

[54] STEERABLE RADAR ANTENNA

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[58] Field of Search..... 343/761, 757, 839, 911 L

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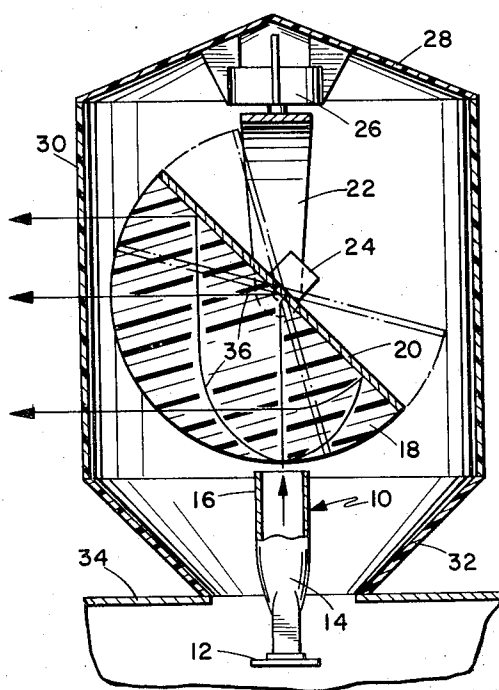
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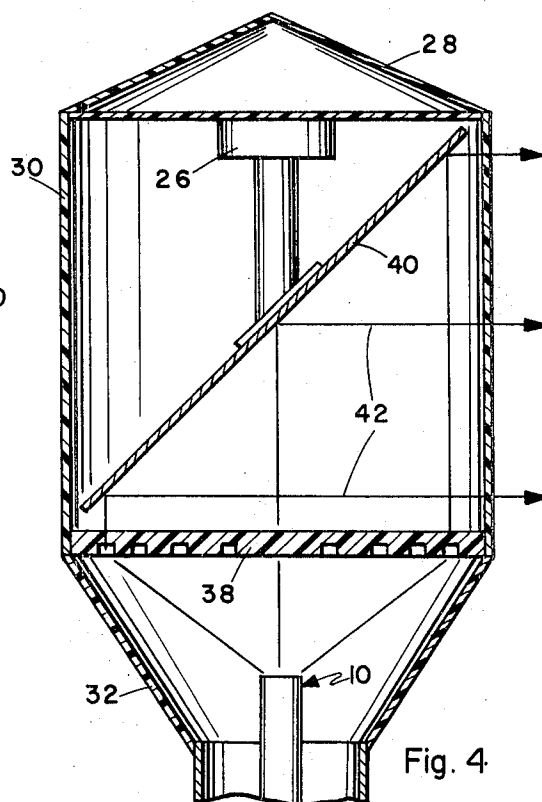
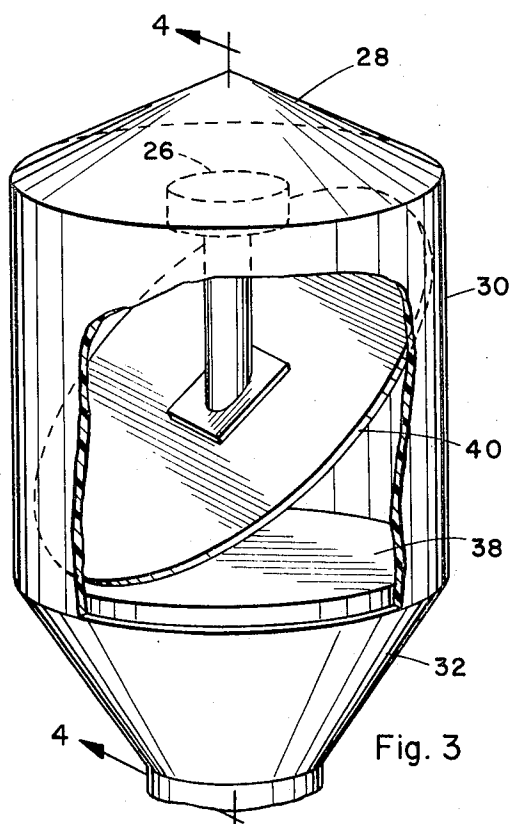
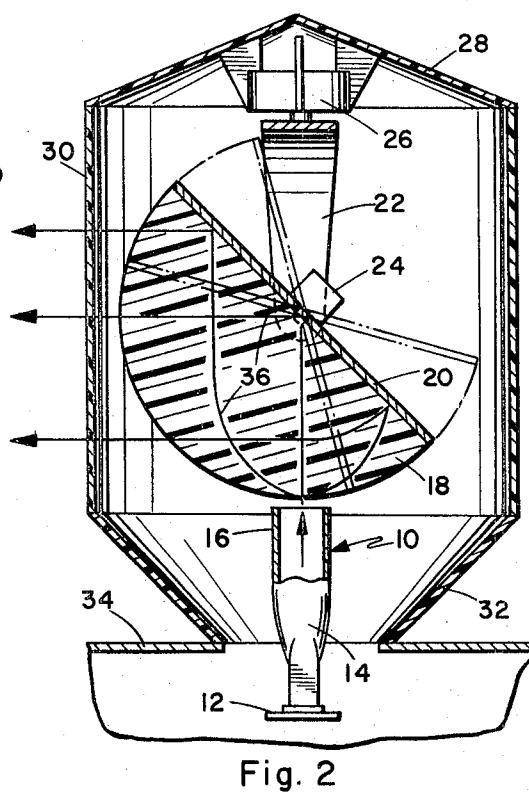
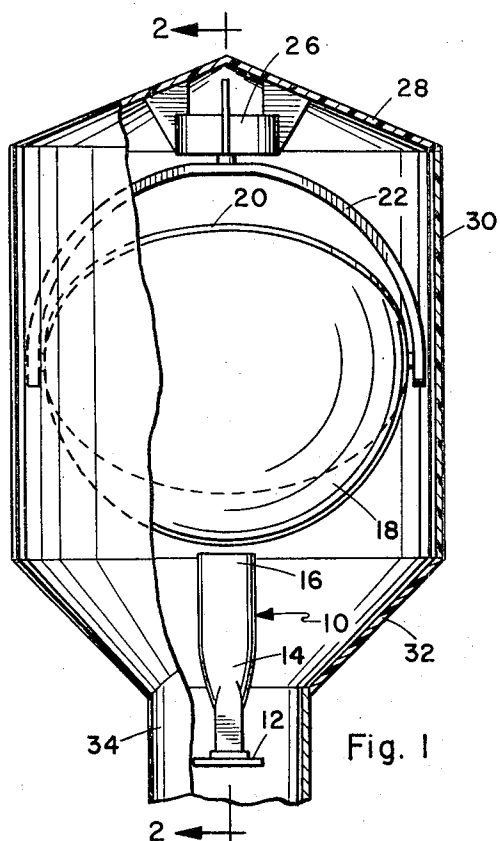
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ABSTRACT

