Dec. 6, 1966 R. PINIZZOTTO ETAL 3,290,601

LINE CORD AND MONOPOLE ANTENNA SYSTEM

Filed June 7, 1963

FIG. 1.

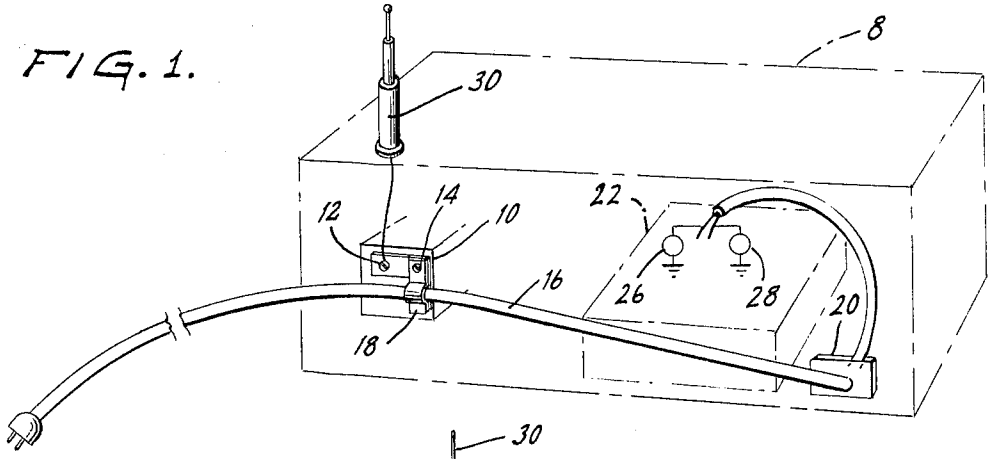
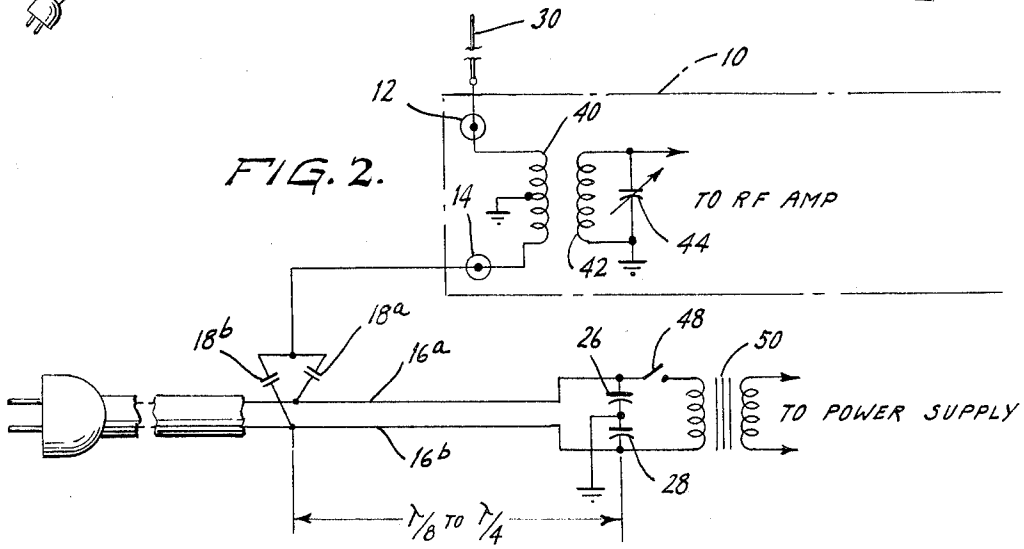


FIG. 2.



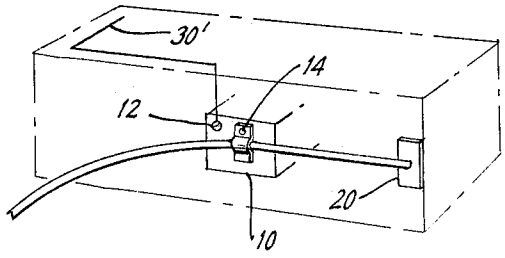


FIG. 3.

INVENTORS
ROSARIO PINIZZOTTO
ADOLPH G. KARDOLEY
BY
Robert D. Santoro
ATTORNEY

United States Patent Office 3,290,601
Patented Dec. 6, 1966

3,290,601
LINE CORD AND MONOPOLE ANTENNA SYSTEM

Rosario Pinizzotto, Primos, and Adolph G. Kardoley, Philadelphia, Pa., assignors to Philco Corporation, Philadelphia, Pa., a corporation of Delaware

Filed June 7, 1963, Ser. No. 286,292
7 Claims. (Cl. 325—372)

The present invention relates to radio receiving antennas and more particularly to antennas for power line connected radio receivers.

