Oct. 29, 1963 A. T. LLOYD 3,109,175

ROTATING BEAM ANTENNA UTILIZING ROTATING REFLECTOR WHICH SEQUENTIALLY ENABLES SEPARATE GROUPS OF DIRECTORS TO BECOME EFFECTIVE

Filed June 20, 1960 3 Sheets-Sheet 1

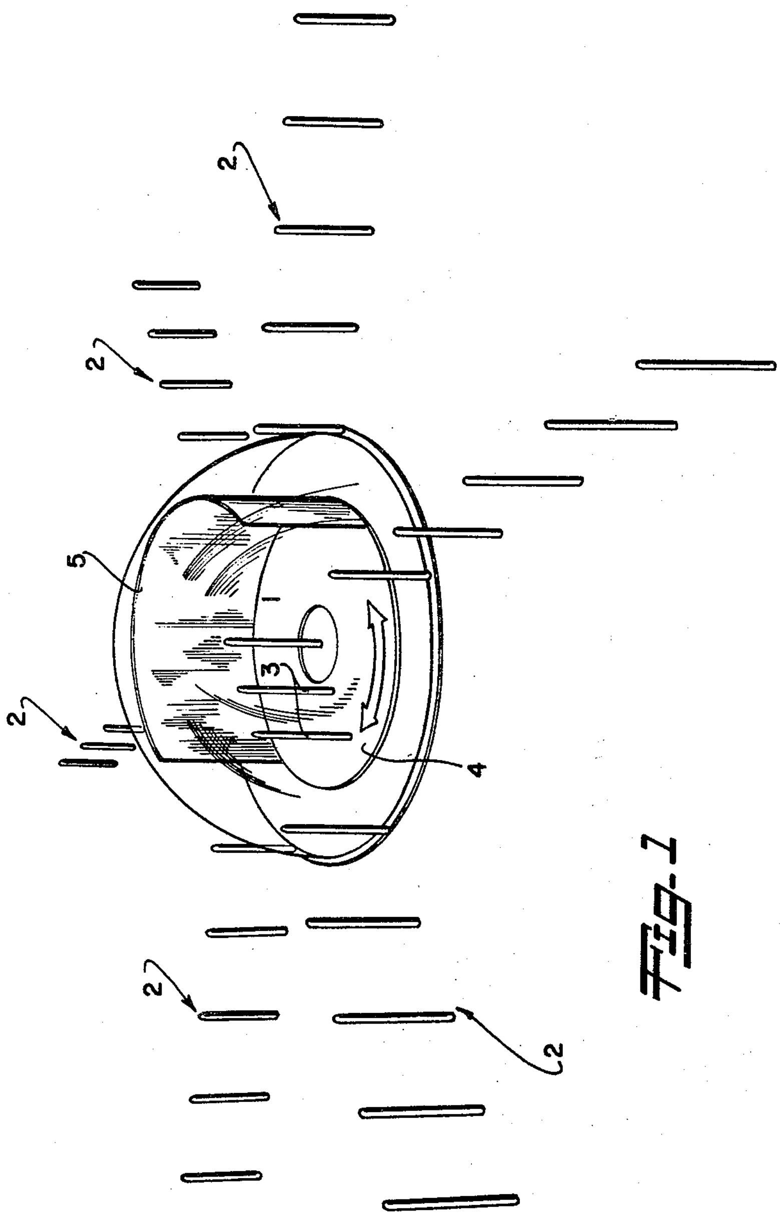

Fig-1

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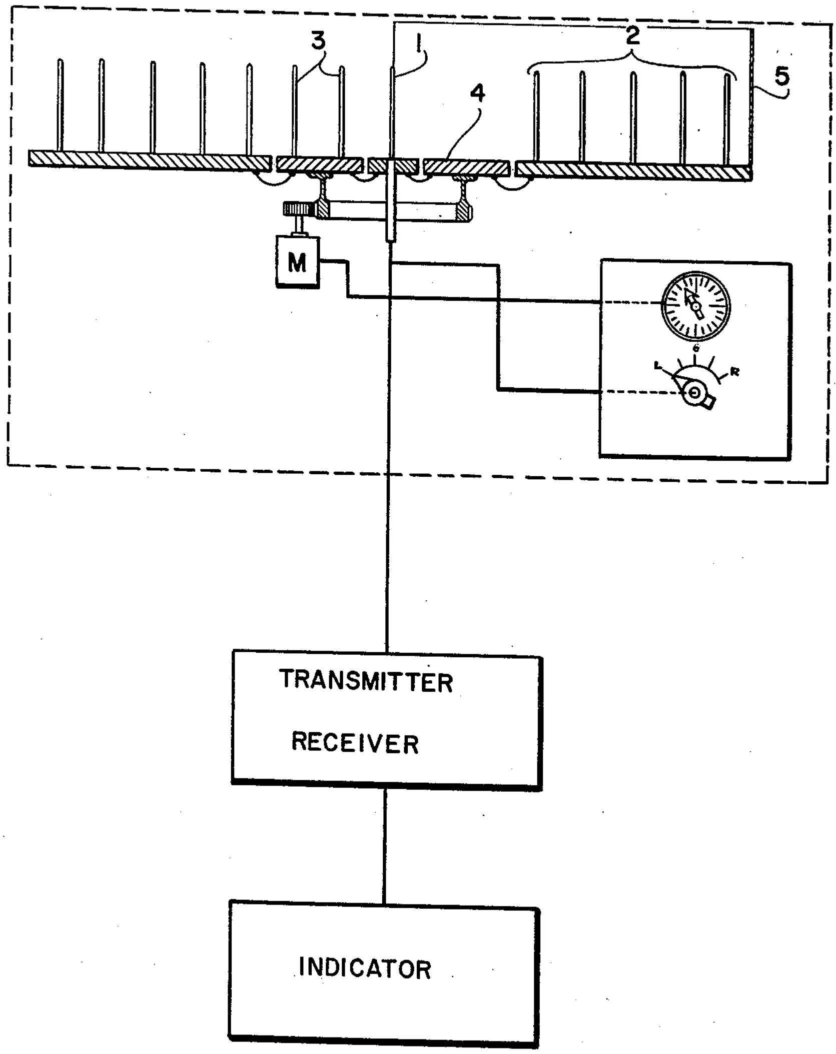

Fig. 2

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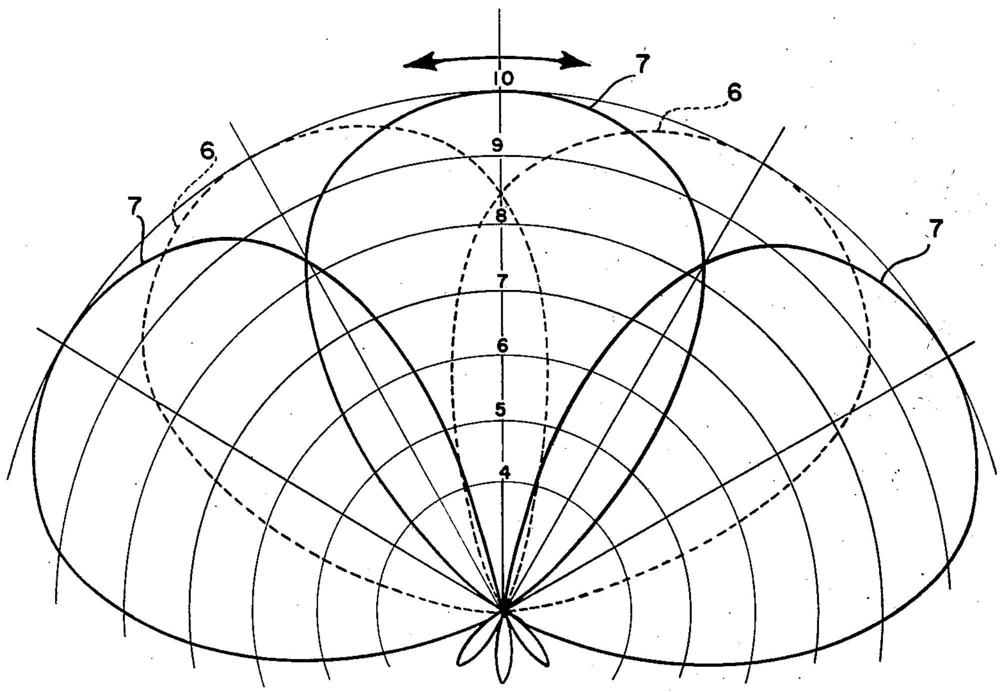

Fig. 3

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ROTATING BEAM ANTENNA UTILIZING ROTATING REFLECTOR WHICH SEQUENTIALLY ENABLES SEPARATE GROUPS OF DIRECTORS TO BECOME EFFECTIVE

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4 Claims. (Cl. 343—761)

This invention relates to a system of generating and propagating electrical energy from an antenna, and more particularly to an antenna system for unidirectional beam rotation of electric waves.

Heretofore, beam rotation of electric waves has been effected by either mechanically rotating the antenna system or by phase switching techniques, which causes the lobe pattern to be displaced. As is well known, the mechanically rotated antenna system has considerable inertia and mass and inherently requires relatively large power drives and is limited in speeds of rotation. Lobe switching on the other hand generally requires a duplication of feed elements and incorporates electrical contacts which are alternately made and broken.

Another known method of providing a movable beam pattern is by electronic scanning. This method is particularly adapted for sweeping an arc but is not well-suited for complete 360° rotation.

