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COLLAPSIBLE HELICAL ANTENNA

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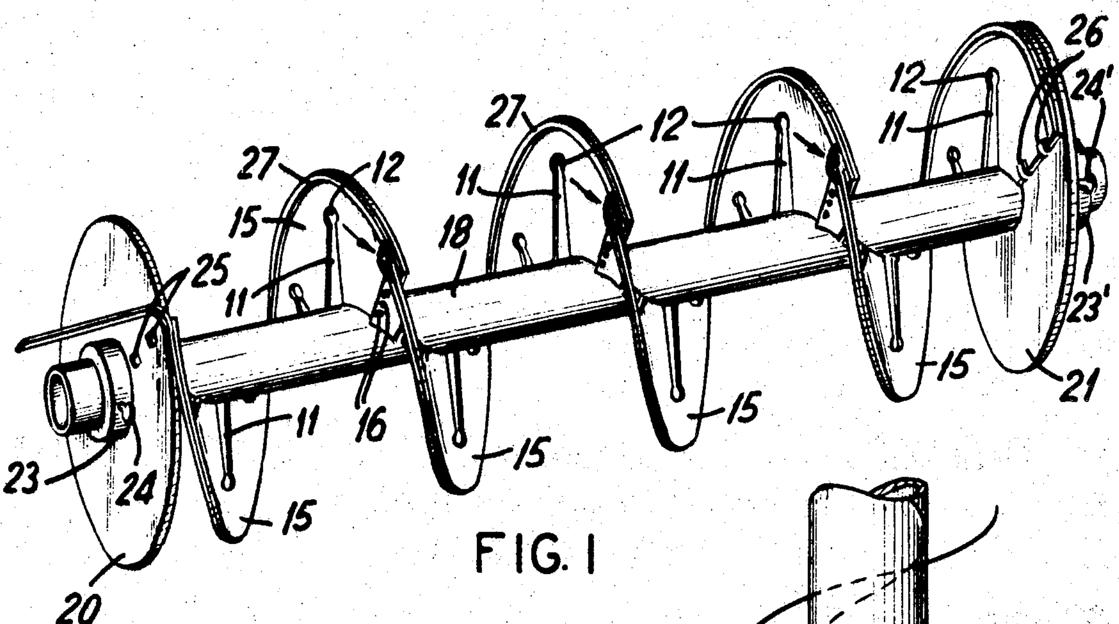

