Nov. 28, 1950 R. J. MARSHALL 2,531,454

DIRECTIVE ANTENNA STRUCTURE

Filed Feb. 4, 1942

FIG. 1

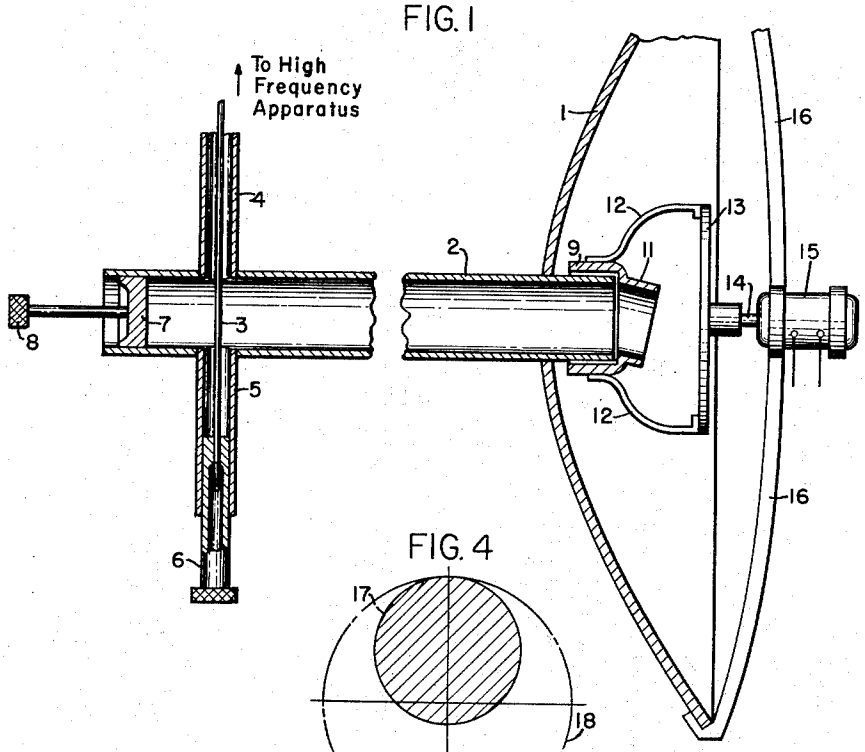


FIG. 4

FIG. 2

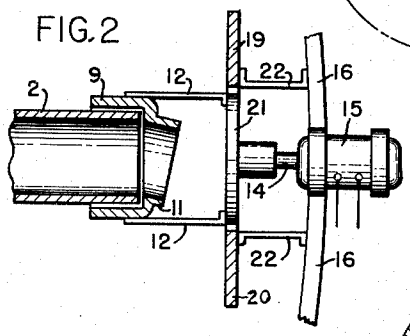


FIG. 3

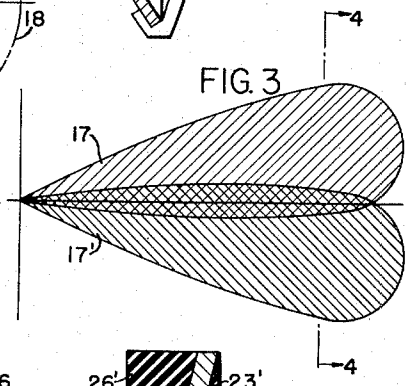


FIG. 5

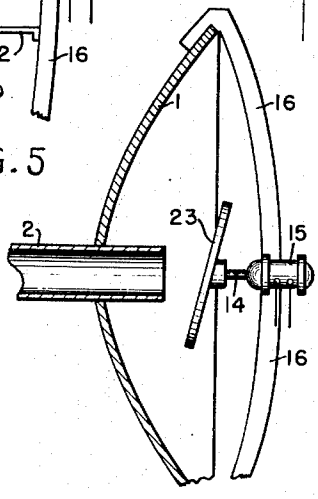


FIG. 6

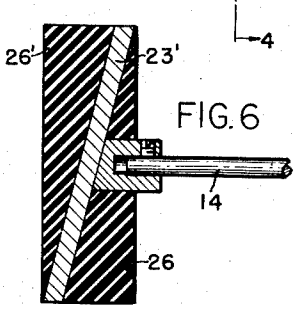
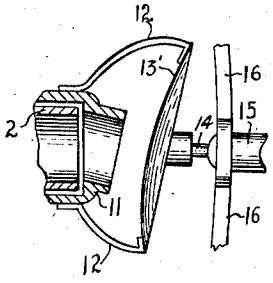


FIG. 7



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DIRECTIVE ANTENNA STRUCTURE

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18 Claims. (Cl. 250—33.65)

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This invention relates, generally, to the directional reception or transmission of high frequency electromagnetic energy and the invention more particularly relates to a novel directive antenna structure having a series of differing zones of reception or transmission, said series being repeated in regular sequence.

