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Mosko
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[54] SPIRAL ANTENNA

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[73] Assignee: The United States of America as represented by the Secretary of the Navy

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[52] U.S. Cl. 343/895
[51] Int. Cl. H01q 1/36
[58] Field of Search 343/895, 908, 792.5

[56] References Cited

UNITED STATES PATENTS

2,005,805 6/1935 Round ....343/895 X
3,039,099 6/1962 Chait et al. ....343/895 X
3,106,714 10/1963 Minerva 343/792.5

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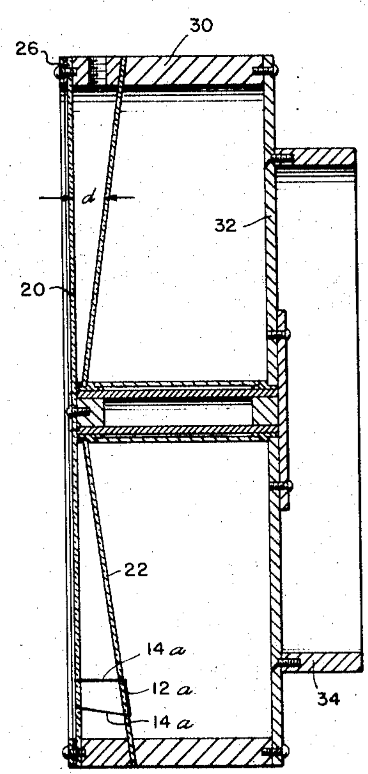
[57] ABSTRACT

Spiral antenna in which adjacent conductors are three dimensional and composed of spaced segments of a spiral disposed in one plane, the ends of which are joined by conductors disposed in another plane which have lengths greater than the spacing between the ends of the segments, thereby increasing the wire length of the convolutions over that of conductors having convolutions which lie only in one plane.

4 Claims, 5 Drawing Figures



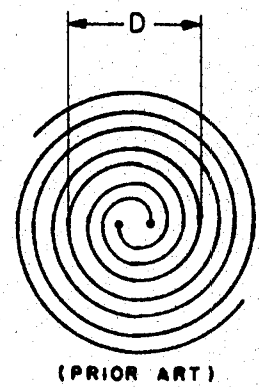


FIG. P.A.

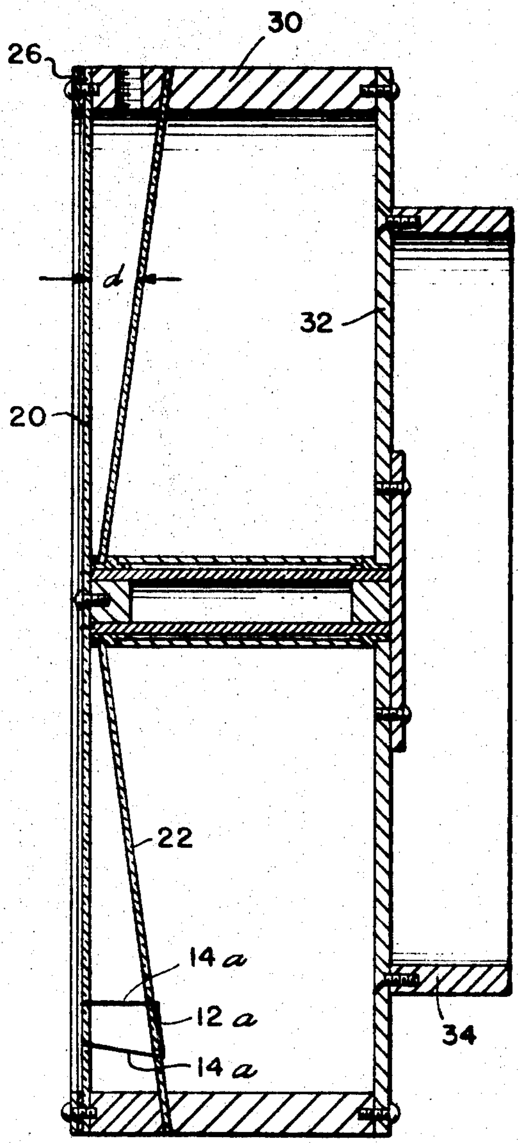


FIG. 3.