A steerable radar antenna having a fixed energy feed requiring no rotary joints in the waveguide, including a microwave lens and a moveable reflector which operate conjunctively to collimate and direct the RF energy, and a drive means.

3 Claims, 4 Drawing Figures





STEERABLE RADAR ANTENNA

SUMMARY OF THE INVENTION

The antenna comprises a fixed source of RF energy, eliminating the need for rotary joints in the waveguide, and a pivotally mounted reflector driven by a conventional servo drive mechanism. Interposed between the fixed energy source and the reflector is a microwave lens which directs the energy from the source toward the reflector and, in cooperation with the reflector, causes the emitted beam to be collimated.

BACKGROUND OF THE INVENTION

The present invention relates to scanning antennas, and more particularly to a steerable radar antenna which is suitable for mounting on an aircraft, or in any location where space is at a premium.

In the prior art, scanning antennas generally utilize a rotatable reflector and primary radiator or feed system which rotates with the reflector during scanning. The primary radiator is coupled to a source of RF energy by means of a waveguide which requires one or two rotary joints therein to accomplish azimuth and/or elevation scanning of the antenna. Practical rotary joint design is difficult under the most ideal conditions due to the inherent power loss in such a coupling, and becomes even less practical in the design of a high power compact unit to be used in a high altitude aircraft capacity due to strict dimensional limitations.

One method devised to scan a radar beam without the use of rotary joints is to couple a stationary RF feed to a stationary main reflector by means of a pivotal or rotatable subreflector. This method is useful when an extremely high scan frequency is required, or in deep space applications where the main reflector is so large that rotation is not practical. However, the scanning arc of such an antenna is generally limited to a relatively small solid angle due to the fixed nature of the main reflector, so the design is impractical for many uses, including that of present concern.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevation view of a typical configuration of the antenna;

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is a perspective view partially cut away, of an alternative configuration; and

FIG. 4 is a sectional view taken on line 4—4 of FIG. 3.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

The feed 10 provides a point source of circularly polarized RF energy and may consist of a flange 12 which mates with a standard waveguide flange in the vehicle (not shown), a rectangular-to-circular waveguide transition 14, and a polarizer 16. The feed will remain fixed with respect to the vehicle's coordinate system, thereby eliminating the need for bulky rotary joints in the waveguide.

In the first embodiment, shown in FIGS. 1 and 2, a microwave lens, more specifically a Luneberg-type lens 18 comprising a hemisphere of dielectric material, is disposed immediately above energy source 10 and is mounted on the reflector 20. The reflector is a flat circular plate with its underside flush against the plane of

the great circle of the hemispherical lens 18. Reflector 20 could be other than planar to accommodate a modified type of Luneberg lens, or to produce a different mapping pattern.

