May 27, 1941. N. E. LINDENBLAD 2,243,677

WIDE BAND ANTENNA

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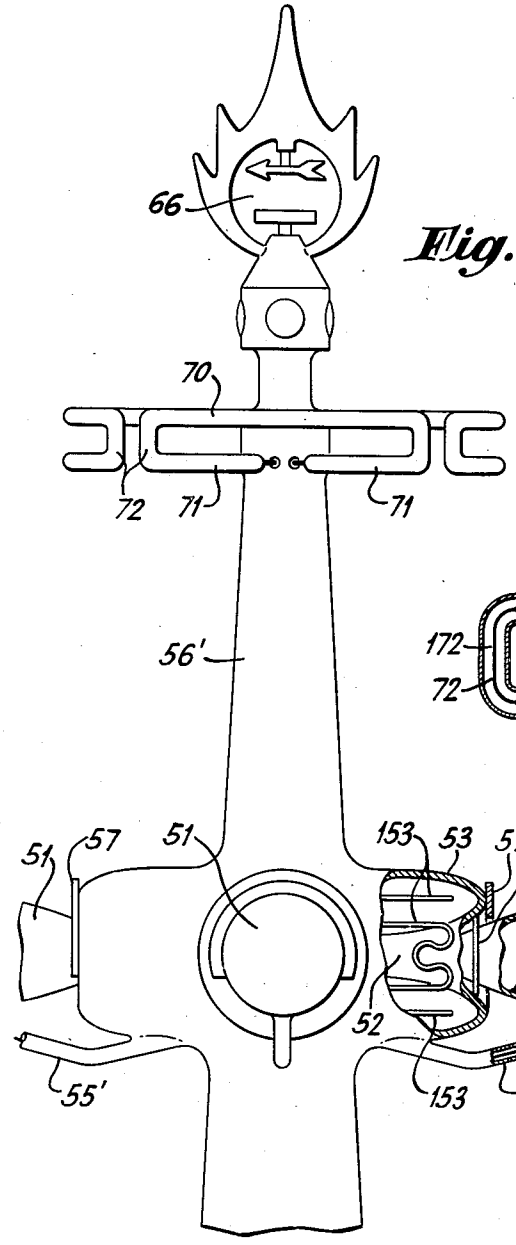


Fig. 1

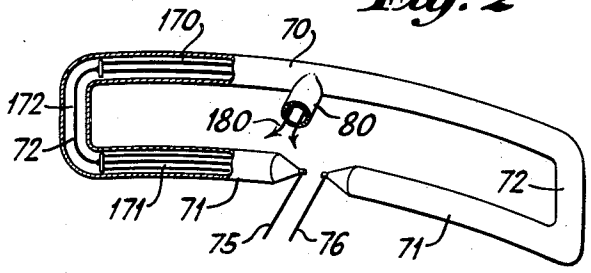


Fig. 2

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WIDE BAND ANTENNA

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Application May 13, 1939, Serial No. 273,395

9 Claims. (Cl. 250—33)

This application is a continuation in part of my application #208,573, filed May 18, 1938 (RCA D. #14,956), and relates to an extremely wide band short wave antenna having means incorporated therein for maintaining its characteristics constant during severe winter weather.

An object of the present invention is to provide a wide band antenna which has its electrical characteristics unaffected by winter weather and sleet forming conditions.

A further object of the invention is to provide means within a large diameter radiator for preventing a formation of ice on its exterior.

The antenna which I have described in detail in my prior copending application, above referred to, comprises one or more conductors having a diameter which is a large fraction of the length of the working wave. The dimensions are accurately determined with respect to the operating wave length. These conductors are preferably hollow and in order to prevent ice forming on the exterior surfaces of the conductors, thus changing their proportions, introducing extra resistive losses, and also adding weight and other hazards, in accordance with the present invention, I have provided heating elements in the hollow spaces within these conductors.

A more complete understanding of the present invention will be had by referring to the following detailed description, which is accompanied by a drawing in which Figure 1 shows partly in section an antenna constructed according to my invention, and Figure 2 shows in enlarged detail and partly in section the top portion of the antenna shown in Figure 1.

