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ANTENNA

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FIG-1

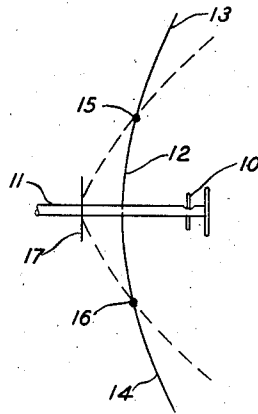


FIG-2

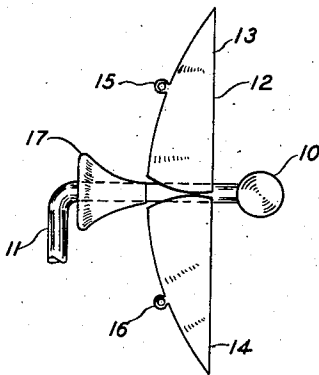
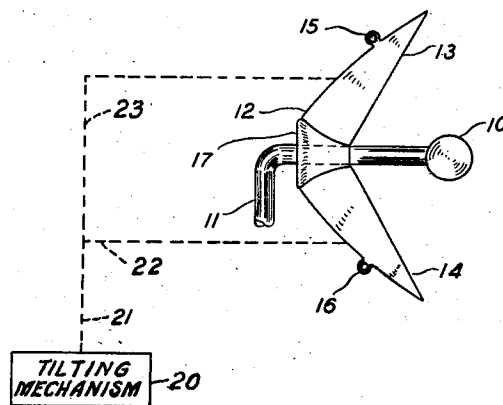


FIG-3



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## UNITED STATES PATENT OFFICE

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## ANTENNA

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3 Claims. (Cl. 250-11)

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The present invention relates to antennas such as may be used with radio object-locating systems, and particularly to an antenna having a parabolic reflector adapted to radiate electromagnetic energy in alternately different energy distribution patterns.

One application of the present invention may be in an automatic tracking object-locating system where the antenna is used first in searching for targets and then in automatic tracking with a different type of energy distribution pattern. The present invention is adapted to provide a fan beam for general searching, the beam being wide vertically and narrow horizontally, and then, alternatively, to provide a pencil beam for tracking which may be rotated for conical type scan. A pencil beam characteristically is narrow both vertically and horizontally.

Accordingly, one of the objects of the present invention is to provide an antenna adapted to radiate a beam of energy which scans a field in space with either a fan beam, or a pencil beam in a conical or like manner.

Still another object of this invention is to provide a paraboloidal reflector in two or more parts, each part being movable relative to the normal or principal axis of the paraboloid, for producing a variety of energy distribution patterns.

Other objects and novel features of the invention will be apparent from the following description.

In the drawing:

Fig. 1 is a diagrammatic side view of the antenna embodying the reflector of the present invention.

Fig. 2 is a side view of the antenna with the reflector of the present invention shown in one position, and

Fig. 3 is a side view of the antenna embodying the reflector of the present invention shown with two parts of the reflector in tilted position.

With reference to the drawing, a radiating element such as a dipole and housing 10, fed by a wave guide or coaxial line 11, is constructed and located in a conventional manner for illuminating a reflector 12. Reflector 12, shown in solid lines (Fig. 1), is preferably a paraboloidal surface having its focal point at the apparent center of radiation of the radiating source 10. Reflector 12 is preferably made in two parts by cutting the paraboloid along a substantially horizontal plane through its center, thus forming an upper half section 13 and a lower half section 14.

Sections 13 and 14 are pivotally mounted or hinged on horizontal axes 15 and 16, respectively,

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in any suitable manner. The axes 15 and 16 are disposed on opposite sides of the principal axis of reflector 12 and lie in a plane perpendicular to the principal axis. For example, axes 15 and 16 may be horizontal rods or shafts hinged or otherwise pivotally mounted on the rear surface of each of sections 13 and 14, preferably at approximately the center portions thereof. Any suitable mechanical or electrical means, conventionally indicated by box 20 and broken lines 21, 22 and 23, may be provided for moving sections 13 and 14 about their horizontal axes and preferably such movement should be of equal magnitude for both sections. Thus, sections 13 and 14 are adapted to be tilted about axes 15 and 16 to the position indicated by dotted lines in Fig. 1, or to the position indicated in Fig. 3.

