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HELICAL-AND-WHIP ANTENNAS

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FIG. 1.

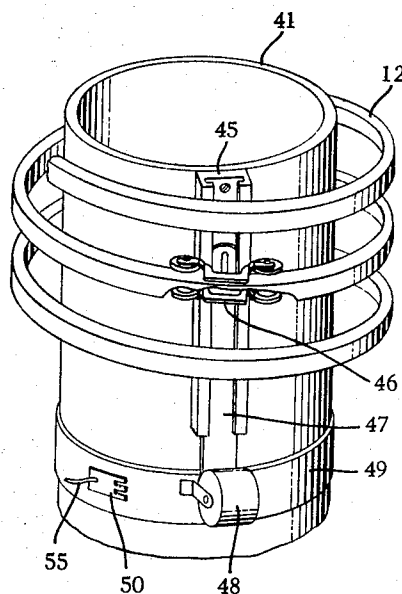
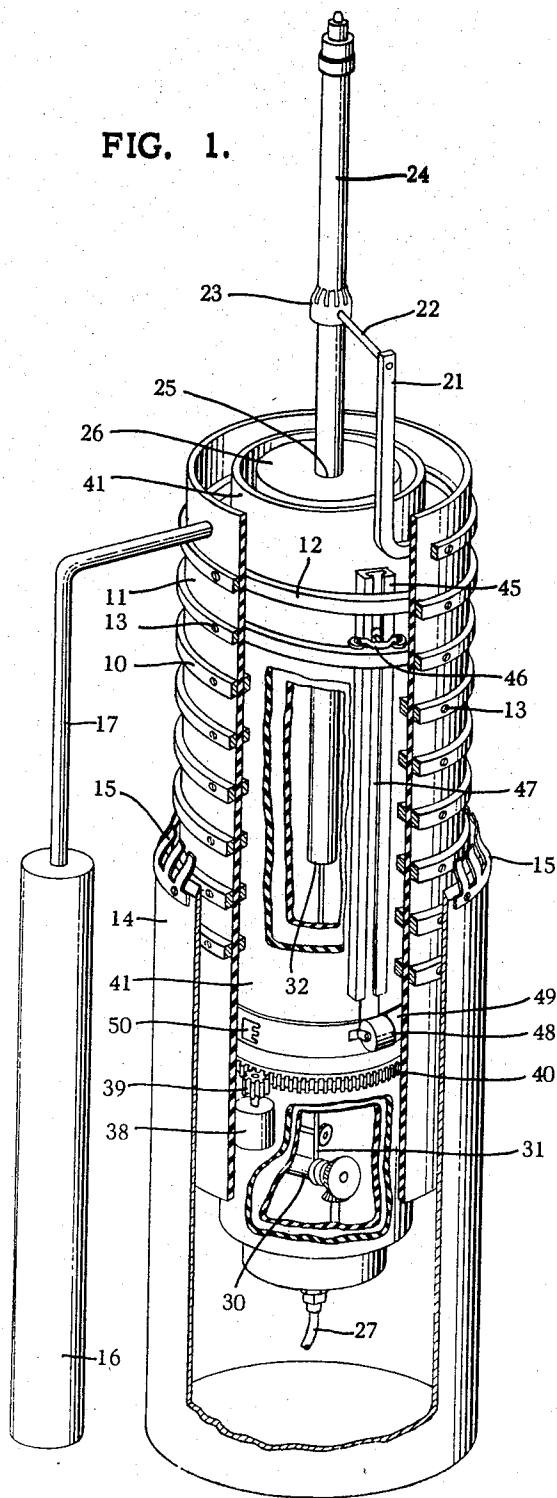


FIG. 2.

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HELICAL-AND-WHIP ANTENNAS

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8 Claims. (Cl. 343—725)

The present invention relates to helical-and-whip antennas, and more particularly to variable pitch helical-and-whip antennas that are continuously tunable and can be operated over a wide frequency range.

It is well known in the antenna field that when it is necessary to use a vertical radiator that is physically and electrically short with respect to a quarter wavelength, a great improvement in efficiency and an increase in radiation resistance is obtained by connecting a helical coil of suitable wire and constant pitch between the lower end of the vertical radiator and ground, thereby making the coil of wire, or helix, a part of the radiating system, so that the system comprising the vertical whip antenna in series with the vertical helix acts as a quarter wavelength antenna. It is also well known that if the lower end of the helix is connected directly to ground, a point of impedance match may be obtained for a coaxial feed line by means of a tap above the grounded end of the helix, thereby eliminating the need for a matching system or network between the feed line and the radiating system. Unfortunately, however, the adjustment of the tap point becomes critical as the frequency of operation is increased and the length of the helix remaining in the system is decreased. In addition, the voltage between turns of the helix becomes great as the frequency of operation is increased. There is a need for an antenna that meets the above mentioned problems. There is also a need for a continuously tunable helical-and-whip antenna.

