WINDSHEILD ANTENNA FOR AUTOMOBILE

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ABSTRACT
A glass antenna for automobiles which comprises a first antenna element set so as to be adapted for an FM broadcast band and a second antenna element. These antenna elements cooperate to receive an AM broadcast electric wave. The feeding points of the antenna elements are connected to each other through means for effecting reactance. The antenna elements are provided in relation to the window glass of the car.

3 Claims, 11 Drawing Figures
Fig. 10

Fig. 11

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WINDSHIELD ANTENNA FOR AUTOMOBILE

BACKGROUND

This invention relates to an antenna for automobile and, more particularly, to a “glass antenna” specially adapted to catch electric waves in a plurality of electric wave bands which are very different in frequency, for example, AM and FM broadcasting bands.

Heretofore, a whip antenna has been used widely as an antenna for automobile, which antenna has an extendable rod shaped configuration projecting upright from the car body. Such antenna is advantageous in adaptability for the reception of electric waves over the wide bands, but, on the other hand, due to its rod shaped configuration, it has many disadvantages as follows; for example, when the car provided with this antenna in the extended state passes through the entrance of a garage, the antenna will run thereagains and will be easily damaged, when the car mounting the whip antenna is running at high speed, the antenna is vibrated by the wind-pressure thereagainst so that it produces a noise so as to disturb the reception of broadcasting or other electric wave, and, further, the provision of this whip antenna to a car breaks the sense of beauty thereof.

In order to remove the above-mentioned disadvantages of the whip antenna, a new type of so-called “glass antenna” for car was developed, in which conductive members in the form of an antenna are used in relation to the glass window of a car. The conductive members are in the form of electric conductors such as wires or strips, and fixed tightly to the surface of the glass window or fixedly disposed between the glass layers of the glass window.

Furthermore, an attempt was made to use a glass antenna for the reception of both AM and FM broadcasts. One example of such glass antenna is constructed so that a substantially T shaped configuration is formed on the front glass window of a car by means of a pair of reversed L shaped copper wires, the thus-formed T shaped glass antenna having two upper free ends, the lower ends being connected each other and to a radio receiver through a feeder. In this manner, since the copper wires are connected at the lower ends, one T shaped conductor may be used instead of two reversed L shaped conductors.

This conventional T shaped glass antenna is set so as to receive both AM (Medium Band, 535 - 1605 KHz) and FM (Very High Frequency, 76 - 90 MHz, in Japan) broadcasting. However, since the AM and the FM are very different in frequency, in other words, the respective wave length is very different, it is very difficult to set the configuration, that is, the length of the antenna conductor so that satisfactory quality as an FM/AM antenna is attained; therefore, so far the reception efficiency of either AM or FM broadcast had to be necessarily sacrificed. In the case of an AM antenna, although it is preferable that the effective length of the antenna be selected to be equal to the wave length (λ) of AM or to a preset fractional wave length thereof, for example, ½λ, ¼λ, etc., where a antenna element made of copper wire, etc. is provided on or in the front window, its shape or size is naturally limited, so the antenna is designed so as to provide the maximum efficiency within the permitted limits. When it is intended to receive AM broadcasting by using such antenna, impedance matching between the antenna, that is, the antenna element and the feeder, and the receiver practically does not matter. However, in general, in the case of the reception of FM broadcasting, said impedance matching becomes a considerably important matter. Therefore, where the antenna which takes the effective length as lengthened as possible to catch the AM electric wave favorably is used to receive the FM, the correct impedance matching could not be effected.

SUMMARY

An object of this invention is to provide an antenna wherein the FM reception efficiency can be increased without any decrease in the AM receiving quality of the AM.

In accordance with this invention, a first antenna element for receiving FM broadcasting and a second antenna element, which are separated, are provided on and/or in the window glass. The FM antenna element is connected to the feeder of a car radio set, and also connected to the second antenna element through means for effecting reactance which may be an inductor and/or a capacitor. This reactance element may be provided on or in the window glass by, for example, printing, coating or the like. The glass window means a front window, a rear window or a side window or a combination thereof. It should be understood that the wording “means for effecting reactance” as used herein means a circuit means including an inductor and/or a capacitor, as well as a circuit means including an active element such as a transistor, a diode or the like.

DESCRIPTION OF THE DRAWINGS

This invention will now be better illustrated with reference to the attached drawings, given by way of non-limiting example, in which:

FIG. 1 represents diagrammatically one embodiment of the antenna according to the present invention, adapted on the front window glass of an automobile;

FIGS. 2 to 4 represent schematically and elongatedly various antennas of this invention in relation to the front glass window;

FIGS. 5 and 6 represent schematically and elongatedly other antennas of this invention in relation to the rear glass window;

FIGS. 7 to 10 represent schematically and elongatedly still other antennas of this invention each including a radio frequency pre-amplifier; and

FIG. 11 represents a circuit diagram of one example of the radio frequency pre-amplifier.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIGS. 1 to 4, 1 shows the front glass of a car, 2 and 3 antenna elements provided on and/or in the front glass 1, specially 3 being an antenna portion for the reception of FM broadcasting, 4 a reactance element comprising a coil and/or an inductor, and 5 a feeder with one end connected to the FM antenna element 3 and to one terminal of the inductor 4, the other end of said feeder being connected to a car radio set 6. As stated above, the inductor may be preferably formed on and/or in the glass window by two-dimensional printing or coating to give a desirable inductance value.

