Nov. 7, 1944. E. F. McDONALD, JR 2,361,953

RADIO RECEIVER

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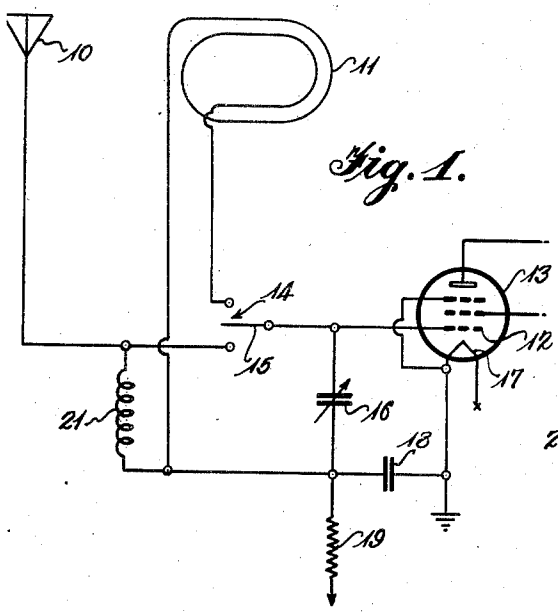

Fig. 1.

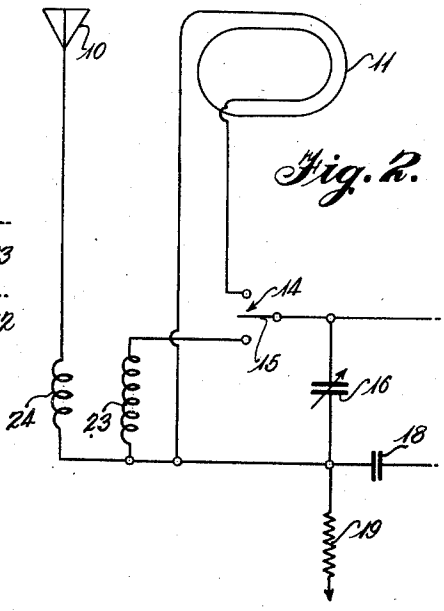

Fig. 2.

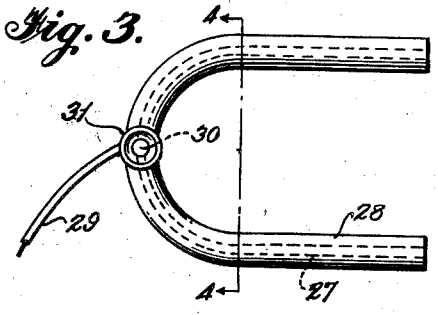

Fig. 3.

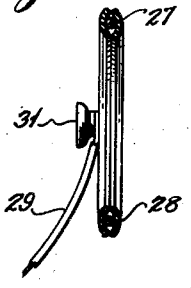

Fig. 4.

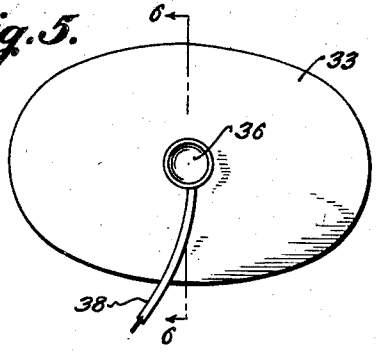

Fig. 5.

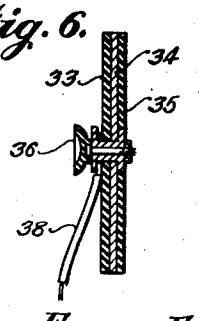

Fig. 6.

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Fig. 7.