Reflector 20 is pivotally mounted on a yoke 22 and an elevation drive assembly 24 is mounted on the upper surface of the reflector and engages the yoke for elevational steering of the reflector. The yoke 22 is centrally mounted to an azimuth drive assembly 26 whose vertical scanning axis is collinear with the point source feed. The drive assemblies are conventional servo drive packages and are shown somewhat diagrammatically in the drawings.

Azimuth drive assembly 26 is fixedly mounted on the underside of the radome cap 28 which is secured atop a cylindrical radome 30. Radome 30 is mounted on frustoconical fairing 32 which is secured to the fin 34 or other portion of an aircraft, or any suitable frame member of a vehicle.

In the operation of the antenna illustrated in FIGS. 1 and 2 semi-isotropic radiant energy emitted from the feed 10 is partially collimated by the lens 18, as indicated by the optical tracings 36, then reflected by the reflector 20 back through lens 18 where it is further collimated, and is emitted from the antenna as an essentially parallel beam. Upon reflection the sense of polarization is reversed so that the final emitted beam is circularly polarized in the opposite sense of the feed. This reversal also occurs when the antenna is operating in its receiving mode.

Elevation steering is accomplished by elevation drive 24, which is capable of positioning the reflector 20 approximately 30° above and below the 45° zero elevation command position as shown in phantom in FIG. 2, corresponding to a possible deviation of the emitted beam of plus or minus 60° from the horizontal. Azimuth scanning capability of 360° is provided by drive 26.

A modification of the antenna is shown in FIGS. 3 and 4, in which the microwave lens takes the form of a circular Fresnel-type plate lens 38 which is horizontally mounted at the junction between fairing 32 and radome 30. In this modification as shown no elevation drive is provided so that reflector 40 is of elliptical form corresponding to the diagonal cross section of cylindrical radome 30. Azimuth scanning drive 26 is connected directly to the upper surface of reflector 40, and again the scanning axis is collinear with the center of point source 10. Optical tracings 42 in FIG. 4 indicate the path of the radiant energy as it is emitted from source 10, collimated by Fresnel lens 38, reflected and emitted as a parallel beam. Elevation scanning means could clearly be included without disrupting the parallelism of the emitted beam.

When used in its intended capacity, the unit will be mounted atop the tail section of an aircraft. Space stabilization signals computed from vertical and heading gyro outputs combined with command elevation and azimuth signals in the steering unit will generate the drive signals for the unit.

Both embodiments of the invention are simple, compact, and capable of being mounted atop a narrow fin, the diameter of the microwave lens being on the order of 6 inches and the housing and drive structures correspondingly dimensioned. Other uses for the antenna, airborne, vehicular or terrestrial, are apparent, and the invention is not intended to be limited to the specific structure or mounting means herein described.

LIST OF ASSIGNED NUMBERS OF PARTS

- 10. Feed
- 12. Flange
- 14. Rectangular to circular waveguide transitor
- 16. Polarizer
- 18. Luneberg lens
- 20. Reflector
- 22. Yoke
- 24. Elevation drive assembly
- 26. Azimuth drive assembly
- 28. Radome cap
- 30. Radome
- 32. fairing
- 34. Structural member of vehicle
- 36. Optical tracings
- 38. Fresnel-type lens
- 40. Reflector for 38
- 42. Optical tracing for 38

I claim:

- 1. A steerable radar antenna comprising:
 - a drive assembly;
 - a reflector having a generally hemispherical lens with the substantially planar surface thereof mounted on the reflective surface of said reflector, said re-
 - lector and lens comprising a unit operated by said
 - drive assembly; and
 - at least one stationary feed disposed adjacent to the
 - generally hemispherical surface of said lens and ca-

pable of coupling RF energy to said lens.

- 2. A steerable radar antenna comprising:
 - a drive assembly;
 - a reflector operated by said drive assembly;
 - a stationary punctiform feed for RF energy compris-
 - ing:
 - an open-ended waveguide;
 - a rectangular-to-circular waveguide transition
 - flanged to the open end of said waveguide;
 - a polarizer to produce circular polarization at-
 - tached to said waveguide transition such that cir-
 - cularly polarized energy is radiated from said po-
 - larizer generally in the direction of said reflector;
 - and
 - a microwave lens disposed between said energy
 - feed and said reflector directing said RF energy
 - toward said reflector and cooperating with said
 - reflector to produce a collimated emitted beam.

- 3. A steerable radar antenna comprising:
 - a drive assembly;
 - a cylindrical radome;
 - an elliptical reflector diagonally disposed in said ra-
 - dome and operated by said drive assembly;
 - a stationary feed to couple RF energy to said reflec-
 - tor; and
 - a Fresnel-zoned plate lens disposed between said en-
 - ergy feed and said reflector.

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