In Figure 1, wherein the same reference numerals are used as in my prior copending application above referred to, I have shown a turnstile radiator comprising four radiating elements 51. These elements are connected to a transmission line, not shown, at the ends which are partially covered by a shell portion 53. The shell of the transmission line is connected to shell 53 by a tapered transition section 52. The ratio of the diameters of the inner and outer conductors along the length of the tapered portion is so proportioned that the transmission line is properly matched to the radiating portion of the antenna. In order to maintain a constant and high ratio of resistance to reactance my antenna is arranged so that each of the shells 53 comprise approximately half of a quarter wave radiator and the enlarged central conductors 51 the other half. This makes the shell portion 53 of the antenna effectively act as an inductive impedance and the center conductor extension 51 as a capacitive impedance. The aim is to obtain a combination of the capacitive reactance C of the extending portion of conductor 51 and the inductive reactance L of shell 53 such that the

$$\sqrt{\frac{L}{C}}=R$$

the radiation resistance of each radiating component of the antenna, for as wide as frequency band as possible. It will be seen that a very slight change in dimensions of either the shell portion or the central conductor may result in a large change in the characteristics of the antenna. Since the antenna, constructed according to my invention, is ordinarily mounted on the top of a tall building or other exposed location the antenna is subject to ice formations over its exterior surface during the winter season. The presence of ice on the exterior surfaces may alter the dimensions enough to change the characteristics noticeably. In order to prevent this affect I have provided within the extending portion 51, heating elements 151, and within the shell portion 53 heating elements 153. Since an additional supporting arm 55' is provided for each of the elements 51 the most convenient way of connecting the heating elements 151 to a source of power, without at the same time connecting anything in shunt to the radio frequency feed circuit, is to pass the power supply conductor through the hollow support 55'. This connection permits a metallic grounding of all parts of the antenna as far as direct current voltages and lightning strokes are considered but requires a gradual taper of the characteristic impedance of the throat expansion to compensate for its effect on the impedance of the antenna. In order to prevent water from running into the transition section or throat 52, I have provided rain shields 57 and 58 at the outer end of the throat. Shield 57 is semi-circular and attached to the end of shell 53 while shield 58 is in the form of a ring surrounding extension 51 and just behind shield 57. These shields may be constructed of mica or other high quality insulating material.

The turnstile antenna as a whole is supported in any desired location by means of the pedestal 56. Above the turnstile and supported by column 56' is a ring-shaped antenna composed of a plu-

rality of bent dipoles 70 and 71. The conductor 71 of each dipole is broken at its center point and the radio frequency energy is supplied at that point by means of conductors 75 and 76. The other conductor 70 has substantially no radio frequency voltage at its center point and the radio frequency energy is supplied at that point by means of conductors 75 and 76. Since ice formations on the audio ring-shaped antenna would also seriously affect its electrical characteristics, to say nothing of possible mechanical damage, electrical heating elements 170 and 171 are placed within its hollow interior. The heating elements 171 within portions 71 are shown in the part sectional view in Figure 2, as are also the heating elements 170 within the portion 70. The heating elements 170 and 171 are conveniently connected together at their ends by conductor 172. The electrical energy for heating the elements 171 and 170 is applied thereto by means of conductors 180 passing through the hollow supporting member 80. The end of heating element 171 near the point of connection of conductor 75 may be in one form of construction grounded to the shell though both sides of the heater power line may be separately passed through support 80 and thence to a source of power if desired. The heating elements 170 and 171, 153 and 151 may be connected together within the pedestal 56 in any desired manner and a common connection brought therefrom to a source of electrical power or each group may be separately energized.

While I have particularly shown and described several modifications of my invention, my invention is not to be limited thereby but may be modified within the scope of the invention.

In order to adjust the amount of heat supplied by the heating units to the severity of ice conditions, I may provide thermostats which in response to a drop in temperature automatically energize the heating units. The heating energy may be applied automatically by means of differentially operating thermostats which keep the circuit closed for the temperature region favorable to the formation of ice.

I claim:

1. An antenna system comprising a hollow radiating conductor element, a radio frequency transmission line having a conductor connected to said radiating element, a hollow connection to ground from a point on said radiating element remote from the connection of said transmission line, means for heating said radiating element therewithin and electrically conducting energy supply means for said heating means passing through said hollow connection.