U. S. Patent 2,581,983 to Thompson, which is assigned to the assignee of the present invention, describes a line cord antenna for line operated receivers of waves of very high carrier frequency. This antenna, which has been in commercial use for a number of years, has certain limitations which affect its utility in low signal areas. One limitation is that the sensitivity of the line cord antenna tends to decrease as the carrier frequency to which the receiver is tuned increases. Another limitation of this prior art line cord antenna is that the sensitivity of the antenna is a function of the dress of the line cord, i.e. the position of the line with respect to the receiver chassis.

It is an object of the present invention to provide an antenna for line connected receivers which has more uniform sensitivity over a wide frequency band than prior art line cord antennas.

More particularly it is an object to provide an antenna which has substantially uniform sensitivity over the standard FM broadcast band.

Another object is to provide an antenna system for line-connected receivers which is substantially insensitive to line cord dress.

In general, the novel antenna system comprises a line cord adapted to connect the power supply circuits of said receiver with a source of electric power, means having a low impedance at carrier wave frequencies connecting the receiver end of the line cord to the receiver chassis, means for coupling one terminal of the radio frequency input circuit of said receiver to the line cord at a point physically displaced, along said line cord, from the receiver-connected end thereof, a monopole antenna element independent of said line cord and means connecting a second terminal of said radio frequency input circuit of said receiver to said monopole antenna element.

For a better understanding of the present invention together with other and further objects thereof reference should now be had to the following detailed description which is to be read in conjunction with the accompanying drawing in which

FIG. 1 is a diagrammatic representation, partially in phantom, of one preferred embodiment of the invention;

FIG. 2 is a schematic drawing showing the electrical circuitry of the embodiment of FIGURE 1; and

FIG. 3 is a diagrammatic representation of another embodiment of the invention.

Referring now to FIGURE 1, phantom lines **8** represent the cabinet of a broadcast receiver. The tuning assembly of the receiver is shown in fragmentary detail at **10**. Tuning assembly **10** is provided with terminal screws **12** and **14** which are electrically connected to the ends of the antenna tuning coil (not shown in FIGURE 1). The line cord **16** of the receiver **8** passes without any break in the insulation under a metallic clip **18** on tuning assembly **10**. From clip **18** line cord **16** passes to a conventional interlock means **20** and thence to chassis **22** (shown in phantom). Interlock **20** comprises conventional means for disconnecting the line cord **16** from the receiver chassis when the back (not shown) of the receiver is removed.

Clip **18** is apertured to receive, and in the position shown is mechanically supported by and electrically connected to, terminal screw **14**. In a typical FM broadcast receiver the dimensions of clip **18** are such that it provides a capacitance of the order of 15–20 picofarads between terminal screw **14** and the conductors of line cord **16**.

In addition to the usual connection of the conductors of line cord **16** to the receiver power supply circuit (not shown), the conductors of line cord **16** are connected to chassis ground for radio frequency signals at their receiver-connected ends by capacitors **26** and **28**. Chassis ground may be the metallic chassis if one is present or the ground connection of a printed circuit board. Capacitors **26** and **28** may be located, for example, in the vicinity of the receiver on-off switch (not shown in FIGURE 1).

A monopole antenna element, shown in FIGURE 1 as a telescoping monopole element **30** mounted on the cabinet **8** of the receiver, is electrically connected to the second terminal screw **12** of tuning assembly **10**. Again taking a conventional FM broadcast receiver as a convenient example, the clip **18** preferably is located approximately 30 inches from the grounded end of line cord **16**. More generally the distance should be of the order of $\lambda/8$ to $\lambda/4$ at the midpoint of the reception band of interest. As will become clear presently, the precise length is selected to provide optimum impedance match between the portion of the antenna system represented by line cord **16** and the RF circuit of the receiver. Monopole element **30** may be a conventional telescoping antenna element of the type now in commercial use on small broadcast receivers. Monopole element **30** may have a length of the order of approximately 30 inches when extended.

FIG. 2 is a schematic showing of the embodiment of FIGURE 1. Parts in FIGURE 2 corresponding to like parts in FIGURE 1 have been identified by corresponding reference numerals. In FIGURE 2 center tapped antenna coil **40** is shown connected to antenna terminal screws **12** and **14**. The center tap of coil **40** is connected to chassis ground. Coil **40** is inductively coupled to secondary winding **42** which may be variably tuned, as by variable capacitor **44**, to the frequency of the incoming carrier wave. The signal appearing across circuit **42–44** is supplied to the first RF stage of the receiver. The coils **40** and **42** form a conventional balanced-to-unbalanced transformer circuit. Other known forms of balanced-to-unbalanced transformers may be substituted therefor without departing from the invention.

