Feb. 24, 1942. W. H. GRIMDITCH 2,273,955

LOOP ANTENNA

Filed June 5, 1939

Fig. 1

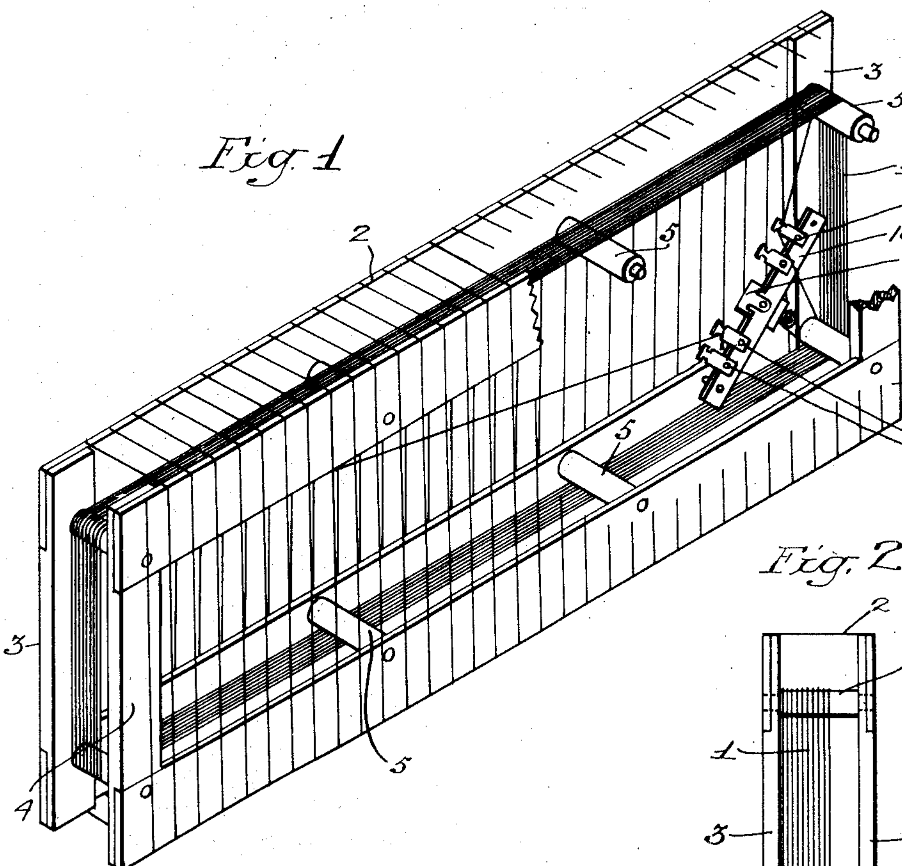


Fig. 2.

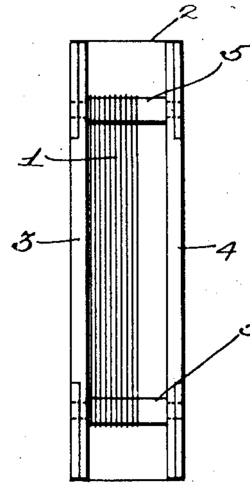
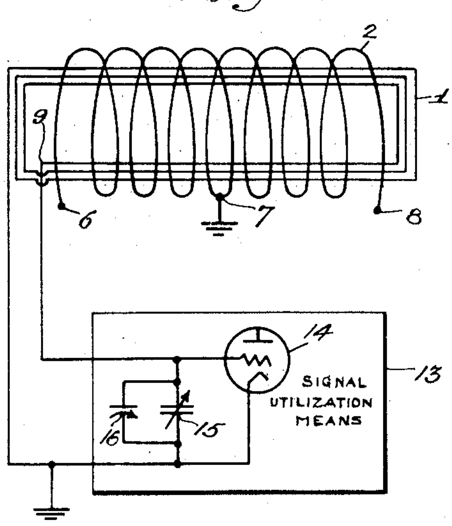


Fig. 3.



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UNITED STATES PATENT OFFICE

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LOOP ANTENNA

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Application June 5, 1939, Serial No. 277,550

8 Claims. (Cl. 250—33)

This invention relates to loop antennas or aerials, and more particularly to a novel construction for shielded loop antennas which are capable of being conveniently disposed in the cabinet of a radio receiver.

In order to improve the portability of radio receivers and to simplify their installation it has been found desirable to employ compact loop antennas in place of the more usual and cumbersome outdoor antenna structures. Further, in order to improve the signal-to-noise ratio of such loop antennas it has been found desirable to surround them with an electrostatic shield to discriminate against a large variety of electrostatic disturbances generated by nearby electrical apparatus such as commutator equipped devices, electrical ignition systems, switches, and the like. Where such a loop antenna is to be employed in radio receivers designed for mass production, it is obvious that the loop antenna and shield structure must not only be relatively inexpensive but must be simple in its construction and must present no unusual problem of assembly.

One of the objects of this invention, therefore, is to provide a simple but highly efficient shielded loop antenna for use in radio receiving equipment.

