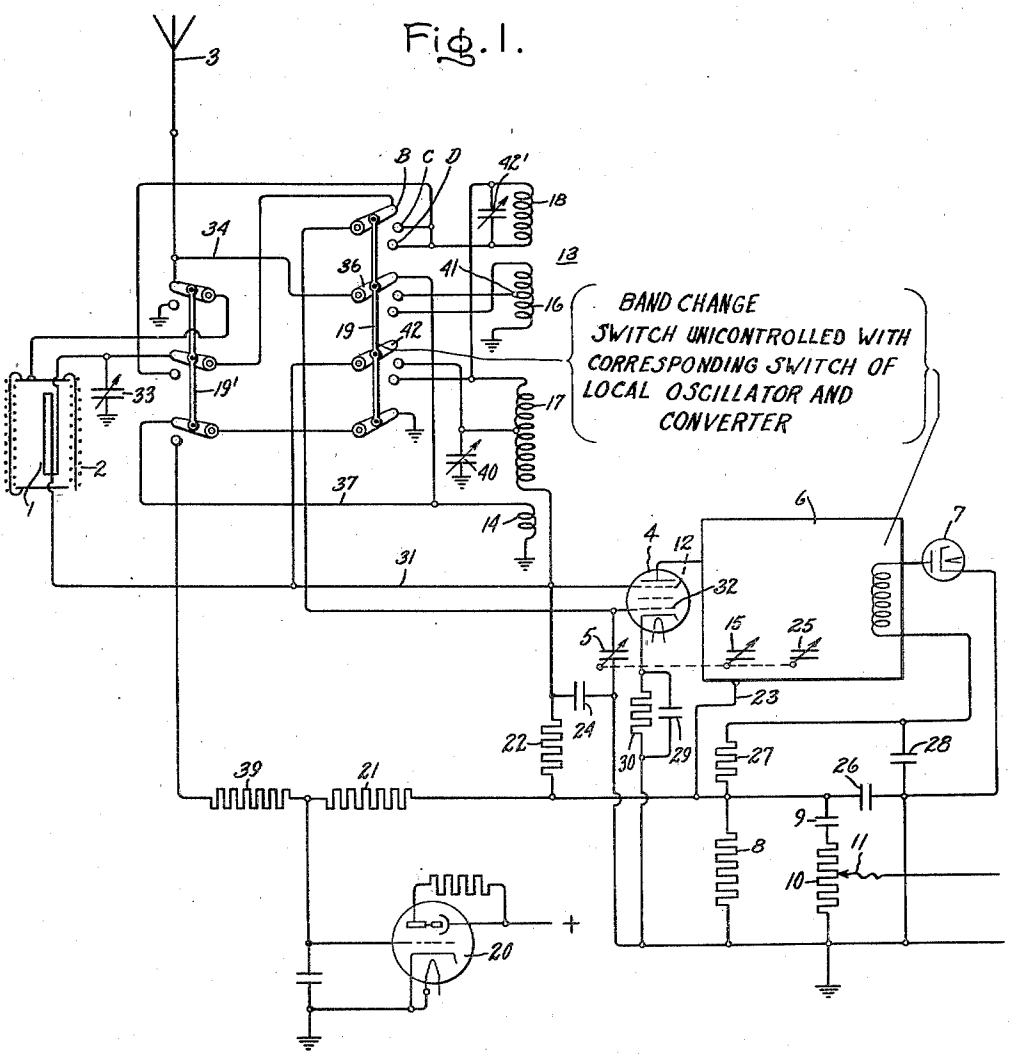
Nov. 7, 1939. A. G. MANKE 2,179,298

SIGNAL SYSTEM

Filed June 2, 1938 2 Sheets-Sheet 1

Fig. 1.




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SIGNAL SYSTEM

Filed June 2, 1938 2 Sheets-Sheet 2

Fig. 4.

