ANTENNA WITH ADJUSTABLE-RATIO DUAL CAPACITIVE LOADING

Donn V. Campbell, Neptune, N.J., assignor to the United States of America as represented by the Secretary of the Army

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4 Claims

ABSTRACT OF THE DISCLOSURE

The vertical section of the antenna comprises an inductively loaded coaxial line supported inside a hollow mast. A horizontal array of conductors at the top of said coaxial line and connecting the top-loading capacity. Each component of capacity is connected to a different one of the conductors of said coaxial line and the ratio of said components of capacity is variable while the total or sum remains constant. Thus the antenna impedance may be changed while holding the antenna tuning fixed.

The invention described herein may be manufactured, used, and licensed by or for the Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to antennas and more particularly to antennas which utilize loading in the form of capacitance, inductance, or both, for shortening the physical antenna length or height relative to the electrical length. The specific antenna illustrated herein utilizes both inductive and capacitive loading to achieve the desired result. The capacitive loading comprises an array of conductors disposed in the horizontal plane at the top of the antenna. Some of these conductors are connected to the outer conductor of the coaxial line which comprises the vertical section of the antenna and the remainder to the inner conductor thereof. The loading capacity is thus composed of two components: $C_1$, being the capacity to ground of the top-loading conductors connected to the inner conductor of the coaxial line; and $C_{oo}$ the capacity of those conductors connected to the outer conductor thereof. The resonant frequency of the antenna and hence the tuning thereof is determined by the total capacity to ground and the total inductance, which in each case will comprise any loading capacity and inductance plus the inherent capacity and inductance of the antenna structure. With an extensive system of top-loading conductors, the top-loading capacity will comprise the greater part of the total capacity. The impedance of the antenna depends on the ratio of $C_{oo}$ to $C_1$. It is often desirable to have an antenna in which the impedance can be varied to match antenna feeds or sources of varying impedance while maintaining a constant tuning or antenna resonant frequency. This is accomplished in accordance with the present invention by providing an antenna in which the ratio of $C_{oo}$ to $C_1$ may be varied while the sum of these two capacities remains sensibly constant. This is accomplished by connecting the conductors of the two components, $C_{oo}$ and $C_1$, of the top-loading array with one or more movable or traveling insulators, each containing a pair of pulleys on which the flexible conductors are wound. The traveling insulator can be moved back and forth and as it is so moved, the wire from one pulley is paid out to increase the capacity of one component, and simultaneously the other pulley or reel takes up an equal amount or length of the opposite component of top-loading capacity, thus achieving the desired result.

It is thus an object of the present invention to provide an antenna capable of being varied in impedance while maintaining constant tuning.

A further object of the invention is to provide an antenna with two components of top-loading capacity, the ratio of the components being variable, while the sum thereof remains constant.

These and other objects and advantages of the invention will become apparent from the following detailed description and drawings, in which:

FIG. 1 is a pictorial view of an illustrative embodiment of the present invention. FIG. 2 is a top view of the conductors comprising the top-loading capacity of the antenna of FIG. 1 and FIG. 3 shows the movable insulator which separates the two components of top-loading capacity.

