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(54) VEHICLE ANTENNA.

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Description

FIELD OF THE INVENTION

This invention relates to an antenna for use on a motor vehicle, particularly for cellular radio.

BACKGROUND ART

It is well known to use the conductors of heated windows of motor vehicles as radio receiving and transmitting antennas.

Advantageously, such antennas do not project outside the vehicle and are not therefore susceptible to inadvertent damage or vandalisation. Also, mounting holes in the vehicle bodywork can be avoided. Efficient reception can be achieved with such antennas on the usual AM and FM broadcast bands, and efficient transmission can be achieved in the 4m to 2m VHF mobile radio band, if necessary with the aid of matching and tuning circuitry.

Cellular mobile radio is now an important means of communication. However, the usual frequency range for this i.e. 890-960 MHz, corresponds to a mid-band free-space wavelength of 324mm and it is therefore not appropriate to use the conductors of a vehicle heated window as the antenna. In practice a short whip antenna mounted on and projecting from the vehicle body is used.

Alternatively a conductor applied to a window can be used as an antenna and examples of such antennas are shown in FR-A-2571179 and JP-A-59196605. However, the problem with the types of antennas disclosed in these documents are that in order to obtain adequate reception of signals the conductors need to be relatively large in size and therefore can obscure a driver's vision. Furthermore, these antennas are inductively linked to a part of the vehicle body and thus do not operate in a manner equivalent to the conventional short whip antenna mentioned above.

DISCLOSURE OF THE INVENTION

An object of the present invention is to provide an antenna which is suitable for use with cellular radio yet which is incorporated in a vehicle window.

According to the present invention therefore there is provided a vehicle window having a plurality of peripheral edges comprising a top edge, a bottom edge and two upright side edges, and an antenna for use with radio apparatus, said antenna comprising in combination an elongate conductor, applied to one surface of said window, and a separate conductive strip also applied to said surface of the said window and defining a ground plane for the said antenna, characterised in that said conductive strip extends along, in close proximity to, one of said peripheral edges so as to be capacitatively linked thereto to provide said ground plane, the length of the said conductive strip extending along said one of said peripheral edges to provide the said ground plane being greater than half the wavelength of the central frequency of the frequency band to which said radio apparatus is tuned, said elongate conductor having terminal means at one end thereof, said one end being located adjacent to the said strip and separated from said strip by a narrow gap, and the other end of the said elongate conductor projecting freely away from said strip, the length of said elongate conductor being a minor proportion of the length of any of said peripheral edges.

With this arrangement it has been found possible to achieve good reception and transmission without unduly obscuring vision through the window. In particular, surprisingly, it has been found possible to achieve excellent reception and transmission with a conductor length which is shorter (e.g. at least 30% shorter) than the free-space quarter-wavelength of the mid-band frequency required to define a resonant monopole, due to the dielectric effect of the window glass to which the antenna conductor is applied.

Conveniently, the conductor may be fixed to a vehicle rear window near the top edge thereof. Where the window also has heater wires these should be separate from the antenna. The conductor preferably extends in a direction from a top edge towards a bottom edge of the window and thus, the conductor may extend in a vertical plane.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described further by way of example only and with reference to the accompanying drawings in which:-

Figure 1 is a diagrammatic view of one form of a window according to the invention;

Figure 2 is an enlarged view of a detail of the window.

Figures 3 + 4 are polar diagrams showing performance of different antennas.

BEST MODE OF CARRYING OUT THE INVENTION

The window is a rear window of a motor car, although it is to be understood that the invention can be applied to any suitable window of any suitable vehicle.

The window comprises a glass pane 1 which is generally rectangular or trapezoidal and has top and bottom long edges 2, 3 which extend at least substantially horizontally, and two short upright side edges 4, 5. The pane 1 may be flat or curved and lies in a plane (or is curved relative to a plane) which is substantially vertical or inclined to the vertical, as is conventional. The pane 1 fits within an opening in a metal body of the vehicle and is sealed relative to the periphery of the opening with a sealing gasket formed from rubber or similar material.