It is therefore apparent that a need exists for a simple and inexpensive method of providing beam rotation which will eliminate the characteristic large masses as well as the obvious undesirable disadvantages of physical switching.

It is a primary object of this invention to provide a rotating beam pattern antenna system which eliminates one or more disadvantages of known systems.

Another object of this invention is to provide a high gain radiation and reception of R-F energy without rotating of the feeder element in an antenna array.

A further object of the invention is to provide a simplified antenna system having high gain radiation and reception and employing a small rotating element.

These and other objects will be made apparent from the following description and drawings wherein:

FIGURE 1 is a simplified perspective view of the invention,

FIGURE 2 is a schematic of antenna system incorporating the invention,

FIGURE 3 is a radiation pattern which is characteristic of an antenna embodying the invention.

It has been recognized that if an antenna shorter than a half wave length and not connected to a power source is placed parallel to and slightly less than a quarter-wave length from a half-wave driven antenna it reacts as a director. Power is absorbed and re-radiated having such a phase relation that the fields of the driven and director antennas add in the direction of the director. The proper phase relation is obtained if the parasitic or undriven element is spaced one quarter-wave length from the driven element, thereby producing the required cancellation and reinforcement. However, if a director is spaced less than a quarter wave length in front of the driven element, the required phase or time delay must be provided by electrical means. One way of accomplishing the delay is to make the length of the director slightly less than that of the driven element. It then acts as a capacitive reactance and causes the current in the director to lead. Tuning provides the proper lead in current which causes the waves to add in the forward direction. Addition of parasitic elements further increases the directivity of the combination commonly referred to as an array.

While the above discussion refers to a free space half-wave length elements, it is to be understood that a grounded quarter-wave length antenna has essentially the same characteristics. The vertical quarter-wave antenna acts like one-half of a half-wave antenna, wherein the ground or earth plane acts as a mirror to provide the missing quarter-wave section.

In the description to follow, an array comprised of quarter-wave elements is illustrated and described; however, as is obvious the same results can be obtained by using a half-wave free space antenna. For example, in the illustrated embodiment the parasitic elements are slightly less than a quarter-wave in length to provide proper time delay for enhancing the unidirectional pattern.

Referring now to FIGURE 1, an exciter or driven element 1 is connected to a source of energy or to a receiver, schematically shown in FIGURE 2, and mounted on a stationary platform or ground plane, in a conventional manner, and requiring no special transmission coupling. A plurality of parasitic arrays 2 are radially mounted around the driven element at desired intervals, six (6) arrays being illustrated. The parasitic arrays 2 are similarly stationary and may be mounted on the same platform or ground plane as the driven element.

A pair of parasitic elements 3 are mounted on a rotating ring 4, which is driven by suitable gearing and motor as schematically shown in FIGURE 2. Behind the driven element and opposite to the parasitic elements 3, a cylindrical parabolic reflector 5 having an open top is mounted on the periphery of ring 4. A radio frequency transparent dome 6 may be utilized to cover the rotating assembly for protection against the weather, dust, foreign matter, etc.

When one or more of the parasitic elements are displaced the parameter values of the antenna system change thereby causing a change in the lobe pattern coverage. A typical polar coordinate pattern for the antenna illustrated is shown in FIGURE 3. It will be recognized that as the ring rotates the rotating parasitic elements are aligned with the driven element 1 and parasitic array 2; an end fire array is presented and the antenna pattern 6 is produced. The pattern 7 is plotted for the results of gain and pattern measurements with the rotatable elements set at 30° from end fire position and were identical to the end fire measurements.

While a specific embodiment of the invention has been shown and described, it should be understood that certain alterations, modifications and substitutions may be made to the instant disclosure without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. An antenna system comprising a plurality of end fire arrays, each array consisting of a plurality of grounded quarter wave length parasitic elements, disposed in radial relation to each other and having a common driven element, a rotating ring arranged for rotation around said driven element, at least one of said parasitic elements mounted on said rotatable ring, a reflector mounted on the other side of said ring opposite to said parasitic elements and means for rotating said ring whereby said driven element is successively coupled to said arrays.

2. The antenna system as defined by claim 1, wherein said driven element and the parasitic elements other than those mounted on said ring are stationary.

3. The antenna system as defined by claim 1, wherein said reflector is cylindrical and parabolic.

4. In an antenna system, the combination comprising a stationary driven element, a ring mounted for rotation

about said driven element, a reflector and at least one parasitic element attached to said ring, said driven element, reflector and parasitic elements cooperating together and being so designed and spaced as to provide a unidirectional radiation pattern, a plurality of parasitic arrays arranged radially around said driven element and parallel thereto, each array consisting of a plurality of grounded quarter wave length parasitic elements, said parasitic arrays being so dimensioned as to further enhance the directivity of said radiation pattern, and means for rotating said ring, whereby said driven element is successively coupled to said parasitic arrays thereby providing a rotating beam.

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