Nov. 28, 1961 A. ALFORD 3,011,167

DIRECTIVE ANTENNA

Filed Dec. 30, 1955

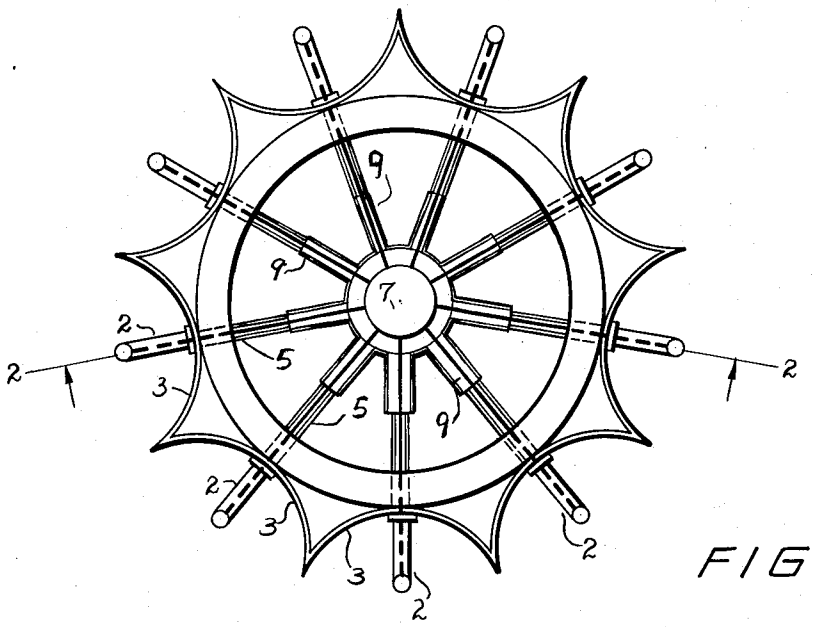


FIG. 1

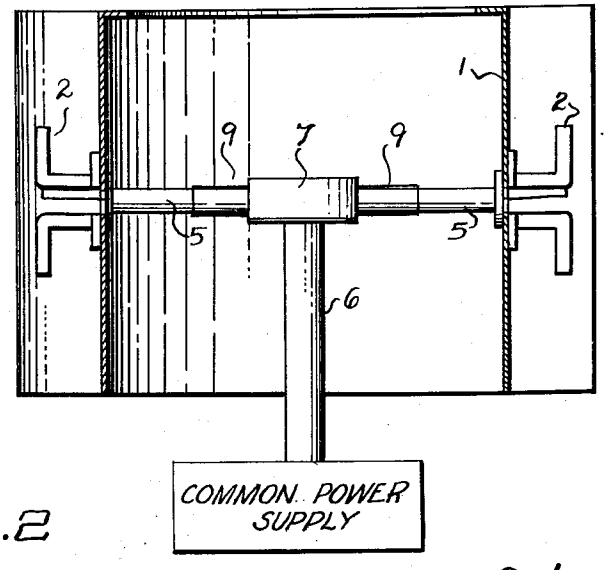


FIG. 2

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3,011,167

DIRECTIVE ANTENNA

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The present invention relates to a directive radiation of radio frequency waves using a carrier wave and side bands to provide a radiation for accurately determining direction.

The antenna of the present invention is constructed to radiate a pattern in the shape of a limacon and a second pattern in combination with this to produce equal spaced maxima and minima about the whole azimuth.

The antenna of the present invention may, and is preferably rotated to produce an amplitude modulation of the carrier in any desired depth. This antenna is intended to attain objectives similar to copending application of Robert M. Sprague, Serial No. 544,924, filed November 4, 1955, now Patent No. 2,973,514, granted February 28, 1961, which disclosure is hereby incorporated as a part of this specification.

In the present invention there is provided a means and method of transmitting a carrier wave having a limacon pattern, and further means for obtaining an additional signal in the form of a multi-lobe pattern by the use of spaced dipoles positioned about a center vertical axis. Rotation of the antenna about this vertical axis will thereby produce a modulation at the frequency of rotation for the limacon pattern and also at the frequency of rotation times the number of lobes for the multi-lobe pattern. For example, if the frequency of rotation of the antenna is 900 r.p.m. or 15 r.p.s. there will be one modulation of 15 r.p.s. due to the limacon and if there are nine dipoles producing a nine lobe pattern, there will be a second modulation of 135 c.p.s. (9 times 15 c.p.s.) for the multi-lobe pattern. These two patterns will combine to produce nine accurately determinable maxima and minima about the axis of rotation of the antenna.

In the present invention the limacon pattern is obtained by purposely mis-matching the line feeding the dipoles to obtain different amounts of energy in each of the dipoles. However, other well known types of coupling to obtain different amounts of energy in the dipoles for the purpose of obtaining the limacon pattern may be used.

