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Sauer et al.

[11] **3,766,563**

[45] **Oct. 16, 1973**

[54] **METHOD AND MEANS OF IMPROVING RECEPTION OF VEHICULAR WINDOW-MOUNTED ANTENNA**

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[22] Filed: **Dec. 6, 1971**

[21] Appl. No.: **205,147**

[30] **Foreign Application Priority Data**

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Nov. 19, 1971 France 7141442

[52] **U.S. Cl.** **343/713**, 343/841
[51] **Int. Cl.** **H01q 1/32**
[58] **Field of Search** 343/711, 712, 713, 343/841, 842, 705, 708

[56] **References Cited**

FOREIGN PATENTS OR APPLICATIONS

2,060,418 6/1971 Germany 343/713

Primary Examiner—Eli Lieberman
Attorney—Dale A. Bauer et al.

[57] **ABSTRACT**

Method of and means for improving the receptive qualities of a window- or windshield-mounted antenna of an automotive vehicle, by providing a closed annular conductive screen extending about, exteriorly of, adjacent, and in fixed relation with the antenna secured to the surface of a window or windshield, and in grounding such screen from a point thereof to a selected point of the vehicle or the coaxial cable lead-in from antenna to receiver.

17 Claims, 9 Drawing Figures

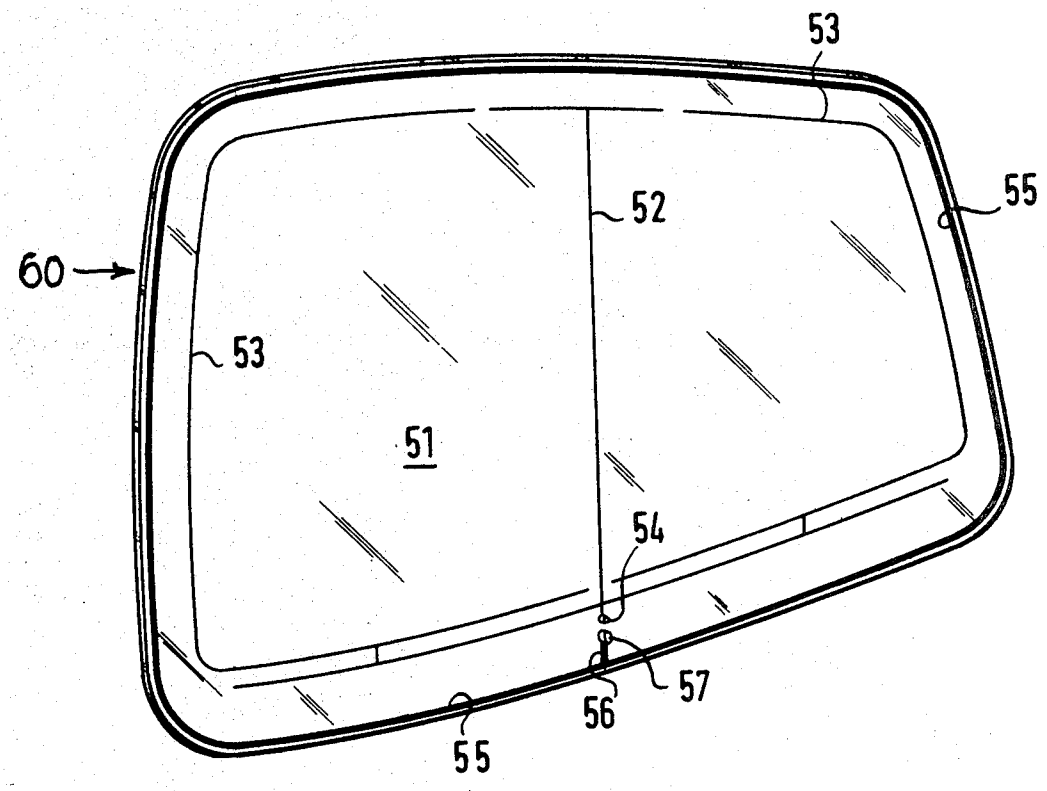


Fig.1

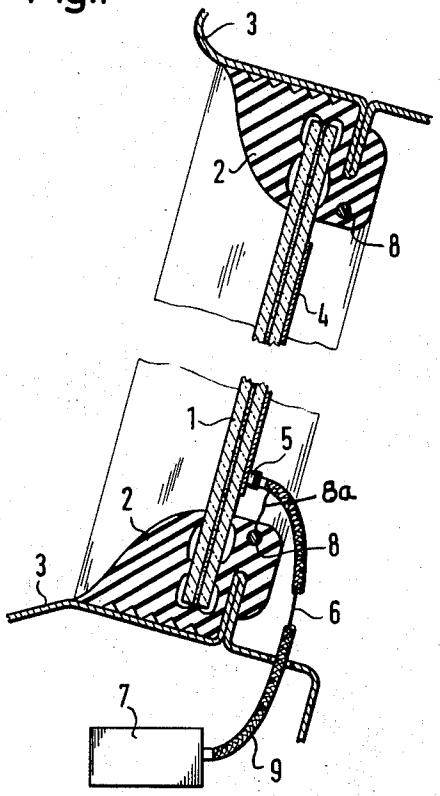


Fig.2

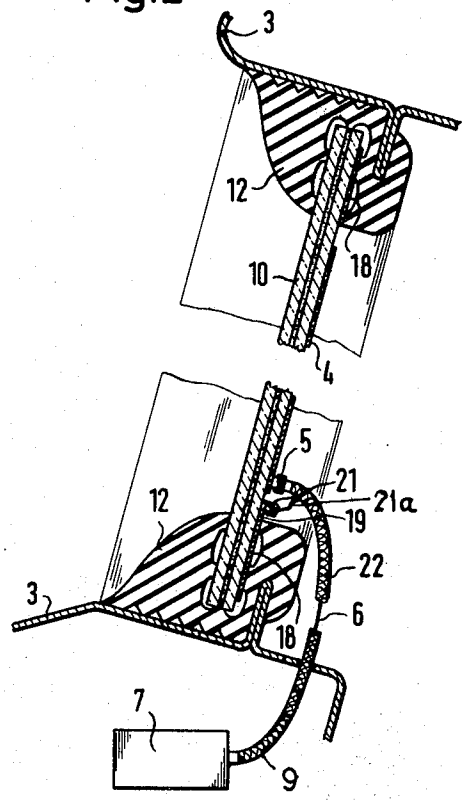


Fig.3

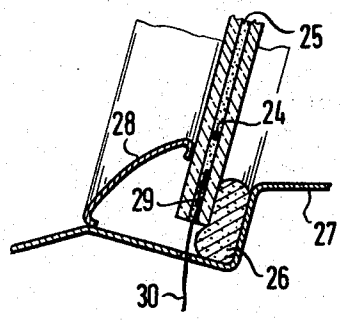


Fig.4

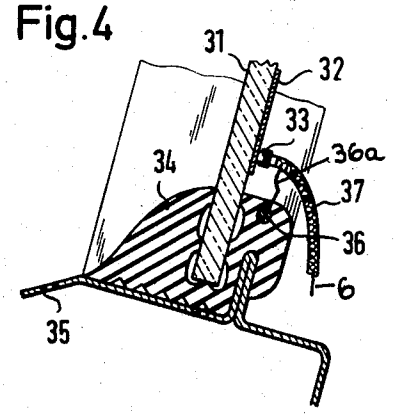


Fig.5

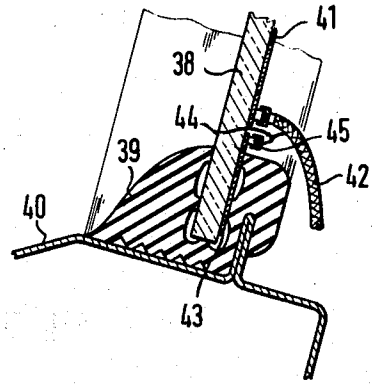


Fig.6

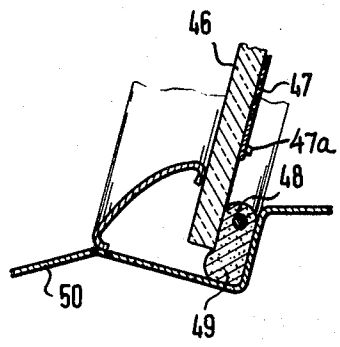


Fig.7

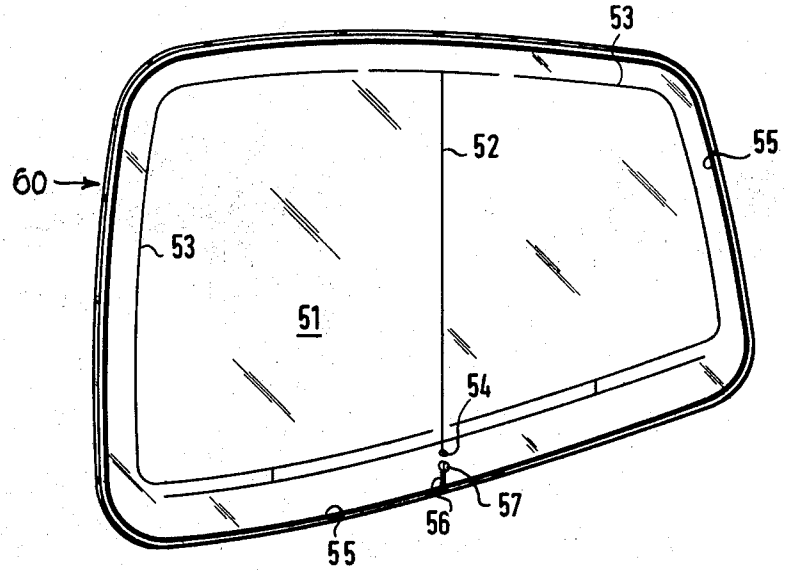


Fig.8

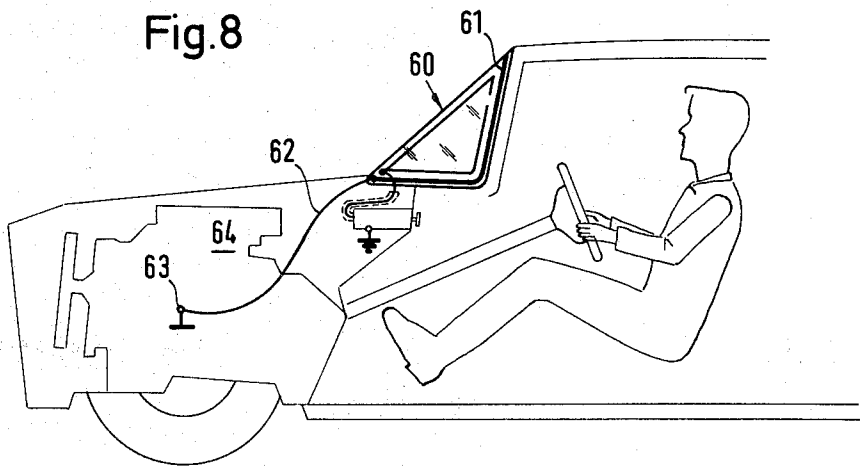
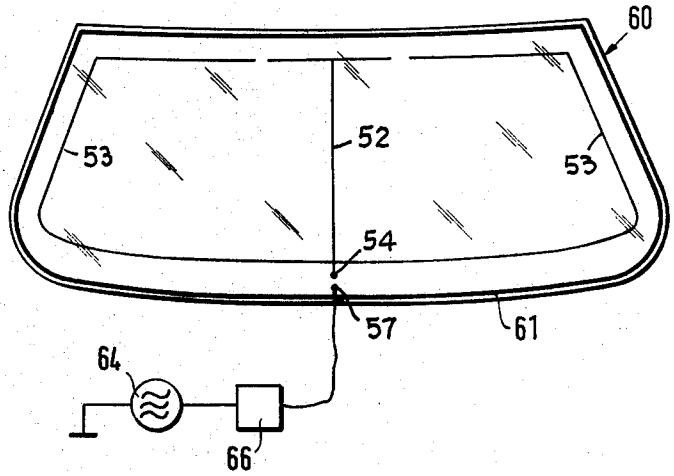