The pane 1 incorporates a heater (demister) which comprises a series of parallel, horizontal wires 6 running between upright busbars 7, 8, such wires and bars being incorporated in the inner surface of the glass pane or applied thereto e.g. as narrow, flat, printed, conductive strips. The bus bars 7, 8 are connected to the usual d.c. power supply of the motor car via an operating switch. Thus, one busbar 7 is connected to earths (i.e. the car body), and the other busbar 8 is connected by a lead to positive power supply via the operating switch which may be located for example on the car dashboard.

The heater wires 6 extend across a major part of the surface area of the window pane but there is a space between the top edge 2 of the window pane 1 and the uppermost heater wire 6. In this space there is a short, straight upright conductor 9 which is incorporated in or applied to the inner surface of the pane. Thus, the conductor 9 may comprise a 0.4mm wire fixed by adhesive to the surface of the pane 1, or the conductor may comprise a narrow flat printed conductive strip, say 1 to 1½ mm wide.

The conductor 9 lies in a vertical plane and terminates at its upper end 10 close to the top edge 2 of the window pane 1 near to but well spaced from one side edge 5. The top end 10 of the conductor 9 has thereat a portion of increased width which forms a square terminal 11, say 3½ to 4 mm square.

There is a space between the terminal 11 and the top edge 2 of the window pane 1 and within this space there is a flat strip 12 which is applied to the surface of the pane 1 and extends horizontally along part of the top edge 2. This strip 12, like the conductor 9 and the terminal 11, may be a flat printed conductive strip (say 10-20 mm wide) of similar nature to the printed strips conventionally used for window heaters (demisters).

A very narrow gap (say 1-2 mm) is defined between the terminal 11 and the strip 12 and the terminal 11 is located in the middle of the strip 12.

A coaxial cable 13 has its central conductor connected to the terminal 11 and its outer conductor connected to the middle of the strip 12 immediately above the terminal 11. The cable 13 is led around the interior of the car to a conventional cellular radio/transmitter 14 which may be mounted e.g. on the car dashboard. The cable 13 is connected directly to the usual antenna socket of the radio/ transmitter. The radio/transmitter is tuned to operate in the usual cellular radio band i.e. 890-960MHz.

The conductor 9 acts as an antenna for the radio/transmitter 14 and the strip 12 acts to define a ground plane for the antenna. The strip 12 extends up to the edge 2 of the window pane 1 and in effect forms part of the vehicle body in so far as the strip is so close to the body as to be capacitively linked thereto. The width of the strip 12 is large enough to ensure that the strip projects beyond any peripheral window trim thereby to avoid spurious capacitive effects with the trim. The length of the strip 12 is not critical but is greater than half the wavelength of the central frequency of the band to which the radio/transmitter is tuned.

The conductor 9 is relatively short, that is, the length of the conductor 9 is much less than the length of any of the edges 2, 3, 4, 5 of the window pane 1. Moreover the length of the conductor 9 is less than the quarter-wavelength of the middle frequency of the band to which the radio apparatus is tuned. More specifically the effective length of the conductor 9, i.e. the length from the bottom end of the conductor to the bottom edge of the ground plane strip 12 is trimmed to give resonance at the mid-band frequency of 925MHz of the band to which the radio apparatus is tuned. In practice, the length will be approximately 55mm which is approximately 30% less than the free-space quarter-wavelength, this being possible due to the dielectric effect of the glass which modifies the antenna properties of the conductor 9.

The coaxial lead is connected directly to the radio apparatus and matching circuitry or the like is not required since the antenna structure provides 'ideal' matching to the radio apparatus.

A bandwidth of the order of 100MHz (1.3:1 vswr) is attainable.

It is of course to be understood that the invention is not intended to be restricted to the details of the above embodiment which are described by way of example only.