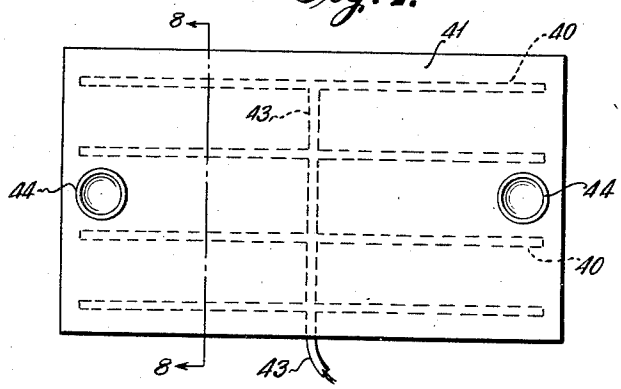

Fig. 8.

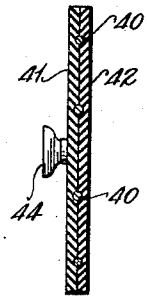

Fig. 9.

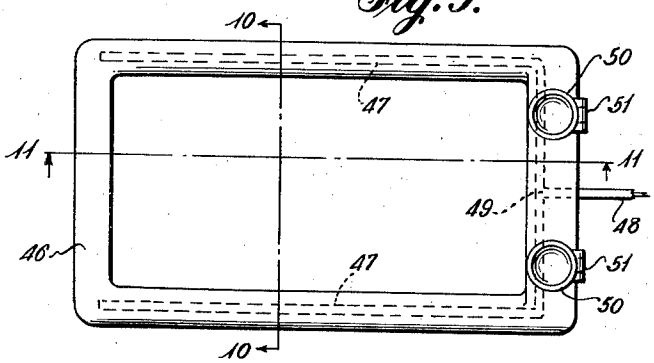

Fig. 10.

Fig. 11.

Fig. 12.

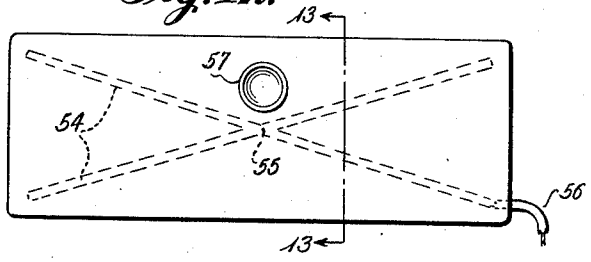

Fig. 13.

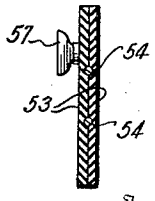

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Fig. 14.

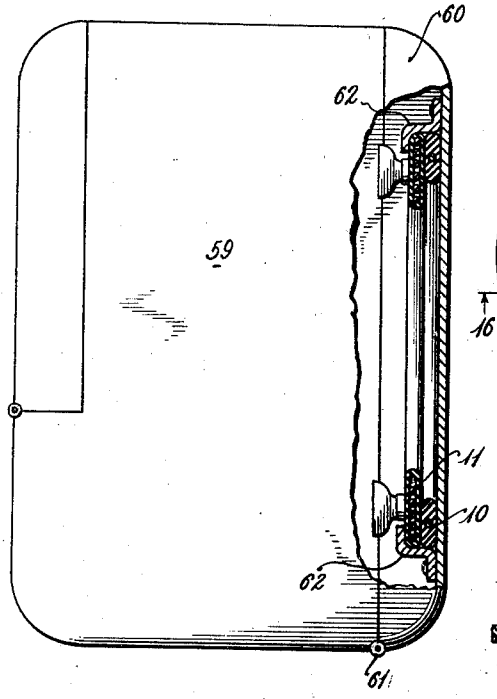


Fig. 15.

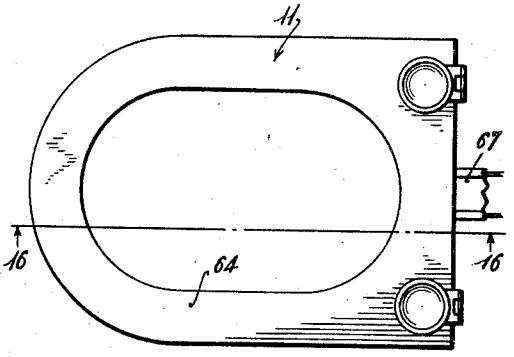


Fig. 16.