Fig.9



METHOD AND MEANS OF IMPROVING RECEPTION OF VEHICULAR WINDOW-MOUNTED ANTENNA

BACKGROUND OF THE INVENTION

This invention relates to a method of and means for improving the receptive qualities of an antenna formed by electrical conductors embedded or disposed in, or affixed on the interior surface of a window or windshield of a vehicle, and to a windshield or window assembly so equipped. In the following description the term "windshield" is to be taken as inclusive of a window of the vehicle.

The noise level effective upon a windshield antenna is ordinarily greater than that on an antenna located on but exteriorly of the vehicle, because the conductors forming the receptive part of the antenna are, at least in part, only a very small distance from metallic parts of the body of the vehicle on which the windshield is mounted. Such parts carry or are affected by numerous sources of voltage and currents all of which create parasitic noise emanations effective upon the antenna and the receiver to which it is connected.

For example, such parasitic noise is engendered at least in part, by the electrical equipment of the vehicle such as the ignition circuitry, relays, contactors, as well as radiations of variable intensity emanating from sources exteriorly of and apart from the vehicle. The disturbing energies created by components of field intensity parallel with the periphery or circumference of the windshield, and the currents which circulate in the metal of the vehicle body, combine to inductively affect the receptive qualities of the antenna. The voltage components perpendicular to the peripheral edge of the windshield combine to produce a capacitive effect upon the antenna.

It has been proposed to improve the receptive qualities of a windshield antenna, by disposing a conductor in the vicinity of the windshield mounting and grounding it at one end to the metal of the vehicle. Such expedients at best effect small improvement in reduction of noise level in the receiver and are in general unsatisfactory because they create problems of installation and maintenance.

SUMMARY OF THE INVENTION

The present invention makes use of the known fact that improvement in reception effected by an antenna of the type mentioned, depends not only on the level of intensity of the signal received, but equally importantly, on depression or lowering of the noise level created by parasitic signals effective upon the antenna. The invention differs from prior art procedures in disposing in the vicinity of and about the periphery of the antenna windshield, a conductor in the form of a closed screening band.

We have found that by using such a band grounded to a selected point on the vehicle, a particularly efficient anti-parasitic effect is produced which materially reduces noise otherwise deleteriously effective upon the receiver. The improved results are of particular interest and effectiveness where the antenna embedded in or affixed to the surface of the windshield, is in the form of a central "T" plus side branches generally paralleling the ends of the windshield, such as is disclosed in the United States application Ser. No. 180,361, filed

Sept. 14, 1971, owned by the same assignee as in the present application.

It is thought that the windshield equipped in accordance with the present invention, neutralizes or suppresses the perturbations otherwise creating an undesirably high noise level in the receiver, establishes in the space enclosed by the annular screening band extending about the periphery of the windshield, a current which changes rapidly and acts to attenuate the electric field therein, more or less strongly, due to the action of the material of the band. In accordance with a particularly desirable construction the closed screening band is located within or in the immediate vicinity of material having a dielectric coefficient or insulating property of high value. The rubber gasket conventionally used in mounting the rim of the glass windshield, forms an excellent material with the aforesaid property. Alternatively, in those cases where the glass is held within its mounting channel formed in or defined by the body of the vehicle, the ring of adhesive or mastic used to affix the windshield therein, is also satisfactorily usable to enclose and support the screening band. In short it is only necessary that the band pass exteriorly about and in the immediate vicinity of the antenna conductors.