Heretofore, directive antenna means have been employed for setting up a series of directed zones of transmission or reception, such antenna means comprising a radiating antenna and a cooperating eccentrically mounted parabolic or other reflector, such reflector being rotated to produce the desired space pattern. The rotation of these reflectors at high speeds is undesirable owing to the windage and to gyroscopic effects. Furthermore, such reflectors are usually supported in large diameter bearings where a wave guide is used to convey the energy to or from the antenna means, such large bearings having but a short life in use and tending to cause overheating and excessive wear of the relatively movable parts.

One object of the present invention is to provide a novel directive antenna structure adapted in use to establish a series of overlapping zones of electromagnetic radiation or reception, said series being repeated indefinitely.

Another object of the present invention is to provide a novel antenna structure comprising a reflector and wave guide means for supplying electromagnetic radiation to said reflector or receiving radiation therefrom.

Still another object of the present invention is to provide a novel directive antenna structure comprising a fixed reflector, wave guide means for conveying energy to or from said reflector, and motor-driven deflecting means cooperating with the mouth of said wave guide for producing a lobe of electromagnetic radiation or reception whose central axis continuously revolves defining the surface of revolution of a cone, the apex of such surface being centered at the antenna structure.

Other objects and advantages will become apparent from the specification, taken in connection with the accompanying drawings wherein the invention is embodied in concrete form.

In the drawings,

Fig. 1 is a sectional view of an antenna structure embodying the principles of the present invention.

Fig. 2 is a detailed view showing a somewhat modified construction.

Figs. 3 and 4 are longitudinal and transverse

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sections of the received or transmitted lobes of electromagnetic energy.

Fig. 5 is a view similar to Fig. 1 but of a somewhat modified structure.

Fig. 6 is a detailed cross-section of a modification of the structure of Fig. 5.

Fig. 7 is a fragmentary sectional view of a slight modification of Fig. 1.

Similar characters of reference are used in all of the above figures to indicate corresponding parts.

Referring now to Fig. 1 of the drawings, a reflector 1 as of the parabolic type is shown mounted on the end portion of a wave guide 2, which in turn feeds into or is fed from a concentric line 3, 4. The inner conductor 3 of the concentric line 3, 4, is shown extending into a stub guide 5 having a movable plug 6 therein for matching the impedance of line 3, 4 to guide 2. A plunger 7 having a handle 8 is also movable in the end portion of guide 2 for aiding in this adjustment. The discharge end of wave guide 2 within reflector 1 is shown surrounded by deflector member or nozzle 11 preferably having the form of the wave guide section and extending at an angle to the guide 2, the deflecting member 11 being provided with an annular flange or sleeve 9 overlying the end portion of guide 2 but preferably not contacting this guide. The deflecting member 11 is carried by arms 12 preferably of dielectric material that are attached to a circular plate 13 which in turn is mounted to be rotated or otherwise moved upon the end of a motor shaft 14 which is driven by a motor 15. Thus, where the antenna structure is used as a radiator, energy leaving guide 2 is directed by deflector 11 so as to strike plate 13 at an angle to the perpendicular and is reflected from this plate back against the reflector 1 and then projected substantially as a lobe such as the lobe 17 shown in Figs. 3 and 4. Nozzle 11 and plate 13 thus serve as deflection means for conveying energy between guide 2 and reflector 1. As motor shaft 14 revolves, this lobe also revolves, its longitudinal axis describing the surface of a right circular cone. On the other hand, if the antenna structure is used as a receiver it will have a revolving zone of electromagnetic reception which in any instance will have the form as shown at 17 but which will revolve as indicated in Figs. 3 and 4. The motor 15 is shown supported by arms 16 which preferably are of dielectric material connected at their outer ends to reflector 1 or other support.

In order to help reduce the gyroscopic action

of revolving plate 13 the structure of Fig. 1 may be modified as in Fig. 2, if desired, wherein the reflecting plate 20 corresponding to plate 13 of Fig. 1 is formed in two parts, an outer annular part 19 carried by struts 22 attached to arms 16 and an inner circular portion 21 that is rotated by motor 15 and which carries the arms 12 supporting the deflector member 11. The action here is similar to that in Fig. 1 except that only a small portion of the reflector disc 20 revolves, namely, the portion 21.

In Fig. 5 the deflector member is shown in the form of an inclined disc 23 positioned in front of the mouth of guide 2. Energy discharged by guide 2 is deflected by disc 23 to one side and against the inner surface of reflector 1 and as the disc 23 revolves this energy is directed progressively against different portions of the reflector 1 to produce the revolving lobe of electromagnetic energy shown in Fig. 3. Likewise, if the structure of Fig. 5 is used as a receiving antenna its zone of sensitivity will revolve as shown in Fig. 3 due to the rotation of the deflector 23.

Owing to the fact that the deflector 23 is inclined with respect to its axis of rotation this deflector tends to produce more or less windage and vibration which can be reduced by encompassing this deflector in an insulating cylinder having portions 26 and 26' at opposite sides of the disc 23' as shown in Fig. 6. The action of the structure in Fig. 6 is similar to that of Fig. 5.

In Fig. 7 a slight modification of the structure of Fig. 1 is shown wherein the plate 13' is shown in the form of a semispherical disk instead of the flat disk 13 shown in Fig. 1, the disk 13' also being inclined as illustrated. The action, however, is quite similar to the structure of Fig. 1.

