Electrostatically- Shielded Loop Antenna

April 25, 1961 W. S. SKIDMORE 2,981,950

ELECTROSTATICALLY-SHIELDED LOOP ANTENNA

Filed Feb. 27, 1959 2 Sheets-Sheet 1

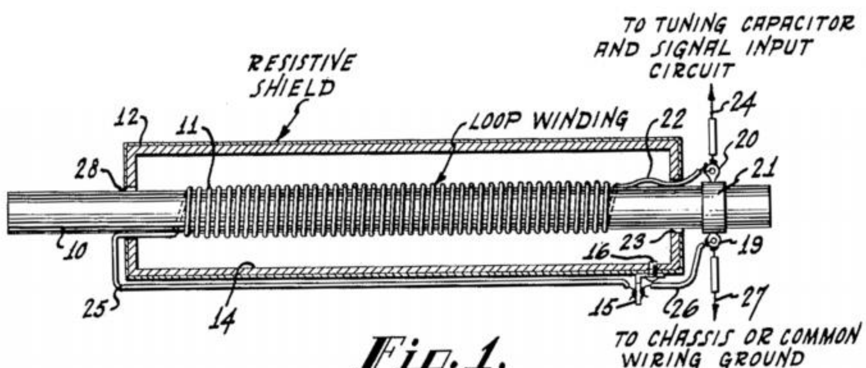

Fig. 1.

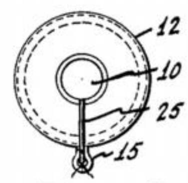

Fig. 2.

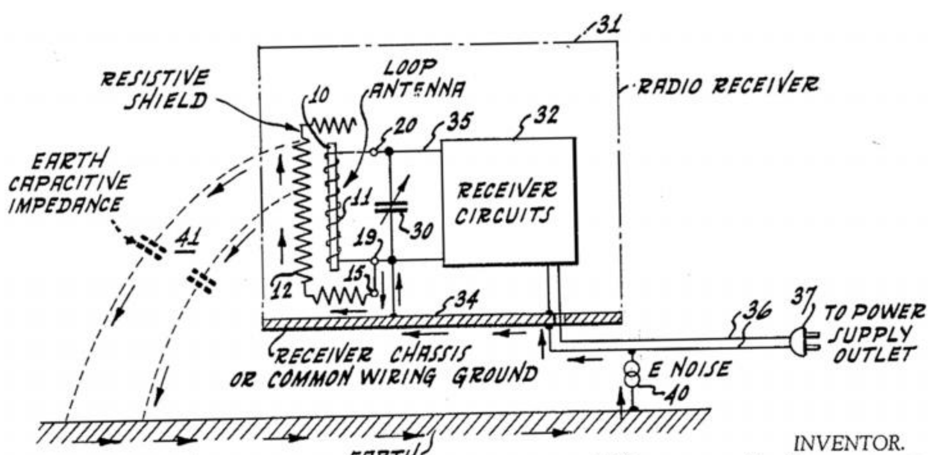

Fig. 3.

