

July 21, 1925.

1,546,731

J. H. HERZOG

RADIO APPARATUS

Filed Jan. 23, 1923

2 Sheets-Sheet 1

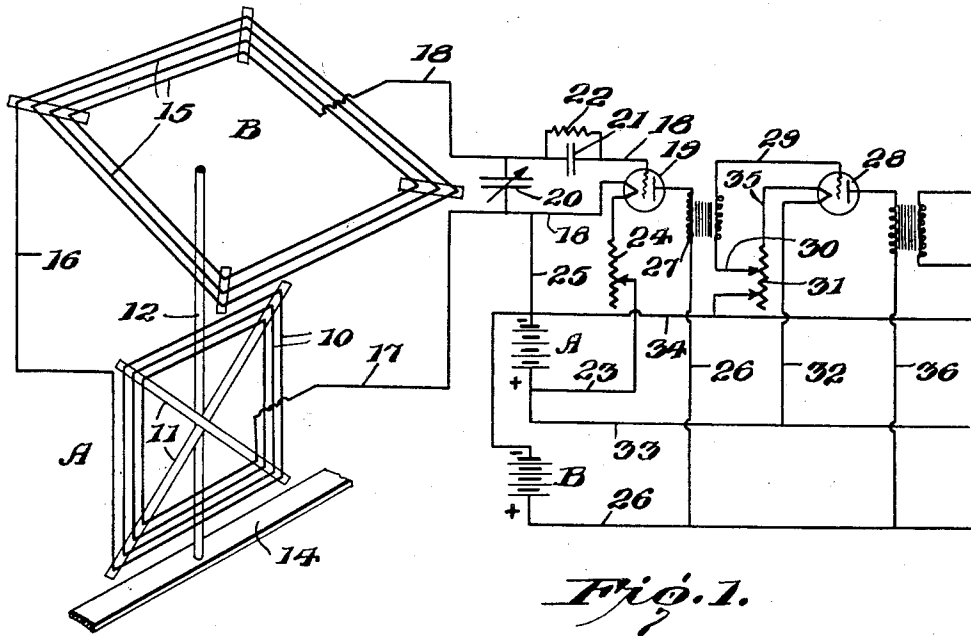


Fig. 1.

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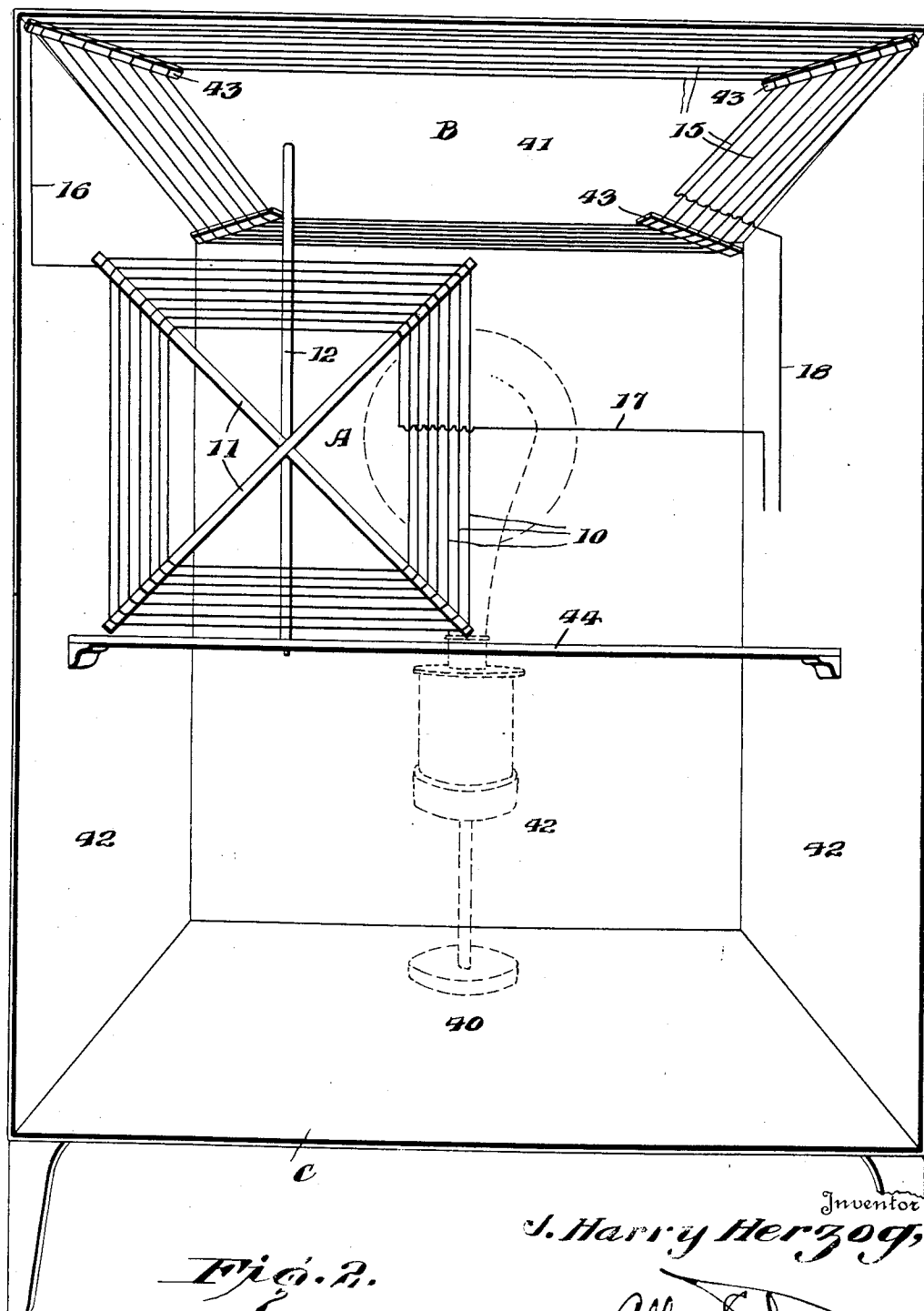
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

