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(54) Plane slot antenna.

(57) A plane slot antenna including a peripheral conducting surface (11), a central conducting surface (13) provided in the peripheral conducting surface with a space (21) in between, and a plurality of coaxial lines (20, 30). The cores (21, 31) of the coaxial lines are connected to the central conducting surface at different points thereof and outer skins (22, 32) of the coaxial lines are connected to the peripheral conducting surface. The antenna further includes a switch (40) provided between the coaxial lines and a signal receiver so that the switch changes a connection between one of the coaxial lines and the signal receiver so that the antenna receives signal of best possible strength and phase.

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A plane antenna

The present invention relates to a plane antenna which is installed in a horizontal portion such as roof, trunk lid, etc. of the body surface of an automobile, etc.

Antennas without projections are in demand as mobile antennas for use in automobiles, etc., since such antennas eliminate wind noise and improve the external appearance of the vehicle. In this respect, plane or flat plate for antennas are desirable.

One type of the plane antenna is a slot antenna. In this antenna, a portion of the antenna conductor is cut out in the form of a circle. In other words, the circle cut-out generally is made by uniformly cutting a spaced slots arranged in a circle.

In other words, in the slot antennas, a closed-circle slot is formed between a central conductor and a peripheral conductor. The core conductor of a coaxial cable is connected to the edge of the central conductor, and the outer skin of the coaxial cable is connected to the peripheral conductor, so that signals received by the antenna can be led out via the coaxial cable. Furthermore, the radiation pattern of a conventional device of this type has the form of a distorted figure eight.

However, in the conventional antenna of the above-mentioned type, the directionality (sensitivity) varies according to the position where the coaxial cable is connected (i. e., the signal extraction position). As a result, when the direction of motion of the vehicle (such as an automobile, etc.) changes, the sensitivity also changes. Accordingly, in cases where the direction of motion of the vehicle is frequently altered, there are frequent changes in the sensitivity. In the case of radio reception, etc., this makes the received signal difficult to hear.

In the present invention, two or more signal line lead-out positions are provided in a circular slot antenna, and signal is outputted through whichever position is favorable in terms of a specified condition.

In the present invention, since two or more signal line lead-out positions are provided, and signal is output through the best lead-out position in terms of a specified condition, the reception sensitivity is consistently stable even if the direction of motion of the vehicle is frequently changed.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is an explanatory diagram which illustrates one embodiment of the present invention.

In the circular slot antenna 10 shown in Fig. 1,

a central conductor or central conducting surface 13 is installed in the central portion of a peripheral conductor or peripheral conducting surface 11, and a closed-circle slot or space 12 is formed between the peripheral conductor 11 and central conductor 13. The areas shaded with diagonal lines in Fig. 1 indicate conductive parts.

The core conductor 21 of a first coaxial cable or coaxial line 20 is connected to the right edge of the central conductor 13 with respect to Fig. 1, and the outer skin 22 of the first coaxial cable 20 is connected to the peripheral conductor 11 in a position near the right edge of the central conductor 13. The core conductor 31 of a second coaxial cable or coaxial line 30 is connected to the lower edge of the central conductor 13 with respect to Fig. 1, and the outer skin 32 of the second coaxial cable 30 is connected to the peripheral conductor 11 in a position near the lower edge of the central conductor 13.

The core conductor 23 on the other end of the coaxial cable 20 and the core conductor 23 at the other end of the coaxial cable 30 are arranged so that switching between the two can be accomplished by means of a switch 40.

Furthermore, a detecting means (not shown) is provided so that it detects the strength and/or phase of the reception signal, and operates the switch 40 so that either the coaxial cable 20 or 30 which can provide the most favorable strength and/or phase is selected.

The circumference of the closed-circle slot 12 is set so that it is roughly equal to the wavelength of the reception signal.

The circular slot antenna 10 as a whole is made of a thin film. In use the antenna is bonded to a plastic trunk lid, etc., of an automobile.

In use, if the switch 40 is initially connected to the core conductor 33 of the coaxial cable 30 with the reception signal strength at a prescribed level or higher, and when the direction of motion of the automobile changes so that the strength of the reception signal traveling through the coaxial cable 30 drops below the prescribed level, then this drop in the signal strength is detected by the detecting circuit, and a control means (not shown) switches the switch 40 so that the reception signal is now sent to a receiver (not shown) via the coaxial cable 20. Afterward, if the strength of the signal sent via the coaxial cable 20 should drop, the switch 40 is then switched back to the coaxial cable 30, and the above-mentioned operation is repeated whenever necessary.

In the above description, the switch 40 is used in order to facilitate the description of the invention.

In actuality, however, the signal extraction position can be selected electronically as described below.

Specifically, a diode is connected to the core conductor 23 of the coaxial cable 20, and a bias is applied to this diode in forward and reverse directions. The system is arranged so that the signal traveling through the coaxial cable 20 passes through when a bias is applied, for example, in the forward direction. Furthermore, a diode is connected to the core conductor 33 of the coaxial cable 30 too, and is arranged so that passing or stopping of the reception signal can be selected by changing the application of the bias.

Furthermore, it is preferable to set the lengths of the coaxial cables 20 and 30 as extremely short. In other words, it is advantageous to install the diodes close to directly above the closed-circle slot 12. Thus, the transmission loss can be decreased. Of course, it is possible to install the diodes in positions which are not directly above the closed-circle slot 12. Furthermore, it would also be possible to select the signal extraction position electronically by some method other than that described above.

