PROTECTIVE SHIELD FOR PROVIDING AN IMPEDANCE MATCH BETWEEN A RADAR FEED AND ITS PARABOLIC REFLECTOR

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FIG. 1.

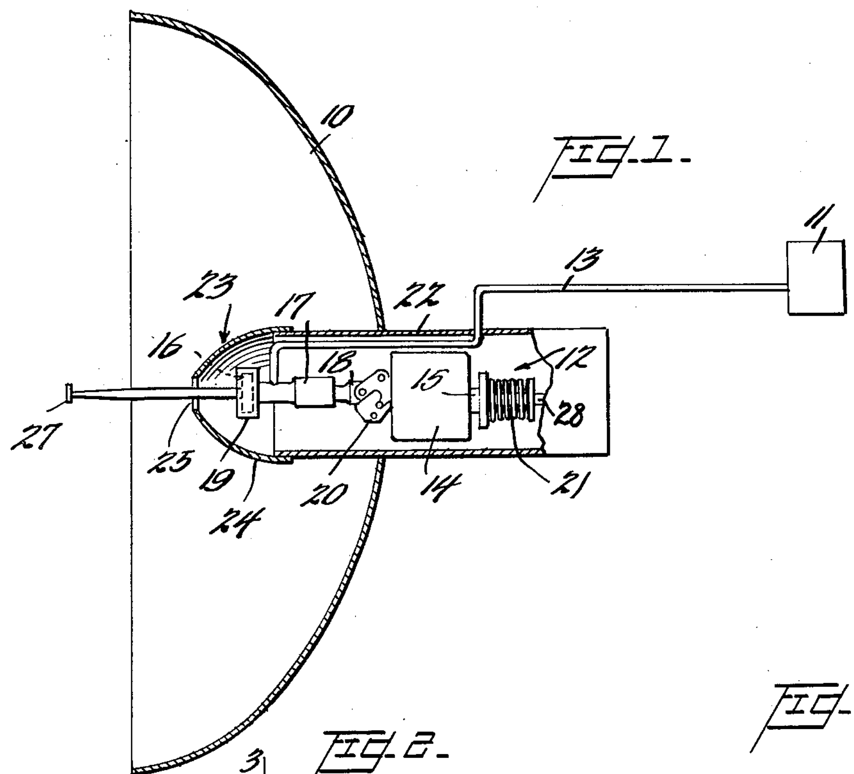


FIG. 2.

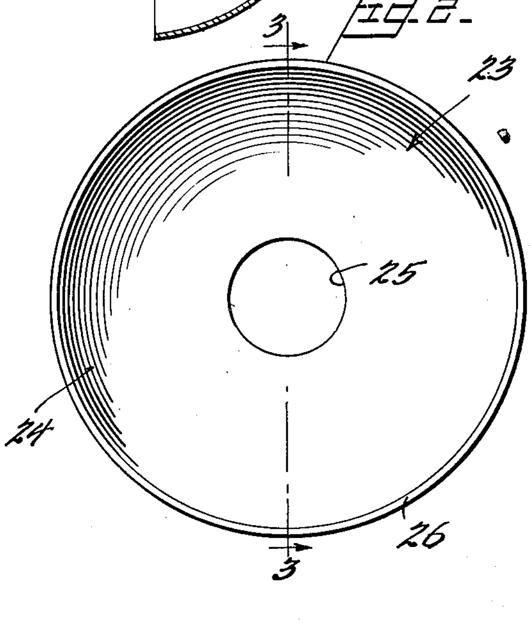
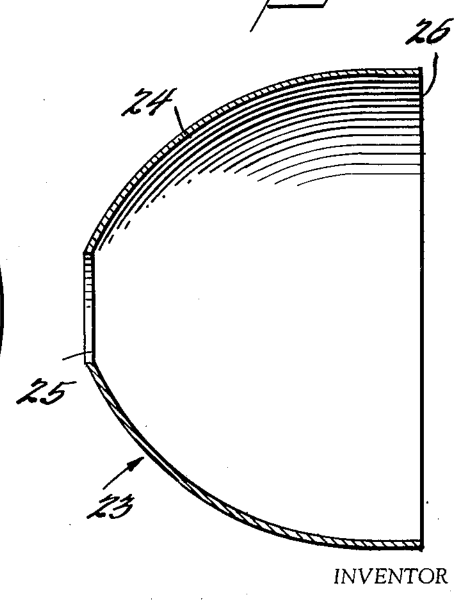


FIG. 3.