Conductors **16*a*** and **16*b*** represent the two conductors of a conventional line cord shown at **16** in FIGURE 1. Capacitors **18*a*** and **18*b*** represent the capacitance provided by clip **18** of FIGURE 1. It is to be understood that other forms of capacitor coupling to conductors **16*a*** and **16*b*** may be substituted for the clip **18** shown in FIGURE 1. For example, the capacitive coupling element shown in FIGURE 2 of the above-mentioned Thompson patent may be employed. Switch **48** and transformer **50** in FIGURE 2 represent the conventional on-off switch and power transformer of the receiver, respectively. The invention is applicable also to transformerless receivers. Therefore the showing of transformer **50** in FIGURE 2 is by way of illustration only and should not be construed in a limiting sense.

The antenna system shown in FIGURES 1 and 2 differs from a conventional center-fed dipole antenna system in that one-half of the antenna, that formed by line cord **16**, has one terminal at ground potential. The connection from the lower terminal of coil **40** to the antenna element **16*a*** and **16*b*** is at a point removed from the ground terminal by an electrical distance of the order of $\lambda/8$ to $\lambda/4$ at the frequency of the carrier wave signal approximately midway in the band of interest. As stated above, this length is selected for optimum impedance match between the antenna element represented by line cord **16** and antenna coil **40**.

FIG. 3 is an embodiment of the invention suitable for use in receivers of relatively large cabinet size. The embodiment of FIGURE 3 differs from the embodiment shown in FIGURE 1 in that the monopole antenna element **30'** comprises a conductor disposed within and preferably supported by cabinet **8**. This conductor may take the form of a wire or a conductive foil. A conductor length of the order to 27½ inches has been found to give satisfactory performance for reception in the standard FM broadcast band. The conductor **35** should be as straight as possible to avoid loss of sensitivity due to bends in the conductor.

The antenna systems shown in FIGURES 1 and 3 have been found to provide substantially uniform sensitivity over the standard FM broadcast band. These antenna systems have been found to be relatively insensitive to changes in position of the line cord in the region from clip **18** to the power socket.

Although the invention has been described with particular reference to certain illustrated embodiments, it will be apparent that the invention is capable of still other forms of physical expression and is limited only by the scope of the appended claims.

We claim:

1. In a line-operated radio receiver including a chassis and a radio frequency input circuit, an antenna system comprising a line cord adapted to connect the power supply circuits of said receiver to a source of electrical power, means having a low impedance at carrier wave frequencies connecting the receiver end of the line cord to the receiver chassis, means for coupling one terminal of the radio frequency input circuit of said receiver to the line cord at a point physically displaced along said line cord from the receiver-connected end thereof, a monopole antenna element independent of said line cord and means connecting a second terminal of said radio frequency input circuit of said receiver to said monopole antenna element.

2. An antenna system in accordance with claim **1** wherein said one terminal is capacitively coupled to said line cord at a point physically displaced from the receiver-connected end thereof by approximately ¼ to ⅛ wavelength at the midband frequency of said radio receiver.

3. An antenna system in accordance with claim **1** wherein said monopole antenna element comprises a telescoping antenna element.

4. An antenna system in accordance with claim **1** wherein said monopole antenna element comprises an antenna element of fixed length disposed within and supported by the cabinet of said radio receiver.

5. An antenna system in accordance with claim **1** including means for maintaining a substantial portion of said line cord between said point of coupling to said first terminal and said receiver-connected end thereof in a fixed position relative to the chassis of said radio receiver.

6. In a line-operated radio receiver including a chassis, an antenna system comprising a line cord adapted to connect the power supply circuit of said receiver to a source of electric power, capacitor means having a low impedance at carrier wave frequencies connecting the receiver end of the line cord to the receiver chassis, a center-tapped antenna coil, the center-tap of said antenna coil being connected to said receiver chassis, means for coupling one end terminal of said center-tapped antenna coil to the line cord at a point physically displaced along said line cord from the receiver-connected end thereof, a monopole antenna element independent of said line cord and means connecting the second end termial of said center-tapped antenna coil to said monopole antenna element.

7. An antenna system in accordance with claim **6** wherein said means for capacitively coupling said one end terminal to said line cord comprises a supporting clip adapted to maintain said point of coupling to said line cord in a fixed position relative to said chassis of said radio receiver.

No references cited.

KATHLEEN H. CLAFFY, *Primary Examiner.*

R. LINN, *Assistant Examiner.*