FIG. 1

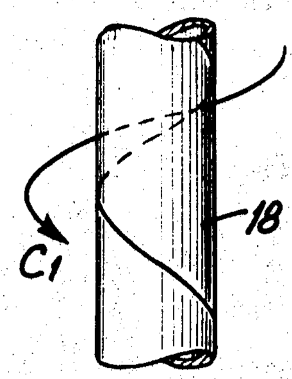

FIG. 2

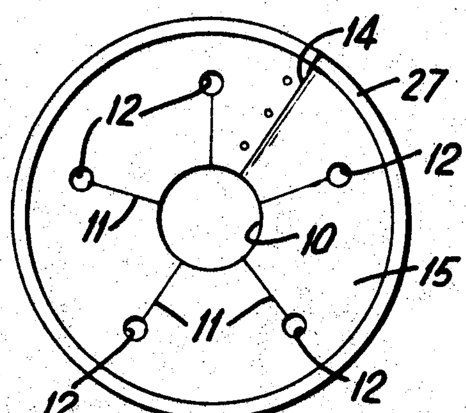

FIG. 3

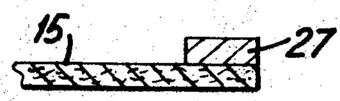

FIG. 5a

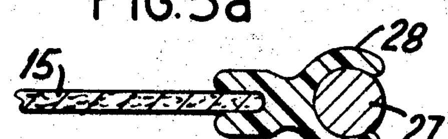

FIG. 5b

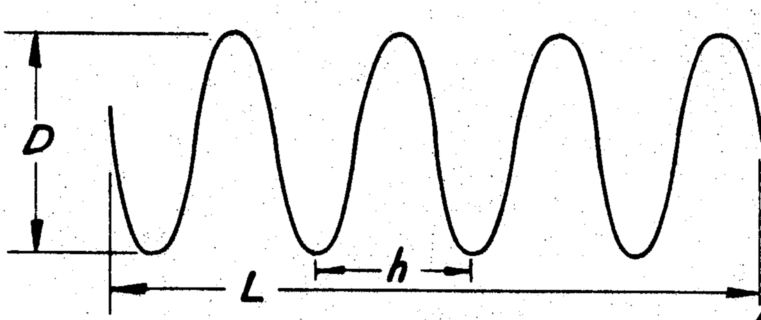

FIG. 4

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COLLAPSIBLE HELICAL ANTENNA

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U.S. Cl. 343—895 5 Claims

ABSTRACT OF THE DISCLOSURE

A collapsible helical antenna formed of a plurality of insulating discs notched to permit torsional motion and lap-joined to produce a helix upon axial separation of the ends. A circumferential conductor, which defines the helical antenna, is carried on the insulating discs.

BACKGROUND OF THE INVENTION

A helical antenna is useful where a circularly polarized radiation field is desirable. Where the circumference and length and the helix are small compared to a wavelength, and the current is approximately uniform in all parts of the helix, the normal radiation mode is excited and radiation is maximum in a plane normal to the helical axis. The radiation may be elliptically or circularly polarized depending upon the helix dimensions. This mode of radiation has poor efficiency and a relatively narrow band width.

If the dimensions of the helix are such that the circumference of one turn is approximately one wavelength, the antenna radiates in the axial mode. In this mode, the radiation of the antenna is relatively broad banded and has good efficiency; as before, the radiation is circularly polarized with a maximum value in the direction of the helical axis.

The gain of the helix over an isotropic circularly polarized radiator is about 12 db. Additional gain may be secured by a number of helices in broadside array, and an omnidirectional pattern obtained by using four helices fed in phase with their axes spaced 90° apart in a horizontal plane in the manner of a turnstile.

Because of its size, and the inflexibility of the conductor, the disadvantages of the helical antenna often overshadow the advantageous gain characteristic.

OBJECT OF THE INVENTION

It is the object of this invention to provide a helical antenna which is light in weight and which is collapsible from its operative or extended position for ease in portability and stowage.

It is a further object of this invention to accomplish the foregoing object conveniently, economically and with sufficient structural rigidity to meet the stringent requirements imposed on helical antennas.

SUMMARY OF THE INVENTION

Briefly, the invention is predicated upon the concept of employing a flat helix of flexible insulating material which is substantially continuous from its inner diameter to its outer diameter, in conjunction with means for determining the helical pitch upon expansion of the member in an accordian-type movement. The insulating helix carries a conductive elongated member thereon which forms an antenna in complete dependency upon the pitch, diameter, length, etc. of the insulating helix.

The above-mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will best be understood by reference to the following description of an embodiment of the invention taken in conjunction

with the accompanying drawings, the description of which follows.

DESCRIPTION OF VIEWS OF THE DRAWING

FIG. 1 is a perspective illustration of the collapsing helical antenna according to the invention.

FIG. 2 is a detail of the center pole used in conjunction with one embodiment of the antenna of the invention.

FIG. 3 illustrates a single disc, a plurality of which form the antenna of the invention.

FIG. 4 is a schematic illustration for calculating and constructing the desired antenna, and

FIGS. *5a* and *5b* illustrates alternative arrangements for mounting the conductive member on the insulating helix.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 illustrates the inventive antenna in perspective. An insulating helix is made up of a plurality of discs **15** (shown in detail in FIG. 3). Each disc includes a center hole **10** and satellite holes **12** communicating with the center hole through slots **11**.

The antenna is constructed by lap-joining a plurality of the discs at their respective splits **14**. The method of joining and the dimensions of the lap depend upon the final structural requisites of the antenna itself, and wide variation is possible in the degree of overlap and the method of joining contiguous discs. Thus, for example, 10° of arc and insulating rivets **16** may be employed for smaller less rugged antennas, while greater segments of arc and glue, as well as rivets, may be employed where ruggedness is a greater consideration. In any event, the insulating nature of the joint must be preserved and any joining material should have this characteristic.

The discs, upon being joined in the manner described, form a helix which may be extended or retracted, yet which maintains its dimensional integrity. Slots **11** allow torsional displacement of each of the discs and hence the helical characteristic of the overall structure. Holes **12** act as limits against further splitting of the slots during displacement.