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PROTECTIVE SHIELD FOR PROVIDING AN IMPEDANCE MATCH BETWEEN A RADAR FEED AND ITS PARABOLIC REFLECTOR

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This invention relates to radar scanner shields and more particularly to a shield used in ultra-high frequency antennas systems which employ a rotating or nutating feed and a stationary reflector.

A large number of radar antenna systems have been devised which use stationary parabolic reflectors to transmit energy which is delivered from a rotating or nutating scanner. In all of these systems an inherent impedance mismatch has resulted due to the return of energy from the reflector to the scanner or vice versa. This impedance mismatch degrades the performance of the entire radar system by pulling the magnetron. Attempts to provide an impedance match by the use of a shield between the scanner and the reflector have met with failure since the minor lobes of the antenna radiation pattern have at the same time been enlarged to distort the radiation field. It is desirable in all radar systems to increase the antenna gain as much as possible and to afford the necessary impedance match without distorting the radiation pattern of the reflector.

It is essential in antenna systems to prevent damage to the nutating mechanism caused by small particles of wind blown debris and the like which would render the nutating mechanism inoperative and would necessitate de-energization of the radar for repairs.

Accordingly, one object of this invention is to provide a shield for a nutating or rotating scanner which will prevent damage to the scanner caused by wind blown debris.

Another object of this invention is to provide a shield which will provide an impedance match between the scanner and the reflector of an ultra-high frequency antenna system.

Another object of this invention is to provide a shield which will match the impedance of the reflector and the scanner and will neither add to nor subtract from the minor lobes inherent in the reflector.

A still further object of this invention is to increase the antenna gain without at the same time distorting the radiation pattern of the reflector.

With these and other objects in view, the invention comprises a continuously curving shield several wave lengths long which is positioned between a nutating or rotating feed and a stationary reflector in an ultra-high frequency antenna system. Energy incident to the shield will be diffused in a plurality of directions to prevent an impedance mismatch between the feed and the reflector and at the same time will prevent distortion of the radiation pattern inherent with the reflector.

Other objects and advantages will be apparent from the following detailed description when considered in conjunction with the accompanying drawings, wherein

Figure 1 discloses one embodiment of the invention showing a reflector and a shield in section, and a simplified view of a nutating mechanism;

Fig. 2 is an enlarged front view looking into the mouth of the shield; and

Fig. 3 is a cross-sectional view of the shield taken along line 3—3 of Fig. 2.

Referring now to the drawings, wherein like reference numerals designate the same elements throughout the several views, there is shown in Fig. 1 a stationary parabolic reflector indicated by the number **10**. A translation device **11**, which may be either a radar transceiver or a microwave receiver or transmitter, is connected by a wave guide **13** to a nutating system, indicated generally as **12**. The nutating mechanism **12** includes a motor **14** which drives a shaft **15**. Connected to the shaft **15** is a bell crank **20** which is pin coupled to a rotating crosshead shaft **18**. The bell crank **20** is linked to a push rod **28** which reciprocates as the bell crank is rotated with the shaft **15**. The resultant oscillation of the bell crank **20** deflects an antenna support **17**, which is connected to the crosshead shaft **18**, back and forth with respect to the axis of rotation. An antenna feed or feed horn **27**, which is connected by means of a gimbal ring **19** to the antenna support **17**, is thus caused to nutate with a spiral scan. A spring **21** on the shaft **15** balances the centrifugal force set up in the rotating and reciprocating parts. At the junction of the antenna support **17** and the antenna feed **27** is a radio frequency wobble joint **16** in the wave guide **13** which permits energy to be delivered from the translating device **11** to the antenna feed **27**. The nutating mechanism **12** causes the energy from the translating device **11** to sweep across the reflector **10** at a predetermined rate dependent upon the period of nutation. The nutating mechanism shown is merely illustrative of the type of apparatus used, and any of several well known types which rotate or nutate the antenna feed will suffice.

The antenna feed **27** may be of any suitable type, however, the one shown is disclosed in the United States Patent 2,422,184 to Cutler and hence is not described in detail.

A metallic shield **23** has a continuously curving surface **24** so that the shield has a constantly varying slope. The shield **23** is positioned between the nutating feed **27** and the reflector **10** and is provided at one end with an aperture **25**, which is just large enough to permit the antenna feed **27** to emerge. At the other end of the shield **23** is an aperture or mouth **26**, which is of a diameter larger than that of aperture **25** so that the shield fits snugly over a housing **22** which protrudes through the reflector **10**. The shield **23** will thus house the gimbal ring **19** and the wobble joint **16** and will protect the other parts of the nutating mechanism **12**.