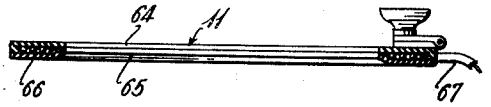
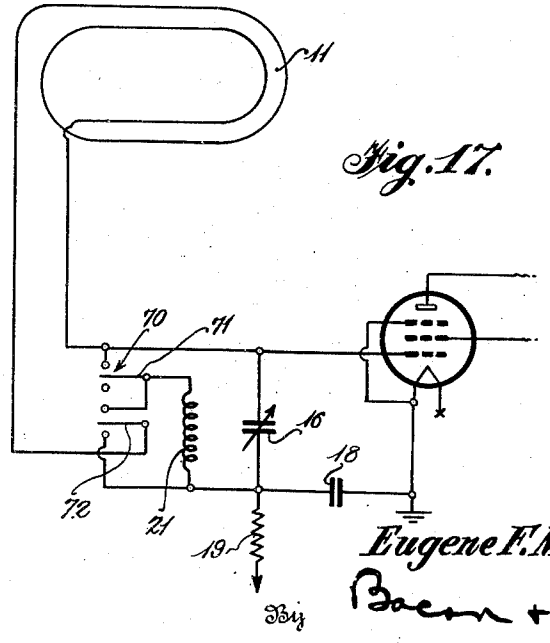


Fig. 17.



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Patented Nov. 7, 1944 2,361,953

UNITED STATES PATENT OFFICE

2,361,953

RADIO RECEIVER

Eugene F. McDonald, Jr., Chicago, Ill.

Application July 10, 1941, Serial No. 401,826

4 Claims. (Cl. 250—14)

This invention relates to radio receivers and more particularly to circuits and antenna structure for radio receivers designed for short wave reception or for reception in both the broadcast band and short wave bands.

The invention has particular application to radio receivers of the portable type having self-contained batteries but may be employed with any type of receiver. In its most specific aspect the invention relates to apparatus for enhancing the reception of signals by a receiver positioned within a shielding structure such as an automobile, airplane, train, ship, etc. provided with windows or other openings.

Such radio receivers have been provided with loop antennas connected to the input circuit of the set by a flexible connector, the antenna having vacuum cup or other suitable means for quickly attachably and detachably securing the antenna to a supporting surface such as the glass of a window so that the antenna was positioned to receive signal energy even when the set was positioned within a shielding structure. Loop antennas have proved effective for the broadcast band but have not proved effective for higher frequency bands such as the higher frequency short wave bands used for short wave broadcasting. In accordance with the present invention an antenna particularly adapted for short wave reception may be connected to the set by a single flexible connector so as to enable the antenna to be positioned adjacent an opening in a shielding structure. This antenna may likewise be provided with means for quickly attachably or detachably securing the same to a supporting surface and is of the capacity type, which capacity cooperates with a tuning inductance carried by the set and the capacity of a tuning condenser for tuning the input circuit of the set to the desired signal frequency.

It is therefore an object of the invention to provide an improved antenna and circuit therefor for enhancing reception of radio signals in short wave bands.

Another object of the invention is to provide an improved antenna structure for enhancing radio signal reception in short wave bands by a radio receiver positioned within a shielding structure having an opening therein.

A further object of the invention is to provide a portable radio receiver with a plurality of antennas capable of being selectively connected to the input circuit of the set through flexible connectors so that an antenna suitable for a desired frequency band may be positioned apart from the set but connected thereto so as to enhance reception of the desired signal frequency.