No particular precautions are necessary in grounding the screening ring. For instance it may be connected to the metallic sheath of the coaxial lead-in cable connecting the antenna to the receiver and which has means electrically connecting it to the grounded chassis of the receiver.

However it is particularly advantageous to ground the band to a point where the perturbing voltages have the same frequency but opposite phase as those extant in the zone of the windshield mounting. Thereby the perturbing voltages are particularly well compensated or suppressed. A suitable detector of classic construction enables the location of such a point of the vehicle, without great trouble.

Furthermore it is also possible to select another point or location on the vehicle where the perturbing voltages are extant, by means of phase-changing circuitry such as a simple reactance, inductance or capacitance, or an oscillating circuit, to identify with sufficient accuracy the phase of the voltage component required to oppose, annul or suppress the perturbating signals present in the vicinity of the windshield. When the source of the perturbations is known, the voltage required for compensating or suppressing that emanating from such known source, is readily determined.

In carrying the invention into practice in accordance with a particularly advantageous construction, the peripheral portion of the windshield itself may be used to support the screening band. Thus when the antenna conductors are also in the form of conductor wires, strips or bands attached or affixed to the interior surface of the windshield, the screening band may be formed of the same material as the antenna conductors, and similarly applied and affixed by the same procedure and at the same time as the antenna.

When the output terminal of the antenna is in the form of a contact or binding post at the border of the windshield, as shown in applicants' French application number 71.09741, the screening band of the present invention is readily formed as a closed annulus and its outlet terminal may be located at the same place as that

of the antenna but, of course, electrically separated and insulated therefrom.

The invention as above outlined will be better understood after a study of the specification in connection with the drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a broken vertical section through one construction of windshield embodying the invention, normal to the plane thereof;

FIG. 2 is a view like FIG. 1 but showing a modification;

FIG. 3 is a sectional detail view of a construction embodying the invention, wherein the windshield is adhesively attached within a channel of the vehicle body;

FIG. 4 is a view corresponding to FIG. 1 but embodying a one-piece pane of tempered glass;

FIG. 5 is a view corresponding generally to FIG. 2 but showing a construction wherein is used a single pane of tempered glass, as in FIG. 4;

FIG. 6 is a sectional view corresponding to FIG. 3 but embodying a one-piece pane of tempered safety glass as in FIGS. 4 and 5;

FIG. 7 is a perspective view of a windshield embodying an antenna and screening band applied directly to the glass pane;

FIG. 8 is a schematic view showing a windshield-mounted antenna with means of compensating the voltages engendered in the screening band; and

FIG. 9 is a schematic view showing a way for compensating the perturbing voltages otherwise effective on the antenna.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1 a windshield 1 of an automotive vehicle and of laminated safety glass construction, is mounted in the continuous V-shaped channel of body 3 of the vehicle by means of a rubber gasket or seal ring 2. The antenna 4 is in the form of electrically conductive strips secured to the interior surface of the windshield as by adhesive or by the baking thereon of a liquid or paste-like composition. One terminal end of the antenna has a connector or binding post 5 to which is electrically connected a coaxial input cable including conductor 6 attached to the post and leading to a receiver 7. The cable has outer metallic sheathing 9 with end grounded to the metallic casing or chassis of the receiver.

A band 8 which may be of copper and/or of the same conductive material as antenna 4, is embedded in ring 2 and extends continuously in and along the peripheral portion of the windshield. The band forms a shielding screen of the invention and is, as shown, electrically connected at 8*a* with the sheathing 9 of the receiver input cable. Band 8 being thus connected to the body of the vehicle, collects a large portion of the electromagnetic field developed in the metallic parts of the body 3 by perturbing voltages and currents and which would otherwise deleteriously affect the receptive quality of the antenna and create a high level of noise in the receiver. Sheathing 9 is electrically connected to the casing or chassis of receiver 7 and which, as is well known, is grounded to the metal of the vehicle.