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RADIO APPARATUS.

Application filed January 23, 1923. Serial No. 614,417.

To all whom it may concern:

Be it known that I, JOHN HARRY HERZOG, a citizen of the United States of America, and a resident of Brooklyn, county of Kings, State of New York, have invented certain new and useful Improvements in Radio Apparatus, of which the following is a specification.

This invention relates to certain improvements in radio apparatus; and the nature and objects of the invention will be readily recognized and understood by those skilled in the art involved in the light of the following explanation and detailed description of the accompanying drawings illustrating what I at present consider to be the preferred embodiments or electrical and mechanical expressions of the invention from among various other forms, arrangements, combinations and constructions of which the invention is capable within the spirit and scope thereof.

The present invention is primarily directed to antennae of the coil or loop types for use in radio receiving apparatus. Coil antennae are generally typified by a number of loops of wire or similar conductor wound on and around a suitable frame which is positioned and mounted in a vertical plane so as to be rotatable or movable around a vertical axis. Antennae of this general type have marked directional characteristics which result in the strongest currents being induced in such an antenna when it is pointing in the direction of approaching radio waves, that is with the waves traveling in the plane of the coil, while the weakest or practically zero currents are induced therein with the various waves approaching or traveling in a direction at right angles to the plane of the coil. With the use of antennae of the coil types in receiving apparatus the directional characteristics are utilized in receiving waves by adjusting the position of such an antenna to raise the currents induced in the antenna circuits to a maximum, as well as to cut or minimize interference from waves which it is not desired to receive, and interference from so-called "strays".

It is well known that a loop antenna is bi-directional or in other words that it receives waves travelling in either direction in the plane in which the loop is disposed. An essential object of the present invention

is the provision of a rotatable loop antenna in conjunction with a fixed horizontal coil which constitutes a capacity or electrostatic antenna, the relation of the two antennae being such that there is a reaction between the two which results in blocking out signals or waves from one of the two directions from which an ordinary loop receives, by means of which action unidirectional reception is possible.

With the foregoing and various other objects in view, which other objects will be readily recognized and appreciated by those familiar with this art, the invention consists in certain novel features in arrangement, combinations and mounting of the various elements thereof, as will be more fully and particularly referred to and explained hereinafter.

Referring to the accompanying drawings:

Fig. 1, is a purely diagrammatical view of an antenna of the coil or loop type embodying the principles of the invention, a portion of a radio receiving circuit being shown operatively coupled therewith.

Fig. 2, is a more or less diagrammatical view in perspective of a cabinet of a radio receiving unit with an antenna of the invention mounted and enclosed therewithin, one side of the cabinet being removed and the receiving apparatus and circuits not being shown.