Thus, for example, instead of being applied directly to the surface of the window pane 1, the conductor 9 (and/or the strip 12) may be applied to a small transparent sheet of soft plastics (e.g. by printing on the plastics),

such sheet being affixed to the window pane 1 by adhesive or by virtue of the adherent properties of the plastics material. Also, although the antenna is shown applied to a rear window it is to be understood that it may be applied to a side or front window. Being so small, the antenna does not significantly obscure vision.

Figure 3 shows typical performance of a conventional roof-mounted rod antenna (effectively quarter-wave monopole), and Figure 4 shows typical performance of the antenna of Figures 1 and 2.

Figures 3 and 4 are polar diagrams recorded by driving a car (Ford Granada) fitted with the antennas in a tight circle at a distance in the range 200-500m from a low power 925 MHz test transmitter. Figure 3 shows the power of the received signal with the roof-mounted monopole, and Figure 4 shows the power of the received signal with the antenna of Figures 1 and 2 applied to the rear window. The polar diagrams show that the performance obtained with the antenna of Figures 1 and 2 is surprisingly roughly comparable with that of a conventional antenna.

Claims

1. A vehicle window having a plurality of peripheral edges comprising a top edge (2), a bottom edge (3) and two upright side edges (4, 5), and an antenna for use with radio apparatus, said antenna comprising in combination an elongate conductor (9), applied to one surface of said window, and a separate conductive strip (12) also applied to said surface of the said window and defining a ground plane for the said antenna, characterised in that said conductive strip (12) extends along, in close proximity to, one of said peripheral edges (2) so as to be capacitively linked thereo to provide said ground plane, the length of the said conductive strip extending along said one of said peripheral edges to provide the said ground plane being greater than half the wavelength of the central frequency of the frequency band to which said radio apparatus is tuned, said elongate conductor (9) having terminal means at one end thereof, said one end being located adjacent to the said strip (12) and separated from said strip by a narrow gap, and the other end of the said elongate conductor projecting freely away from said strip, the length of said elongate conductor (9) being a minor proportion of the length of any of said peripheral edges (2, 3, 4, 5).

2. A vehicle window according to claim 1, wherein the conductor (9) extends in a direction from a top edge (2) towards a bottom edge (3) of the window.

3. A vehicle window according to claim 2, wherein the conductor (9) extends in a vertical plane.

4. A vehicle window according to any one of claims 1 to 3, wherein said antenna is for use with said radio apparatus operable in the frequency band 890-960MHz, and the length of the conductor (9) is less than the free-space quarter-wavelength of the mid-band frequency.

5. A vehicle window according to claims 3 and 4 wherein the end (11) of the conductor (9) remote from the said strip is spaced from the strip by a distance less than the free-space quarter-wavelength of the mid-band frequency.

6. A vehicle window according to claim 5, wherein the said distance is at least 30% less than the free-space quarter-wavelength of the mid-band frequency.

7. A vehicle having a window with an antenna according to any one of the preceding claims.

8. A vehicle according to claim 7, wherein said radio apparatus comprises transmitting circuitry for transmitting radio signals in the predetermined frequency band via said antenna.

Patentansprüche

1. Fahrzeugfenster mit mehreren Umfangsrändern, bestehend aus einem oberen Rand (2), einem unteren Rand (3) und zwei aufrechten Seitenrändern (4, 5), und mit einer Antenne zur Verwendung für Rundfunkgeräte, die einen auf einer Oberfläche des Fensters aufgebrachten, langgestreckten Leiter (9) aufweist, der mit einer ebenfalls auf der Fensteroberfläche aufgebrachten, separaten Leiterbahn (12) kombiniert ist, die eine Massefläche für die Antenne bildet,
dadurch gekennzeichnet, daß sich die Leiterbahn (12) dicht entlang eines der Umfangsränder (2) erstreckt