At FIG. 2 is shown a windshield pane of the same general construction as in FIG. 1. The antenna conductor 4 is similarly attached to the interior surface of the pane and is electrically attached by post 5 to the internal conductor 6 of coaxial cable 9. Rubber ring 12 mounts the pane to the vehicle body 3 in the same general way as in FIG. 1. However, the screening band 18 of the invention is, in FIG. 2, a flat closed annulus located and essentially concealed between the rim or periphery of the pane and rubber ring 12. Band 18 may be of the same metallic material as antenna 4. At its lower and essentially central point, the band has an upwardly-extending and exposed tab affording connection by a binding post 21 to a short run of wire 21a by which it is electrically connected to the metallic sheathing 22 of coaxial cable 9. As in FIG. 1 the inner conductor 6 of this cable electrically connects through binding post or terminal 5, the antenna 4 to the input terminal of receiver 7.

As previously stated, parasitic currents otherwise deleteriously effective upon the antenna, are greatly reduced or weakened by the presence of the band 8, FIG. 1, or 18, FIG. 2, so that the level of noise at the receiver is correspondingly lowered or suppressed. The mounting rings 2 or 12, as the case may be, may be formed of a material having a low loss factor. When it is desired to provide an especially great weakening or dissipation of the parasitic field special materials may be interposed between the screening band and the windshield mounting.

FIG. 3 shows another way of carrying the invention into practice. Here the windshield which is of the laminated safety-glass type, has the antenna conductors 24 embedded in the thermoplastic interlayer 25 of the windshield. The windshield is fixed within a channel formed in the vehicle body by and between portions 27 and 28, by means of a mastic or adhesive band 26 and which, as shown, engages the periphery of the pane and forces it against the bead defined by the inwardly-curled exterior rim of portion 28.

Also located or embedded within thermoplastic interlayer 25 is the screening band 29 of electrically conductive material several millimeters in width and forming a closed annulus located outside of and spaced from the antenna conductors 24. The band is electrically connected with the metallic frame or chassis of a receiver, not shown, but like item 7, FIGS. 1 and 2, by a conductor 30.

FIG. 4 shows a construction embodying the invention in a manner essentially like FIG. 1. But in FIG. 4 the windshield 31 is composed of a single unitary pane of tempered safety glass. Hence it is sufficient to identify rubber mounting gasket 34, vehicle body 35, antenna 32, binding post 33 by which the antenna is electrically connected through lead 6 of the coaxial cable to the input of a receiver such as 7, FIG. 2, and screening band annulus 36 embedded in gasket 34 interiorly of the body. A conductor 36*a* electrically connects the band to the sheathing 37 of the lead-in cable, as and for the purpose described in connection with FIGS. 1 and 2.

The embodiment of FIG. 5 is essentially like that depicted upon FIG. 2 except that windshield 38 is formed of a single unitary pane of tempered safety glass. In view of the similarity of construction with FIG. 2 it is sufficient to identify rubber mounting gasket 39, portion 40 of the vehicle body, antenna 41 attached to the interior surface of the windshield, coaxial cable having metallic sheathing 42, closed annular screening band 43 interposed between and concealed by the periphery of the interior surface of the windshield and gasket 39,

binding post or terminal 45 connected to an integral tab of band 43, and conductor 44 by which the band is connected to sheathing 42. As in FIG. 2, the antenna and band, 41 and 43, respectively, may be formed by the deposition onto the surface of the windshield, of a suitable known conductive liquid or paste, followed by baking thereof to effect firm and permanent adhesion.