In the above description, though the switch 40 is arranged so as to be switched automatically, it would be possible to arrange for manual operation of the switch 40.

Furthermore, in the above-described embodiment, the core conductors 21 and 31 of the coaxial cables 20 and 30 were connected to the edge portions of the central conductor 13. reason for this is that the reception signal current is concentrated in the periphery or edge of the central conductor 13, especially in the case of the F frequency band, etc.

Furthermore, though in the embodiment, the closed-circle slot 12 is rectangular, the slot 12 could also be square, circular or elliptical in shape. Generally, the efficiency is better if the closed-circle slot is circular.

In addition, though the lead-out positions of the coaxial cables 20 and 30 are installed on the right edge and lower edge of the central conductor 13 with respect to Fig. 1, they can be provided on the left edge and upper edge of the central conductor 13. Moreover, it would also be possible to install more than two signal line lead-out positions or more than two coaxial cables. In such cases as well, the output would be extracted from whichever position is favorable in order to attain the best possible strength and/or phase of the reception signal.

Thus, according to the present invention, a reception sensitivity remains stable even if the direction of motion of the vehicle in question is frequently altered.

Claims

1. A plane antenna of the type of a circular slot antenna, characterized in that two or more signal line lead-out positions are provided and an output is extracted from whichever position is favorable in terms of a specified condition.
2. A plane antenna according to claim 1, characterized in that said specified condition is the strength or phase of the reception signal.
3. A plane antenna according to claim 1, characterized in that selection of one of said two or ore lead-out positions is accomplished electronically.
4. A plane slot antenna characterized by comprising:
 - a peripheral conducting surface (11);
 - a central conducting surface (13) provided in said peripheral conducting surface with a space (21) in between;
 - a plurality of coaxial lines (20, 30), core conductors (21, 31) of said coaxial lines connected to said central conducting surface at different points on said central conducting surface and outer skins (22, 32) of said coaxial lines, connected to said peripheral conducting surface; and
 - a switching means (40) provided between said coaxial lines and a signal receiver, said switching means switching a connection between one of said coaxial lines and said signal receiver depending upon the strength and phase of received signal.
5. A plane slot antenna according to claim 4, characterized by further comprising a detecting means detecting said strength and phase of said received signal so that said switching means switches said connection between said coaxial lines and said signal receiver.

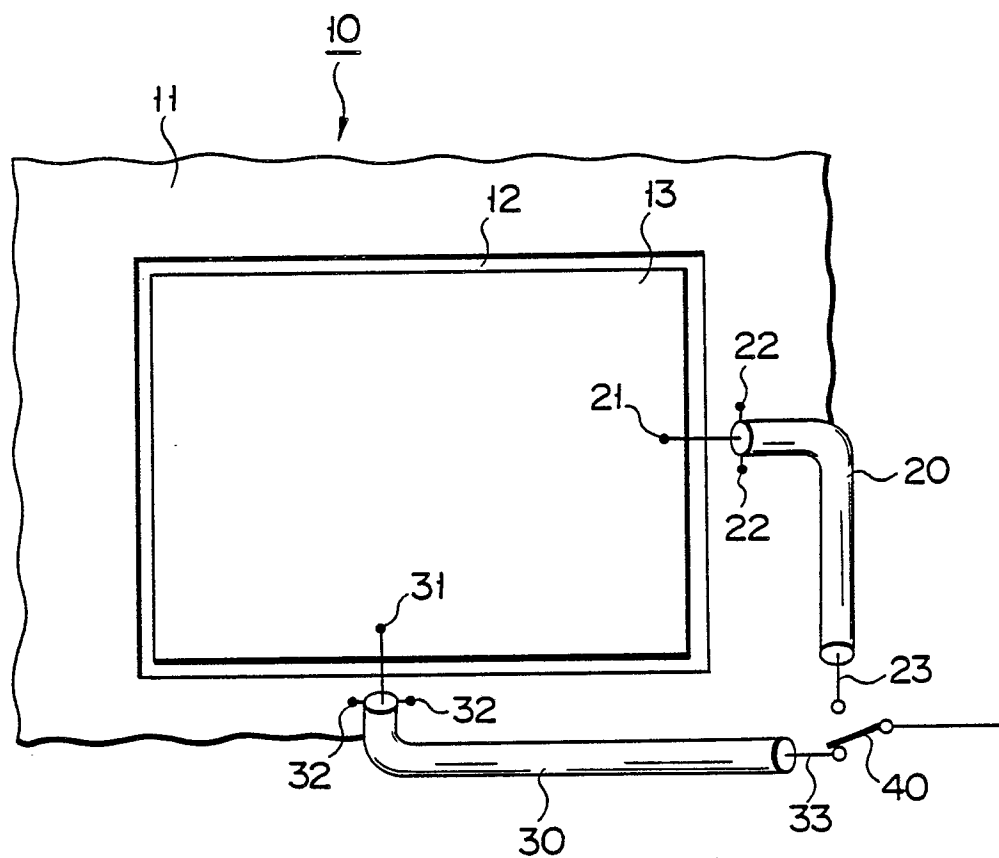


FIG. 1