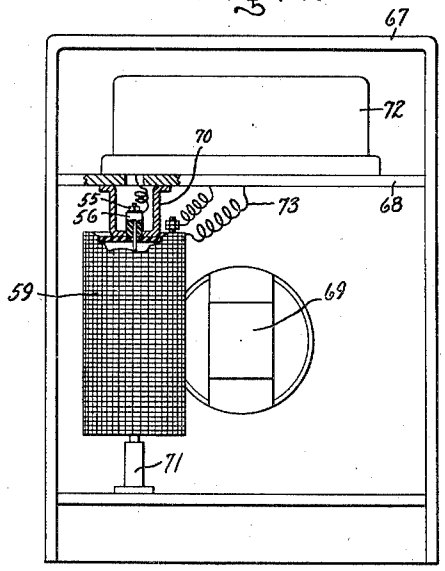



Fig. 2.

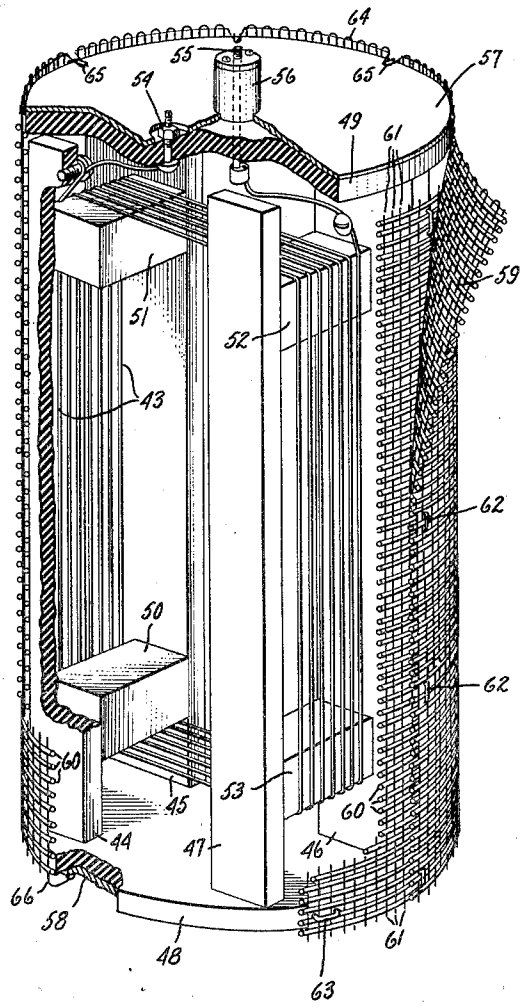
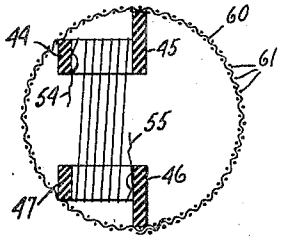



Fig. 3.




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# UNITED STATES PATENT OFFICE

2,179,298

## SIGNAL SYSTEM

Arthur G. Manke, Stratford, Conn., assignor to General Electric Company, a corporation of New York

Application June 2, 1938, Serial No. 211,428

5 Claims. (Cl. 250—20)

My invention relates to signal systems and more particularly to antenna switching arrangements therefor. It relates more particularly to household radio receivers and it has for one of its objects to facilitate the obviation of the necessity for an external antenna for such receivers.

In copending application Serial No. 210,673 filed by James E. Beggs entitled Radio receiver and which is assigned to the same assignee to which my present application is assigned, there is shown a radio receiver adapted for household use and which employs a shielded loop antenna.

My invention has for another of its objects to provide certain improvements in such receivers employing loop antennae relating more particularly to multiband reception.

A further object of my invention is to utilize the loop shield as receptor in one band of frequencies to be received and to provide a switching arrangement facilitating the employment of different receptors in the different bands, and particularly to provide a switching arrangement facilitating the use of the loop as the receptor in one band and the loop shield as the receptor in another band.