Other objects and advantages of the invention will appear in the following description of preferred embodiments of the invention shown in the attached drawings of which

Fig. 1 is a schematic diagram of a circuit by which antennas may be selectively connected to the input circuit of the set;

Fig. 2 is a view similar to Fig. 1 showing a modified connection;

Fig. 3 is an elevation of a preferred type of antenna for short wave reception;

Fig. 4 is a sectional view of the antenna of Fig. 3 taken on the line 4—4 of Fig. 3;

Fig. 5 is an elevation of a modified form of antenna;

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 5;

Fig. 7 is an elevation of a further modified form of antenna;

Fig. 8 is a sectional view taken on the line 8—8 of Fig. 7;

Fig. 9 is an elevation of another modified form of antenna;

Fig. 10 is a sectional view taken on the line 10—10 of Fig. 9;

Fig. 11 is a sectional view taken on the line 11—11 of Fig. 9;

Fig. 12 is an elevation of a still further modified form of antenna;

Fig. 13 is a sectional view taken on the line 13—13 of Fig. 12;

Fig. 14 is an end view of a portable radio set with part of the casing broken away to show one way of supporting a plurality of antennas in the set;

Fig. 15 is an elevation of a loop antenna particularly suitable for broadcasting reception;

Fig. 16 is a sectional view on the line 16—16 of Fig. 16; and

Fig. 17 is a schematic diagram of a connection enabling a loop antenna to be employed both for reception of signals in the broadcast band and for reception of signals in a higher frequency band.

Referring more particularly to the drawings, the antenna 10 of Fig. 1 may be any of the antennas of Figs. 3 to 13, inclusive, whereas the antenna 11 may be the loop antenna of Figs. 15 and 16 or a similar loop antenna. Signal energy may be fed selectively from either of the antennas 10 and 11 to the control grid 12 of the input tube 13 of the receiving set, which tube is shown as the pentode type usually employed for radio frequency amplification but which may be any

other type employed for the input tube of a radio receiver such as a pentagrid converter or mixer. A single-pole double-throw switch 14 may be operated by the usual band switching devices (not shown) of the radio set and with its central contact 15 in its upper position the loop antenna 11 is connected across a tuning condenser 16 to form a parallel tuning circuit which in turn is connected across the control grid 12 and the cathode 17 of the tube 13 through a coupling condenser 18, the coupling condenser 18 being employed to enable an A. V. C. voltage to be applied to the grid 12 through a resistor 19. The loop antenna 11 is constructed so that its inductance cooperates with the capacity of the condenser 16 to tune the parallel tuning circuit including the loop antenna 11 and the condenser 16 to a desired frequency in the broadcast band.

When the contact 15 of the switch 14 is in its lower position the antenna 10 is connected to one terminal of a parallel tuning circuit including an inductance 21 and the condenser 16. The value of the inductance 21 is such that it cooperates with the capacity of the condenser 16 and the antenna 10 to tune the input circuit to a desired frequency in a short wave band. It will be apparent that either the condenser 16 or the inductance 21 may be variable and that a plurality of inductances 21 or condensers 16 with suitable switching arrangements may be provided to adapt the set for reception upon a plurality of short wave bands and that a plurality of antennas 10 may also be employed for the same purpose.

In Fig. 2 is shown a modified circuit in which the antenna 10 is inductively coupled to an inductance 23 by means of a coil 24 in series with the antenna 10. Otherwise the circuit is the same as the circuit of Fig. 1. The coil 24 is loosely coupled to the inductance 23 so that the tuning circuit including the inductance 23 and the condenser 16 is more nearly independent of variations in effective capacity of the antenna, such as those due to the body capacity of the user of the set or grounded conductors in the vicinity of the antenna 10.

The antenna 10 may have a variety of constructions. A preferred construction is shown in Fig. 3 in which the antenna includes a conductor 27 positioned within a horseshoe shaped insulating structure 28 which may be of cardboard, fiber or plastic material and which may be transparent, if desired. A lead-in 29 in the form of an insulated flexible conductor may be connected to the conductor 27 at 30 and the insulating structure 28 may be provided with a vacuum cup 31 providing for quickly attaching the antenna to a supporting surface or detaching the antenna from said surface. This construction minimizes obstruction to vision if the antenna is placed upon the transparent material closing a window in a shielding structure such as the window or windshield of an automobile or airplane.