und zur Bildung der Massefläche mit diesem Rand kapazitiv gekoppelt ist, wobei sich die Leiterbahn über ihre Länge entlang eines der Umfangsränder erstreckt, so daß die dadurch gebildete Massefläche größer ist als die halbe Wellenlänge der Mittelfrequenz des Frequenzbandes, auf das das Rundfunkgerät abgestimmt ist, wobei an dem einen Ende des langgestreckten Leiters (9) Anschlüsse vorgesehen sind, wobei das eine Ende des Leiters nahe der Leiterbahn (12) angeordnet und von der Leiterbahn durch einen schmalen Spalt getrennt ist und das andere Ende des langgestreckten Leiters in von der Leiterbahn abgewandter Richtung frei herausragt, und wobei die Länge des langgestreckten Leiters (9) einem kleinen Bruchteil der Länge eines der Umfangsränder (2, 3, 4, 5) entspricht.

2. Fahrzeugfenster nach Anspruch 1,
bei dem sich der Leiter (9) in von einem oberen Rand (2) zu einem unteren Rand (3) des Fensters verlaufender Richtung erstreckt.

3. Fahrzeugfenster nach Anspruch 2,
wobei sich der Leiter (9) in einer vertikalen Ebene erstreckt.

4. Fahrzeugfenster nach einem der Ansprüche 1 bis 3,
wobei die Antenne zur Verwendung für Rundfunkgeräte bestimmt ist, die innerhalb des Frequenzbandes von 890 bis 960 MHz zu betreiben sind, und wobei die Länge des Leiters (9) geringer ist als die Viertelwellenlänge der Bandmittenfrequenz.

5. Fahrzeugfenster nach den Ansprüchen 3 und 4,
wobei das von der Leiterbahn abgewandte Ende (11) des Leiters (9) einen Abstand von der Leiterbahn hat, der kürzer ist als die Viertelwellenlänge der Bandmittenfrequenz.

6. Fahrzeugfenster nach Anspruch 5,
wobei der Abstand um mindestens 30 % kürzer ist als die Viertelwellenlänge der Bandmittenfrequenz.

7. Fahrzeug mit einem Fenster, das eine Antenne nach einem der vorhergehenden Ansprüche aufweist.

8. Fahrzeug nach Anspruch 7,
wobei das Rundfunkgerät einen Sendekreis aufweist, um über die Antenne Rundfunksignale im vorgegebenen Frequenzband zu senden.

Revendications

1. Fenêtre de véhicule ayant une pluralité de bords périphériques comprenant un bord supérieur (2), un bord inférieur (3) et deux bords latéraux droits (4, 5), et une antenne pour une utilisation avec un appareil de radio, ladite antenne comprenant en combinaison un conducteur allongé (9), appliqué sur une surface de ladite fenêtre, et une bande (12) conductrice séparée appliquée également sur ladite surface de ladite fenêtre et définissant un plan de masse pour ladite antenne, caractérisée en ce que ladite bande conductrice (12) s'étend le long et à la proximité immédiate d'un (2) desdits bords périphériques de manière à être reliée à celui-ci de manière capacitive pour fournir ledit plan de masse, la longueur de ladite bande conductrice s'étendant le long dudit bord périphérique pour fournir ledit plan de masse étant supérieure à la moitié de la longueur d'onde de la fréquence centrale de la bande de fréquence à laquelle l'appareil de radio est accordé, ledit conducteur allongé (9) ayant des moyens de borne à une extrémité de celui-ci, ladite extrémité étant adjacente à ladite bande (12) et séparée de ladite bande par un espace étroit, et l'autre extrémité dudit conducteur allongé s'écartant librement de ladite bande, la longueur dudit conducteur allongé (9) étant un rapport mineur de la longueur de chacun desdlts bords périphériques (2, 3, 4, 5).

2. Fenêtre de véhicule selon la revendication 1, dans laquelle le conducteur (9) s'étend dans une direction depuis un bord supérieur (2) vers un bord inférieur (3) de la fenêtre.

3. Fenêtre de véhicule selon la revendication 2, dans laquelle le conducteur (9) s'étend dans un plan vertical.

4. Fenêtre de véhicule selon l'une quelconque des revendications 1 à 3, dans laquelle ladite antenne est

utilisée avec ledit appareil de radio fonctionnant dans la bande de fréquence de 890 à 960 MHz, et la longueur du conducteur (9) est inférieure au quart de la longueur d'onde en espace libre de la fréquence de milieu de bande.