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ELECTROSTATICALLY-SHIELDED LOOP ANTENNA

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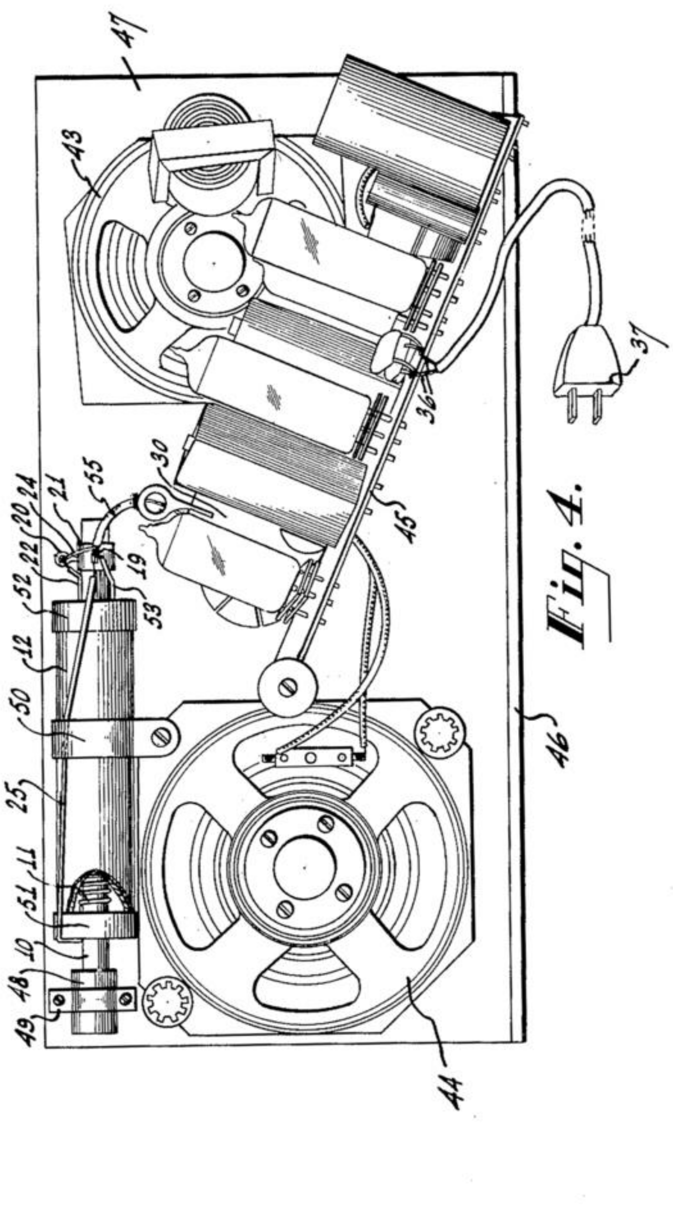

Fig. 4.

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ELECTROSTATICALLY-SHIELDED LOOP ANTENNA

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17 Claims. (Cl. 343—788)

The present invention relates to loop antennas for radio signal reception, and more particularly to electrostatic shielding means therefor capable of discriminating against electrostatic disturbances generated by nearby electrical apparatus in operation.

Many broadcast radio receivers in widespread use are, for example, energized through plug-in power cord connections with house-current power supply lines or outlets. Such supply lines are often connected with sources of electrical noise such as fluorescent or neon lamps, motors and like electrical equipment. A receiver thus connected is, therefore, subject to electrical noise pickup resulting from the flow of noise currents from the power supply line or outlet into the receiver and through the electrostatic or distributed capacity coupling of the tuned antenna circuit to earth ground which provides the return path for the noise currents to the source. Since the noise currents flow through the antenna circuit impedance, a noise voltage is developed across the antenna circuit which becomes translated to appear in the receiver sound output. This often makes such receivers practically unusable in noisy areas, such as urban downtown areas for example.

Any reduction of the electrostatic or distributed capacitive coupling of a tuned antenna circuit to earth ground produces a corresponding decrease in noise currents flowing through the antenna circuit impedance and therefore less noise in the receiver sound output. In general, a large portion of this coupling is due to capacitive impedance from the winding turns of the loop antenna to earth ground, and various and somewhat costly expedients have been proposed for eliminating this coupling.

Generally, electrostatic shielding of the loop antenna has been proposed, involving the use of copper or aluminum in a Faraday shield, or other similar discontinuous conductive metallic shield construction, to reduce "shorted-turn" or eddy current loss effects on the antenna. For a practical shield size, however, residual shorted-turn effects appreciably reduce the "Q" and inductance of the antenna. Therefore, initially, the antenna must be designed with a higher "Q" and more inductance than one without an electrostatic shield, thereby requiring more ferrite material, in the case of the ferrite-cored antenna, and special type windings. For this reason, cost reduction considerations in practical commercial receiver construction have militated against the adoption of loop antenna shielding. As a result, the performance of loop antenna receivers has been poor in areas where there are fluorescent lamps and other electrical noise generating equipment in operation.

It is, therefore, an object of the present invention to provide an improved and low cost electrostatically shielded loop antenna for radio signal receivers, and the like, which provides effective shielding against electrostatic disturbances without changing the inductance or appreciably changing the "Q" of the antenna winding.

