 of the reflector and the central portion thereof. The other line is projected from that feed horn diametrically opposite the first mentioned horn, in this case horn 14b, to a point along the free edge of the portion 11 nearest the point 18. The intersection of these two lines 19 and 20 determines the minimum diameter of the shield 15 while the first mentioned line 19 determines the closest disposition of the edge 16 of shield 15 to the reflector 10.

Stated in another way, on the layout of the reflector and feed horns, the horns being at the focal plane of the reflector and arranged in two pairs, one pair vertical and the other pair horizontal, a line drawn from the near feed horn to the outermost edge of the reflector portion and from the far feed horn to the outermost point on the shield portion. The feed horn shield is so positioned that its edge nearest the reflector falls on the latter line and its diameter is such that the edge thereof falls outside the intersection of these two lines thus giving a complete line-of-sight shielding of the feed horns without shadowing any of the surface of the reflector.

This antenna arrangement has been evaluated and the results indicate satisfactory operation with signals which include those that are randomly polarized. There has been observed a minimum of 10 decibel reduction in spillover with an approximate 0.5 decibel reduction in forward lobe again.

It will be understood that various changes in the details, materials and arrangements of parts (and steps), which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

We claim:

1. A shielding arrangement for minimizing the spillover lobes of an antenna system having a generally parabolic reflector and a plurality of feed horns disposed in the focal plane of said reflector which comprises:

- (a) a metallic shield coextensive with the edge of said reflector and extending therefrom in the direction of the axis of said reflector toward said focal plane,
- (b) a second cylindrical shield coaxial with said axis extending from said focal plane toward said reflector and enclosing said feed horns,
- (c) said second shield having a diameter and length proportioned so as to permit illumination of the entire reflector surface by said horns.

2. A shielding arrangement for minimizing the spillover lobes of an antenna system which comprises:

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- (a) a metallic reflector having a generally parabolic central portion and a cylindrical outer portion coaxial with the axis of said central portion and extending in a direction toward the focal plane of said central portion,
- (b) electromagnetic radiating means disposed in the focal plane of said central portion,
- (c) an electrically conducting cylindrical shield disposed about said radiating means and coaxial with said axis, said shield being of a diameter and length whereby said radiating means may only illuminate said central portion.
3. The antenna system according to claim 2, wherein said radiating means is disposed symmetrically about said axis.
4. The antenna system according to claim 3, wherein the diameter of said shield is such that it is further from said axis than the intersection of a pair of lines one of which extends from the furthest portion of said radiator from said axis to the outer edge of said central portion and the other of which lines extends from the diametrically opposite edge of said radiating means to the outer edge of said cylindrical outer portion.
5. The antenna system according to claim 4, wherein the edge of said shield nearest said reflector extends in a direction toward said reflector just short of the first of said lines.
6. The antenna system according to claim 5, wherein said radiating means are a plurality of feed horns disposed symmetrically about said axis and in said focal plane.
7. A shielding arrangement for minimizing the spillover lobes of an antenna system which comprises:
- (a) a generally parabolic metallic reflector having an extended edge portion substantially cylindrical and coaxial with the axis of reflector,
- (b) four feed horns supported in the focal plane of said reflector, said horns disposed at the vertices of a square and being equidistant from said axis,

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- (c) an electrically conducting cylindrical shield coaxial with said axis enclosing said horns,
- (d) the diameter and length of said shield being dependent on the relative positions of two projected lines,
- (e) one of said lines extending from one horn to the nearest point along the inner edge of said extended portion of said reflector and the other line extending from the horn diametrically opposite said one horn to a point on the outer edge of said extended portion nearest the first said point,
- (f) the diameter of said shield being such that it extends outwardly beyond the intersection of said lines and the edge of said shield proximate said reflector extending just short of the first of said lines,
- (g) whereby the entire parabolic portion of said reflector may be illuminated by said feedhorns without the creation of spillover lobes.
8. The arrangement according to claim 7, wherein said extended portion constitutes only a small fraction of the entire reflecting surface of said reflector.

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