It is an object of the present invention, therefore, to provide a helical-and-whip antenna that is continuously tunable.

It is another object of the present invention to provide a helical-and-whip antenna with a helix having a continuously varying pitch.

It is still another object of the present invention to provide a system for operating a helical-and-whip antenna, including apparatus for moving a tap along the helix, for lowering and raising the helix, and for varying the length of the whip antenna connected to the top of the helix.

According to the present invention, the top of a helical antenna is connected to a whip antenna that can be raised and lowered with respect to the helix. The helix may be lowered into a grounded metallic well to short out its bottom portion when less of the helix is required to increase the effective height of the whip antenna. A radio-frequency tap slides along the turns of the helical antenna and is connected to a coaxial feed line by means of a retractable reel. The helical antenna is wound at a continuously varying pitch, so that the lower portion of the helix has many turns per unit length, and the upper portion has relatively few turns per unit length.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be

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understood by reference to the following description, taken in connection with the accompanying drawings, in which,

Figure 1 is a cut-away isometric view of an antenna showing the preferred embodiment of the present invention.

Figure 2 shows the radio-frequency tap of Figure 1 in detail.

Referring now to the drawings, Figure 1 shows the helical-and-whip antenna according to the present invention. Outer helix 10 is wound about the outer surface of helix sleeve 11 and inner helix 12 is wound about the inner surface of helix sleeve 11. Screws 13 electrically and mechanically connect outer helix 10 to inner helix 12, so that they function as one helix. One helix could have been used instead of two, but a more complex mechanical supporting structure would be required if only one helix were used. Outer and inner helices 10 and 12 are wound at a continuously varying pitch having more turns per unit length at the bottom than at the top. One reason is that by using a continuously varying pitch, the distribution of voltage along the helix is such that where the voltage between turns is greater, the spacing between turns is greater. Another reason is that by using a continuously varying pitch, the adjustment of a tap point on the helix does not become critical as the frequency of operation is increased. Helix sleeve 11 is slidable within grounding sleeve 14, and outer helix 10 makes electrical contact with grounding fingers 15 of grounding sleeve 14. Thus, when helix sleeve 11 is completely inserted within grounding sleeve 14, outer and inner helices 10 and 12 are completely shorted out, and the further that helix sleeve 11 protrudes from grounding sleeve 14, the longer is the portion of outer and inner helices 10 and 12 that is in the antenna circuit. Hydraulic actuator 16 is used to raise and lower helix sleeve 11 by means of piston 17, which raises and lowers the entire antenna shown in Figure 1 along with helix sleeve 11, with the exception of grounding sleeve 14 and grounding fingers 15.

Upper end 21 of inner helix 12 is connected by means of conductor 22 and whip fingers 23 to whip antenna 24, so that whip antenna 24 makes electrical contact with upper end 21 as whip antenna 24 is slid up and down through whip fingers 23. Whip antenna 24 passes through opening 25 into chamber 26, which is filled with hydraulic fluid. To raise whip antenna 24, hydraulic fluid is pumped into chamber 26 through hydraulic line 27. The hydraulic fluid rises to the top of hollow whip antenna 24, and the hydraulic pressure forces whip antenna 24 to rise through opening 25. To lower whip antenna 24, motor operated windlass 30 winds up rope 31, which is attached to end 32 of whip antenna 24. Thus, whip antenna 24 can be raised and lowered with respect to helix sleeve 11 to vary the length of whip antenna 24 when the system is to be operated at a frequency at which the length of whip antenna 24 itself is equal to, or greater than, a quarter wavelength when fully extended. Inner and outer helices 10 and 12 may be lowered into grounding sleeve 14 to short-out their bottom portions when it is desired to operate the system at a high frequency for which the length of whip antenna 24 may be close to a quarter wavelength, in which case less of outer and inner helices 10 and 12 is required to increase the effective height of whip antenna 24 to a quarter wavelength.