It is a further object of this invention to provide an improved electrostatically shielded ferrite-rod type loop antenna for radio signal receivers, and the like, which is of simplified and low cost construction and which is adapted to be mounted as a unit and connected in a receiver to prevent the undesirable effects therein of RF noise currents conveyed by electrostatic coupling from external sources.

It is also an object of this invention to provide an improved electrostatically-shielded ferrite-rod type loop antenna for power-line-operated radio receivers, which effectively eliminates power-line electrical noise pickup through antenna capacitive or electrostatic coupling to earth without affecting the antenna inductance or appreciably affecting the signal pickup qualities.

It is still another object of this invention to provide an improved, resistive, electrostatic shield structure for a loop antenna of the ferrite-rod type that is low in cost, light in weight, and does not adversely affect the signal pickup characteristics of the loop winding, yet is effective to reduce or prevent electrostatic coupling with said winding.

In accordance with the invention, the loop antenna winding or coil for a radio signal receiver is provided with a surrounding shield which is highly resistive to the flow of induced electrical currents, yet is uniformly conductive as an equi-potential termination means for external electrostatic noise fields tending to couple capacitively with the antenna winding. In a practical form, this may be provided by an enclosure of insulating material surrounding the antenna winding in spaced relation thereto and coated on at least one of its inner or outer surfaces with a film or layer of resistance material, such as low cost, non-metallic, finely divided carbon, graphite, aquadag, or the like. A carbonized paper form or one of resistive-coated cloth, or an aquadag-painted paper tube, or a paper form impregnated with a non-metal, like graphite, may be used as a highly effective and low-cost electrostatic shield for the antenna winding, in accordance with the invention. A carbon film or layer on a nonconductive paper, Bakelite, or polystyrene tube or form, with end caps, also coated, has been used effectively.

As applied to a practical ferrite-rod type loop antenna, the use of such low-cost non-metallic resistance material to shield the antenna has been found to practically eliminate electrostatic noise pickup of the type referred to, without affecting the inductance, or without appreciably affecting the quality or "Q," and signal interception ability of the antenna winding. For loop antennas of equivalent performance, this shielding is substantially as effective as a Faraday shield of copper or aluminum, but is less expensive, making it practical for use in all low-cost table models as well as other receivers.

This improved electrostatically shielded loop antenna operates in accordance with the principle that the antenna capacitive impedance to earth is relatively large, so that the electrostatic shield may be made to have a resistivity which is high to signal eddy currents but which is still relatively low in comparison to the aforesaid antenna capacitive impedance to earth. Therefore, the resistive shield may serve as an effective low-impedance termination for noise electrostatic lines of force and as a conductor of power-line noise currents around the loop antenna winding. Furthermore, the use of a resistive shield does not introduce any appreciable eddy current flow so that there is no "shorted turn" effect, and the relatively costly Faraday-type shield construction is entirely eliminated without losing any of its benefits. Effectively, the electrostatic lines of force tending to couple to the loop antenna winding are confined to the boundary of the shield which provides a substantially equi-potential conductor surrounding the winding without substantially impeding the flow of electromagnetic lines of force from a signal source thereto.

The antenna thus can be completely enclosed by the shielding material within a range of resistivities, with no appreciable reduction in antenna "Q" due to dielectric loss effects, with a reasonable winding-to-shield spacing, so that the performance for signal reception is not appreciably affected. Carbonized papers, resistive-coated cloth, and aquadag coatings on nonconducting forms with resistivities of 100 to 2,000 ohms per unit square have given satisfactory results.

The invention will, however, be further understood from the following description, when considered in connection with the accompanying drawings, and its scope is pointed out in the appended claims.

In the drawings:

Figure 1 is a view in elevation, and partly in cross-section, of an electrostatically-shielded ferrite rod or core-type loop antenna for power operated radio receivers, and the like, embodying the invention;

Figure 2 is an end view of the loop antenna of Figure 1 showing further details of construction;

Figure 3 is a schematic circuit diagram of a radio receiver of the line-power-operated type provided with an electrostatically shielded antenna embodying the invention and showing its mode of operation; and

Figure 4 is a rear view in elevation, of a line-power-operated radio receiver provided with an electrostatically-shielded ferrite-rod antenna, representing an embodiment of the invention in commercial form.