As many changes could be made in the above construction and many apparent widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A directive antenna system comprising, a stationary reflector, a wave guide extending through said reflector and communicating therewith, a deflector member comprising a wave guide portion cooperating with the mouth of said wave guide and extending at an acute angle thereto, and a rotatable plate positioned in front of said deflector member and connected for rotating the latter therewith.

3. A high frequency directive antenna system comprising, a parabolic reflector, a wave guide projecting through said reflector substantially concentrically with the axis thereof, a deflector plate positioned in front of the mouth of said wave guide and inclined at an acute angle relative to said guide, and means for rotating said deflector plate to render said antenna structure successively sensitive to differing zones of electromagnetic reception, said inclined deflector plate being contained within an insulating cylinder that is symmetrical with respect to the axis of rotation of said plate.

3. In a directive antenna having a paraboloidal reflector, and a wave guide emptying into the cavity formed by said paraboloidal reflector, the combination comprising a deflector mounted asymmetrically relative to an axis of rotation and operative when rotated to deflect electromagnetic waves from said guide onto successive portions of said reflector, and dielectric means filling out the asymmetrical portions of said deflector to a form symmetrical about said axis.

4. In a directive antenna structure having a substantially parabolic reflector, and a wave guide extending substantially coaxially with said reflector, the combination comprising an eccentric nozzle member adapted to deflect electromagnetic waves issuing from the end of said guide, and means for rotating said member relative to said reflector.

5. The combination as claimed in claim 4 wherein said nozzle member includes a sleeve portion surrounding but rotatable relative to said end of said guide.

6. A directive antenna structure having a substantially parabolic reflector, an electromagnetic wave conductor extending through said reflector substantially coaxially with said reflector, means including a movable deflector having a major portion within the concavity of said reflector eccentrically disposed relative to the axis of said reflector for directing waves from said conductor onto a portion of said reflector, and power means disposed on the side of said deflector opposite said conductor for moving said deflector relative to said reflector to direct said waves onto successive portions of said reflector.

7. In a directive antenna structure having a substantially parabolic reflector and an electromagnetic wave conductor adapted to radiate energy into the cavity formed by said reflector, the combination comprising a support extending across said cavity, a deflector adapted to reflect radiant energy onto said parabolic reflector, and power means on said support adapted to move said deflector relatively to said parabolic reflector.

8. The combination as claimed in claim 7, wherein said deflector comprises an eccentric nozzle for said radiant energy rotatable relative to said reflector.

9. The combination as claimed in claim 7, wherein said deflector comprises an eccentric nozzle for said radiant energy rotatable relative to said conductor, and a convex deflector plate rotatable relative to said reflector for diverting radiant energy onto successive portions of said reflector.

10. A directive antenna system comprising a concave reflector, an electromagnetic energy conductor fixed thereto and extending through said reflector, means at least partially within the concavity of said reflector for interchanging energy between said conductor and a portion of said reflector, and means for moving said interchanging means to cause said reflector portion to change successively, whereby the directivity characteristic of said system is varied.

11. A system as in claim 10, wherein said interchanging means comprises a deflector member for changing the directivity characteristic of said energy interchange, and wherein said moving means comprises means for rotating said deflector member relative to said reflector.

12. Apparatus as in claim 10, wherein said interchanging means comprises a deflecting plate positioned before an end of said conductor and maintained at an angle thereto.

13. In a directive antenna system having a concave reflector and an electromagnetic energy conductor coupled thereto, the combination comprising a support extending across said reflector, deflecting means for interchanging energy between said reflector and said conductor, and

power means mounted on said support for moving said deflector means relative to said reflector whereby the directivity characteristic of said system is varied.

14. A directive antenna comprising a reflector, a wave guide projecting through said reflector and fixed thereto, a wave guide section communicating with said first guide and in non-alignment with respect thereto, and means for moving said section relative to said guide to vary the directivity characteristic of said system.

15. A directive antenna system comprising a reflector, an electromagnetic energy conductor fixed thereto and extending through said reflector, means for interchanging energy between said conductor and a portion of said reflector, and means for moving said interchanging means to cause said reflector portion to change successively, whereby the directivity characteristic of said system is varied, said interchanging means comprising a deflector member in the form of a section of electromagnetic energy conductor disposed in non-alignment with respect to said first conductor.

16. A directive antenna system comprising a reflector, an electromagnetic energy conductor fixed thereto and extending through said reflector, means for interchanging energy between said conductor and a portion of said reflector, and means for moving said interchanging means to cause said reflector portion to change successively, whereby the directivity characteristic of said system is varied, said interchanging means comprising a convex deflecting plate positioned

before an end of said conductor and maintained at an angle thereto.

17. In a directive antenna structure having a substantially parabolic reflector, a wave guide section having an open end and an axis acutely angularly disposed relative to the axis of said reflector, said wave guide section being rotatable relatively to said reflector about said reflector axis.

18. In a directive antenna structure having a concave reflector having an axis, a wave guide section having an open end and acutely angularly disposed relative to the axis of said reflector, said wave guide section being rotatably relatively to said reflector to produce a conically rotatable directivity characteristic.

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