The continuously curving contour **24** of the meallic shield **23** diffuses the energy which is being delivered to or from the antenna feed **27** so that no energy is reflected back into the antenna feed **27** from the gimbal ring **19** or other parts of the nutating mechanism **12** to cause an impedance mismatch. The energy which impinges upon the shield **23** is reflected at an infinite number of different angles so that any of the energy, which, if further reflected from the reflector **10**, will not disturb the relationship between the major and minor lobe characteristics of the parabolic reflector **10**. Thus the shield **23** will not affect the minor lobes inherent in the parabolic reflector **10**.

The length of the shield **23** must be several wave lengths of the frequency being used so that the shield **23** is physically large enough to shield the nutating system **12**. The use of a continuously curving shield having a length of several wave lengths permits the antenna system to function properly over a very wide frequency band at all times.

It is to be understood that the above described arrangements are merely illustrative of the application of the principles of the invention, and that numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. In a radar antenna system, a parabolic reflector, a movable antenna feed, means to move the feed, and a shield having a constantly varying longitudinal peripheral slope and located between the reflector and the feed and opening toward the reflector to prevent an impedance mismatch between the feed and the reflector.

2. In an ultra-high frequency antenna system, a parabolic reflector, a movable antenna feed, means for moving said feed, and a shield several wave lengths long and having a constantly varying longitudinal slope on the exterior, said shield being in the radiation path between the feed and the reflector and opening in the opposite direction as the reflector.

3. An antenna system comprising a stationary parabolic reflector, a movable feed for transmitting and receiving ultra-high frequency energy, means for moving the feed, and a protective impedance mismatch preventing shield several wave lengths long, said shield partially covering the feed and the feed moving means and located in the path of radiation between the feed and the reflector to deflect any energy impinging on the shield away from the feed and to the reflector, said shield presenting, on a longitudinal cross section, two symmetrical convex sides having continually changing slopes extending between two straight ends, one of which is larger than the other, the larger end facing the parabolic reflector.

4. An ultra-high frequency antenna system comprising a feed horn; a parabolic reflector; means to move said feed horn relative to said reflector so that the antenna will scan; and a shield having a constantly changing longitudinal peripheral slope and an aperture at one end so that the said horn may extend therethrough, said shield having a second aperture, said second aperture facing the reflector and larger in diameter than said first aperture in order to position the shield around said feed moving means for protection thereof, said shield serving to prevent an impedance mismatch between the feed horn and the reflector.

5. In an ultra-high frequency antenna system, a parabolic reflector to direct ultra-high frequency energy, an antenna feed movable with respect to said reflector, means to move said feed, a shield surrounding said feed moving means and that part of the feed adjacent the concave side of the reflector, said shield having a con-

stantly varying slope and opening in an opposite direction from the parabolic reflector.

6. In an ultra-high frequency antenna system, a movable antenna scanner for transmitting energy, means for moving the scanner, a housing for the moving means, a stationary parabolic reflector having a central opening through which the said housing and a portion of the moving means of the scanner protrude, a constantly curving shield several wave lengths long positioned between a portion of the movable scanner and the stationary reflector and opening toward the reflector, said shield having at one end an opening through which the scanner protrudes and at the other end an opening which fits over the said housing so that the shield is positioned within the path of radiation to diffuse any energy received from the scanner to prevent impedance mismatching between the scanner and the reflector to increase antenna gain and to avoid distortion of the radiation pattern of the reflector.

7. In an antenna system; a stationary reflector; a movable feed means for transmitting and receiving ultra-high frequency energy; means for moving the feed means; and a metallic shield several times longer than the wave length of the energy transmitted and/or received and having two convex sides of constantly changing slope along its longitudinal cross section, said shield opening toward the reflector and having an aperture through which the feed means projetcs so that the shield covers and protects portions of the feed means and the feed moving means, said shield being located in the path of radiation and serving to prevent impedance mismatching between the reflector and the feed means by reflecting incident energy from the feed to the reflector.

8. In an ultra-high frequency antenna system, a parabolic reflector having a central aperture, a movable antenna feed projecting through the aperture in the reflector, means to move the feed, a housing for the feed moving means, said housing projecting through the aperture in the reflector and surrounding a portion of the feed, a shield opening toward the reflector and having one end fitted over the housing, said shield having an aperture at the other end through which the feed means projects.

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