Referring to the drawings, in which like reference characters refer to like parts throughout the various figures, and referring particularly to Figures 1 and 2, **10** is an elongated core or rod, of ferrite or other suitable magnetically conductive material, for a radio receiver loop antenna, on which is located a single-layer loop winding or pickup coil **11**. The winding may occupy any length of the core, but in the present example it occupies substantially less than the full length of the core, as shown, with spacing at each end. Surrounding the winding in substantially concentric, spaced relation thereto, and terminating short of the ends of the ferrite core, is a resistive shield **12** which may be in any suitable form to enclose the winding. In some cases it may fully enclose the winding and the core. In the present example the shield is an elongated, tubular, thin-walled structure having closed ends and a hollow interior provided by a relatively thin resistive surface layer or coating of graphite, aquadag, or like electrically resistive material, applied over the entire surface and ends of an elongated tubular supporting form or casing **14** of relatively stiff insulating material, such as paper, Bakelite, polystyrene, or the like.

The resistive shield **12** is provided with a terminal **15** of conducting material electrically connected therewith, as shown, near the high signal potential end of the loop winding. In the present example, the terminal is a metallic eyelet having a base which is secured to the resistive shield surface at a suitable point, as above noted, by fastening means, such as a screw **16** tapped into the shield form **14**. The terminal may then be used to ground the sheld or provide other circuit connections with it. Placing the terminal near the high signal potential end of the loop winding keeps at a minimum the amount of shield resistance in series with any loop stray capacity to the shield and thereby minimizes the dielectric losses at the high frequency end of the loop tuning range.

Electrical connections with the loop winding may be provided in any suitable manner, and preferably by a pair of conductive terminals or eyelets **19** and **20** mounted in spaced relation to each other, as shown, on an insulating ring **21** which is fitted tightly to and surrounds the core **10** at one end, outside the shield. The high signal potential end of the loop winding, represented by the lead **22**, extends through the central core opening **23** in the shield **12** to connect with the external terminal **20**. A conductor **24** connected with the terminal **20** represents the circuit connection with the tuning capacitor and signal input circuit at the high potential side thereof in a receiver, as will hereinafter be shown and described.

The low signal potential end of the loop winding **11** is provided with an end lead **25** which extends along the core through the central core opening **28** in the shield, and thence is wrapped around the shield form and along the outside thereof to connect with the shield terminal **15**, as shown. Figure 2 shows the low potential lead **25** of the loop winding and its position at the end of the antenna. The end lead could be located inside the shield. However this arrangement facilitates its connection with the shield terminal **15**.

From the terminal **15**, a conductor **26** is connected with the terminal **19** and thence through a conductor **27** to the chassis or common wiring ground for the receiver with which the antenna is used. In this circuit arrangement, the shield **12** and the low potential lead **25** of the antenna winding **11** are both connected to the same point on the chassis or common wiring ground for the receiver. This connection for the winding may be a D.-C. connection as shown, or when employed in the input grid circuit of a tube, it may be a capacitive connection to permit the application of conventional AGC voltage to the tube through the winding.

Referring now to the circuit diagram of Figure 3, the loop antenna of Figures 1 and 2 is shown schematically in connection with a variable tuning capacitor **30** of a radio receiver **31** for tuning the receiver circuits **32** to incoming signals in a predetermined frequency band such as the broadcast band. The low potential terminal **19** of the loop winding **11** and the ground terminal **15** of the resistive shield **12** surrounding the loop winding, is connected as shown, to the receiver common circuit ground means **34**. This may be a conductive chassis or a common wiring ground conductor capacitively coupled to the chassis. The high potential terminal **20** is connected to the tuning capacitor **30** and the signal input circuit **35** of the receiver.