Another object of my invention relates to control of the sensitivity of the visual resonance indicator which is commonly employed in such receivers in accordance with the receptor employed.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawings in which Fig. 1 represents an embodiment of my invention; Fig. 2 represents the loop antenna structure employed therewith; Fig. 3 represents a sectional view of Fig. 2; and Fig. 4 represents such a loop structure mounted in the cabinet of a radio receiver.

Referring to Fig. 1 of the drawings I have illustrated therein a radio receiver employing a loop antenna 1 which may be housed within a shield 2 which, itself, may be employed as an antenna and a third antenna 3, which may or may not be employed, as is desired by the user. These different antennae are arranged for connection to the input circuit of an electron discharge device 4, which in the diagram illustrated, is connected to act as an amplifier. The radio frequency oscillations received therein and amplified thereby are supplied to equipment which I have indicated by the rectangle 6, and which may comprise the usual converter stage and intermediate frequency amplification stages of the radio receiver. The output from this portion of the receiver may be impressed upon the diode detector 7 whereby the rectified unidirectional and signal potentials appear upon a resistance 8 which is connected between its anode and cathode. Across this resistance is connected a potentiometer comprising condenser 9 and resistor 10 having a variable contact 11 thereon. The signal oscillations appearing between contact 11 and ground may be supplied to any subsequent audio amplification stages and to the loud speaker of the receiver.

Resistance 8 is, of course, by-passed for radio frequency currents by the usual condenser 26 and has connected in series with it a filter comprising resistance 27 and condenser 28 to prevent the transfer of radio frequency potentials to resistance 8 and to circuits connected thereto.

At 13 I have shown a transformer comprising primary windings 14 and 16 and secondary windings 17 and 18. This transformer is adapted to transfer energy received from antennae 2 and 3 and to impress it between the control grid and cathode of discharge device 4. Different connections of this transformer are necessary when the receiver is operated in different frequency bands as, for example, the broadcast band and short wave bands. To effect the necessary changes in connection when connecting the receiver for operation in these different bands a switch 19 is operated. This switch has three positions B, C and D. In the position B of the switch the receiver is connected for operation in the broadcast band; in position C of the switch the receiver is connected for operation in a next higher frequency band; and in position D it is connected for operation in a still higher frequency band. This switch may be of any suitable construction such as the commonly employed Yaxley switch and should be uni-controlled with similar switches employed in the output circuit of discharge device 4 and in the local oscillator and incorporated within the equipment 6. This last-mentioned section of the switch and the circuits connected therewith are not shown in the drawings since an understanding thereof is not necessary to my present invention.

A second switch 19' is also employed, this switch having two positions and being adapted to effect certain circuit connections when the loop antenna is employed, and other circuit connections when the shield of the loop is employed as an antenna.

In the lower portion of the drawings I have shown an electron discharge device 20 which may be utilized as a visual resonance indicator. That is, this discharge device may be one of a so-called "Magic Eye" type, the grid potential of which may be varied in accordance with the condition of resonance of the receiver to received signals. This potential controls the fluorescence of a screen within the discharge device to produce the resonance indication. To effect this operation the control grid of discharge device 20 is connected through resistance 21 to the negative terminal of resistance 8. Since the unidirectional potential on resistance 8 varies in intensity in accordance with the intensity of the received signal, and hence in accordance with the condition of resonance of the receiver with the signal the discharge device 20 indicates this condition of resonance.

The potential of resistance 8 is also supplied through resistance 22 and circuits presently to be indicated to the control grid and suppressor grid of the discharge device 4 for automatic volume control purposes. For these same purposes it is also supplied through conductor 23 to any additional discharge devices within the equipment 6. Resistance 22 has associated therewith a condenser 24 properly proportioned to prevent the transfer of audio frequency potentials from resistance 8 back to the grid of the discharge device 4. A filter similar to this is of course also employed in the conductor 23.

