April 4, 1950 | J. W. TILEY | 2,503,010

HELICAL BEAM ANTENNA

Filed Sept. 10, 1948

FIG. 1.

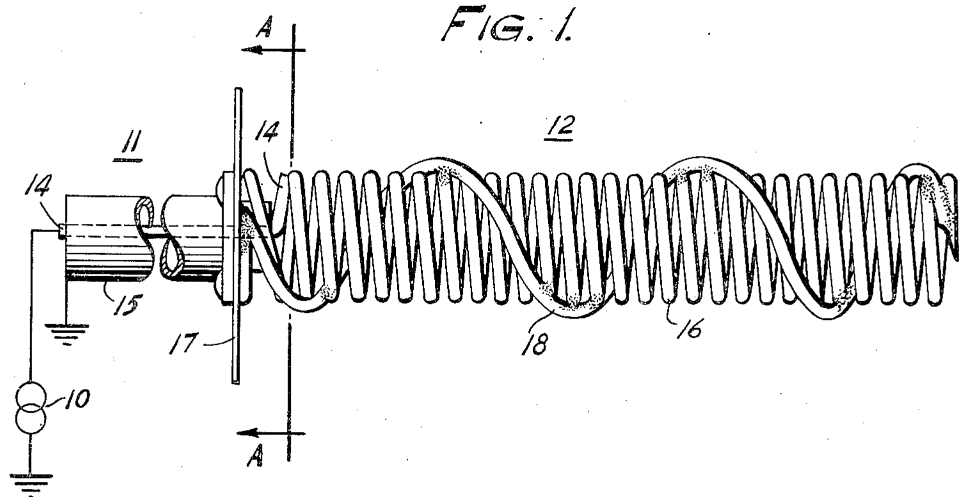
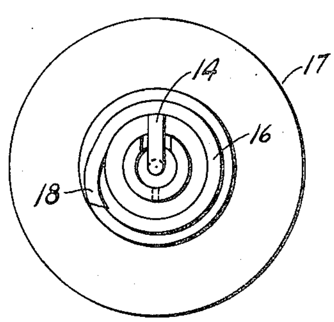


FIG. 2.



INVENTOR.
JOHN W. TILEY
BY
Brown, Denk & Synnestvedt
AGENTS

Patented Apr. 4, 1950

2,503,010

UNITED STATES PATENT OFFICE

2,503,010

HELICAL BEAM ANTENNA

John W. Tiley, Philadelphia, Pa., assignor to Philco Corporation, Philadelphia, Pa., a corporation of Pennsylvania

Application September 10, 1948, Serial No. 48,655

2 Claims. (Cl. 250—33)

1

The invention herein described and claimed relates to an improvement in helical beam antennas.

A helical beam antenna is a relatively new form of antenna comprising a helix excited by electromagnetic wave energy having a wavelength whose dimension is of the same order of magnitude as the circumference of the helix. When so excited, the helix radiates electromagnetic wave energy predominantly in the direction of the helix axis. This mode of operation is known as the axial or beam mode, and the antenna is referred to as a helical beam antenna. Several magazine articles describing the structure and characteristic of the helical beam antenna have recently been published. These include "Helical beam antenna," Electronics, April 1947, pages 109–111; "A helical antenna for circular polarization," Proceedings of the I. R. E., December 1947, pages 1484–1488; "Characteristics of helical antennas radiating in the axial mode," Journal of Applied Physics, January 1948, pages 87–96; and "Measured impedances of helical beam antennas," Journal of Applied Physics, February 1948, pages 193–197.

The present invention modifies the prior art helical beam antennas in such manner that its operation over relatively wide frequency bands for plane polarization is improved. For, by means of the present invention, the radiation pattern established at the predetermined center operating frequency remains substantially unchanged as the frequency is varied over a range substantially wider than that over which the prior art helical beam antenna radiating a plane-polarized signal can be operated without causing substantial changes in its radiation pattern.

It is a principal object then of this invention to provide a helical beam antenna adapted for wide-band plane-polarized high frequency applications.

It is another object of this invention to provide a helical beam antenna whose radiation pattern for a plane-polarized signal remains substantially unchanged when the frequency is varied over a band of frequencies substantially wider than that over which the prior art helical beam antenna can be varied without causing substantial changes in the radiation pattern of the plane-polarized signal.

