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(54) Three-wave receiving antenna apparatus

(57) In a three-wave receiving apparatus mounted on, e.g. a vehicle, a GPS wave receiving antenna (20) capable of receiving GPS waves from a satellite is integrally mounted in an attachment base (F) of an AM/FM wave receiving antenna (10, 30, 50) capable of receiving AM waves and FM waves. Thus, three waves, i.e. an AM wave, an FM wave and a GPS wave can be received selectively. It is desirable that the GPS wave receiving antenna (20) be contained within the attachment base (F) in the state in which a disk-like antenna body (21) and an amplifier (22) connected to the antenna body (21) are integrally contained in a holding case (23).

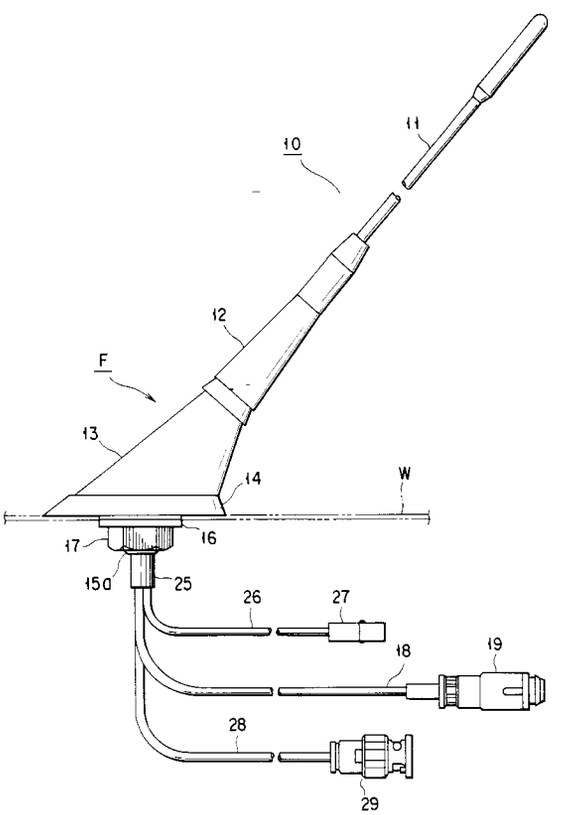

FIG. 1

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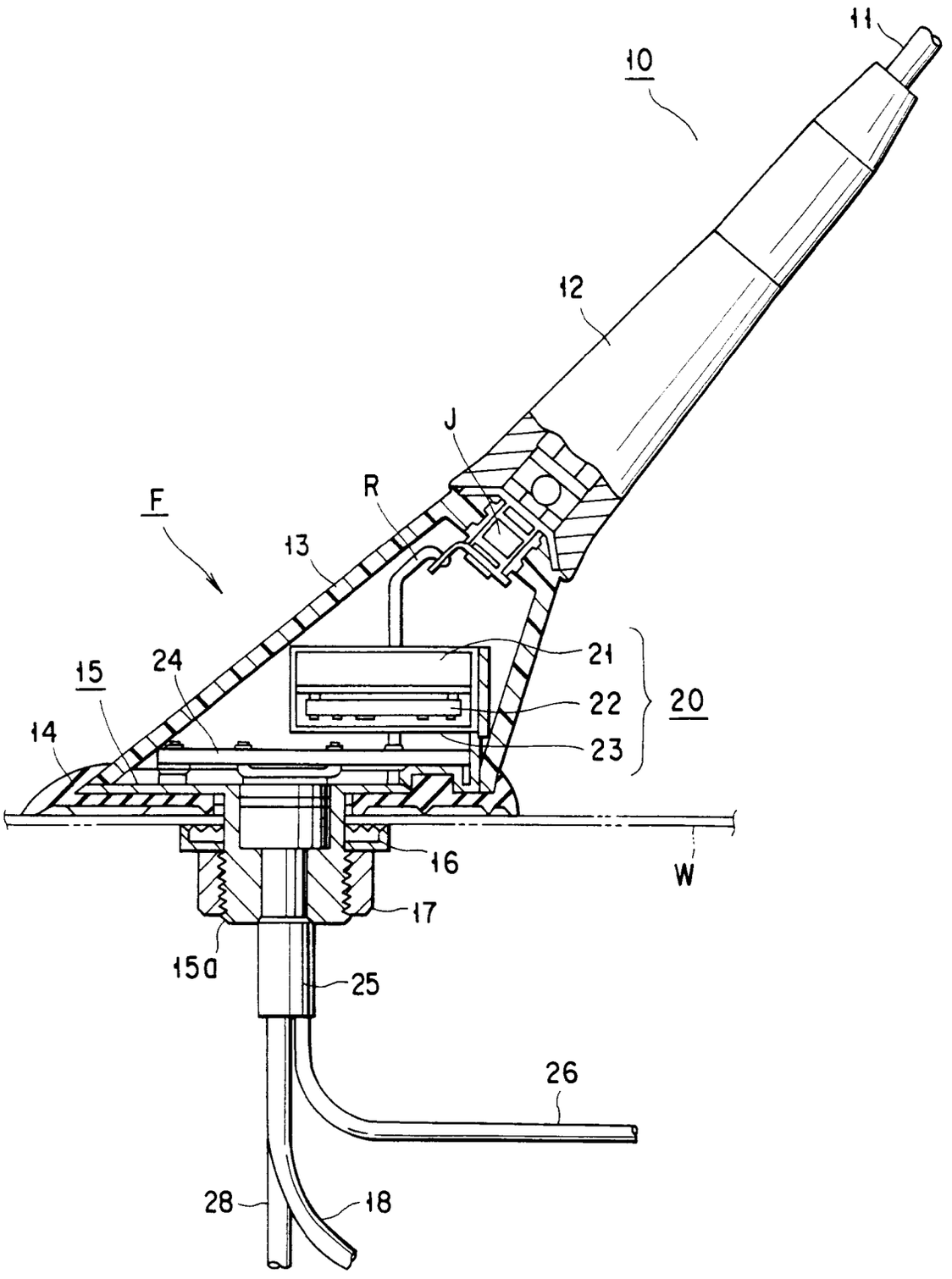

FIG. 2

Description

The present invention relates to an integrated antenna apparatus comprising an AM/FM wave receiving antenna capable of receiving an amplitude-modulated radio wave (hereinafter referred to as "AM wave") and a frequency-modulated radio wave (hereinafter "FM wave") and a GPS wave receiving antenna capable of receiving a wave transmitted via a satellite (hereinafter referred to as GPS (Global Positioning System) wave), the integrated antenna apparatus being suitable for, e. g. a vehicle antenna apparatus.

It is technically possible, needless to say, to attach a GPS wave receiving antenna to a predetermined position on an object such as an automobile. However, with recent development of portable telephones, etc., various antennae, such as an AM/FM wave receiving antenna, an antenna for an automobile radio telephone and an automobile TV antenna, are attached to, e.g. the body of an automobile.