For a further understanding of my invention I will trace the circuits with the switches 19 and 19' in the positions indicated on the drawings.

It will be noted that the switch 19 is in its extreme upper, or B, position in which the receiver is connected for operation in the broadcast band. The switch 19' is, similarly, in its upper or "loop" position in which the receiver is connected for reception by the loop 1.

The circuit of the loop now extends from the cathode of discharge device 4 through condenser 29, which is connected to by-pass cathode bias resistor 30, condenser 24, conductor 31, loop 1, middle armature of switch 19' in its upper position, and upper armature of switch 19 in its upper position to the control grid 32 of discharge device 4. Thus it will be seen that the loop 1 is connected directly between the control grid 32 and the cathode of the discharge device. The input tuning condenser 5 for the discharge device is likewise connected between the grid and cathode of this discharge device thereby to tune the loop to frequencies to be received.

Other condensers 15 and 25 of the input circuit to the converter and in the circuit of the local oscillator respectively are arranged for unicontrol with condenser 5, as conventionally indicated in the drawings. A trimmer condenser 33 is also connected across the loop and is variable for purposes of initial adjustment in the manner of the usual trimmer condenser.

It will be observed that the automatic volume control potential supplied through resistance 22 is impressed through the circuit just described both upon the suppressor grid 12 and also upon the control grid 32 of the discharge device 4.

The shield about the loop 2 is grounded through the upper armature of switch 19' in its upper position, conductor 34, armature 36 of switch 19 in its upper position, conductor 37, lower armature of switch 19' in its upper position, and lower armature of switch 19 in its upper position to ground. This latter connection including conductor 37 also short circuits the primary winding of transformer 14 thereby preventing certain absorption effects due to stray capacity coupling.

The circuits of the other windings of the transformer are open circuited by the switches 19 and 19' in the positions shown.

In this condition of the switches the full potential of resistance 8 is supplied through resistance 21 to the control grid of the visual resonance indicator 20 the circuit of resistance 39 being opened at the lower contact of switch 19. In this condition maximum response of the visual resonance indicator is obtained.

With the switches in this position the receiver is adapted for operation in the broadcast band. The loop 1 may be oriented for minimum reception of noise, or other undesired signals. The static shield 2 aids very substantially in the suppression of reception of noise currents and is so constructed as will later be described to avoid detrimental capacity and resistance effects upon the loop.

In this way the receiver may be tuned throughout the entire broadcast band of from 540 to 1575 kilocycles, with alignment with the other circuits controlled by tuning condensers 15 and 25 equally as satisfactorily as though a vertical antenna of the more common type were employed. The loop, however, possesses the important advantage that it obviates the necessity for an external antenna and may itself be mounted within the cabinet where it is not visible and where it does not affect the appearance of the receiver.

If it be desired to utilize an external antenna however, such as that indicated at 3, as in cases where one is present, this may be effected merely by operating the switch 19' to the lower position. The upper armature of switch 19' then grounds the static shield of the loop directly. The lower armature of switch 19 interrupts the short circuit across the primary winding 14 of the transformer 13 and at the same time at its lower contacts connects resistance 39 between the grid of the visual resonance indicator 20 and ground. By removing the short circuit across the primary winding 14 that winding now becomes effective between the antenna and ground. This winding may, of course, be one of the usual type in which it resonates with the antenna capacity at a frequency lower than the lowest frequency to be received. By connecting resistance 39 between the grid of discharge device 20 and ground a sufficient amount of current is caused to flow through resistances 21 and 39 to ground to reduce the magnitude of the potential which is supplied to the grid of discharge device 20. This reduces the sensitivity of response of the visual indicator 20 to operation of the tuning condensers 5, 15 and 25 and thus causes the device 20 to produce substantially the same character of indication as is produced during reception by the loop.