The radio-frequency tap will now be described. Motor 38 rotates gear 39, which rotates gear ring 40. Gear ring 40 is fastened about tap sleeve 41, and motor 38 can thus rotate tap sleeve 41 clockwise or counter-clockwise with respect to helix sleeve 11 and chamber 26. Track 45 is mounted lengthwise along tap sleeve 41,

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and trolley 46 is free to slide up and down track 45. Trolley 46 is electrically connected to strap 47, which is reeled in by reel 48. Strap 47 makes electrical contact with band 49 in the vicinity of reel 48. Contact fingers 50 make electrical contact with band 49, while permitting band 49 to rotate. The operation of trolley 46 will be made clearer by referring to Figure 2.

Figure 2 shows a section of tap sleeve 41 with a portion of inner helix 12 wound around it. Radio-frequency coaxial feed line 55 makes electrical contact with inner helix 12 through contact fingers 50, band 49, strap 47, and trolley 46, in turn. Inner helix 12 is shown cut away in the vicinity of trolley 46. Tap sleeve 41 and track 45 are non-conductors. Trolley 46 is forced to move along inner helix 12 and up or down track 45 as tap sleeve 41 rotates. Thus, the amount of rotation of tap sleeve 41 determines the location of the radio-frequency tap point on inner helix 12. Since outer and inner helices 10 and 12 are wound at a continuously varying pitch, with the lower portions of the helices having many turns per unit length and the upper portions having relatively few turns per unit length, the adjustment of the tap point does not become critical as the frequency of operation is increased and the helices are lowered into grounding sleeve 14, decreasing the effective length of the helices remaining in the system.

Track 45, by maintaining the length of strap 47 close to the periphery of inner helix 12, allows the capacitance between strap 47 and the helix to be such that a transmission line having the desired characteristic impedance can be obtained without making strap 47 of as great an area as would be necessary if strap 47 passed through the center of inner helix 12.

While particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

I claim:

1. A helical-and-whip antenna comprising: first means including a whip antenna; second means including a helical antenna having first and second portions, said first portion of said helical antenna being slidably connected to said whip antenna; a grounding means slidably connected to said second portion of said helical antenna for shorting out a section of said second portion; third means for increasing and decreasing the length of the section of said second portion of said helical antenna that is shorted out by said grounding means; fourth means for increasing and decreasing the effective length of said whip antenna by varying the location along the length of said whip antenna of the connection between said helical and whip antennas; and a radio-frequency tap slidably connected to said helical antenna.

2. A helical-and-whip antenna as defined in claim 1 in which said helical antenna comprises a helix having a continuously varying pitch, said first portion of said helical antenna having relatively few turns per unit length, and said second portion of said helical antenna having relatively many turns per unit length.

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3. A helical-and-whip antenna as defined in claim 1 in which said radio-frequency tap comprises a contact for sliding along the turns of said helical antenna, a strap connected to said contact, a take-up reel for winding and unwinding said strap, and a radio-frequency coaxial feed line connected to said strap.

4. An antenna comprising a helix having a continuously varying pitch and a radio-frequency tap for sliding along the turns of said helix.

5. A helical-and-whip antenna comprising: first means including a whip antenna; second means including a helical antenna having first and second portions; whip-connecting means electrically connecting said first portion of said helical antenna to said whip antenna, said whip antenna being able to slide along said whip-connecting means without loss of electrical contact; third means for sliding said whip antenna along said whip-connecting means; a grounding means; grounding connector means electrically connecting said grounding means to said second portion of said helical antenna, said helical antenna being able to slide along said grounding connector means without loss of electrical contact; fourth means for sliding said helical antenna along said grounding connector means; and a radio-frequency tap for sliding along the turns of said helical antenna.

6. A helical-and-whip antenna as defined in claim 5 in which said helical antenna comprises a helix having a continuously varying pitch, said first portion of said helical antenna having relatively few turns per unit length, and said second portion of said helical antenna having relatively many turns per unit length.

7. A helical-and-whip antenna as defined in claim 6 in which said radio-frequency tap comprises a mounting means, a track mounted on said mounting means and running parallel to the vertical axis of said helical antenna, a contact for sliding along both said track and the turns of said helical antenna, a strap connected to said contact, a take-up reel for winding and unwinding the free play in said strap, a band electrically connected to said strap and mounted along said mounting means, a radio-frequency coaxial feed line, and feed-line connecting means electrically connecting said radio-frequency coaxial feed line to said band, said contact being forced to slide along the turns of said helical antenna and along said track, and said feed-line connecting means being able to slide along said band, when said mounting means is moved.

8. Apparatus as defined in claim 7 in which said track runs in proximity to said helical antenna.

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