In Fig. 1 of the accompanying drawings I have diagrammatically disclosed a receiving antenna embodying the principles of the invention operatively connected and coupled in a receiving circuit, a portion only of the receiving circuit being shown merely for purposes of explanation. The illustrated embodiment of the antenna includes a vertically disposed coil A formed of a wire conductor 10 wound around a suitable frame 11 to provide a series of spaced continuous connected loops which in the present instance all lie in the same vertical plane to form a flat coil. Any number of turns of the conductor 10 may be wound around the frame to form a coil having the required number of loops to meet the conditions under which the antenna is to be operated, or any other form or arrangement of coil may be utilized having the equivalent characteristics, as will be readily apparent to those skilled in this art. The coil A, so formed on the frame 11, is mounted in a

vertical position on the shaft 12 which is rotatably supported on a suitable base or stand 14. Thus, coil A is rotatable around a vertical axis to position with the vertical plane thereof pointing in the desired direction.

A second coil B formed of a series of continuous connected and spaced loops or turns of a wire conductor 15, in a manner similar to coil A is disposed and suitably mounted in a horizontal plane directly above and spaced from the vertically disposed rotatable coil A. The horizontally disposed fixed coil B is connected in series with the vertically disposed rotatable coil A, through a conductor 16 connected between the outer loop of the coil forming conductor 15 of coil B, and the outer loop of the coil forming conductor 10 of coil A. The inner loops of the vertical coil A and horizontal coil B are connected to wires or other suitable conductors 17 and 18, respectively, and these wires 17 and 18 are led to and suitably connected into the circuits of the receiving apparatus. Thus, the receiving antenna consists of the rotatable vertically disposed coil A mounted below and connected in series with the fixed horizontally disposed coil B in which the received waves induce a current which is conducted by wires 17 and 18 to the receiving circuits of the apparatus.

In the present instance, a portion of a radio receiving circuit is shown merely to illustrate for purposes of explanation the manner of connecting and coupling the antenna of the invention therewith. It will be understood that antennae embodying the invention are adapted for use with any and all desired types and arrangements of receiving apparatus and circuits, and therefore it is not desired to limit the invention to use with the type of receiving circuit and apparatus indicated diagrammatically in Fig. 1 of the accompanying drawings. The antenna connecting wires 17 and 18 are suitably connected to an audion tube 19 forming the detector of the receiving circuits, and a variable condenser 20 is connected across the wires 17 and 18 in the usual manner. The wire 18 is connected to the grid of the detector tube 19 and is provided with a grid leak formed of the condenser 21 and the resistance 22 shunted therearound, in the usual manner. The battery A furnishes current for the filament of the tube 19 through the circuit formed by the wires 23, 24, 18 and 25, while the plate of the tube 19 is supplied with current from battery B through wire 26 connected through the primary of a transformer 27. One stage of audio amplification is indicated and consists of the usual audion tube 28 having the grid thereof connected by wire 29 through the secondary of the transformer 27, from the transformer

to the filament circuit by wire 30 and variable resistance 31. The filament of tube 28 is connected with battery A by circuit 32, 33, 34, 31 and 35, and the plate is connected with battery B through wires 36 and 26. The receiving circuits and apparatus above briefly outlined can be formed with any desired number of stages of amplification through suitable connections, as will be clear to those skilled in the radio art, and it is not deemed necessary to explain and describe in detail a complete receiving apparatus and its circuits further than the receiving circuits shown and described above in order to bring out the application of the invention.

With the two coils connected in series, as shown, it is found that the stationary coil acts as a capacity or electrostatic antenna receiving waves from all directions, while the vertical loop acts substantially in the same manner as is well known, the signal strength in the receiving apparatus being at the maximum when the loop points toward the station from which it is desired to receive. However, I have discovered that there is a peculiar relation or co-action between the stationary coil, which acts as a capacity, and the loop whereby signals from one direction in which the loop lies will be blocked out and only those from the opposite direction received. In this way the combined antenna possesses a uni-directional effect which gives far greater selectivity than is possible with an ordinary loop.