The windshield mounting depicted upon FIG. 6 is essentially like that shown at FIG. 3 so that it wil be sufficient to identify windshield 46 of a single pane of tempered safety glass, antenna 47 attached to the interior surface of the windshield, vehicle body portion 50 forming a continuous channel for reception of the periphery of the pane, and mastic or adhesive packing 49 interposed in a continuous manner between the periphery of the windshield on its interior surface, and the channel of the body. In this instance however, the screening band 48 having the same function as item 8, FIG. 1; 18, FIG. 2, etc., is embedded in the mastic mounting 49 and, by means not shown, electrically connected with the metallic frame of a receiver such as 7, FIGS. 1 and 2. It will be understood also that antenna 47 has a binding post or terminal 47*a* by which it is connected, as by wire 6 of a coaxial cable as in FIG. 1, to the input of a receiver.

FIG. 7 shows in perspective a windshield 51 having affixed to one surface, an antenna including a central branch 52 of "T" formation, and right and left side branches 53 extending generally parallel with the borders of the windshield and spaced inwardly from the edges thereof by a few centimeters. Being in such close proximity to the metallic body of the vehicle, it is exposed to the perturbing currents and effects thereof flowing therein. The several branches of the antenna are connected to a common terminal 54.

A screening band 55 extends continuously along the border of the windshield and is spaced a few millimaters inwardly thereof. As previously noted, this band may be of the same material as that of the antenna 52, 53, and applied in the same manner as and at the same time. In accordance with this invention the band forms a closed annulus and has the exposed conducting tab 56 extending upwardly from a central point in its lower run, with binding post or terminal 57 for connection with a lead such as 44 FIG. 5, to the sheathing of a coaxial lead-in cable like 42, FIG. 5.

It will be understood that it is possible to employ modifications of the constructions depicted upon FIGS. 1 to 7, without departing from the spirit and objects of the invention. In particular it should be noted, as previously indicated, that the anti-parasitic effect can be enhanced when the screening band is connected to a point where the voltages there extant are of the same frequencies as the perturbing voltages existing in the vicinity of the windshield mounting, but have a phase opposite thereto. When the source of the perturbations is known, it is possible to determine the compensating voltage by measurements in the immediate vicinity thereof.

FIG. 8 shows an example of compensating the perturbing voltage. The screening band 61 of windshield 60, located and mounted in one of the ways previously described, is connected by a conductor 62 to a point 63 of the engine block 64. Point 63 is determined by a classical measuring instrument. If the voltages present at this point, their frequencies and value, correspond to the perturbing voltages present in the vicinity of the windshield mounting and are of proper phase, the invention will operate at peak efficiency in reduction of the noise level effective otherwise upon the receiver.

In the usual situation the requirements for satisfactory compensation or suppression are not readily ascertained. It suffices however to locate a point where the perturbing voltages present the same frequencies as exist in the vicinity of the windshield mounting. As indicated upon FIG. 9, the interpositioning of a complementary electric circuit 66 enables obtention of substantially ideal conditions, namely, the determination of a satisfactory voltage value having a phase opposite to the perturbing voltage. This circuitry 66 includes electronic components which enable adjustment of voltages from a source 64 and adjustment in the phase thereof.

The circuitry normally extends over a band of considerable width. But as the band width is reduced by adjustment it is possible to obtain satisfactory results by limiting the band width to include only the frequency of the principal or main perturbing voltage. Thus circuitry 66 may comprise in general a self inductance, a capacitance and/or an ohmic voltage divider effective as a coupling element.

The foregoing disclosure is to be taken in an illustrative rather than a limiting sense, as numerous changes, alterations and modifications will become clear to those skilled in the art, after a study thereof in connection with the accompanying drawing.

We claim:

1. The method of reducing the level of noise signals otherwise inductively effective upon an antenna mounted in or on the windshield of an automotive vehicle, and essentially in the plane of the windshield, comprising, surrounding the antenna with an endless electrically conductive band in adjacent relation therewith in a plane generally parallel to said first-named plane and insulated from the metallic mass of the vehicle, and grounding the band by connecting the same at a point thereof to said mass.