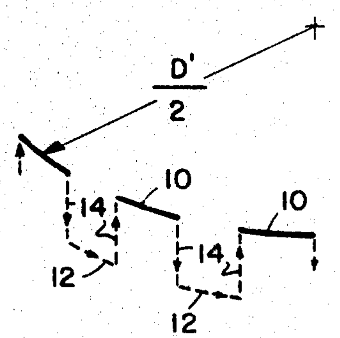


FIG. 1.

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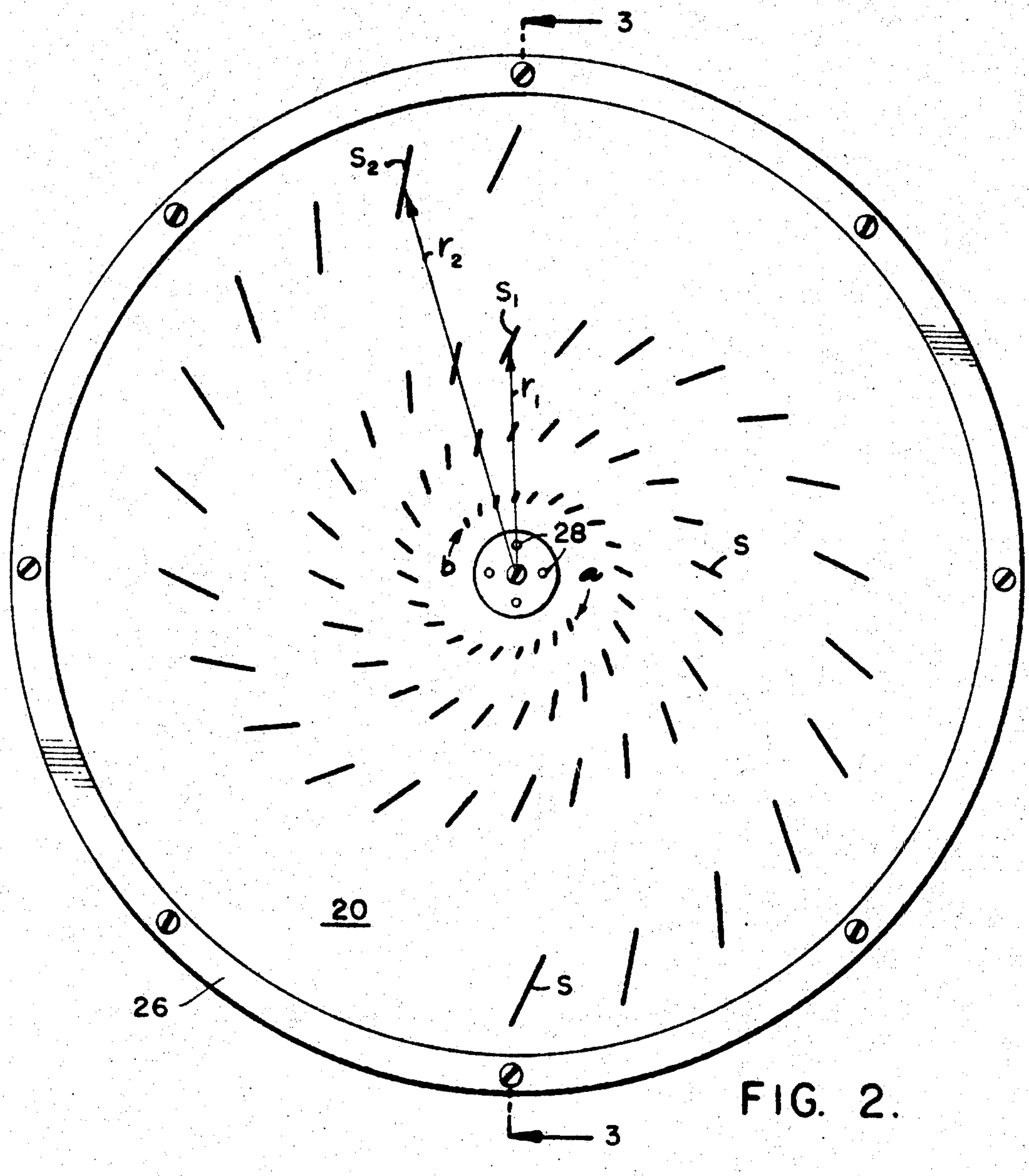