Thus, under the circumstances, it is difficult to provide an installation space for additionally attaching the GPS wave receiving antenna, and the work for attaching the GPS wave receiving antenna is complex and time-consuming. In the case of the automobile, the external appearance thereof may be deteriorated. Furthermore, since the number of antennae projecting out of the automobile body increases, the possibility of accidents due to contact with outside objects may increase.

The object of the present invention is to provide the following three-wave receiving antenna apparatuses:

(a) A three-wave receiving antenna apparatus capable of receiving an AM wave, an FM wave and a GPS wave, which apparatus can easily be attached to an object such as a vehicle, without deteriorating the external appearance of a vehicle, etc. or increasing possibility of accidents due to contact between the antenna and external objects; and
(b) A three-wave receiving antenna apparatus whereby the presence of a GPS wave receiving antenna is not known to a third person and high weatherability of the GPS wave receiving antenna is ensured.

In order to achieve the object, the three-wave receiving antenna of the present invention has the following structures:

(1) A three-wave receiving antenna apparatus wherein a GPS wave receiving antenna capable of receiving GPS waves is integrally mounted in an attachment base of an AM/FM wave receiving antenna capable of receiving AM waves and FM waves;
(2) The apparatus according to above (1), wherein the AM/FM wave receiving antenna is a vehicle antenna having a rod antenna element, and the GPS wave receiving antenna is contained in a casing of a hollow attachment base holding a proximal end portion of the rod antenna element; and
(3) The apparatus according to above (2), wherein the GPS wave receiving antenna is contained in a hollow portion of the attachment base in the state in which a disk-like antenna body and an amplifier connected to the antenna body are integrally contained in a holding case.

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 a side view schematically showing the structure of a three-wave receiving antenna apparatus according to a first embodiment of the invention;
FIG. 2 is a side view showing, in partial cross section, a main part of the three-wave receiving antenna apparatus according to the first embodiment of the invention;
FIG. 3 is a side view schematically showing the structure of a three-wave receiving antenna apparatus according to a second embodiment of the invention;
FIG. 4 is a side view showing, in partial cross section, a main part of the three-wave receiving antenna apparatus according to the second embodiment of the invention;
FIG. 5 is a side view schematically showing the structure of a three-wave receiving antenna apparatus according to a third embodiment of the invention;
FIG. 6 is a side view showing, in partial cross section, a main part of the three-wave receiving antenna apparatus according to the third embodiment of the invention;
FIG. 7 shows actual measurement data of VSWR characteristics of the GPS wave receiving antenna in the embodiments of the invention;
FIG. 8 shows actual measurement data of gain characteristics of the GPS wave receiving antenna in the embodiments of the invention; and
FIG. 9 shows actual measurement data of directivity of the GPS wave receiving antenna in the embodiments of the invention.

(First Embodiment)

FIGS. 1 and 2 show the structure of a three-wave receiving antenna according to a first embodiment of the present invention, which is applied to a vehicle roof antenna. FIG. 1 is a side view showing the entire apparatus, and FIG. 2 is a side view showing a main part of the apparatus in partial cross section.

In FIGS. 1 and 2, reference numeral 10 denotes an AM/FM wave receiving antenna for a vehicle, which can receive AM waves and FM waves. The antenna 10 com-

prises a rod antenna element 11 and a holding portion 12 for stably holding a proximal end portion of the rod antenna element 11. The holding portion 12 is coupled to a top portion of an attachment base F. The attachment base F functions to fix the proximal end portion of the rod antenna element 11 of the AM/FM wave receiving antenna 10 to a vehicle wall W. The attachment base F comprises structural elements described below.

Specifically, the attachment base F comprises a hollow-conical resin casing 13 formed of a resin with a relatively low dielectric constant; a rubber pad 14 fitted on a bottom opening end formed obliquely at a bottom portion of the resin casing and having a peripheral bottom portion closely attachable to the outer surface of the vehicle wall W; a metal base 15 mounted on a bottom opening portion of the resin casing 13 in the state in which the metal base 15 is held by an inner surface of a bottom wall of the rubber pad 14; a grounding washer 16 fitted on the outer periphery of a cylindrical portion 15a projecting from a central portion of the metal base 15; and a fixing nut 17 engaged with the outer periphery of the cylindrical portion 15a so as to fix the grounding washer 16 and bring it into pressure contact with the bottom surface of the vehicle wall W.

A joint member J is buried in a top portion of the resin casing 13 of the attachment base F. An external end portion of the joint member J is mechanically coupled to the holding member 12 for the rod antenna element 11 and a portion of the external end portion is electrically connected to the rod antenna element 11. An internal end portion of the joint member J is connected via a lead line R and a wiring board 24 (described later) to one end of an AM/FM wave feeder 18. The feeder 18 is introduced into the attachment base F through an insulating pipe 25 inserted into the cylindrical portion 15a of the metal base 15. the other end of the AM/FM wave feeder 18 is provided with a connector 19 for connection between the feeder 18 and an AM/FM wave receiving set (not shown).

A GPS wave receiving antenna 20 capable of receiving a GPS wave is provided within the resin casing 13. The GPS wave receiving antenna 20 is constructed such that a disk-shaped antenna body 21 and an amplifier 22 connected to the antenna body 21 are horizontally arranged in parallel within a holding case 23. The wiring board 24 is situated below the holding case 23. The wiring board 24 is, for example, a printed wiring board on which necessary circuit elements are arranged.

The amplifier 22 is connected via the wiring board 24 to one end of a power cord 26 introduced into the attachment base F through the insulating pipe 25. A connector 27 is attached to the other end of the power cord 26.

The antenna body 21 of the GPS wave receiving antenna 20 is directly, and not via the wiring board 24, connected to one end of a GPS wave feeder 28 introduced into the attachment base F through the insulating pipe 25. The other end of the GPS wave feeder 28 is provided with a connector 29 for connection between the feeder 28 and a GPS wave receiving set (not shown).

In the three-wave receiving antenna according to the first embodiment, the GPS wave receiving antenna 20 is integrated within the attachment base F of the AM/FM wave receiving antenna 10. Thus, the three-wave receiving antenna can receive three kinds of waves (AM wave/FM wave/GPS wave). Although the GPS wave receiving antenna 20 is newly provided, the work for attaching the antenna is the same as that for attaching the conventional AM/FM wave receiving antenna 10. Accordingly, the work for attaching the antenna to the vehicle wall W does not become complex, even if the GPS wave receiving antenna 20 is newly provided. Furthermore, since the GPS wave receiving antenna 20 is mounted in a compact manner within the attachment base F situated at the proximal end portion of the AM/FM wave receiving antenna 10, the external appearance of the vehicle body is not deteriorated, and accidents due to contact between the GPS wave receiving antenna and outside objects do not occur. Besides, in this embodiment, the GPS wave receiving antenna 20 is contained within the hollow-conical resin casing 13 which is a main structural part of the attachment base F, and thus a dead space is effectively used and there is no need to provide a new installation space. Since the GPS wave receiving antenna 20 cannot be seen from the outside of the resin casing 13, there is an advantage in preventing a theft. In addition, since the GPS wave receiving antenna 20 is surrounded by the wall of the attachment base F, it can be surely protected against weather. Therefore, the GPS wave receiving antenna 20 has high weatherability.

(Second Embodiment)

FIGS. 3 and 4 show the structure of a three-wave receiving antenna according to a second embodiment of the present invention, which is applied to a vehicle manual-operation antenna. FIG. 3 is a side view showing the entire apparatus, and FIG. 4 is a side view showing a main part of the apparatus in partial cross section.

In FIGS. 3 and 4, reference numeral 30 denotes an AM/FM wave receiving antenna capable of receiving AM waves and FM waves. The antenna 30 comprises a rod antenna element 31 and a conductive holding portion 32 for stably holding a proximal end portion of the rod antenna element 31. The holding portion 32 is inserted and fixed, via an insulating cylindrical member 40, in a central portion of an attachment base F for fixing the entire antenna to a vehicle wall W.

The attachment base F comprises a substantially hollow, disk-like resin casing 33 formed of a resin with a relatively low dielectric constant; a rubber pad 34 fitted in an opening bottom end portion of the resin casing 33 and having a bottom surface closely attachable to the

outer surface of the vehicle wall W; a cylindrical metal base 35; a grounding washer 36 fitted on the outer periphery of a cylindrical portion of the cylindrical metal base 35; and a fixing nut 37 engaged with the outer periphery of the cylindrical portion of the cylindrical metal base 35 projecting outward of the vehicle wall W so as to fix the grounding washer 36 and bring it into pressure contact with the bottom surface of the vehicle wall W.

An end portion of the conductive holding portion 32 holding the proximal end portion of the rod antenna element 31 is connected to one end portion (a central conductor) of an AM/FM wave feeder 38. The feeder 38 is introduced into the attachment base F through a hollow portion in the cylindrical portion of the cylindrical metal base 35. The other end of the AM/FM wave feeder 38 is provided with a connector 39 for connection between the feeder 38 and an AM/FM wave receiving set (not shown).

A GPS wave receiving antenna 20 capable of receiving a GPS wave is provided within the resin casing 33. The GPS wave receiving antenna 20, like the first embodiment, is constructed such that a disk-shaped antenna body 21 and an amplifier 22 are held within a holding case 23. The amplifier 22 is connected to one end of a power cord 26 introduced into the attachment base F through the hollow portion in the cylindrical portion of the cylindrical metal base 35. A connector 27 is attached to the other end of the power cord 26.

The antenna body 21 is connected to one end of a GPS wave feeder 28 introduced into the attachment base F through the hollow portion in the cylindrical portion of the cylindrical metal base 35. The other end of the GPS wave feeder 28 is provided with a connector 29 for connection between the feeder 28 and a GPS wave receiving set (not shown).

The second embodiment has the same advantages as the first embodiment, and a description of the advantages is omitted in order to avoid repetition.

(Third Embodiment)

FIGS. 5 and 6 show the structure of a three-wave receiving antenna according to a third embodiment of the present invention, which is applied to a motor-driven antenna for a vehicle. FIG. 5 is a side view showing the entire apparatus, and FIG. 6 is a side view showing a main part of the apparatus in partial cross section.

In FIGS. 5 and 6, reference numeral 50 denotes an extendible AM/FM wave receiving antenna capable of receiving AM waves and FM waves. The antenna 50 comprises an extendible rod antenna element 51 and a greatest-diameter rod 52 serving as a holding portion for holding a proximal end portion of the rod antenna element 51. The greatest-diameter rod 52 is slidably coupled to an attachment base F for fixing the entire antenna apparatus to a vehicle wall W.

The attachment base F comprises a substantially hollow, disk-like resin casing 53 formed of a resin with a relatively low dielectric constant; a rubber pad 54 fitted in an opening bottom end portion of the resin casing 53 and having a bottom surface closely attachable to the outer surface of the vehicle wall W; a cylindrical metal base (not shown); a grounding washer 56 fitted on the outer periphery of a cylindrical portion of the cylindrical metal base; and a fixing nut 57 engaged with the outer periphery of the cylindrical portion of the cylindrical metal base projecting outward of the vehicle wall W so as to fix the grounding washer 56 and bring it into pressure contact with the bottom surface of the vehicle wall W.

The greatest-diameter rod 52 of the rod antenna element 51 slidably coupled to the cylindrical metal base of the attachment base F is connected to one end of an AM/FM wave feeder 58 via a contact portion (not shown). The other end of the AM/FM feeder 58 is coupled to a connector 59 for connection between the power cable 58 and an AM/FM wave receiving set (not shown).

A GPS wave receiving antenna 20 capable of receiving a GPS wave is provided within the resin casing 53. The GPS wave receiving antenna 20 is constructed, like the first embodiment, such that a disk-shaped antenna body 21 and an amplifier 22 are contained within a holding case 23. The amplifier 22 is connected to one end of a power cord 26 introduced into the attachment base F. A connector 27 is attached to the other end of the power cord 26.

The antenna body 21 is connected to one end of a GPS wave feeder 28 introduced into the attachment base F. The other end of the GPS wave power cable 28 is provided with a connector 29 for connection between the feeder 28 and a GPS wave receiving set (not shown).

A motor mechanism 60 for driving the extendible AM/FM wave receiving antenna 50 comprises a motor 61, a rope transfer mechanism 62 rotated by the motor 61, and a storing cylinder 63 for extendibly/retractably storing the rod antenna element 51, 52 which is extended/retracted in its longitudinal direction by a rope (not shown) transferred by the rope transfer mechanism 62.

The third embodiment has the same advantages as the first embodiment, and a description of the advantages is omitted in order to avoid repetition.

(Example of Actual Data)

FIG. 7 shows an actual measurement result of VSWR characteristics of the GPS wave receiving antenna 20. A curve A indicates characteristics of the GPS wave receiving antenna 20 formed as a single component, and a curve B indicates characteristics of the GPS wave receiving antenna 20 and AM/FM wave receiving antenna 10 which are integrated.

As is clear from FIG. 7, even if the GPS wave receiving antenna 20 is integrated with the AM/FM wave receiving antenna 10, the VSWR characteristics are not greatly deteriorated, as compared to the case where the

GPS wave receiving antenna 20 is used as a single component.

FIG. 8 shows an actual measurement result of gain characteristics of the GPS wave receiving antenna 20. A curve A indicates characteristics of the GPS wave receiving antenna 20 formed as a single component, and a curve B indicates characteristics of the GPS wave receiving antenna 20 and AM/FM wave receiving antenna 10 which are integrated.

As is clear from FIG. 8, even if the GPS wave receiving antenna 20 is integrated with the AM/FM wave receiving antenna 10, the gain characteristics are not greatly deteriorated, as compared to the case where the GPS wave receiving antenna 20 is used as a single component.

FIG. 9 shows an actual measurement result of directivity (a radiation pattern measured in a perpendicular plane of a circularly polarized wave) of the GPS wave receiving antenna 20. A curve A indicates characteristics of the GPS wave receiving antenna 20 formed as a single component, and a curve B indicates characteristics of the GPS wave receiving antenna 20 and AM/FM wave receiving antenna 10 which are integrated.

As is clear from FIG. 9, even if the GPS wave receiving antenna 20 is integrated with the AM/FM wave receiving antenna 10, the gain characteristics are not greatly deteriorated, as compared to the case where the GPS wave receiving antenna 20 is used as a single component.

(Summary of the Embodiments)

The structures and advantages of the three-wave receiving antenna apparatuses of the embodiments may be summarized as follows.

[1] In the three-wave receiving antenna apparatus according to this embodiment, the GPS wave receiving antenna 20 capable of receiving the GPS wave is integrally mounted in the attachment base F of the AM/FM wave receiving antenna (10, 30, 50) capable of receiving AM and FM waves.

In this three-wave receiving antenna apparatus, the GPS wave receiving antenna 20 is integrally mounted in the attachment base F of the AM/FM wave receiving antenna (10, 30, 50), and the three kinds of waves can be received. Thus, although the GPS wave receiving antenna 20 is newly provided, the work for attaching the antenna to the object such as a vehicle does not become complex. Furthermore, since the GPS wave receiving antenna 20 is mounted in a compact manner within the base portion of, e.g. the AM/FM wave receiving antenna 10, the external appearance of the vehicle body is not deteriorated, and accidents due to contact between the GPS wave receiving antenna and outside objects do not occur.

[2] The three-wave receiving antenna apparatus according to this embodiment is the apparatus of the above embodiment [1], and the AM/FM wave receiving antenna (10, 30, 50) is a vehicle antenna having a rod antenna element (11, 31, 51), and the GPS wave receiving antenna 20 is contained in the casing (13, 33, 53) of the hollow attachment base F which holds the proximal end portion of the rod antenna element (11, 31, 51).

In this three-wave antenna apparatus, the GPS wave receiving antenna 20 is contained in the casing (13, 33, 53) of the attachment base F for attaching to the vehicle wall W the proximal end portion (12, 32, 53) of the rod antenna element (11, 31, 51) of the vehicle AM/FM wave receiving antenna (10, 30, 50). Thus, a dead space is effectively used and there is no need to provide a new installation space. Since the GPS wave receiving antenna 20 cannot be seen from the outside of the casing (13, 33, 53), there is an advantage in preventing a theft. In addition, since the GPS wave receiving antenna 20 is surrounded by the wall of the casing (13, 33, 53), it can be surely protected against weather.

[3] The three-wave receiving antenna apparatus according to this embodiment is the apparatus of the above embodiment [2], and the GPS wave receiving antenna 20 is contained in the hollow portion of the attachment base F, in the state in which the disk-shaped antenna body 21 and the amplifier 22 connected to the antenna body 21 are integrally stored in the holding case 23.

In this three-wave receiving antenna apparatus, the GPS wave receiving antenna 20 is contained in the casing (13, 33, 53) of the attachment base F in the state in which the GPS wave receiving antenna 20 is contained in the holding case 23. Thus, the GPS wave receiving antenna 20 is doubly protected. Even if the GPS wave receiving antenna 20 is open to the weather for a long time, leaking of water can be prevented and the function thereof is stably maintained. In addition, the GPS wave receiving antenna 20 can easily be exchanged by changing the holding case 23 itself.

Claims

1. A three-wave receiving antenna apparatus characterized in that a GPS wave receiving antenna (20) capable of receiving electric waves from a satellite is integrally mounted in an attachment base (F) of an AM/FM wave receiving antenna (10, 30, 50) capable of receiving amplitude-modulated waves (AM) and frequency-modulated waves (FM).