A modified structure is shown in Figs. 5 and 6 which may include an insulating plate 33 to which is attached a metal plate 34 covered by another insulating member 35. The insulating plate 33 may be of any suitable insulating material and the metal plate 34 may be of thin sheet metal or foil. One of the insulating members 33 or 35 may be of sufficient strength to impart rigidity to the antenna structure and the other merely a thin insulating covering for the member 34. A rubber vacuum cup 36 may be riveted or otherwise secured through the various members of the antenna and serve as a connector for connecting a flexible conductor 38 to the metal member 34. Instead of employing a metal place, a grid of conductors 40 may be positioned between insulating members 41 and 42 as shown in Figs. 7 and 8. The conductors 40 may be connected at their midpoints to a common conductor 43 which forms the lead-in for the antenna. The antenna of Fig. 7 may be provided with a plurality of vacuum cups 44 for securing the same to a supporting surface.

The antenna of Figs. 9, 10 and 11 may comprise an insulating structure 46 in the form of a ring with a conductor 47 extending around approximately three sides of the ring. The lead-in conductor 48 may be connected to the midpoint 49 of the conductor 47 and the insulating structure 46 may be provided with a plurality of vacuum cups 50 hinged thereto by means of hinges 51 so that the antenna may be attached to a supporting surface and positioned at a desired angle to the surface. The antenna of Figs. 9, 10 and 11 also minimizes obstruction to vision if the antenna is positioned upon a transparent panel. The antenna of Figs. 12 and 13 may comprise sheets of insulating member 53 with conductors 54 extending diagonally thereacross and connected together at the midpoints 55. One of the conductors 54 may extend from the antenna in the form of a lead-in 56 for connection to the radio set and the antenna may be provided with a vacuum cup 57 for securing the same to a supporting surface.

The structure of a portable radio receiver set illustrated in Fig. 14 shows how a plurality of antenna may be supported in such a set. For example, the set 59 may be provided with a rear closure 60 hinged to the main casing of the set at 61. An antenna 10 for short wave reception and an antenna 11 for broadcast reception may be held in the closure member 60 by means of pivoted holding members 62. As shown in Figs. 15 and 16, the antenna 11 may include insulating members 64 and 65 in the form of a ring and a coiled conductor 66 may be positioned between the members 64 and 65 to form a loop antenna, the ends of the loop extending from the antenna and being supported in the edges of a flexible fabric member 67 to form a connection to the set.

It is noted that in Fig. 14, the capacity antenna 10 is carried by the portable set 59 and has a relatively large confined area and relatively small linear dimensions, the confined area of the capacity antenna 10 being comparable to the size of the portable set 59. By "confined area" of the capacity antenna 10 it is understood that I mean that area confined within the outermost edges of the metal forming the capacity antenna. That is, in the capacity antenna shown in Fig. 9 such confined area is substantially equal to the area confined within or bounded by the insulating structure 46.

In Fig. 17 is shown a circuit for employing a loop antenna such as the antenna 11 of Figs. 15 and 16 for both reception in a broadcast band and in a higher frequency band. A two-pole double-throw switch 70 may be employed to connect the loop antenna across the tuning condenser 16 when the central contacts 71 and 72 are in their lower position for operation of the antenna 11 as a loop antenna. With this connection the inductance of the antenna 11 in co-

operation with the capacity of the condenser 16 forms a parallel tuning circuit for tuning to a desired frequency in the broadcast band.