FIG. 2.

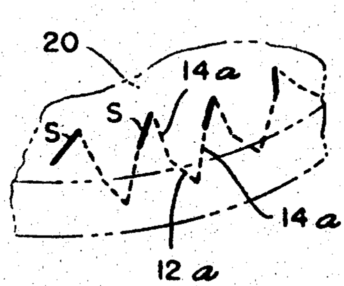

FIG. 4.

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SPIRAL ANTENNA

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

As exemplified by U.S. Pats. No. 2,863,145 and No. 2,947,000 to Turner and Marston, respectively, spiral dipole antennas which respond to wide frequency ratios are now well known and have the advantage over former rod-type antennas in that they occupy less space. In each of these patents the two conductors are wound in the form of equi-distant spaced spirals having portions which radiate at certain frequencies. As disclosed by Turner, the circumference of a circle at which response occurs equals one wave length of the particular frequency, the diameter of the circle thus having the wave length divided by pi. Turner also disclosed that this relationship determines the minimum size of a many turn spiral antenna. As will subsequently appear, this assumption is valid only if the conductors are simple convolutions in a single plane in which the length of a convolution is pi times its diameter.

SUMMARY OF THE INVENTION

In the present invention, the total length of each conductor forms a spiral, similar to the patents referred to but the circumferential length at a given convolution is not a function of pi since the spiral is formed by winding the conductor in a direction other than planar which increases the length of a convolution beyond the relationship of pi times its diameter. A wave length of conductor may thus be disposed in a considerably smaller diameter, thus reducing the size of the antenna in some proportion to the added length of conductor over that of a single planar wound conductor as disclosed in the prior art referred to.

BRIEF DESCRIPTION OF THE DRAWING

FIG. P.A. illustrates prior art;

FIG. 1 is an isometric view of a portion of a conductor convolution, illustrating the general principle of the invention in one of its various forms;

FIG. 2 is an elevation of a preferred embodiment of the invention, illustrating the conductors, as viewed from the front of the antenna;

FIG. 3 is a section taken on line 3—3, FIG. 2; and

FIG. 4 is a three-dimensional phantom view of a portion of FIGS. 2 and 3.

DESCRIPTION OF GENERAL CONCEPT

The detailed description of a preferred embodiment, to follow, may be better understood by first comparing the inventive concept with a spiral antenna having conductors which lie in a single plane, such as those disclosed in the prior art referred to.

Referring first to FIG. P.A., the circumferential length of a particular convolution of an Archimedian spiral, as disclosed by Turner, is expressed by πD which may be considered as one wave length and the diameter at which response occurs. Referring now to FIG. 1, which represents a portion of a like convolution, a conductor may be formed so that portions **10** are in one plane, portions **12** are in another spaced plane and portions **14** join portions **10** and **12**. It will be apparent that the wave length of a convolution, formerly expressed as πD, is now increased by the summation of the lengths of portions **14** contained in one convolution. (It being assumed that portions **12** are of a length equal to the gaps between portions **10, 10**.) It follows, then, that a convolution of one wave length will have a diameter less than D in FIG. P.A. and the overall diameter of the antenna may be reduced in some proportion to the added lengths **14, 14** in one convolution. Thus a diameter D', FIG. **1**, for a convolution analogous to a convolution of FIG. P.A., is less than D of FIG. P.A. in some proportion to the added lengths of wire **14**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