In order to form a helix of predetermined diameter, lead angle, number of turns and length, center pole **18** is provided which in conjunction with center holes **10** defines the helical parameters. That is, upon expansion, the helical disc center holes will trace the path shown in FIG. 2 about the center pole. As will be seen, this path may be calculated. In this regard, it may be noted that either the diameter of the center hole **10** or the diameter of the center pole may be taken as the independent variable.

It has been found that due to mechanical characteristics and load deflection, a two-inch diameter, .25 inch wall thickness fibre glass tubing is preferable for the center support for either mono or modular constructed antenna from 4 to 20 feet long.

While the center pole prevents any extension of the helix beyond that which causes contact with the center holes of the discs, the collapse of the helix is prevented by means of insulative end plates **20** and **21** which are secured by any conventional means to both the center pole and the respective ends of the insulating helix. Exemplary securing means comprising flanges **23** and **23'** and thumb screws **24** and **24'** for the center pole and resilient fingers **25** and **26** for the end discs are shown.

Conductive member **27** terminates on the insulative helix at one end while at the other, it is furnished with a suitable connector or fitting (not shown) to the line.

With reference to FIG. 4, a typical antenna and the method of calculating its various parameters follow where: D represents the disc center diameter; D' the disc center diameter; R the helix radius; C the helical circumference;

L the length of the antenna; R′ the center pole radius; C′ the disc circumference at the center pole (see FIG. 2); A the lead angle; and H the coil spacing.

The following equations may be employed to calculate the various parameters:

$$\text{Coil spacing } (H)=(2\pi R) \tan A \quad (1)$$
$$\text{Antenna length } (L)=H\times \text{number of turns} \quad (2)$$
$$\text{Circumference } (C)=2\pi R/\cos A \quad (3)$$
$$\text{Diameter } (D)=C/\pi \quad (4)$$
$$\text{Circumference } C'=2\pi R'/\cos A \quad (5)$$
$$\text{Diameter } D'=C'/\pi \quad (6)$$

It is envisaged that there are a great number of methods by which the antenna conductor member **27** may be attached to the insulating helix. Thus, for example, the conductor may be set in an extruded plastic strip and then cemented to the edge of the disc such as shown in FIG. 5A. Or, a conductive epoxy may be sprayed or silk screened to the edge of the disc, or the conductor may be flame sprayed to hte edge. Alternatively, the entire disc may be made of copper-clad material and unwanted copper etched away. With any of the foregoing arrangements, after assemblage and lapping of the respective discs, the point of lap would then be sprayed with conductive material for purposes of continuity (as shown in FIG. 1—arrows).

FIG. 5B shows an alternative arrangement where a continuous extruded polyethylene snap ring **28** is circumferentially disposed about the disc and is then cemented or riveted thereto for permanent positioning. A cylindrical conductor **27′** may then be inserted into the snap ring and would provide a continuous conductive member from end to end of the helix.

While a particular arrangement has been described including a center pole for limiting the helical pitch, it is also possible to utilize pitch spacing members disposed between adjacent discs to rigidly position the structure. Further, while the principles of the invention have been described in connection with specific apparatus, it is to be clearly understood that this description is made only by

way of example and not as a limitation to the scope of the invention as set forth in the objects thereof and in the accompanying claims.

What is claimed is:

1. A collapsible helical antenna comprising:

a flat helix of flexible insulating material substantially continuous from an inner diameter to an outer diameter, said helix comprising a plurality of radially split discs serially joined at corresponding opposing edges of said slits;

means for determining the pitch of said helix; and an elongated flexible conductive member mounted upon said helix a constant distance from the axis thereof.

2. The collapsible helical antenna claimed in claim **1** in which each of said discs includes a plurality of partial radial slots therein communicating with the disc center for aiding flexibility.

3. The collapsible helical antenna claimed in claim **1** in which said elongated flexible conductive member comprises a conductive strip concentrically formed on each disc.

4. The collapsible helical antenna claimed in claim **1** in which the means for determining the helical pitch comprises an insulating center pole axially threading centrally located apertures in said discs of predetermined diameter relative said center pole diameter.

5. The collapsible helical antenna claimed in claim **1** in which said elongated flexible conductive member comprises a single conductor circumferentially affixed to said insulating helix.

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