The power line supply leads **36** for the receiver, provided with the usual outlet plug **37**, are connected with the receiver circuits as shown, one supply lead being connected or coupled to the receiver common ground means **34**. Noise currents introduced into the power supply leads from a power line source of noise voltage represented by the generator **40**, flow, as indicated by the arrowed lines, from the power cord or leads through the chassis or common wiring ground **34** and thence to the terminals **19** and **15**, and through the relatively low-impedance conductive path around the loop winding as provided by the resistive shield **12**, and thence through the earth capacitive impedance **41** to earth ground and back to the noise source **40**. The tendency for any noise currents to flow from the terminal **15** into the loop winding **11**, and thence to the shield **12** through stray capacitive coupling paths, is substantially prevented by the relatively high capacitive impedance of such stray coupling paths as compared with the direct conductive connection of the terminal **15** with the shield and the relatively low resistive impedance paths between the terminal and all parts of the shield.

Because of the relatively high earth capacitive impedance **41**, the resistive impedance of the shield **12** offers relatively little attenuation to the flow of noise currents along the protective shield path thus provided around the loop winding. The resistive shield, therefore, provides an effective termination conductor for the electrostatic lines of force which couple between the shield and the earth ground as shown. At the same time, the resistance of the shield serves to eliminate any "shorted-turn" effects and thus the shield does not change the inductance of the loop winding **11** or the tuning of the input circuit of the receiver, as would an ordinary metallic Faraday shield. The antenna is thus effectively shielded to practically eliminate electrostatic noise pickup, particularly that resulting from noise currents flowing in through the power supply circuits of the receiver as described. It does this without affecting the inductance, or appreciably affecting the "Q," or the signal interception ability of the loop antenna.

It has been found that the resistive impedance of the shield may be of the order of 500 ohms per unit square, that is, between 50 and 5000 ohms per unit square, depending upon the shape and size of the antenna winding to be protected. Generally speaking, higher values of resistivity are desirable when the shape of the winding and spacing of the shield and winding provide any relatively high value of mutual inductive coupling, and lower values of resistivity are advantageous when the mutual inductive coupling is relatively low and the dimensions of the shield surface are relatively large.

It has further been determined, in connection with one commercial AM radio receiver design, employing a ferrite-rod loop antenna such as is illustrated in Figures 1, 2 and 4, that a range of resistive impedance in the electrostatic shield from approximately 200 to 1000 ohms per unit square afforded the advantages set forth hereinabove. In any case, however, since the antenna capacitive impedance to earth is relatively high, the resistance in the resistive conducting shield 12 is small in comparison, even at resistance values of over 2,000 ohms per unit square. Therefore, it has been found that such a shield serves effectively as a termination for noise electrostatic lines of force that otherwise would couple with the antenna winding turns.

The resistive conducting shield 12 is effectively connected serially into a noise-current circuit between the external power-supply conductors of the receiver and the earth ground. This circuit includes the normal earth capacitive coupling to the loop antenna winding which is, by the present means, shunted to the non-metallic resistive shield around the antenna winding.

Referring now to Figure 4, showing a rear view of a radio receiver of the type shown in Figure 3 provided with an antenna in accordance with the invention, the receiver chassis is a printed circuit board 45 mounted at an angle to a base board 46 on the rear of a front panel 47. The front panel carries two loudspeakers, 48 and 49, and above the chassis 45 and near the top edge, it carries a shielded antenna similar to that shown in Figures 1 and 2.

In the present example, the core 10 of the antenna is mounted at one end in a resilient grommet or sleeve 48 which is secured to the front panel 47 by a strap bracket 49. A second strap bracket 50, also secured to the panel 47, is arranged to grip and further hold the antenna assembly as shown. The tubular shield 12 is provided with end caps 51 and 52 which are likewise coated with resistive material and conductively connected by contact with the shield to complete the shield enclosure for the loop winding 11. The end conductors 22 and 25 are connected respectively with the high and low signal potential terminals 20 and 19 on the insulating sleeve 21 at the opposite end of the core from the bracket 49. A ground conductor 53 connects the terminal 19 with the end cap 52 thereby connecting the entire body of the resistive shield to the terminal 19. The connection between the tuning capacitor 30 on the chassis 45 is provided by a shielded lead 55, the outer conductor of which is connected from chassis ground to the terminal 19, and the inner conductor 24 of which is connected with the high signal potential terminal 20 as shown.