In order to minimize any coupling between the dipoles, which was otherwise found to be excessive, each dipole was mounted at the focal line of a parabola which was in turn fixed to a ground cylinder concentric with the vertical axis. Adjacent parabolas intersect at a distance from the cylinder equal to one-quarter wave length of the mid-operating frequency of the antenna.

These and other features of the present invention will be more fully described in connection with the drawings attached hereto in which:

FIGURE 1 shows a top plan view in somewhat schematic arrangement of the antenna, and

FIGURE 2 shows a cross sectional elevation taken substantially along the line 2—2 of FIGURE 1.

Referring specifically to the figures, there is illustrated a cylinder 1 open at the top and bottom having mounted upon it, nine equally spaced dipoles, 2, 2, 2, etc. These dipoles are positioned so that their vertical axis coincide with the focal lines respectively of nine vertically extending parabolas 3, 3, 3, etc. Each of the vertically extending parabolas 3, 3, 3, etc., are joined to their adjacent parabolas 3, 3, 3, etc., at a distance from the cylinder 1 equal to one-quarter wave length at the mid-operating frequency of the antenna. Further, the antenna is designed so that the distance of the focal lines of each parabola to the cylinder is also approximately one-quarter wave length. The parabolas thus form reflecting ground

sheets and favorably affect individual dipole radiation patterns. The power to each dipole is supplied by coaxial cables 5. These cables are connected in parallel to the main supply cable 6 through a nine to one junction transformer 7.

A limacon pattern may be obtained by purposely mismatching the transmission lines at the junction transformer. The coaxial cables 5 feeding the various dipoles are thus mis-matched by inserting quarter wave line transformers 9 for each cable 5, with the transformers having different characteristic impedances. The selection of these characteristic impedances however should be such as to produce a low SWR preferably of substantially one, along the supply cable 6.

By this mis-matching, different amounts of energy may be applied to successive dipoles whereby a limacon radiation pattern may be obtained.

The azimuth pattern resulting from this array consists of nine equal lobes having a minima greater than zero, which when the antenna is rotated at 900 r.p.m., will produce a 135 c.p.s. modulation.

As the antenna is rotated, the relative phase and magnitude of the fields received at some distant point in space will vary with one cycle variation occurring for each 40° of rotation.

It is to be understood however, that in order for this pattern to be maintained over the frequency band, it is necessary that the individual dipoles themselves be well matched to their respective transmission lines.

This antenna may possess a 135 cycle modulation characteristic over a 950 to 1025 megacycle band at vertical angles of 0° to 40°. The band however cannot be greatly exceeded without a noticeable deterioration of modulation at the high vertical angles.

Having now described my invention, I claim:

1. Means for non-uniform omnidirectional radiation of high frequency radio waves polarized in planes parallel to the main axis of the radiating structure, comprising a plurality of radially spaced longitudinally parallel dipole radiators, a parabolic reflective ground sheet for each dipole, said sheets arranged adjacent one another with the dipole located on the focal line of said sheet, and a common power source for applying different amounts of energy to each dipole radiator to produce a radiation pattern in the form of a limacon with superimposed multilobes.

2. Means for non-uniform omnidirectional radiation of high frequency radio waves polarized in planes parallel to the main axis of the radiating structure, comprising a plurality of radially spaced longitudinally parallel dipole radiators, a parabolic reflective ground sheet for each dipole, said sheets arranged adjacent one another, means comprising a common power source and separate mismatched transmission lines connecting said source with each radiator, whereby a radiation pattern in the form of a limacon with a superimposed multi-lobal radiation may be obtained.

3. Means for non-uniform omnidirectional radiation of high frequency radio waves polarized in planes parallel to the main axis of the radiating structure, comprising a plurality of vertically arranged radially spaced longitudinally parallel dipole radiators and means providing a common power source to said dipoles including means providing different amounts of power to each dipole, whereby a radiation pattern in the form of a limacon having superimposed multilobes may be radiated.

4. Means for omnidirectional radiation of high frequency radial waves polarized in planes parallel to the main axes of the radiating structure, comprising nine radially spaced longitudinally parallel dipole radiators, a parabolic reflective ground sheet for each dipole, said sheets arranged adjacent to one another with the dipole

located on the focal line of said sheets, a common power source for applying different amounts of energy to each dipole radiator to produce a radiation pattern in the form of a limacon with nine superimposed multilobes.

5. Means for uniform omnidirectional radiation of high frequency vertically polarized radial waves, comprising a plurality of radially spaced vertical longitudinally parallel dipole radiators, a parabolic reflective ground sheet for each dipole, said sheets arranged adjacent one another, the dipole located on the focal line of said sheet and a common power source for applying different amounts of energy to each dipole radiator to produce a radiation pattern in the form of a limacon with superimposed multilobes.

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