Another object of the invention is to provide a shielded loop antenna structure whose size and shape is such as to permit ready mounting in the cabinets of console or table model radio receivers.

Still another object of the invention is to provide in such a loop structure a simple and efficient shielding means capable of discriminating very substantially against locally generated electrostatic interference signals.

A further object of the invention is to provide a simple and efficient electrostatic shield which is electrostatically balanced to ground.

The invention may best be understood by reference to the accompanying drawing in which—

Fig. 1 is a perspective view of the shielded loop antenna structure provided by the invention, a portion of the frame being broken away for the sake of illustration;

Fig. 2 is an end view of the same; and

Fig. 3 is a schematic diagram of the loop and its electrostatic shield illustrating one mode of connection to the input circuits of a suitable signal utilization means.

The construction of the loop antenna and its electrostatic shield may best be understood by reference to the perspective and end views of Figs. 1 and 2, in which like reference numerals refer to corresponding parts. It will be observed that a common supporting structure is provided for both a loop winding 1, and a shield winding 2. This supporting structure may comprise a pair of spaced frames 3 and 4 which are preferably of elongated form such as oval or rectangular, the latter form being illustrated. The frames 3 and 4 may be suitably and fixedly spaced relative to each other by means of a plurality of spacers or dowels 5 or the like. The frames and the spacers may be formed of any suitable insulating material such as wood, hard rubber, Bakelite, or the like. The loop antenna coil 1 may be wound upon the spacers 5, as illustrated, and may comprise either a single turn or a plurality of turns or layers of any suitable wire. Enameled copper wire has been found to be satisfactory for this coil and may be employed. The number of turns, and their spacing, will depend upon the frequency range which it is desired to cover, and upon the maximum and minimum capacities of the tuning condenser to be employed.

The shield winding 2 may be wound upon the spaced frames 3 and 4 substantially as illustrated, the winding preferably extending from one end of the framework to the other. Thus, the spaced turns of the shield winding are disposed in transverse relation to the longitudinal axis of the loop antenna, and are disposed in planes substantially perpendicular to the general plane of the loop. This winding may be grounded at any suitable point such, as 6, 7 or 8 (see Fig. 3), but is preferably grounded at the midpoint 7 for a reason hereinafter explained. The shield winding may consist of cotton covered copper wire.

Both the loop antenna coil 1 and the shield coil 2 may be permanently affixed to the spacers and frames, respectively, by dipping the structure and its windings into melted wax or by applying a suitable coil dope. It is particularly important that the position and spacing of the turns in the loop 1 be securely anchored against possible movement, since only thus can the inductance and distributed capacity of the loop be maintained substantially constant.

It will be observed that the spacers 5 are disposed near the inner edges of the members forming the frames 3 and 4. This is the preferred construction, for it increases the separation between the loop 1 and the shield coil 2, thereby reducing the distributed capacity therebetween.

Where one end of the loop is connected to the control grid of a vacuum tube and the other is connected to ground, substantially as shown in Fig. 3, it is especially desirable that the distributed capacity between the shield and the grid end of the loop be as small as possible. In the particular embodiment illustrated, this capacity has been reduced by locating the grid end 9 of the loop substantially midway between the two frames 3 and 4 and by winding the loop toward one of the frames. This may be seen clearly in Fig. 2, from which it will be seen that the end turn of the loop at the grid end thereof is substantially midway between frames 3 and 4, while the end turn at the grounded end of the loop is adjacent to frame 3. In Fig. 3 the innermost turn of loop 1 corresponds to the end turn in Figs. 1 and 2 which is substantially midway between frames 3 and 4. The increased distributed capacity between the shield 2 and the grounded end of the loop, which results from this construction, is of minor importance.

If desired, an insulating terminal strip 10 may be affixed to one of the frames, as illustrated in Fig. 1. The shield winding and the ends of the loop, or any intermediate taps thereon, may be terminated at the lugs 11 on said strip for convenient connection to ground and to the input circuits of a radio receiver or the like. If the loop is to be padded with a small padding condenser, such a condenser 12 may conveniently be mounted on this same terminal strip, as illustrated.

Although the loop antenna structure may be mounted at any convenient point, it is desirable, particularly for table model radio receivers, to mount the structure in a vertical plane at the rear of the receiver's chassis. If the cabinet containing the receiver is of the type having a removable back panel, the loop structure may conveniently be mounted on the inner surface of said panel. The size and shape of the framework to be employed will, of course, depend upon the cabinet in which it is to be used.

Reference is now made to Fig. 3 in which the loop antenna coil 1 and the shielding coil 2 are represented schematically as connected to the input circuit of a suitable signal utilization means 13 which may be a superheterodyne radio receiver. The inner turn of the loop antenna, which is furthest removed from the shield coil 2, may be connected directly to the grid of the vacuum tube 14, while the outer turn of the loop may be connected to ground and to the cathode of the tube 14. In the interests of simplicity no biasing means have been shown. A section 15 of the main tuning condenser gang may be connected across the loop, as illustrated. The usual trimmer condenser 16 may be located either at the loop terminals or at the tuning condenser 15. Other means for coupling loops and vacuum tubes are of course well known.