In a practical form of the shielded antenna as shown in Figures 1 and 4 for example, the core 10, of General Ceramic Ferramic Q material, may have a diameter of .330 inch with a single layer winding of #28 double celanese insulated wire, extending over 3½ inches of its total length of 6¼ inches. The shield of non-metallic paint on a thin walled form may have a length of 4½ inches, a diameter of one inch and a resistive impedance of 200 to 1000 ohms per unit square.

The antenna circuit arrangement of the receiver is as shown in Figure 3. The antenna winding 11 on the core 10 is protected within the shield 12 which serves as an equipotential termination means for external electrostatic noise fields, and in the present case to conduct noise currents introduced through the power-cord leads 36 around the winding 11 and to earth ground through the earth capacitive impedance in the manner shown schematically in Figure 3. It will be noted that the tuning capacitor 30 and the terminal end of the loop antenna are arranged to be relatively closely spaced so that the connection leads between the antenna and the tuning capacitor may be made relatively short, thereby to reduce electrostatic coupling between the loop input circuit connections and earth ground.

Radio receiver antennas constructed and mounted as shown in Figure 4 have been found to provide effective noise reduction in areas where fluorescent lamps and other electrical RF noise-generating equipments are in constant operation. Furthermore, these antennas may be provided at such low cost that they are commercially practical and may thus serve to extend the usefulness of table model and other low-cost line-power-operated radio receivers in noise areas where their operation otherwise would be considered as impossible.

What is claimed is:

1. An electrostatically-shielded loop antenna for a radio signal receiver, comprising an inductive loop winding, a resistive electrostatic shield surrounding the loop winding in spaced relation thereto, and terminal means for connecting the shield and the winding with said receiver, the resistance of said shield being relatively low with respect to the impedance of the electrostatic coupling therefrom to earth ground for the flow of noise currents therethrough and being relatively high with respect to the resistance of a conductive shield for the flow of signal eddy currents induced therein from said winding.

2. An electrostatically-shielded loop antenna for a radio signal receiver of the type having a common circuit ground means, comprising an elongated rod-like core of high frequency magnetic material, an inductive loop winding extending along and surrounding said core, a resistive electrostatic shield extending along and surrounding the loop winding in spaced relation thereto, and terminal means for connecting the shield near one end of the winding and the winding at the opposite end with the common circuit ground means of said receiver, the resistance of said shield being relatively low with respect to the impedance of the electrostatic coupling therefrom to earth ground for the flow of noise currents therethrough and being relatively high with respect to the resistance of a conductive shield for the flow of signal currents induced therein.

3. An electrostatically-shielded loop antenna for a radio signal receiver, comprising an inductive loop winding, a resistive electrostatic shield having a resistivity of the order of 500 ohms per unit square surrounding the loop winding in spaced relation thereto, and terminal means for connecting the shield and the winding with said receiver, the resistance of said shield being thereby relatively low with respect to the impedance of the electrostatic coupling therefrom to earth ground for the flow of noise currents therethrough and being relatively high with respect to the resistance of a conductive shield for the flow of induced signal eddy currents, thereby to reduce noise pickup and shorted-turn effects on said loop winding.

4. In a radio receiver having common circuit ground means, an electrostatically-shielded loop antenna comprising an inductive loop winding of the elongated helical type having spaced high and low potential ends, resistive shield surrounding and extending along the loop wind-

ing in spaced relation thereto, and means connecting the shield near the high signal potential end of the winding with said common ground means, the resistive impedance of said shield being of a value whereby it is effective to prevent appreciable change in the "Q" of said winding and being relatively low with respect to the capacitive impedance of noise-current electrostatic coupling from said shield to earth ground.