When the contacts 71 and 72 of the switch 70 are in their upper position, the loop of the antenna 11 is short-circuited and both of its terminals are connected to one terminal of a parallel tuning circuit including the inductance 21 and the condenser 16 so that the antenna 11 functions as a capacity type antenna. It has been found that this circuit may be employed for medium frequency bands above the broadcast band. The antennas of Figs. 3 to 13 are preferred for short wave reception when the set is positioned within a shielding structure when an antenna such as those shown in Figs. 3 to 13 is positioned adjacent an opening in the shielding structure. It will thus be seen that I have provided an antenna structure and receiving system enabling a portable or other type of radio receiver to be employed under adverse conditions for reception, for receiving short wave signals as well as both broadcast signals and short wave signals.

While I have disclosed the preferred embodiments of my invention, it is understood that the details thereof may be varied within the scope of the following claims.

I claim:

1. In a portable radio receiving set of such size to be conveniently carried by a person and provided with a self contained capacity antenna and operative under normal conditions to receive radio signals, the improvement which comprises means for enhancing reception of said signals under abnormal conditions when said set is positioned within a shielding structure having an opening therein, said means comprising an elongated flexible member electrically connecting said capacity antenna to said set, and means provided on said capacity antenna constructed and arranged for quickly attachably and detachably securing the same to a surface in any one of a plurality of positions relative to said opening and apart from said set, said capacity antenna having a large confined area relative to its largest linear dimension and comparable to the surface area of a side of said set, said capacity antenna being arranged to be placed entirely within the confines of said opening in the shielded structure such that elemental parts of said antenna are near the center of said opening where signal reception is optimum.

2. In a portable radio receiving set of such size to be conveniently carried by a person and provided with a self contained capacity antenna and operative under normal conditions to receive radio signals, the improvement which comprises means for enhancing reception of said signals under abnormal conditions when said set is positioned within a shielding structure having an opening therein, said means comprising an elongated flexible member electrically connecting said capacity antenna to said set and vacuum cups carried by said capacity antenna for quickly attachably and detachably securing the same to surfaces, including vertical surfaces, in any one of a plurality of positions relative to said opening and apart from said set, said capacity antenna having a large confined area relative to its largest linear dimension and comparable to the surface area of a side of said set, said capacity antenna being arranged to be placed entirely within the confines of said opening such that elemental parts of said antenna are near the center of said opening in the shielded structure where signal reception is optimum.

3. In a portable radio receiving set of such size to be conveniently carried by a person and provided with a self contained capacity antenna and operative under normal conditions to receive radio signals, the improvement which comprises means for enhancing reception of said signals under abnormal conditions when said set is positioned within a shielding structure having an opening therein, said means comprising an elongated flexible member electrically connecting said capacity antenna to said set, and means provided on said antenna constructed and arranged for quickly attachably and detachably securing the same to a surface in any one of a plurality of positions relative to said opening and apart from said set, said antenna including an insulating plate with a capacity plate secured thereto and movable as a unit therewith, said capacity plate having a large confined area relative to its largest linear dimension and comparable to the surface area of a side of said set, said capacity plate being arranged to be placed entirely within the confines of said opening such that elemental parts of such capacity plate are near the center of said opening in the shielded structure where signal reception is optimum.

4. In a portable radio receiving set of such size to be conveniently carried by a person and provided with a self contained capacity antenna and operative under normal conditions to receive radio signals, the improvement which comprises means for enhancing reception of said signals under abnormal conditions when said set is positioned within a shielding structure having an opening therein, said means comprising an elongated flexible member electrically connecting said antenna to said set, and means provided on said capacity antenna constructed and arranged for quickly attachably and detachably securing the same to a surface in any one of a plurality of positions relative to said opening and apart from said set, said antenna including an insulating plate secured thereto, said insulating plate having a plurality of vacuum cups secured thereto to constitute said means constructed and arranged for quickly attachably and detachably securing the same to said surface, said capacity plate having a large confined area relative to its largest linear dimension and comparable to the surface area of a side of said set, said capacity plate being arranged to be placed entirely within the confines of said opening such that elemental parts of such capacity plate are near the center of said opening in the shielded structure where signal reception is optimum.

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