2. The method of claim 1, said grounding of the band being to a metallic part of the vehicle where the composite voltage is comparable in value to but of opposite phase from that of the perturbing voltage effective in the plane of the windshield.

3. The method of claim 1, grounding of the band being by connection to the metallic sheathing of a coaxial lead-in cable connected to the grounded casing of a radio receiver.

4. The method of claim 1, grounding of the band being to the engine block of the vehicle's prime mover.

5. The method of claim 1, inserting in the grounding conductor a source of voltage and adjusting said voltage to a value and phase substantially equal to, and opposite to, respectively, the voltage and phase of the perturbing voltage effective on the antenna.

6. In an automotive windshield, antenna conductors secured to or within the windshield in the plane thereof, first lead means to connect said antenna conductors to the input of a receiver, an electrically conductive screening band generally insulated from ground in adjacent surrounding relation with said antenna conductors and in near coplanar relation therewith, and second conductor means to connect said screening band at a point thereof to ground.

7. The windshield of claim 6, said band being in the form of an endless metallic loop.

8. The windshield of claim 7, said antenna being secured to one surface of the windshield, a mounting ring of electrically insulating material encompassing the rim of the windshield to mount the same in a vehicle, said band being embedded in the material of said ring.

9. The windshield of claim 8, said band being interposed between said mounting ring and the adjacent rim portion of the windshield.

10. The windshield of claim 7, said windshield comprising interior and exterior panes of glass with an interposed connecting layer of thermoplastic, said band being embedded in said thermoplastic layer.

11. The windshield of claim 10, said antenna conductors also, being embedded in said thermoplastic layer, within the confines of said band.

12. In an automotive windshield, antenna wires secured to said windshield to define a "T" centrally thereof, and right and left side wires having portions generally paralleling and spaced from the right and left side portions of said windshield, respectively, said "T" and said side wires being connected to a common terminal centrally of the base portion of the rim of the windshield, a metallic screening band generally insulated from ground and secured to said windshield to extend in a closed annulus about said antenna wires between said wires and rim of the windshield, and a ground connection for said band.

13. The combination with the body of an automotive vehicle defining a continuous channel for reception of a windshield, a windshield having its rim portion within said channel, antenna conductor wires secured to said windshield in the plane thereof, a packing ring in said channel interposed between the rim of said windshield and one side wall of the channel, and a metallic screening band embedded in said ring to extend continuously about and exteriorly of said conductor wires.

14. The combination with the body of an automotive vehicle defining a continuous channel for reception of a windshield, a windshield having its rim portion within said channel, said windshield comprising interior and exterior layers of glass interconnected by an interlayer of thermoplastic, antenna conductor wires secured to said windshield in the plane thereof, a packing ring in said channel interposed between the rim of said windshield and one side wall of the channel, and a metallic screening band embedded in said interlayer to extend continuously about and exteriorly of said conductor wires.

15. The method of claim 1, said grounding being at a point of said mass where the prevailing voltage is such as to tend to nullify the perturbing voltage in the vicinity of said band.

16. The method of improving the conditions of reception by a vehicle window antenna which comprises utilizing an endless screening conductor in the zone of the mounting frame around the window and between the frame and antenna, and connecting said endless conductor to a source of voltage that bucks voltage induced in said conductor.

17. The method of claim 16, said source of bucking voltage being at a point of the metallic mass of the vehicle.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,766,563 Dated October 16, 1973

Inventor(s) Gerd Sauer et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Cover page, column 2, under "References Cited", "FOREIGN PATENTS OR APPLICATIONS", insert
--No. 647,665 12/1950 Great Britain 343/705--.
Column 7, line 14, cancel "also," in claim 11.

Signed and sealed this 14th day of May 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents