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(54) **ANTENNA ELEMENT ATTACHING STRUCTURE**

(57) An antenna element installation structure designed so prevent the antenna element from being detached from the antenna base unit. A tapered projecting section 13b having an enlarging diameter is provided at the front end of a coupling extension section 13a extending from the lower end of an element installation screw section 13 provided at the lower end of an element base unit 12 of the antenna element. When a

screw section 13e of the element base section 12 is screwed to a hot fixture 20, the tapered projecting section 13b passes through a push nut 22 and engages with the push nut 22. Thereby, the antenna element cannot be detached inadvertently from the antenna cover 3a of the antenna base unit. The push nut 22 is fixed freely inside the antenna installation section 10 by means of a hot fixture 20 and a metal fixture 21.

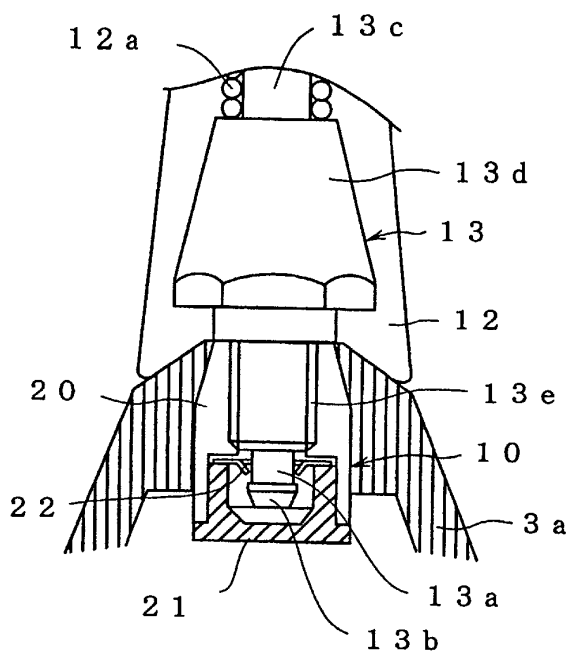


FIG. 8

Description

TECHNICAL FIELD

[0001] The present invention relates to an antenna element installation structure, and is particularly suitable for a vehicle antenna.

BACKGROUND ART

[0002] Various types of antennas are used for installation in vehicles, but the reception sensitivity can be increased by installing the antenna on the roof, which is the highest position of the vehicle. Therefore, conventionally, vehicle antennas installed on the roof of a vehicle have been used. Moreover, since both an FM radio and an AM radio are provided in the vehicle, it is convenient to have an antenna capable of receiving both an FM radio waveband and an AM radio waveband, and therefore, in general, a vehicle antenna is capable of receiving both radio wavebands.

[0003] In a vehicle antenna of this kind, an antenna element 100 as illustrated in Fig. 10(a) is affixed by screw fixing to an antenna base unit 103 as illustrated in Fig. 11. The antenna element 100 illustrated in Fig. 10(a) is constituted by a flexible element base section 112 which is capable of bending when it receives a load in a lateral direction, a whip element 111 extending from the element base section 112, and an antenna top 111a provided on the front end of the whip element 111. A coil may be provided inside the element base section 112, in such a manner that the antenna element 100 can operate at multiple frequencies, due to the action of this coil. In order to prevent wind noise, which is liable to occur when the vehicle is travelling at high speed, a helical-shaped projection is formed on the whip element 111. Moreover, an element installation screw section 113 is formed projecting from the lower end of the element base section 112, in order to screw the antenna element 100 to the antenna base unit 103. This element installation screw section 113 also supplies electricity to the antenna element 100.

[0004] Fig. 10(b) shows the detailed composition of an element installation screw section 113. As shown in the diagram, the element installation screw section 113 is constituted by a main section 113d, and upper projecting section 113c, and a screw section 113e. The upper projecting section 113c is a projection having an approximately circular cross-section, onto which a coil provided in the element base section 112 is screwed, and the main section 113d has a tapered shape overall, the lower end thereof being formed in a hexagonal shape. Furthermore, the screw section 113e is formed as a screw section which is screwed to an antenna installation section 110 of the antenna base unit 103. This element installation screw section 113 is formed integrally as an insert when the element base section 112 is formed, and is prevented from rotating with respect to

the element base section 112 by means of the hexagonal section of the main section 113d.

[0005] The antenna base unit 103 illustrated in Fig. 11 is constituted by an antenna cover 103a made from resin and an open lower section, and a metallic antenna base 105 affixed so as to cover the open face of the antenna cover 103a. A circuit board 109 is accommodated inside the antenna base unit 103, and a frequency dividing circuit and an amplifying circuit for amplifying the frequency-divided reception signals are incorporated into the circuit board 109. The circuit board 109 is fixed by soldering, or the like, to an earthing fixture (not illustrated), this earthing fixture being fixed to the upper face of the antenna base 105. A signal cable 106 for carrying received signals and a power cable 107 for supplying power to the circuit board 109 are connected from the antenna base unit 103. Furthermore, an installation section is formed integrally in a projecting fashion on the lower face of the antenna base 105 in order to install the antenna base unit 103 onto the vehicle roof, by being inserted into a through hole formed in the roof and fastened by an installation nut from inside the vehicle. Moreover, a flexible rubber or resin pad 104 is fitted beneath the antenna base unit 103 in such a manner that the antenna base unit 103 can be installed on the roof in a water-tight fashion, and without causing damage to the roof. Furthermore, an O-ring 108 is installed on the base part of the installation section projecting from the lower face of the antenna base 105, thereby preventing infiltration of water inside the vehicle.

[0006] The metallic antenna installation section 110 is formed as an insert on the antenna base unit 103, and the element installation screw section 113 of the antenna element 100 is screwed detachably onto this antenna installation section 110. Fig. 12 shows a half section of the detailed composition of the antenna installation section 110. As shown in this diagram, the antenna installation section 110 is constituted by a hot fixture 120 formed with a hole in the centre thereof. A screw section 120b is formed on the inner face of the hole provided in the hot fixture 120, in such a manner that the element installation screw section 113 of the antenna element 100 can be screwed therein. Moreover, a knurled section 121c is formed on the outer face thereof, so as to be in tight contact with the antenna cover 103a when the insert is formed.

[0007] However, in a conventional vehicle antenna, the antenna element 100 is fixed to the antenna installation section 110 of the antenna base unit 103 by screw fixing. In other words, the antenna element 100 is fixed detachably to the antenna base unit 103. Therefore, problems arise in that the antenna element 100 may fall off if the screwing thereof becomes loose, or the antenna element 100 may be unfastened from the antenna base unit 103 and stolen.

[0008] Consequently, it is an object of the present invention to provide an antenna element installation structure whereby unintentional detachment of an antenna

element from a antenna base unit is prevented, when an antenna element is installed on an antenna base unit.

DISCLOSURE OF THE INVENTION

[0009] In order to achieve the aforementioned object, the antenna element installation structure according to the present invention is characterized in that it comprises, at the least: an antenna element provided with an element installation screw section on the lower end thereof; and an antenna base unit provided with an antenna installation section into which the element installation screw section screws; a coupling extension section 13a formed with a tapered projecting section at the front end thereof being provided in extending fashion at the lower end of the element installation screw section, and the coupling extension section being inserted into a push nut incorporated into the antenna installation section, when the element installation screw section is screwed to the antenna installation section, in such a manner that the tapered projecting section couples with the push nut.

[0010] Moreover, in the antenna element installation structure according to the present invention, it is also possible that the antenna installation section comprises a hot fixture provided with a screw section in a through hole into which the element installation screw section is screwed, and a metal fixture fitted to the lower portion of the hot fixture; and the push nut, when positioned against a step section formed in the through hole in the hot fixture, is situated in a space formed by the step section and the front end face of a ring-shaped projecting section formed on the metal fixture.

[0011] Furthermore, in the antenna element installation structure according to the present invention described above, it is possible that the diameter of the through hole formed in the push nut is greater than the diameter of the coupling extension section, and is smaller than the diameter of the tapered projecting section.

[0012] According to the present invention described above, when the element installation screw section of the antenna element is installed on the antenna installation section of the antenna base unit, the tapered projecting section formed on the element installation screw section is inserted into the push nut incorporated in the antenna installation section, in such a manner that the tapered projecting section couples with the push nut. Thereby, even if the antenna .. element is turned in the reverse direction so as to detach the antenna element from the antenna base unit, the antenna element cannot be detached inadvertently from the antenna base unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1 shows the composition of a vehicle antenna which adopts the antenna element installation

structure according to the present invention;

Fig. 2 is a plan view showing the composition of an antenna base unit in a vehicle antenna relating to the present invention;

Fig. 3(a) is an upper view showing the composition of an antenna base unit in a vehicle antenna relating to the present invention;

Fig. 3(b) is a lower view showing the composition of an antenna base unit in a vehicle antenna relating to the present invention;

Fig. 4 is a cross-section showing the composition of an antenna base unit in a vehicle antenna relating to the present invention;

Fig. 5 is a half-sectional view showing the composition of an antenna installation section of an antenna base unit in a vehicle antenna relating to the present invention;

Fig. 6(a) is a plan view showing the composition of an antenna element in a vehicle antenna relating to the present invention;

Fig. 6(b) is a lower face view showing the composition of an antenna element in a vehicle antenna relating to the present invention;

Fig. 7(a) is a plan view showing the composition of an element installation screw section of an antenna element in a vehicle antenna relating to the present invention;

Fig. 7(b) is a lower face view showing the composition of an element installation screw section of an antenna element in a vehicle antenna relating to the present invention;

Fig. 8 is a sectional view showing a state where an antenna element is installed on an antenna base unit in a vehicle antenna relating to the present invention;

Fig. 9(a) is a plan view showing the composition of a push nut of an antenna base unit in a vehicle antenna relating to the present invention;

Fig. 9(b) is a side view showing the composition of a push nut of an antenna base unit in a vehicle antenna relating to the present invention;

Fig. 10(a) and Fig. 10(b) are diagrams showing the composition of an antenna element and an element installation screw section in a conventional vehicle antenna;

Fig. 11 is a sectional view showing the composition of an antenna base unit in a conventional vehicle antenna; and

Fig. 12 is a half-sectional view showing the composition of an antenna installation section of an antenna base unit in a conventional vehicle antenna.

BEST MODE FOR CARRYING OUT THE INVENTION

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[0014] An embodiment of an antenna element installation structure according to the present invention is described now by describing a vehicle antenna adopting the antenna element installation structure according to

the present invention.

[0015] Fig. 1 shows the composition of a vehicle antenna adopting the antenna element installation structure according to the present invention. The vehicle antenna shown in Fig. 1 is an antenna to be attached to the roof of a vehicle. The vehicle antenna is constituted by an antenna element 1 and an antenna base unit 3 on which the antenna element 1 is installed. The antenna element 1 is constituted by a flexible element base section 12 which is capable of bending when subjected to a load in a lateral direction, a whip element 11 extending from the element base section 12, and an antenna top 11a provided on the front end of the whip element 11.

[0016] An extension coil is provided inside the element base section 12, in such a manner that the antenna element 1 is able to operate at multiple frequencies due to the action of the extension coil. A helical projection for preventing wind noise which is liable to occur when travelling at high speed is formed on the whip element 11. Moreover, although not shown in the drawings, an element installation screw section for screw fastening the antenna element to the antenna base unit 3 is formed in a projecting fashion on the lower end of the element base section 12. This element installation screw section also serves to supply electric power to the antenna element 1.

[0017] The antenna base unit 3 comprises an antenna cover made from resin, and a metallic antenna base 5 affixed to the bottom portion thereof, and it is capable of accommodating a circuit board therein. A frequency dividing circuit and an amplifier circuit for amplifying the frequency-divided reception signal is incorporated into the circuit board. An installation section is formed integrally in a projecting fashion on the lower face of the antenna base 5 in order to attach the antenna base unit 3 to the vehicle roof by being inserted into a through hole formed in the roof and being fastened by an installation nut from inside the vehicle. Moreover, cables for carrying a received signal and for supplying power to the circuit board are connected to the circuit board. A flexible rubber or resin pad 4 is fitted to the lower portion of the antenna base unit 3 in order to install the antenna base unit 3 on the roof in a water-tight fashion, without damaging the roof.

[0018] Fig. 2 to Fig. 4 shows the composition of the antenna base unit 3. Fig. 2 is a plan view of the antenna base unit 3; Fig. 3(a) is an upper face view thereof; Fig. 3(b) is a lower face view thereof; and Fig. 4 is a sectional view along the centre of antenna base unit 3.

[0019] As shown in these diagrams, the antenna base unit 3 is constituted by a resin antenna cover 3a having an open lower section, and a metal antenna base 5 affixed so as to cover the open face of the antenna cover 3a. A circuit board 9 is accommodated inside the antenna base unit 3, and a frequency dividing circuit and an amplifier circuit for amplifying a frequency divided reception signal are incorporated in the circuit board 9. The circuit board 9 is affixed by soldering, or the like, to

an earthing fixture (not illustrated), and the earthing fixture is affixed to the upper face of the antenna base 5. A signal cable 6 for carrying received signals, and a power supply cable 7 for supplying power to the circuit board 9 are provided leading from the circuit board 9 via a through hole in the installation section 5a formed in the lower face of the antenna base 5. Moreover, a flexible rubber or resin pad 4 is fitted to the lower portion of the antenna base unit 3 in such a manner that the antenna base unit 3 is attached to the vehicle roof in a water-tight fashion, without causing damage to the roof. Furthermore, an O-ring 8 is installed on the base of the installation section projecting from the lower face of the antenna base 5, thereby preventing infiltration of water inside the vehicle.

[0020] A metallic antenna installation section 10 is formed as an insert on the upper portion of the antenna cover 3a constituting the antenna base unit 3. The antenna element 1 is installed by screw fastening onto the antenna installation section 10. The characteristic feature of the antenna element installation structure according to the present invention lies in the antenna installation section 10 and the element installation screw section 13 (see Fig. 6) which is provided on the lower end of the antenna element 1.

[0021] Fig. 5 shows a half-sectional view of the detailed composition of an antenna installation section 10. As shown in this diagram, the antenna installation section 10 comprises a hot fixture 20, a metal fixture 21 fitted to the lower end of the hot fixture 20, and a push nut 22 which is gripped freely between the hot fixture 20 and the metal fixture 21. The hot fixture 20 is formed in an approximately circular shape, the outer circumference thereof being formed with a knurled section 21c, in such a manner that it fits tightly into the antenna cover 3a during insert forming. A screw section 20b is provided on the inner circumference of the through hole in such a manner that the antenna element 1 can be screwed therein.

[0022] A step section is formed in the inner circumference of the through hole of the hot fixture 20, the lower portion thereof being formed into a ring section 20a having an enlarged inner diameter. A ring-shaped projecting section 21a formed in a projecting fashion from one face of the metal fixture 21 is fitted onto the ring section 20a. In this operation, the front end of the ring section 20a of the hot fixture 20 confronts a collar section 21b of the metal fixture 21 and is restricted in position thereby. This fixing is achieved by pressure fitting, but it is also possible to use screw fastening by providing screw threads in the respective members. When the metal fixture 21 is fitted at the lower end of the hot fixture 20, the push nut 22 is positioned in the step section in the through hole of the hot fixture 20, and therefore the push nut 22 can be inserted inside the antenna installation section 10 by fitting of the metal fixture 21. The push nut 22 is accommodated inside a space formed by the step section of the hot fixture 20 and the ring-shaped projection

21a of the metal fixture 21, and hence it is fixed to the antenna installation section 10 in a free state. Thereby, central misalignment of the antenna installation section 10 and the push nut 22 can be absorbed.

[0023] Fig. 9 shows the detailed composition of a push nut 22. However, Fig. 9(a) is a plan view of a push nut 22, and Fig. 9(b) is a side view thereof. As shown in the diagrams, the metallic push nut 22, which has elasticity, is constituted by a circular disc-shaped main section 22a having a through hole 22d. A plurality of cutaway section 22c are provided in a radial direction from the through hole in the circular disc-shaped main section 22d. Due to the cutaway sections 22c, the perimeter section of the through hole 22d is divided into six pieces, and these pieces are formed into a plurality of bend sections 22b which are bent downwards by several ten degrees and inclined in a manner surrounding the through hole 22d.

[0024] Fig. 6 shows the detailed composition of the antenna element 1. However, Fig. 6(a) is a plan view of the antenna element 1, and Fig. 6(b) is a lower face view thereof.

[0025] As shown in the diagrams, the antenna element 1 is constituted by a flexible element base section 12 which is capable of bending when subjected to a load from a lateral direction, a whip element 11 extending from the element base section 12, and an antenna top 11a provided on the front end on the whip element 11. An extension coil can be incorporated inside the element base section 12, and an element installation section 13 is fitted at the lower end of the extension coil. A coupling extension section 13a as described hereinafter is provided at the lower end of the element installation screw section 13. Furthermore, the antenna element 1 is able to operate at multiple frequencies, due to the action of the extension coil. The extension coil and element installation screw section 13 are formed as inserts in the element base section 12. Moreover, a helical projection is formed on the whip element 11, as shown in the diagram, in order to prevent wind noise which is liable to occur when travelling at high speed.

[0026] The element installation screw section 13 is a characteristic feature of the antenna element installation structure according to the present invention, and the detailed composition thereof is illustrated in Fig. 7, wherein Fig. 7(a) is a front view of the element installation screw section 13 and Fig. 7(b) is a lower face view thereof.

[0027] As shown in these diagrams, the element installation screw section 13 is constituted by a main section 13d, an upper projecting section 13c, a screw section 13e, a coupling extension section extending from the lower end of the screw section 13e, and a tapered projecting section 13b having an expanding diameter formed on the front end of the coupling extension section 13a. The upper projecting section 13c formed on the upper end of the main section 13d is a projection of approximately circular cross-section, onto which the extension coil incorporated into the element base section

12 is fitted, and the main section 13d is formed with an overall taper shape, the lower end thereof being formed in a hexagonal shape. Furthermore, the screw section 13e formed at the lower end of the main section 13d is a screw section into which the screw section 20b of the hot fixture 20 in the antenna installation section 10 is screwed. The element installation screw section 13 is formed integrally when the element base section 12 is formed, and is prevented from turning with respect to the element base section 12 by the hexagonal portion of the main section 13d.

[0028] When the antenna element 1 is installed on the antenna base unit 3, the element installation screw section 13 of the antenna element 1 is screwed into the antenna installation section 10 of the antenna base unit 3. In this case, the tapered projecting section 13b formed at the lower end of the element installation screw section 13 confronts the bend sections 22b of the push nut 22, causes the bend sections 22b to expand, and thus penetrates inside the push nut 22. A state where an antenna element 1 is installed on the antenna base unit 3 in this way is illustrated by the sectional diagram shown in Fig. 8. As shown in Fig. 8, the coupling extension section 13a formed extending from the screw section 13e is positioned inside the through hole 22d of the push nut 22. The inner diameter of this through hole 22d is formed larger than the diameter of the coupling engagement section 13a and smaller than the diameter of the tapered projecting section 13b.

[0029] Thereby, even if the screw fastening is undone by rotating the element installation screw section 13 in the reverse direction with respect to the antenna installation section 10, the front ends of the plurality of bend sections 22b surrounding the through hole 22d of the push nut 22 will engage with the interface between the tapered projecting section 13b of enlarged diameter and the coupling extension section 13a. Consequently, the antenna element 1 cannot be detached inadvertently from the antenna base unit 3, even if such detachment is attempted. Moreover, if the antenna element 1 is pulled strongly when in a coupled state, then the front ends of the bend sections 22b will press against the upper side of the coupling face, thereby causing the diameter of the through hole 22d of the push nut 22 to contract further. Therefore, it is possible to prevent detachment more reliably.

[0030] In the antenna element installation structure according to the present invention, an antenna element 1 provided with an element installation screw section 13 formed with a coupling extension section 13a and a tapered projecting section 13b is installed on an antenna base unit 3, but it is also possible to install an antenna element 100 provided with an element installation screw section 113 which is not formed with a coupling extension section 13a or tapered projecting section 13b, as illustrated in Fig. 10. By so doing, it is possible to make the antenna element 100 detachable with respect to the antenna base unit 3.

[0031] In the antenna element installation structure relating to the present invention, the antenna element 1 was taken to be a dual-frequency antenna for AM and FM waveband reception, but it is also possible to adopt a triple-frequency antenna which also incorporates telephone- waveband reception. 5

INDUSTRIAL APPLICABILITY

[0032] As described above, according to the present invention, when the element installation screw section of the antenna element is installed on the antenna installation section of the antenna base unit, a tapered projecting section formed on the element installation screw section is inserted inside a push but built into the antenna installation section, in such a manner that the tapered projecting section is coupled to the push nut. Thereby, even if the antenna element is turned in the reverse direction so as to detach the antenna element from the antenna base unit, the antenna element cannot be detached inadvertently from the antenna base unit. 10 15 20

Claims

1. An antenna element installation structure, comprising, at the least: 25

an antenna element provided with an element installation screw section on the lower end thereof; and 30

an antenna base unit provided with an antenna installation section into which said element installation screw section screw is screwed ; 35

wherein a coupling extension section 13a formed with a tapered projecting section at the front end thereof is provided in extending fashion at the lower end of said element installation screw section, and said coupling extension section is inserted into a push nut incorporated in said antenna installation section, when said element installation screw section is screwed to said antenna installation section, in such a manner that said tapered projecting section couples with said push nut. 40 45

2. The antenna element installation structure according to claim 1, **characterized in that** said antenna installation section comprises a hot fixture provided with a screw section in a through hole into which said element installation screw section is screwed, and a metal fixture fitted to the lower portion of said hot fixture; and said push nut which is positioned at a step section formed in said through hole in said hot fixture, is situated in a space formed by said step section and the front end face of a ring-shaped projecting section formed on said metal fixture. 50 55

3. The antenna element installation structure according to claim 1, **characterized in that** the diameter of the through hole formed in said push nut is greater than the diameter of said coupling extension section, and is smaller than the diameter of said tapered projecting section.

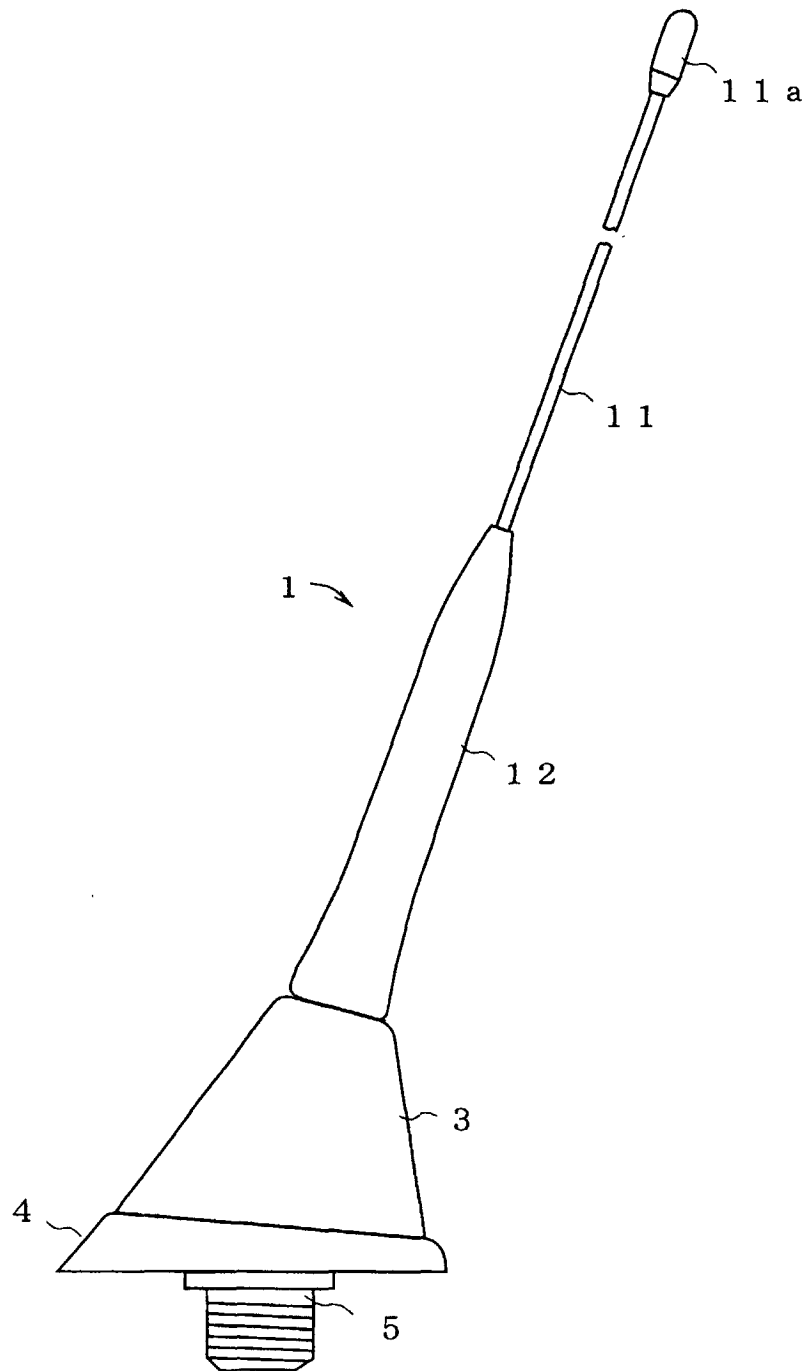


FIG. 1

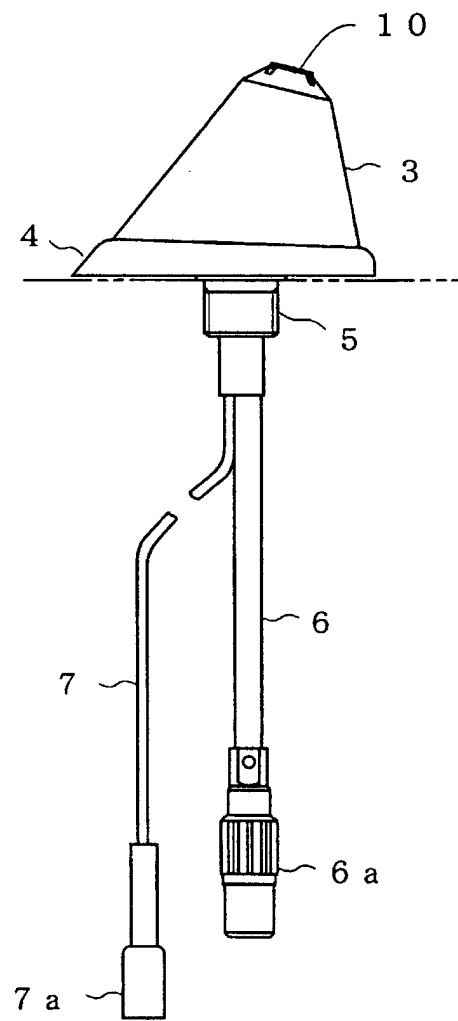


FIG. 2

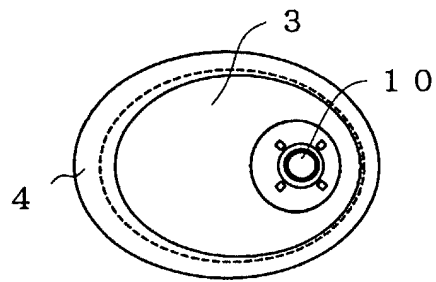


FIG. 3(a)

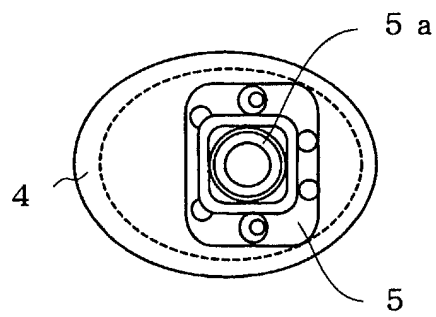


FIG. 3(b)

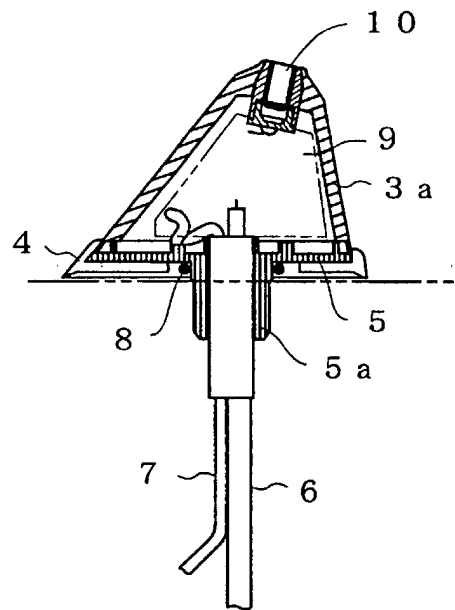


FIG. 4

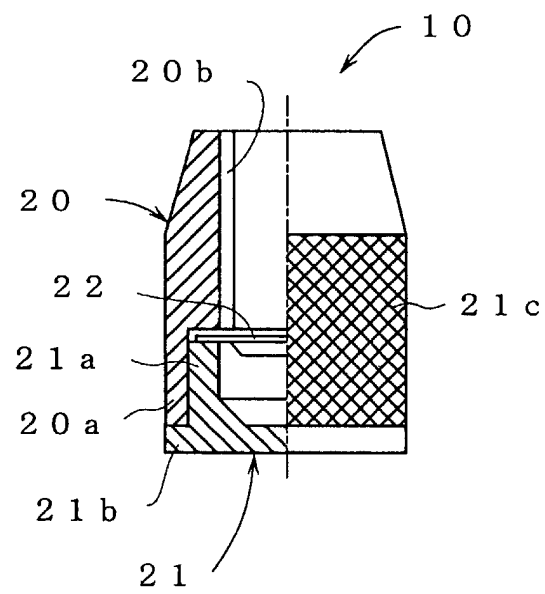


FIG. 5

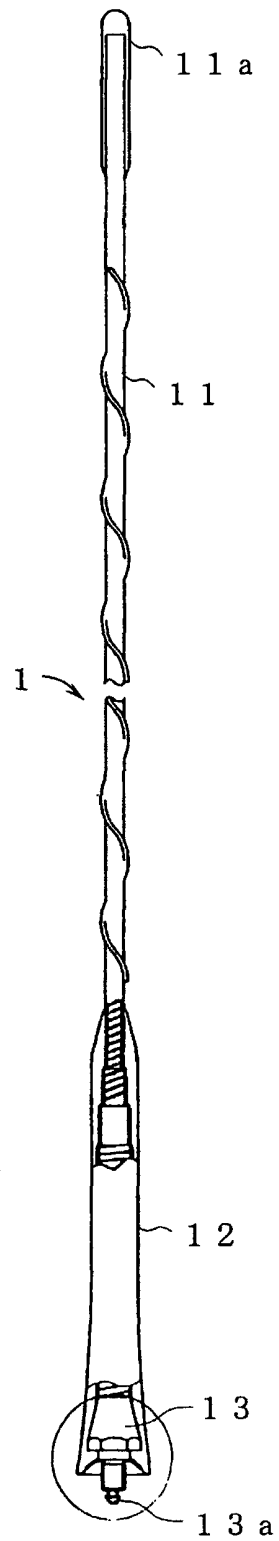


FIG. 6(a)

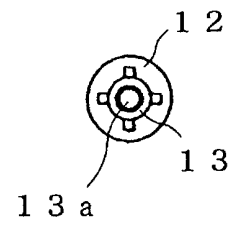


FIG. 6(b)

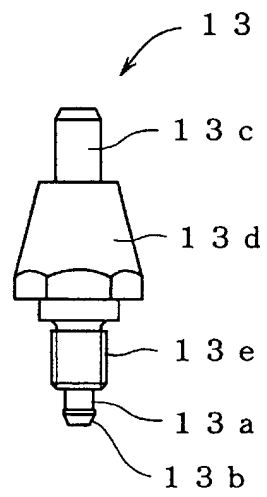


FIG. 7(a)

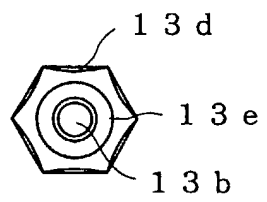


FIG. 7(b)

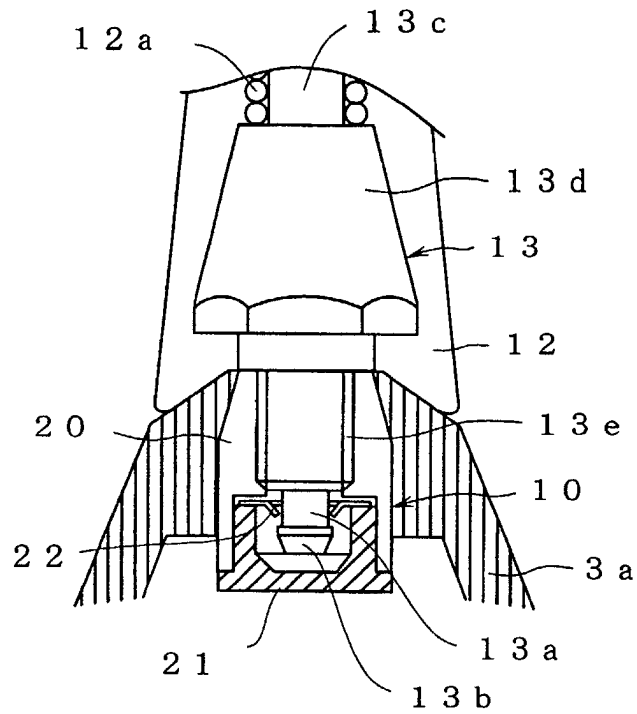


FIG. 8

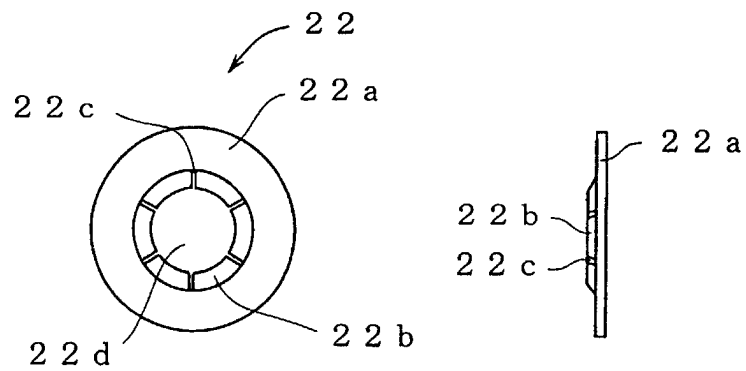


FIG. 9(a)

FIG. 9(b)

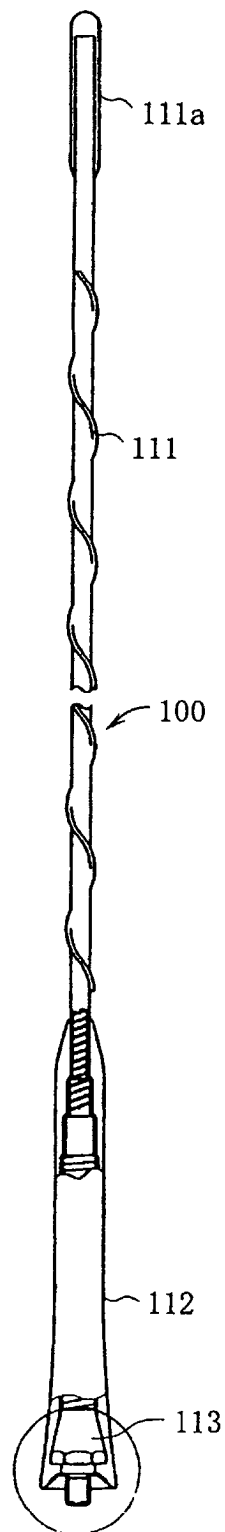


FIG. 10(a)

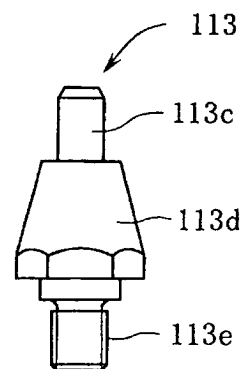


FIG. 10(b)

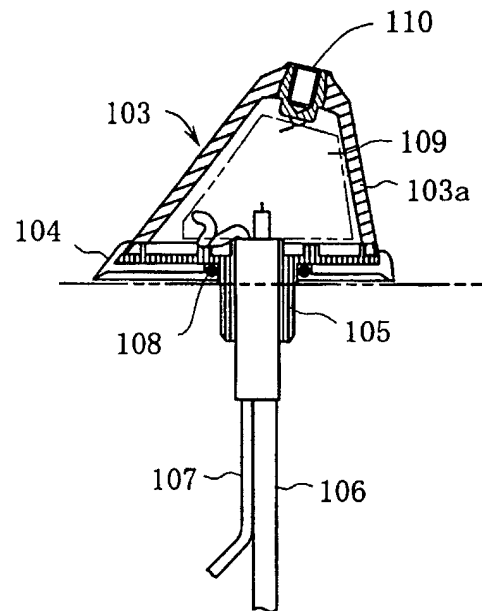


FIG. 11

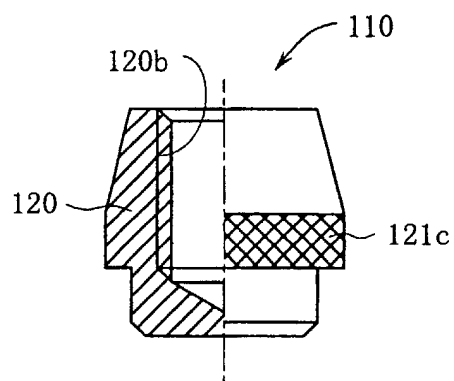


FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/11346

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl.⁷ H01Q1/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl.⁷ H01Q1/22, F16B39/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Toroku Jitsuyo Shinan Koho	1994-2002
Kokai Jitsuyo Shinan Koho	1971-2002	Jitsuyo Shinan Toroku Koho	1996-2002

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2000-252722 A (Yokowo Co., Ltd.), 14 September, 2000 (14.09.2000), Par. No. [0024]; Figs. 2, 4 (Family: none)	1-3
Y	JP 2000-295017 A (Yokowo Co., Ltd.), 20 October, 2000 (20.10.2000), Par. No. [0016]; Figs. 1, 4 (Family: none)	1-3
Y	JP 2000-508085 A (Huma GmbH), 27 June, 2000 (27.06.2000), page 4, lines 3 to 6; Figs. 2, 3 & WO 97/37268 A & US 6086201 A	1-3
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 76129/1982 (Laid-open No. 179526/1983), (Nippon Seiki Co., Ltd.), 01 December, 1983 (01.12.1983), page 10, line 15 to page 13, line 2; Fig. 3	1-3

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search
08 February, 2002 (08.02.02)Date of mailing of the international search report
26 February, 2002 (26.02.02)Name and mailing address of the ISA/
Japanese Patent Office

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/11346

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, Y	JP 2001-241424 A (Hamanaka Nut K.K.), 07 September, 2001 (07.09.2001), Par. Nos. [0042] to [0044]; Fig. 6 (Family: none)	1-3

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