A radio receiving set or unit embodying the enclosed antenna features of the invention is more or less diagrammatically illustrated in Fig. 3 of the accompanying drawings. In the illustrated example an antenna of the invention is permanently mounted and enclosed within a cabinet C formed of any suitable or desired material. The cabinet C comprises bottom 40, top 41 and sides 42, the rear or back of the cabinet being removed in the illustrated example. The horizontal coil B of the antenna is permanently fixed in position on the under side of the top 41 of the cabinet by means of suitable supports such as the arms 43. The coil B is so mounted that the loops formed by the conductor 15 are substantially in a flat horizontal plane, as hereinbefore described with reference to Fig. 1 of the drawings. A bridge or other suitable support is secured, in the present instance, across the interior of the cabinet C extending between opposite sides 42 thereof and below the horizontal antenna coil B. A rotatable shaft 12 is mounted on the support 44 at its lower end and in the top 41 of the cabinet at its upper end. A frame 11 is secured on the shaft 12 and the vertical antenna coil A is formed thereon by the wire conductor 10, as hereinbe-

fore described. Thus the vertical coil A is mounted below the fixed horizontal coil B and is rotatable around a vertical axis on the shaft 12 by any suitable or desired operating means (not shown).

Preferably, the vertical coil A of the antenna is mounted with its vertical axis approximately one-fourth of the width of the horizontal coil, although it is not desired to so limit the relative positions of the coils A and B. The coils are connected in circuit as described hereinbefore, by means of a conductor 16 connecting the outer loops of the coils, and conductor 17 from the inner loop of coil A, and conductor 18 from the inner loop of coil B, the conductors 17 and 18 being connected to the receiving apparatus and circuits (not shown). The cabinet C with the antenna mounted and enclosed therein, has the complete receiving apparatus and circuits also mounted and totally enclosed therein in any desired manner, and are suitably connected with the conductors 17 and 18 of the antenna circuit. A loud speaker, or other suitable amplifier is preferably mounted in the cabinet, as indicated in dotted lines, and operatively connected in the receiving circuits in the usual manner. By the foregoing arrangement of antenna and receiving apparatus mounted and totally enclosed within the cabinet a unit or set is provided in which all outside and exterior antenna, apparatus and circuits therefor are eliminated, and which is exceedingly compact and particularly adapted for use as a portable unit. The provision of the balanced antenna embodying the principles of the antenna features of the invention, permanently mounted and totally enclosed in the above described set or unit makes possible the formation of a practical self-contained set of high efficiency and performance.

There is no limitation whatever as to the enclosing of the combination antenna in the cabinet as it is quite obvious that the device would function to equal advantage regardless of its size, within certain limits, and regardless of the place or manner of its mounting except that it is of course necessary that the vertical loop be rotatable.

The principles of the antenna of the invention are capable of presentation and embodiment in various other forms, and are applicable and adapted to use with any desired type or arrangement of receiving apparatus and circuits, as will be clear to one skilled in the art. Any desired or suitable

form of container to provide the enclosed, self-contained unit of the invention, as well as any desired arrangement and mounting of the antenna and receiving apparatus within and enclosed by a container may be employed. The drawing disclosures of a cabinet and antenna mounted and enclosed therein make it clear that any desired receiving apparatus can be mounted and enclosed in the cabinet or other container in proper operative relation with the antenna in accordance with the invention.

It is also evident that various changes, variations, modifications and substitutions might be resorted to without departing from the spirit and scope of the invention, and hence I do not wish to limit myself to the exact disclosures hereof.

Desiring to protect my invention in the broadest manner legally possible, what I claim is:

1. A radio receiving antenna comprising the combination of a stationary horizontal coil and a vertical rotatable coil connected in series therewith, both coils constituting inductance and both acting as condenser elements to define a capacity antenna.

2. A radio receiving antenna comprising the combination of a stationary horizontal coil and a vertical rotatable coil connected in series therewith, both coils constituting inductance and both acting as condenser elements to define a capacity antenna, the rotatability of the vertical coil varying the reaction between it and the stationary coil for permitting reception of waves from a single desired direction.

3. In a radio receiving apparatus, an antenna including a fixed, horizontally disposed coil acting as a capacity, and a vertical coil movable about a vertical axis and arranged in proximity to the stationary coil, both coils being connected in series and acting as tuning inductance, and both coils acting as condenser plates defining electrostatic receiving means.

4. An antenna circuit for radio receiving apparatus, including a fixed horizontal coil acting as an element of an electrostatic antenna for receiving waves from all directions, and a rotatable vertical coil in series with the stationary coil and acting as the other element of the electrostatic antenna and further co-operating therewith to define tuning inductance.

Signed at Brooklyn, New York, this 30th day of December, 1922.

J. HARRY HERZOG.