5. In a radio receiver having common circuit ground means and a power supply lead connected therewith, an electrostatically shielded loop antenna comprising an inductive loop winding, a resistive shield surrounding the loop winding in spaced relation thereto, and terminal means connecting the shield with said common ground means to provide an effective current path for the flow of power-line noise currents from said ground means through the electrostatic coupling between said shield and said earth ground and exclusive of the loop winding, the resistive impedance of said shield being of a value whereby it is effective to prevent appreciable change in the "Q" of said winding and being relatively low with respect to the capacitive impedance of said electrostatic coupling, and the resistive impedance of said shield further being of a value whereby relatively low resistance paths are provided between said terminal means and all parts of the shield as compared to the impedance of stray capacity coupling paths between the loop winding and the shield.

6. In a radio receiver adapted for plug-in connection with a power supply line, means providing a ground point therein, a tunable signal input circuit including a loop antenna winding having electrostatic coupling to earth ground for noise currents derived from said power line and tending to flow through the input circuit impedance, and means providing a resistive shield about said winding to divert said currents therefrom and reduce electrical noise pickup through said winding without affecting the inductance or appreciably affecting the signal interception ability thereof, said shield means comprising a relatively thin layer of non-metallic resistive material having a uniform resistance per unit square of the order of 500 ohms affixed to a surface of a thin-walled casing of insulating material surrounding said winding in spaced relation thereto and connected with said ground point in said receiver.

7. An electrostatically shielded loop antenna for a power-line-operated radio receiver of the type having a common circuit ground means, comprising an inductive loop winding having high and low signal potential ends, a shield of resistive material surrounding the loop winding in fixed spaced relation thereto, and terminal means for connecting the shield with the common circuit ground means of said receiver, whereby said shield provides means for electrostatically coupling with earth ground for power-line noise currents flowing in said common ground means and for excluding such currents from said loop winding, the resistive impedance of said shield being relatively low with respect to the capacitive impedance of the earth-to-shield electrostatic coupling and of a value to provide no appreciable change in the tuning or the signal interception ability of the loop winding.

8. An electrostatically shielded loop antenna for power-line-operated radio-receivers and the like having externally connectable power supply circuits, comprising in combination, an inductive loop winding having terminals for connection with a receiver signal input circuit, means providing a thin-walled insulating casing surrounding said winding in spaced relation thereto and having inner and outer wall surfaces, an electrostatic shield for said winding comprising a realtively thin layer of non-metallic resistive material affixed to substantially the entire area of at least one of said wall surfaces, terminal means for said shield providing a connection for applying thereto electrical noise currents from the receiver power supply circuits, to the exclusion of the loop winding, in a noise-current path which includes the resistive shield as equipotential termination to earth ground for said currents, the resistive impedance of said shield being relatively high with respect to the resistance of a conductive shield for signal eddy currents induced therein from said winding and the impedance to the flow of noise currents by way of said shield to earth ground being relatively low with respect to the impedance to the flow of noise currents by way of said loop winding to earth ground.

9. The combination with a radio receiver having signal translating circuits provided with common wiring ground means and a power supply lead connected therewith, of an electrostatically-shielded loop antenna comprising an elongated cylindrical core of high frequency magnetic material, a conductive loop winding on said core intermediate between the ends thereof and having spaced high and low signal potential ends, an insulating casing mounted on the core and surrounding the loop winding, an electrostatic shield carried by said casing and comprising a relatively thin layer of resistive material affixed to the entire area of one surface of said casing, and means providing a conductive circuit connection between said shield near the high signal potential end of the loop winding and the common wiring ground means of the receiver, the resistivity of said shield being of a value such that electrical noise currents from said power supply lead flowing in said common ground means are conveyed through the shield substantially unattenuated for electrostatic coupling therefrom to earth ground exclusive of the loop winding, and without introducing shorted-turn effects on the loop winding by the shield.

10. An electrostatically-shielded ferrite-loop antenna for a power-line-operated radio receiver, comprising an elongated ferrite core element, an inductive loop winding on said core element, a resistive electrostatic shield mounted on said core and surrounding the loop winding in spaced relation thereto, and terminal means mounted on one end of said core element outside said shield for electrically connecting the shield and the winding with said receiver, the resistance of said shield being relatively low with respect to the impedance of the electrostatic coupling therefrom to earth ground for the flow of noise currents therethrough and being relatively high with respect to the resistance of a conductive shield for the flow of signal eddy currents induced therein from said winding, thereby to reduce power-line noise pickup and shorted-turn effects on said loop winding.