While the invention may be practiced with equispaced conductors, as just referred to, the spiral chosen for illustration of the preferred embodiment has conductor segments which have a constant angle with respect to their radius vectors. The radial spacing between adjacent conductors (say a pair 180° out of phase) thus increases with increase of the radius vectors in distinction to remaining constant, as described in connection with the prior art. A spiral which cuts the radius vectors at constant angle is generally known as a logarithmic spiral. This is illustrated in FIG. **2** wherein spiral conductors *a* and *b* have origins 180° apart and the angle between segment s_1 at radius r_1 equals the angle between segment s_2 at radius r_2, etc. Since each conductor *a*, *b*, must be continuous between its origin near the center of the figure and its termination at the periphery of the figure, adjacent segments of each conductor must be joined together. This is attained in a manner similar to that illustrated in FIG. **1** and wherein two legs **14*a***, **14*a*** extend rearwardly perpendicular to the page, one being connected to the outer end of a segment and the other to the inner end of the adjacent segment, the two legs being connected by a bight **12*a*** spaced rearwardly from the plane of the segments.

Referring now to FIG. **2**, the various segments *s* of two conductors *a* and *b* are illustrated as they appear as viewed toward the front face of the antenna. As illustrated, only two conductors are shown having origins and terminations 180° apart. In an actual embodiment, however, four conductors are employed, these being disposed 90° apart. The visible segments *s* lie on a flat dielectric plate **20** which is drilled for receiving the rearwardly extending legs. The legs **14*a***, **14*a*** pass through similar holes in a rearwardly spaced conical dielectric plate **22**, the bights **12*a*** being disposed at the rear surface of plate **22**. The outer ends of all conductors are connected to a ground ring **26** and their inner ends are connected to terminals **28**, these being connected in any well known manner to a source for driving the antenna, or to a receiver, if used in such manner. The distance *d* between the plates constantly increases in a radial outward direction, thus increasing the lengths of the conductors between adjacent segments *s*, the distance being a constant times a wave length. If desired, and weight is not critical, the space between the plates may be filled with a ferro-dielectric material. The plates are secured to a suitable metallic cavity ring **30**, closed at its rear end by a plate **32** which renders the operation of the antenna unidirectional. If desired, the space between plates **22**, **32** may be filled with foam material to render the space electrically absorbent. Any suitable mounting device, such as ring **34**, may be employed to secure the antenna to its supporting structure.

As will be apparent, the surface of plate **20** is generated by a straight line rotated perpendicular to the antenna axis (planar) and the surface of plate **22** is generated by a straight line rotated nonperpendicular to such axis (cone). These surfaces may be of other shapes but normally will be formed as surfaces of revolution of either straight lines or curves.

What is claimed is:

1. A reduced size antenna comprising:

a dielectric planar mounting surface;

at least two substantially identical equiangularly spaced conductors;

each conductor having segmental portions lying adjacent said surface, the segmental portions forming a spiral;

said segmental portions being series connected by other portions of the conductor;

each of said other portions having a length in excess of the distance between ends of adjacent segments;

said other portions being disposed away from the plane of said mounting surface;

whereby the conductor length of a convolution of the spiral is greater than the length around the convolution.

2. An antenna in accordance with claim **1** including a second dielectric surface disposed in spaced relation to said mounting surface, each of said other portions extending between said mounting surface and the second dielectric surface and each having a portion disposed adjacent and supported by the second dielectric surface.

3. An antenna in accordance with claim **2** wherein the second dielectric surface is conical and the distance between it and the mounting surface constantly increases in a radially outward direction.

4. An antenna in accordance with claim **3** wherein each of said segments is disposed at a constant angle to its radius vector.

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