FIG. 1 is a view of the antenna as seen looking up at it from the surface of the earth 33. The hollow mast 5 is shown in section to illustrate the interior features thereof. The mast is made of any type of insulating or dielectric material which is transparent to waves of the antenna's operating frequency. Spaced along the inside of the mast 5 are a plurality of toroidal ferrite cores 11. A coaxial line 9 comprises the vertical radiating section of the antenna. The lower end of the line 9 projects through a hole in the mast 5 and is connected to a utilization device 10, which may be a receiver or transmitter. The lower end of outer conductor of the coaxial line may be grounded to counterpoise 12. Fixed inductive loading of the antenna is provided by winding one or more turns of the coaxial line around each of the ferrite toroids in the mast. The top-loading capacity is provided by an array of metallic rods and wires disposed in the horizontal plane at the top of the mast. A metallic ring 13 mounted atop the mast supports four rigid metal rods or tubes 15, 17, 19, and 21. As seen in FIG. 2, the rods 15 and 19 together form the diagonals of a square. The rods 15 and 21 are conductively connected to and supported by the ring or collar 13. Rods 17 and 19 are supported by two insulators 24 which are in turn supported by ring 13. Flexible conductive wires 35, 37, 39, 41, 43, and 45 are supported by the outer ends of the four rods. Traveling or adjustable insulators 27 connect the flexible wires 39 and 41, and 35 and 45, thus insulating the two components of capacity from each other. These insulators are capable of movement or adjustment in the directions of the double-headed arrows. As seen in FIG. 2, the two rods 17 and 19 are connected together electrically by a jumper 23 which in turn is connected to the upper end of the inner conductor of the coaxial line 9 via lead 26. The outer conductor of the coaxial line is terminated at its upper end at the metal ring 13. Thus the inner conductor is electrically connected to the wires 35, 37, and 39. The capacitance of these elements to ground comprises the aforementioned $C_{oo}$. Similarly, the outer conductor capacity to ground, $C_{oo}$, is determined by the capacitance of the rods 15 and 21 and that of the wires 41, 43, and 45. As can be seen in FIG. 2, if the two insulators 27 are both moved upward, the lengths of the two wires 35 and 39 will increase, thus increasing $C_{oo}$; and simultaneously the lengths of wires 41 and 45 will decrease by an equal amount, thus decreasing $C_{oo}$ by the same amount that $C_{oo}$ has increased. Further, since the total length of wire has remained constant, the total antenna capacity has remained constant and the resonant frequency will remain fixed. The height of the antenna, the amount of inductive loading provided by the toroidal coils and the total top-loading capacity are all chosen to provide an antenna of the desired electrical length, while maintaining good radiation characteristics.

FIG. 3 shows an enlarged cross-sectional view of the movable insulators 27. The hollow insulator casing 32...
contains a pair of pulleys or reels 29 and 31 on which the two wires are wound. The reels may be spring-loaded in such a way that as the insulator is moved in one direction, the wire is "taken-up" by one spool and "let-out" by the other.

While the invention has been described in connection with an illustrative embodiment, obvious modifications thereof are possible without departing from the spirit of the invention. For example, while the top-loading capacity has been illustrated as a square array of flexible wires supported by rigid diagonal rods, other configurations are within the scope of the invention. Also, two movable insulators on opposite sides of the array have been illustrated, however if a smaller range of adjustment of the ratio of $C_2$ to $C_1$ is all that is required, only one movable insulator could be used and the other insulator 27 would then be fixed in position. Accordingly, the invention should be limited only by the scope of the appended claims.

What is claimed is:

1. An antenna comprising, a vertically disposed coaxial line, an array of top-loading conductors disposed in a horizontal plane at the top of said coaxial line, some of said top-loading conductors being connected to the inner conductor of said coaxial line and the remainder being connected to the outer conductor thereof, thereby providing two components, $C_1$ and $C_2$, respectively, of top-loading capacity for said antenna, and means for varying the ratio of $C_1$ to $C_2$ while maintaining the sum thereof constant.

2. The antenna of claim 1 wherein some of said conductors comprising both $C_1$ and $C_2$ comprise flexible conductors, and wherein said means comprises at least one traveling insulator connecting the flexible conductor comprising the said two aforementioned components of top-loading capacity, whereby the relative lengths of the flexible conductors comprising $C_2$ and $C_1$ may be changed by moving said insulator while the total length of said conductors remains constant.

3. The antenna of claim 2 wherein said coaxial line is supported by a hollow vertical mast of dielectric or insulating material, with said coaxial line running up the inside of said hollow mast, and at least one toroidal ferrite core within said mast with said coaxial line wound around said core to provide inductive loading of said antenna.

4. An antenna comprising, a vertically disposed hollow mast with a coaxial line running up the inside thereof, at least one toroidal ferrite core within said mast with said coaxial line wound around said core to provide inductive loading, a metallic collar atop said mast, four rigid conductors projecting horizontally from said collar at ninety degree intervals, two of said adjacent rigid conductors being insulated from said collar, means to connect the outer conductor of said coaxial line to said collar and the inner conductor thereof to the two insulated conductors, flexible conductors connecting the outer ends of said four rigid conductors, insulators in said flexible conductors which connect the rigid conductors which are connected to the different conductors of said coaxial line, at least one of said insulators being movable so that the lengths of flexible conductor connected to each of said different conductors of said coaxial line is adjustable, with the total length of said flexible conductors remaining fixed.

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Herman K. Saalbach, Primary Examiner
S. Chatmon, Jrs., Assistant Examiner
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