5. Fenêtre de véhicule selon les revendications 3 et 4, dans laquelle l'extrémité (11) du conducteur (9) éloignée de ladite bande est espacée de la bande par une distance inférieure au quart de la longueur d'onde en espace libre de la fréquence de milieu de bande.

6. Fenêtre de véhicule selon la revendication 5, dans laquelle ladite distance est d'au moins 30 % inférieure au quart de la longueur d'onde en espace libre de la fréquence de milieu de bande.

7. Véhicule ayant une fenêtre avec une antenne selon l'une quelconque des revendications précédentes.

8. Véhicule selon la revendication 7, dans lequel ledit appareil de radio comprend des éléments de circuit de transmission pour transmettre des signaux radio dans la bande de fréquence prédéterminée via ladite antenne.

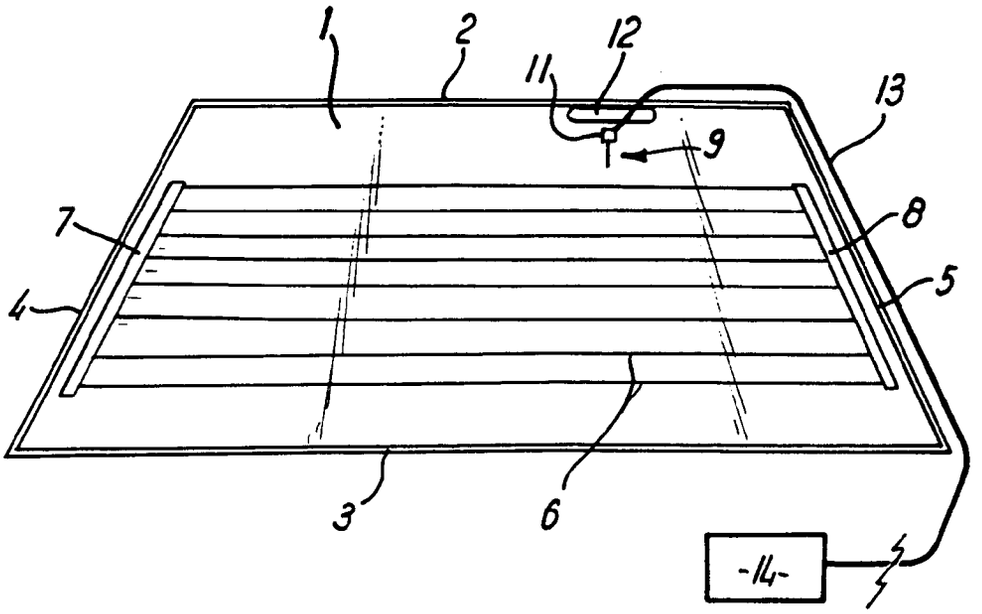

FIG.1

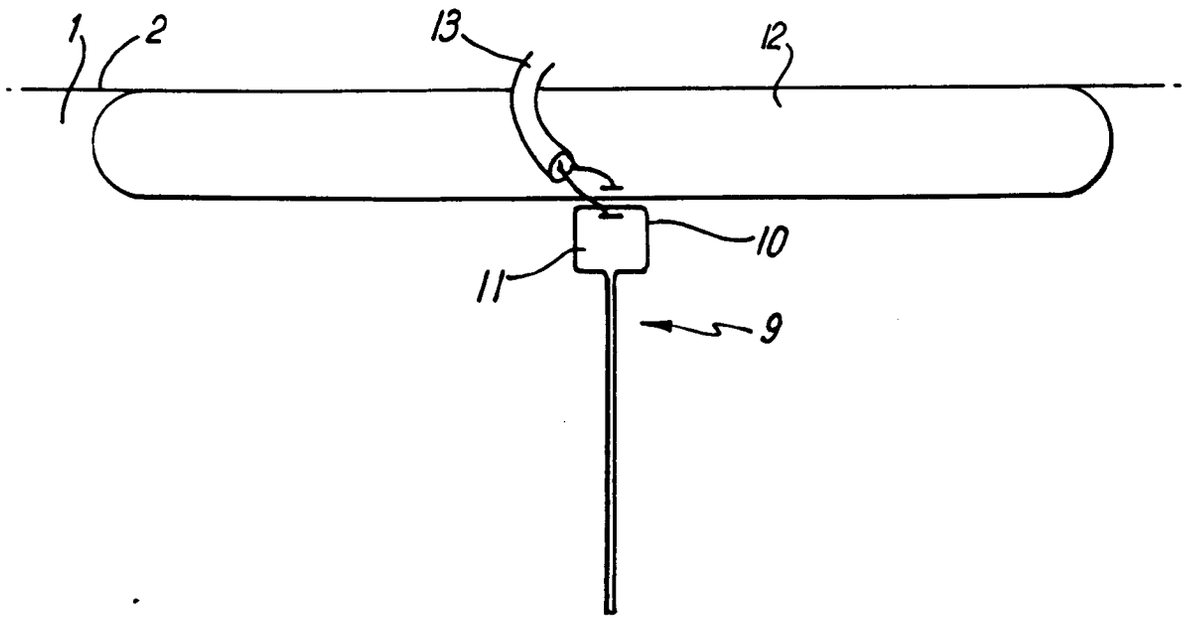

FIG.2

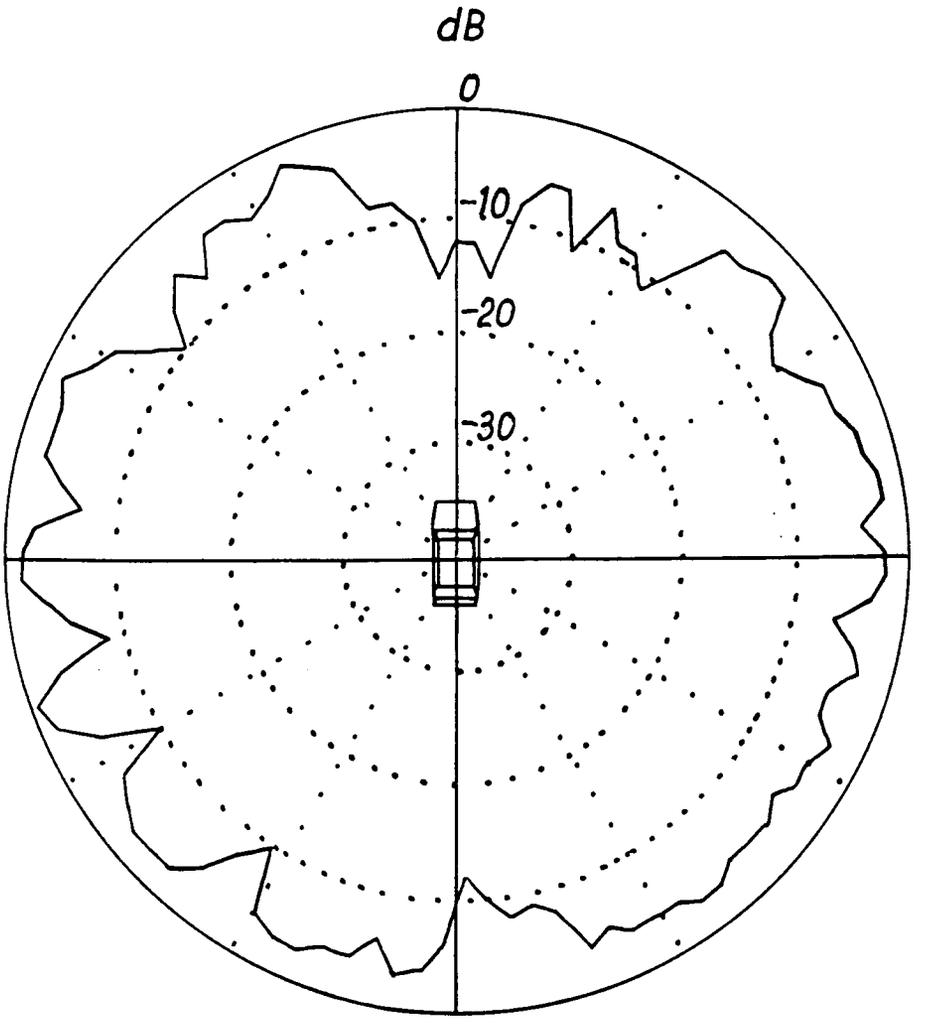

Fig3

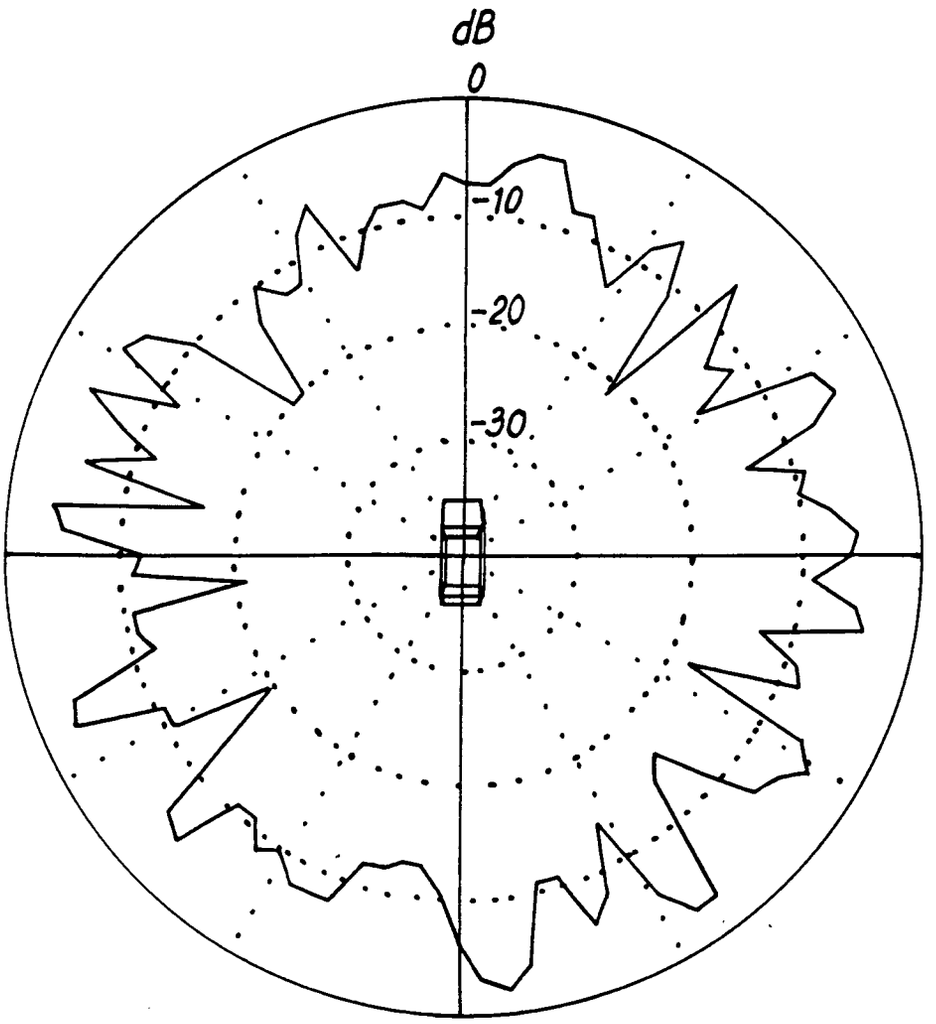

Fig.4