In operation, in the case of the reception of AM broadcasting, the antenna elements 2 and 3 provided to the window glass are both active, so they will catch an
electric wave in the middle frequency band. It should be understood that, as mentioned above, the effective length of the antenna when AM broadcasting is received must be lengthened as much as possible. On the other hand, in the case of the reception of FM broadcasting, as stated above, in order to match the impedance of the antenna with that of the feeder (75Ω), only the antenna element 3 must be used. That is to say, in that case, the excess impedance is cancelled by means of the reactance element 4 interposed between the antenna element 2 and the feeder 5. It should be understood that the configuration of the antenna elements may be changed correspondingly to the shape of the glass window, for example.

FIGS. 5 and 6 show other embodiments of the glass antenna of the present invention. These glass antennas each is intended to specially enhance the efficiency of receiving AM broadcasting as compared with the above-mentioned examples. As understood from the Figures, these antennas each is provided with a first or FM antenna element 9 disposed vertically and substantially centrally of the glass window and a second antenna element 8 with two sets of auxiliary elements 8', said second antenna element having two opposed portions positioned adjacently to the edge portion of the window. Preferably, these antenna elements are provided to the rear window glass 7 of a car. Each of the two sets of auxiliary elements 8' is provided in the space defined by the respective portion of the second antenna element 8. In FIG. 5, the respective auxiliary element is substantially horizontal and has one end connected to the vertical segment of the second antenna element 8. In FIG. 6, the respective auxiliary element is substantially vertical, thus substantially in parallel with the FM antenna 9, and has two ends connected respectively to the horizontal segments of the second antenna 8.

In operation, in the case of the reception of AM broadcasting, the first and second antenna elements and the auxiliary elements are all active to receive an electric wave in the middle frequency band. In this case, by the function of the auxiliary elements 8', the antennas illustrated in FIGS. 5 and 6 are considerably increased in effective height thereof and enhance in antenna gain by several dB in comparison with the forms shown in FIGS. 2 to 4. In the case of the reception of FM broadcasting, as stated above, by means of the reactance element 10, only the first antenna element 9 acts to match the impedance thereof with that of the feeder 11.

In connection with the embodiment in FIG. 6, it has been described that the auxiliary elements are provided substantially in parallel with the FM antenna element. However, it should be noted that, to prevent an interaction between the FM antenna element and the auxiliary elements, the distance therebetween must be made long as much as possible, preferably more than 20 cm. Furthermore, the auxiliary elements may be inclined to the FM antenna by, for example, 5° to 20°, preferably 10° to 13°, by which the reception sensibility of the FM antenna is increased much more than in the case where the auxiliary elements are provided in parallel with the FM antenna element, and, also, the antenna gain is enhanced by about 3 to 5 dB as compared with the conventional whip antenna.

FIGS. 7 to 10 show still further embodiments of this invention wherein a first antenna conductor 15 for receiving FM broadcasting is provided vertically and substantially centrally of the glass window 13 of an automobile, and another or second antenna conductor 14 is provided so as to extend on one side (refer to FIGS. 9 and 10) or both sides (refer to FIGS. 7 and 8) with respect to said first conductor 15, said first conductor 15 being connected to said second conductor 14 through a reactance element 16, and, further, a radio frequency pre-amplifier 17 is provided connecting said two antenna elements to a radio receiver 19 through a feeder 18. Preferably, the second conductor or wire strip 14 will be disposed adjacent to the edge of the window glass 13. It is understood that each antenna conductor may be constructed of two or more conductive members. The preamplifier (17) is a solid state chip type integrated circuit and is provided adjacent to the feeding points of the antenna conductors 14 and 15. As shown in FIG. 10, this amplifier circuit may be provided on or in the glass 13.

In FIG. 11, one example of the circuit diagram of this solid state amplifier is illustrated, but, in place thereof, various other circuit forms will be used; therefore, this invention should not be limited by such circuit. The illustrated circuit 17 comprises a field effect transistor (FET), a coil (L1), capacitors (C3 - C4) and resistors (R1 - R4). The circuit constant is determined so as to compensate at least 6 to 10 dB corresponding to the reduced gain in comparison to the antenna gain of the whip antenna.

It is understood that the present invention is not restricted to the above described examples, but that it includes any other alternative embodiment deriving from the above indicated inventive concept.

We claim:

1. An antenna for a car radio set comprising in combination, a window glass disposed on a car; a first antenna element for reception of electric waves in FM broadcasting band and extending along said window glass substantially centrally and vertically, said first antenna element having at least one free end terminating at the upper portion of the glass and the other end connected to a first conductive terminal which is connected to a feeder from the car radio set within the car; a second antenna element for receiving AM broadcasting electric waves and extending along peripheral edge portions of said window glass, said second antenna element having one end connected to a second conductive terminal, said first and second conductive terminals being disposed at the lower end of the glass window; and an inductive element connected between said two conductive terminals.

2. The antenna of claim 1 further including a radio frequency amplifier inserted between the feeding point of said first antenna element and the feeder of the car radio set but adjacent to said feeding point.

3. The antenna of claim 2 wherein said high frequency amplifier is a solid state chip type integrated circuit.