These and other objects, features and advantages of the present invention, and the manner in which the objects are obtained, will be best understood from a consideration of the following detailed description and from the accompanying drawings wherein:

2

Figure 1 is a diagrammatic side view of a helical beam antenna embodying the improvement of present invention; and

Figure 2 is an end view of the helical beam antenna looking toward the left from the position indicated by the dotted line A—A in Figure 1.

Referring now to Figure 1, there is shown a source of high frequency voltage 10, a coaxial transmission line 11, and a helical beam antenna 12. Coaxial transmission line 11 comprises, as is conventional, an inner conductor 14 and a cylindrical outer conductor 15. Helical beam antenna 12 comprises a helix 16 of copper or other material of good conductivity. The circumference of the helix is of the order of one wavelength at the center operating frequency. The diameter of the helix is, therefore, a function of the spacing between turns, the closer the spacing the larger the diameter. The axial length of the antenna, expressed in terms of the electromagnetic wave energy which it radiates into free space, may be of the order of several wavelengths.

A ground plane 17, of copper or other conductive material is employed at the junction of the coaxial line 11 and the helical beam antenna 12. The cylindrical outer conductor 15 of coaxial line 11 is secured to ground plane 17, as is a portion of the end turn of the helix 16. Inner conductor 14 of coaxial line 11 is secured to the helix 16 at a suitable driving point. The helical beam antenna thus far described is entirely conventional.

In accordance with a preferred embodiment of the present invention, a helical strap 18, of copper or other material of good conductivity, interconnects points on adjacent individual turns of the helix 16. The location of these points may be best defined by describing the manner in which the pitch and position of strap 18, relative to that of helix 16, are determined.

The pitch of the strap 18 is determined first, by proceeding as follows: Electromagnetic wave energy of a preselected center frequency, for example, 3300 megacycles, is applied to the helix. Means are provided for observing the field intensity at a remote point located on the projected axis of the helix; such means may conveniently comprise a dipole pickup and meter. Then, by means of a shorting clip, adjacent turns at the output end of the helix are shorted. The shorting clip is then moved slowly along the helix, i. e. along the path of the helical turns, until the input end of the helix is reached. During this movement, the shorting clip is maintained at all times parallel to the axis of the helix, and in contact with adjacent turns. As the shorting clip is so moved, the relative field strength at the selected remote point is carefully observed. It is noted that the field intensity varies in sine-wave fashion, passing through maximum and minimum values a number of times. The locations of the shorting clip on the helix when the field intensity is minimum is noted and marked. The points so marked are then connected with a conductive strap. The strap thus determined is found to be helical in configuration with a relatively large pitch.

The configuration and pitch of the strap having been determined, in the manner described above, it is next necessary to ascertain the optimum position of the helical strap relative to that of the principal helix. To accomplish this, the helical strap is rotated slowly about the helix, maintaining good contact therewith, and as this is done, the field-intensity meter is closely observed to determine the strap position at which the field intensity is maximum. The helical strap is then secured to the helix in the position which produces maximum field intensity.

Alternatively, the configuration and pitch of the strap may be determined by noting the locations of the shorting clip on the principal helix when the reading of the field intensity meter is maximum, rather than minimum as described above. The shorting-clip positions productive of maximum field intensity are, however, not as sharply defined as those which produce minimum field strength.

When the prior art helical beam antenna is provided with a helical strap 18 whose pitch and relative position are determined in the manners described above, the frequency of the applied electromagnetic wave energy may depart substantially from the preselected center frequency, in either direction, without causing substantial variations in the field intensity pattern. If, however, strap 18 be removed and the applied electromagnetic wave energy be varied over a similar band of frequencies, substantial variations in the radiation pattern are observed.

Having described my invention, I claim:

1. A helical beam antenna comprising first and second helices of conductive material, said first and second helices being coaxial and substantially co-extensive, said helices having substantially equal diameters but having unequal pitches, the pitch of said second helix being substantially larger than that of said first helix, said second helix being in electrical contact with substantially each of the turns of said first helix.

2. A helical beam antenna comprising first and second helices of conductive material, said first and second helices being coaxial and substantially co-extensive, said helices having substantially equal diameters and having the same screw direction but having unequal pitches, the pitch of said second helix being substantially larger than that of said first helix, said second helix being in electrical contact with substantially each of the turns of said first helix.

JOHN W. TILEY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,495,537	Stafford	May 27, 1924
1,898,661	Hagen	Feb. 21, 1933