The circuit of the control grid of discharge device 4 now extends from the control grid 32 through the upper armature of switch 19 in its upper position, middle armature of switch 19' in its lower position, secondary winding 18 of transformer 13, and the entire secondary winding 17, condensers 24 and 29 to the cathode of the discharge device, this circuit of course, being tunable by condenser 5. Of course, the principal transfer of energy in the transformer takes place between windings 14 and 17, the winding 18 being adapted more particularly for short wave currents. Trimmer condenser 40 is connected

across a portion of this winding and is variable for the purposes of initial adjustment.

For operation in the C band, which is the band next higher in frequency than the broadcast band, the switch 19 is moved to its middle position. The antenna circuit then extends through conductor 34, armature 36 of switch 19 in its middle position to a tap 41 on the primary winding 16 of transformer 13, and thence through this winding to ground. The secondary circuit of the transformer 13 then extends from the control grid 32 of the discharge device 4 through the upper armature of switch 19 in its middle position, secondary winding 18, upper portion of winding 17, armature 42 of switch 19 in its middle position and condensers 24 and 29 to the cathode of the discharge device. The circuit is likewise tunable over the C band by the condenser 5.

In this condition of the switch 19 the circuit of resistance 39 is interrupted at the lower armature of switch 19, thereby increasing the sensitivity of the visual resonance indicator 20.

It may be desired however, to obviate entirely the use of the external antenna 3. In accordance with my invention, this antenna 3 may be omitted entirely, the loop shield 2 of the loop being utilized in its place. This is effected by operating the switch 19' to its upper position, thereby connecting the shield of the loop to the antenna terminal of the receiver, whereby this shield operates as an antenna or receptor in the short wave band. It has been found that very satisfactory operation may be had in this way.

For operation in a still higher frequency band D, switch 19 is moved to its lower position. The circuit of the antenna then extends from shield 2 through conductor 34 and the entire primary winding 16 of the transformer to ground. The secondary circuit of the transformer extends from the control grid 32 through the upper armature of switch 19 in its lower position, secondary winding 18, armature 42 of switch 19 in its lower position and thence through conductor 31 and condensers 24 and 29 to the cathode of the discharge device, this circuit likewise being tunable over the said band by means of condenser 5. The secondary winding 18 of transformer 13 is shunted by trimmer condenser 42' which is variable for purposes of initial adjustment for D band operation.

The loop structure, which I prefer to employ, is shown in detail in Fig. 2 and comprises the turns of conductor 43 which are wound upon a form of suitable material, such as wood comprising uprights 44, 45, 46 and 47, extending between end disks 48 and 49. These uprights may, of course, be spaced apart as desired by means of these end disks. They are also provided with spacer members 50, 51, 52 and 53 about which the conductor of the loop is wound. The ground, or low potential terminal of the loop is brought out through a terminal connection 54 and the high potential terminal of the loop is brought out through a terminal connection 55, the latter connection being provided within the non-conducting bearing 56 whereby the loop structure may be mounted for rotation, a similar bearing being of course provided on the lower disk 48. The disks 48 and 49 suitably are of non-conducting material but are provided with conducting surfaces 57 and 58 of sheet copper, for example. These members 57 and 58 serve as shields for the loop at the ends of the structure. The shield 59 about the sides of the loop is preferably of suitable fabricated form comprising vertical strands 61 of conductor and horizontal strands 60 of non-conducting material such as cotton or woolen yarn. This fabric is of sufficient width to extend between the ends of the loop structure and of sufficient length to reach around the external circumference of the disks 48 and 49. It is wrapped about these circumferences as shown, and the ends thereof overlapped and stapled as indicated at 62 and 63 to the loop forms and disks. The upper ends of the vertical conducting strands are connected together conductively as indicated at 64 and are also conductively connected as by soldering at a plurality of points 65 to the end shield 57. The lower terminals of these vertical strands are not connected together, but are left insulated from each other, and open, thereby to prevent the circulation of any currents in these conductors. It is desirable, however, that the lower end shield 58 be connected to the upper end shield 57 and to the other parts of the shield, and this is done by connecting it as shown at 66 to the lower end of a single one of the vertical strands. In this way, all parts of the shield are maintained substantially at the same potential.