2. An antenna system comprising a hollow radiating conductor element, a radio frequency transmission line having a conductor connected to said radiating element, a hollow connection to ground from a point on said radiating element remote from the connection of said transmission line, electrical means for heating said radiating element therewithin and energy supply means for said heating means passing through said hollow connection.

3. An antenna system comprising a hollow radiating conductor with a transverse dimension which is critical with respect to the radiation properties of said antenna and which is electrically grounded at one point along its length, means within said conductor for heating the exterior surface thereof whereby ice formation is prevented whereby said transverse dimension is maintained constant and power supply leads for said heating means running through the ground connection.

4. An antenna system comprising a hollow conductor element having a diameter which is a large fraction of the length of the operating wave, a concentric conductor, transmission line and means for coupling said line to said conductor element comprising a tapered concentric conductor section having a central conductor and an outer shell surrounding said conductor, the ratio of the diameter of said conductor and shell being so proportioned along the length of said tapered section that a gradual transition between said transmission line and said antenna is obtained without material change in impedance, means within said conductor element and said outer shell for heating each of said elements.

5. An antenna system comprising a hollow conductor element having a diameter which is a large fraction of the length of the operating wave, a concentric conductor transmission line and means for coupling said line to said conductor element comprising a tapered concentric conductor section having a central conductor and an outer shell surrounding said conductor, the ratio of the diameter of said conductor and shell being so proportioned along the length of said tapered section that a gradual transition between said transmission line and said antenna is obtained without material change in impedance, a hollow conductive connection between a point in said central conductor and said outer shell, means within said conductor element and said outer shell for heating each of said elements and power supply leads for said heating means within said central conductor passing through said hollow conductive connection.

6. An antenna system comprising a hollow central conductor element having a transverse dimension which is a large fraction of the length of the operating wave and an outer shell surrounding a portion of said conductor, said central conductor extending beyond the end of said outer shell, the overall length of said shell and the exposed portion of said central conductor being substantially equal to one quarter the length of the operating wave, the capacitative reactance C of said extending portion and the inductive reactance L of said shell portion being so related that

$$\sqrt{\frac{L}{C}}=R$$

the radiation resistance of each component of said antenna, and means within said conductor element and said shell portion for heating each of said elements whereby said constants are unaffected by ice conditions.

7. An antenna system comprising a hollow central conductor element having a transverse dimension which is a large fraction of the length of the operating wave and an outer shell surrounding a portion of said conductor, said central conductor extending beyond the end of said outer shell, the overall length of said shell and the exposed portion of said central conductor being substantially equal to one quarter the length of the operating wave, the capacitative reactance C of said extending portion and the inductive reactance L of said shell portion being so related that

$$\sqrt{\frac{L}{C}}=R$$

the radiation resistance of each component of

said antenna, a hollow conductive connection between a point in said central conductor and said outer shell, means within said conductor element and said shell portion for heating each of said elements whereby said constants are unaffected by ice conditions, and power supply leads for said heating means within said central conductor passing through said hollow conductive connection.

8. A horizontal loop antenna comprising four dipole antenna forming a circle, each dipole comprising a pair of hollow conductors arranged in parallel planes and each bent in the arc of a circle, means for connecting the conductors of each dipole together at their extreme ends, one conductor of each pair being broken at its midpoint forming a pair of adjacent ends, hollow supporting means connected to the midpoints of the other conductor of each pair, means for connecting a radio frequency transmission line to the adjacent ends of each dipole and heating elements within each of said hollow conductors.

9. A horizontal loop antenna comprising four dipole antenna forming a circle, each dipole comprising a pair of hollow conductors arranged in parallel planes and each bent in the arc of a circle, means for connecting the conductors of each dipole together at their extreme ends, one conductor of each pair being broken at its midpoint forming a pair of adjacent ends, hollow supporting means connected to the midpoint of the other conductor of each pair, means for connecting a radio frequency transmission line to the adjacent ends of each dipole, heating elements within each of said hollow conductors, and power supply leads connected to said heating elements and passing through said hollow supporting means.

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