11. An electrostatically-shielded ferrite-loop antenna as defined in claim 10, wherein the electrostatic shield is provided by a relatively thin surface coating of non-metallic resistive material affixed to the entire surface and ends of an elongated tubular closed casing of relatively stiff insulating material.

12. An electrostatically-shielded ferrite-loop antenna for a power-line-operated radio receiver of the type having a common circuit ground means, comprising an elongated ferrite rod-like core element, an inductive loop winding on said core element, said winding having high and low signal potential terminals mounted on one end of core element, a shield of non-metallic resistive material surrounding a portion of the core element and the entire loop winding in fixed spaced relation thereto, and terminal means for connecting the shield with the common circuit ground means of said receiver, whereby said shield provides means for electrostatically coupling with earth ground for power-line noise currents flowing in said common ground means and for excluding such currents from said loop winding, the resistive impedance of said shield to the flow of noise currents therethrough being of the order of from 100 to 2000 ohms per unit square and thereby being relatively low with respect to the capacitive impedance of the earth-to-shield electrostatic coupling but relatively high to signal eddy current flow therein, whereby said shield provides no appreciable change in the tuning or the signal interception ability of the loop winding.

13. An antenna unit of a type adapted to be used as a

signal pick-up device in a receiver of radiated electromagnetic waves, said unit comprising a loop antenna winding, means providing an electrostatic shield substantially enclosing said winding and spaced therefrom, said shield means having a resistivity of the order of 500 ohms per unit square, and means for making an electrical ground connection to said shield means.

14. In combination, a radio receiver comprising signal translating circuits provided with common wiring ground means, a loop antenna, a thin electrostatic shield substantially enclosing said antenna and spaced therefrom, said shield having a resistivity of the order of 500 ohms per unit square, and means for connecting said shield and said antenna to the common wiring ground means.

15. In a radio receiver adapted for plug-in connection with a power supply line, means providing a common circuit ground point therein, a tunable signal input circuit including a loop antenna winding having electrostatic coupling to earth ground for noise currents derived from said power line and tending to flow through the input circuit impedance, means providing a resistive shield about said winding to divert said currents therefrom and reduce electrical noise pickup through said winding without affecting the inductance or appreciably affecting the signal interception ability thereof, the resistive impedance of said shield means being relatively low with respect to the impedance of the electrostatic coupling therefrom to earth ground for the flow of noise currents therethrough and being relatively high with respect to the resistance of a conductive shield for the flow of signal eddy currents induced therein from said winding, and means providing an electrical connection between said shield means and said ground point in said receiver.

16. In a radio receiver adapted for plug-in connection with a power supply line, a tunable signal input circuit including a loop antenna having an elongated ferromagnetic core and a loop winding thereon having electrostatic coupling to earth ground for noise currents derived from said power line and tending to flow through the input circuit impedance, means providing a common circuit ground point in said receiver, and means providing a grounded electrostatic shield about said winding to divert said currents therefrom and reduce electrical noise pickup through said winding, said shield means comprising a coating of non-metallic resistive material affixed to the entire outer surface of an elongated cylindrical casing of insulating material surrounding said winding in spaced relation thereto and connected with said ground point in said receiver, and the resistive impedance of said shield means to the flow of noise currents being relatively low with respect to the capacitive impedance of said electrostatic coupling and relatively high with respect to the resistance of a conductive shield for the flow of induced signal eddy currents from said winding, thereby to provide no appreciable change in the tuning or the signal interception ability of the loop winding.

17. A loop antenna for radio signal reception including an enclosure for permitting the unimpeded flow of electromagnetic variations while providing electrostatic shielding between the space outside said enclosure and the space inside the enclosure, said enclosure comprising a casing of insulating material, a substantially continuous coating of resistive material having a resistivity within an order of magnitude of 500 ohms per unit square disposed on at least a major surface of said casing, and terminal means for effecting electrical contact to said coating.

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Ferrite Loop Antenna inside of a Tube Radio BAMBY from middle 1950'

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