It will be noticed as shown in Fig. 2 that the loop is arranged eccentrically with respect to the axis of the loop structure and with respect to the axis of the cylindrical shield. This eccentric arrangement is better illustrated in Fig. 3 where it will be observed that the high potential end of the loop solenoid is located substantially on a diameter of the shield, the other end of the loop solenoid, which is ordinarily grounded, and at low radio frequency potential, may be arranged in closer proximity to the shield. In this way the capacity effect of the shield upon the loop is reduced.

In Fig. 4 I have shown the loop with its shield 59 mounted within a radio cabinet 67. It is shown mounted below a shelf 68 in the cabinet and in the compartment with the loud speaker 69. The upper bearing 56 of the loop structure is shown supported within a fixed bearing and shield 70 attached to the lower surface of the shelf 68, an additional bearing 71 being provided to support the lower bearing of the loop. The high potential terminal conductor of the loop extends upward through the bearing 56 and is shielded to prevent the reception of noise currents thereby by making the bearing member 70 of suitable conducting material. This member 70, is, of course, suitably grounded to the chassis of the receiver. The connection from terminal 54 may then extend upward through the shield 57 into the radio chassis 72, which is shown mounted on the shelf. An additional connection 73 from any suitable point on the shield extends upward into the chassis for connection to switch the upper blade of switch 19'.

In the use of the invention the receiver is normally placed as desired in the home where it is to be used and the loop structure is then rotated to such a position that reception is had with minimum noise and it is then left in that position. It has been found that in this way and through action of the shield 59, operation of the receiver with a very marked reduction of noise currents is obtained.

While I have shown a particular embodiment of my invention it will, of course, be understood that I do not wish to be limited thereto since different modifications both in the circuit arrange-

ment and instrumentalities employed may be made. I contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to claim by Letters Patent of the United States, is:

1. The combination, in a radio receiver adapted for operation in different wave bands, a loop antenna connected to supply received oscillations thereto, an electrostatic shield surrounding said antenna, means to connect said receiver for operation in said different wave bands, means to connect said loop to said receiver for reception in one of said bands, and means to disconnect said loop from said receiver and to connect said shield to said receiver to act as an antenna for reception in another of said bands.

2. The combination, in a radio receiver adapted for operation in different wave bands, a loop antenna connected to supply received oscillations thereto, an electrostatic shield surrounding said antenna, means to connect said receiver for operation in said different wave bands, means to connect said loop to said receiver and said shield to ground for reception in one of said bands, and means to disconnect said loop from said receiver and said shield from ground and to connect said shield to said receiver to act as receptor in another band.

3. The combination, a receiver, a pair of antennas having different sensitivity, means to tune said receiver over a band of frequencies, means responsive to the received signals to indicate resonance of said receiver to said signals, and means selectively to connect said antennae to said receiver for reception thereby and simultaneously to alter the sensitivity of response of said resonance indicating means to produce substantially uniform response of said indicating means irrespective of the antenna connected to said receiver.

4. The combination, in a radio receiver, a loop antenna, an electrostatic shield about said loop, a band change switch having at least two positions, means operable when said switch is in one position to connect said loop to said receiver for reception thereby and in a different position of said switch to connect said shield to said receiver for reception by said shield.

5. The combination, in a radio receiver, a loop antenna, an electrostatic shield about said loop, a signal responsive resonance indicator, a switch, means operable when said switch is in one position thereof to connect said loop to said receiver for reception thereby and to alter the sensitivity of response of said visual resonance indicator, and means including said switch, in a different position thereof, to interrupt connection of said loop to said receiver, to connect said shield to said receiver for reception by said shield, and to alter the sensitivity of said resonance indicator in a sense opposite to said alteration effected by said first means.

ARTHUR G. MANKE.