If desired, a reflecting member 17 may be mounted in any suitable manner at the back of reflector 12 for reflecting a portion of the energy when sections 13 and 14 are in the tilted position. Thus reflecting member 17 serves to fill in the open gap between sections 13 and 14. Reflecting member 17 may be of any desired shape, such as a substantially plane member perpendicular to the axis of the reflector 12, or such as that shown in Figs. 2 and 3. However, in most applications the angle of the tilt of sections 13 and 14 is so small that there is only a very small gap between the sections, and in such instances a reflecting member 17 may not be necessary.

For locating objects in space it is usually desired to sweep or scan as large a portion of space as possible. This may be accomplished, according to the present invention, by tilting the sections 13 and 14 of reflector 12 to the position shown in Fig. 3. Illumination of reflector 12 by radiator 10 produces a fan beam relatively wide in elevation and relatively narrow in azimuth. A search type scan may be produced with this fan beam by rotation of the antenna about a vertical axis in a well-known manner until a target is located. The sections 13 and 14 then may be tilted about their horizontal axes 15 and 16 to the positions shown in Fig. 2 for producing a pencil beam. This beam, which is generally circular in cross section, may be rotated to provide conical scanning for automatic tracking.

In a practical case, it has been found that the amount of tilting required of sections 13 and 14 of the paraboloidal reflector 12 is very small for the desired flaring of the fan beam. It will be recognized that the amount of flare introduced into the beam from each section 13 and 14 is proportional to twice the angle of tilt. In fact, it

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is desirable to keep the angle of tilt as small as possible in order that coma and aberration will be a minimum. In principle, each section 13 and 14 may be considered as producing its own beam. Tilting the section of the reflector 12 tilts that beam by twice the angle of tilt of the reflector section. Since this occurs for both sections of reflector 12 and adding the resultant radiation patterns of the two sections an equivalent beam results which is substantially four times as wide as the original beam when the two sections of the reflector are not tilted.

While the above description has been principally directed to a paraboloidal reflector in two parts, it will be understood that the reflector may be formed in more than two sections to obtain modified results. For example, another suitable arrangement would be a reflector divided horizontally into three sections with the middle section being stationary and the upper and lower sections being pivotable. Also, if desired, the reflector may be divided vertically into two or more pivotable parts for producing fan type beams which are relatively narrow in elevation and wide in azimuth.

It will also be understood that an antenna embodying a reflector as described may be tilted as a unit or that the radiating elements may be rotated or tilted relative to the reflector for producing a variety of scanning patterns.

While a preferred embodiment of the present invention has been illustrated and described and modifications thereof have been referred to in the present description, it will be understood that these are capable of further modification and improvement without departing from the spirit

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of the invention; therefore, it is not desired that the scope of the invention be limited to the precise details set forth.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent is:

1. An antenna for radio communication systems having, in combination, means for radiating high frequency energy, a reflector for directing the radiant energy along a predetermined path, said reflector being divided substantially horizontally and centrally into two sections, each of said sections being mounted to tilt about a horizontal axis lying in a plane perpendicular to the principal axis of said reflector, one position of said sections forming a paraboloidal reflector adapted to produce a pencil beam of radiant energy, other positions of said sections forming a reflector adapted to produce fan beams of radiant energy, and means for tilting said sections.

2. The combination as claimed in claim 1 wherein a reflecting member is mounted adjacent to the back surface of the reflector, said member being adapted to reflect energy from the radiating means when the sections are in tilted position.

3. An antenna for radio communication systems having, in combination, means for radiating high frequency energy, a reflector for directing the radiant energy, said reflector comprising a plurality of sections normally forming a paraboloid, means for pivotally supporting some of said sections, and means for tilting at least one of said sections relative to the principal axis of said reflector.

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