The shield coil 2 may be grounded at either end 6 or 8, but is preferably grounded at its electrical midpoint 7. Grounding the midpoint of the shield coil has been found to improve the efficiency of shielding. This is probably due chiefly to two factors: firstly, the average impedance to ground of the several turns of the shield coil is reduced, and secondly, the shield coil is thereby electrically balanced to ground. Preferably the number of turns comprising the shield coil should not be too high in order that the impedance between the grounded point of the shield and the turns remote from this grounded point may be kept within reasonable limits.

In one physical embodiment of the shielded loop of this invention, which gave very satisfactory results in the broadcast band, the overall dimensions of the framework illustrated in Figs. 1 and 2 were 17'' x 6¾'' x 1¾'', and the spacers 5 were located 1¼'' from the outer edges of the frame. The loop 1 comprised sixteen closely wound turns of No. 20 enameled copper wire, while the shield coil 2 consisted of thirty turns of No. 26 double cotton covered wire, spaced about two turns per inch. The size and kind of wire employed in the shield is determined largely by mechanical considerations, while the type of wire employed in the loop is determined largely by the Q which is desired. The loop referred to gave a Q of about 100. It is of course understood that the voltage built up across the resonant loop circuit comprising the loop 1 and the tuning condenser 15 is directly proportional to the Q of that circuit.

Although the invention has been described with particular reference to the embodiment of the drawing, it will be understood that the invention is capable of various forms of physical expression, and is therefore not to be limited to the specific disclosure, but only by the scope of the appended claims. The term "central axis" employed in certain of the claims with reference to the loop and shield windings designates the axis about which either winding is wound, i. e. the axis of the helix.

I claim:

1. A shielded loop antenna structure, comprising a supporting framework formed of insulating material and having inner support portions and outer support portions constructed entirely of insulating material, a loop antenna mounted on said inner support portions and having one end connected to a ground, and a shield winding comprising spaced and mutually insulated turns of wire wound on said outer support portions about said loop antenna in spaced relation thereto and having the mid-point of said winding connected to ground.

2. A shielded loop antenna structure, comprising a supporting framework having inner support portions and outer support portions, a loop antenna mounted on said inner support portion, said loop antenna having high and low potential ends, and a shield winding comprising spaced turns of wire wound on said outer support portions about said loop antenna in spaced relation thereto, said loop antenna being disposed asymmetrically with respect to said shield winding with the high potential end of said loop spaced substantially from said winding.

3. A shielded loop antenna structure, comprising a pair of spaced frame members, a plurality of spacer members interconnecting said frame members and disposed in spaced relation to each other and to the outer edges of said frame members, a loop antenna comprising spaced turns of wire wound about said spacer members asymmetrically with respect to said frame members, with the end turn at one end of the loop spaced substantially from both said frame members, a helical shield winding comprising spaced insulated turns of wire wound about said frame members in planes substantially perpendicular to the principal axis of said loop antenna, and a connection between the other end of said loop and a point on said shield winding.

4. A shielded loop antenna for a radio receiver or the like comprising a frame having inner support elements and outer support elements, a loop antenna mounted on said inner support elements, a helical shield winding wound on said outer support elements, the turns of said helical winding being insulated one from the other, and means for connecting a point on said loop antenna to a center-tap on said helical shield winding, and for connecting said center-tap to a point having substantially no radio frequency voltage to ground.

5. A shielded loop antenna structure, comprising an insulating support, a loop antenna winding mounted on said support, a helical shield winding mounted on said support and comprising spaced mutually insulated turns of wire surrounding said loop antenna in spaced relation thereto and disposed in planes substantially perpendicular to the general plane of said loop antenna winding, one point of said shield winding being maintained at a substantially fixed potential, the turns of said shield winding being more widely spaced than the turns of said antenna winding, thereby to reduce the number of turns in said shield and to reduce the maximum impedance between any part of said shield and said point of substantially fixed potential.

6. A shielded loop antenna structure, comprising an insulating support, a loop antenna winding mounted on said support, and a shield mounted on said support comprising a helical winding of spaced mutually insulated turns of wire surrounding said loop antenna in spaced relation thereto and disposed in planes substantially perpendicular to the general plane of said loop antenna, said helical shield winding being of substantially greater length in the direction of its central axis than the loop winding is in the direction of its central axis.

7. A shielded loop antenna structure, comprising a loop antenna winding, a shield surrounding said loop antenna comprising a helical winding of mutually insulated turns of wire, and means connecting said shield winding to ground at a point located substantially at the electrical midpoint of the shield winding, said shield winding being entirely free of any other electrical connection.

8. A shielded loop antenna structure, comprising an insulating support, a helical loop antenna winding mounted on said support, said winding being of very small axial dimension compared to its dimension at right angles to its axis, and a shield mounted on said support comprising a helical winding of spaced mutually insulated turns of wire wound transversely of said loop antenna, said shield winding having its axis in the direction of the last-mentioned dimension of said loop antenna, the axial dimension of said shield winding being very large compared to the axial dimension of the loop antenna, and the turns of said shield winding being substantially greater in number and more widely spaced than the turns of said loop winding.

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