2. The apparatus according to claim 1, characterized in that the AM/FM wave receiving antenna (10, 30, 50) is a vehicle antenna having a rod antenna element (11, 31, 51), and

   the GPS wave receiving antenna (20) is contained in a casing (13, 33, 53) of a hollow attachment base (F) holding a proximal end portion of the rod antenna element (11, 31, 51).

3. The apparatus according to claim 2, characterized in that the GPS wave receiving antenna (20) is contained in a hollow portion of the attachment base (F) in the state in which a disk-like antenna body (21) and an-amplifier (22) connected to the antenna body (21) are integrally contained in a holding case (23).

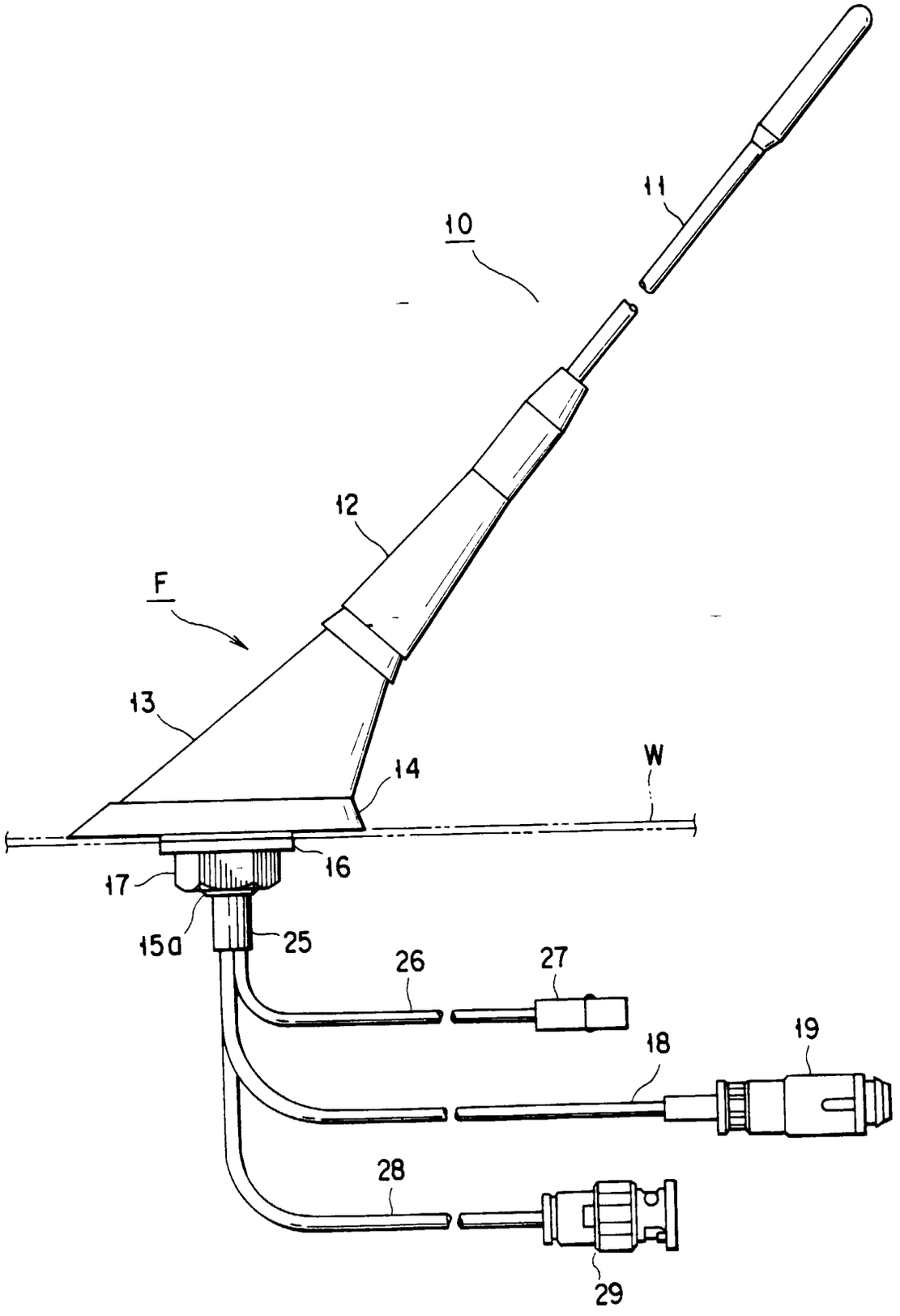

FIG. 1

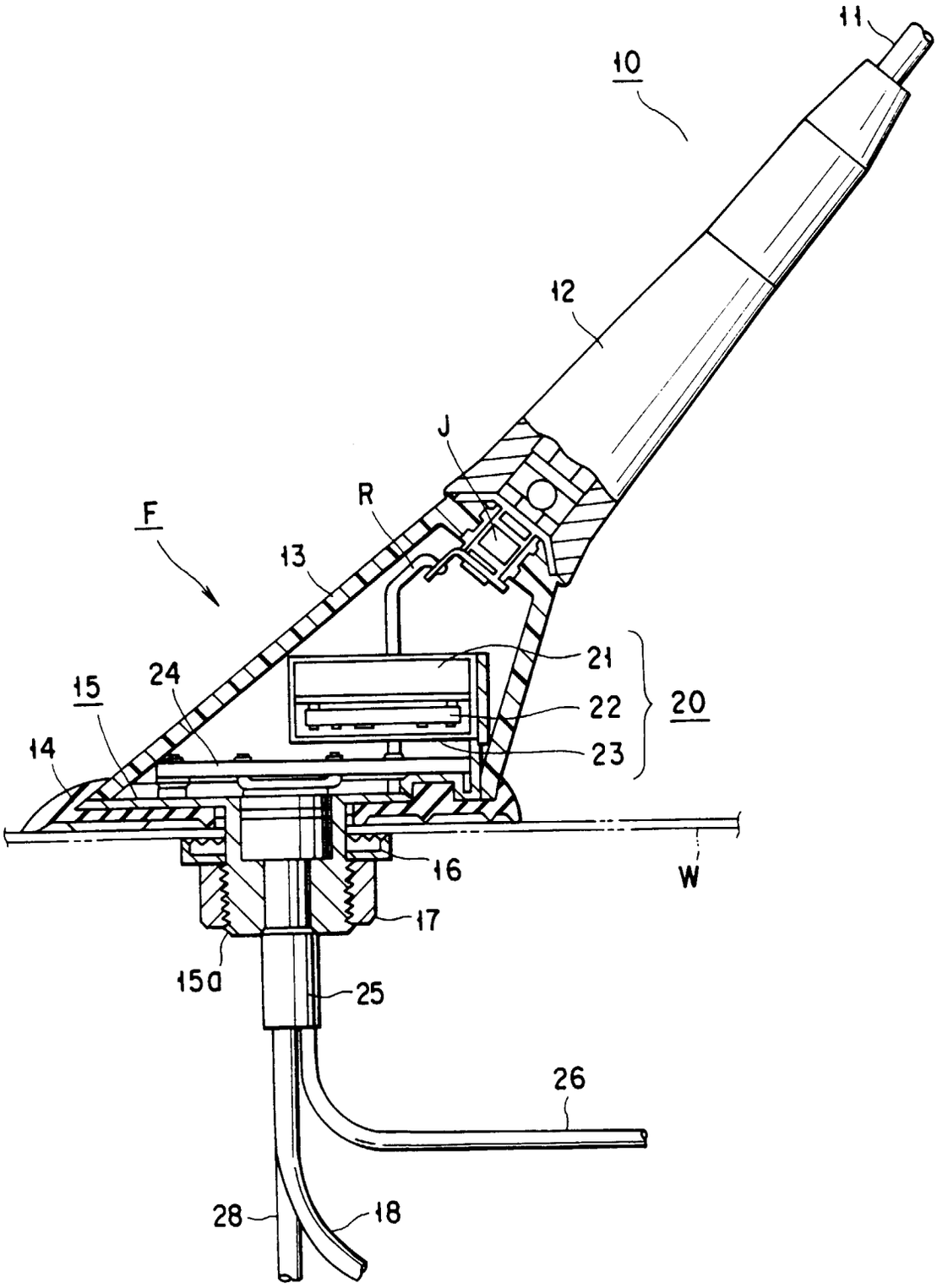

FIG. 2

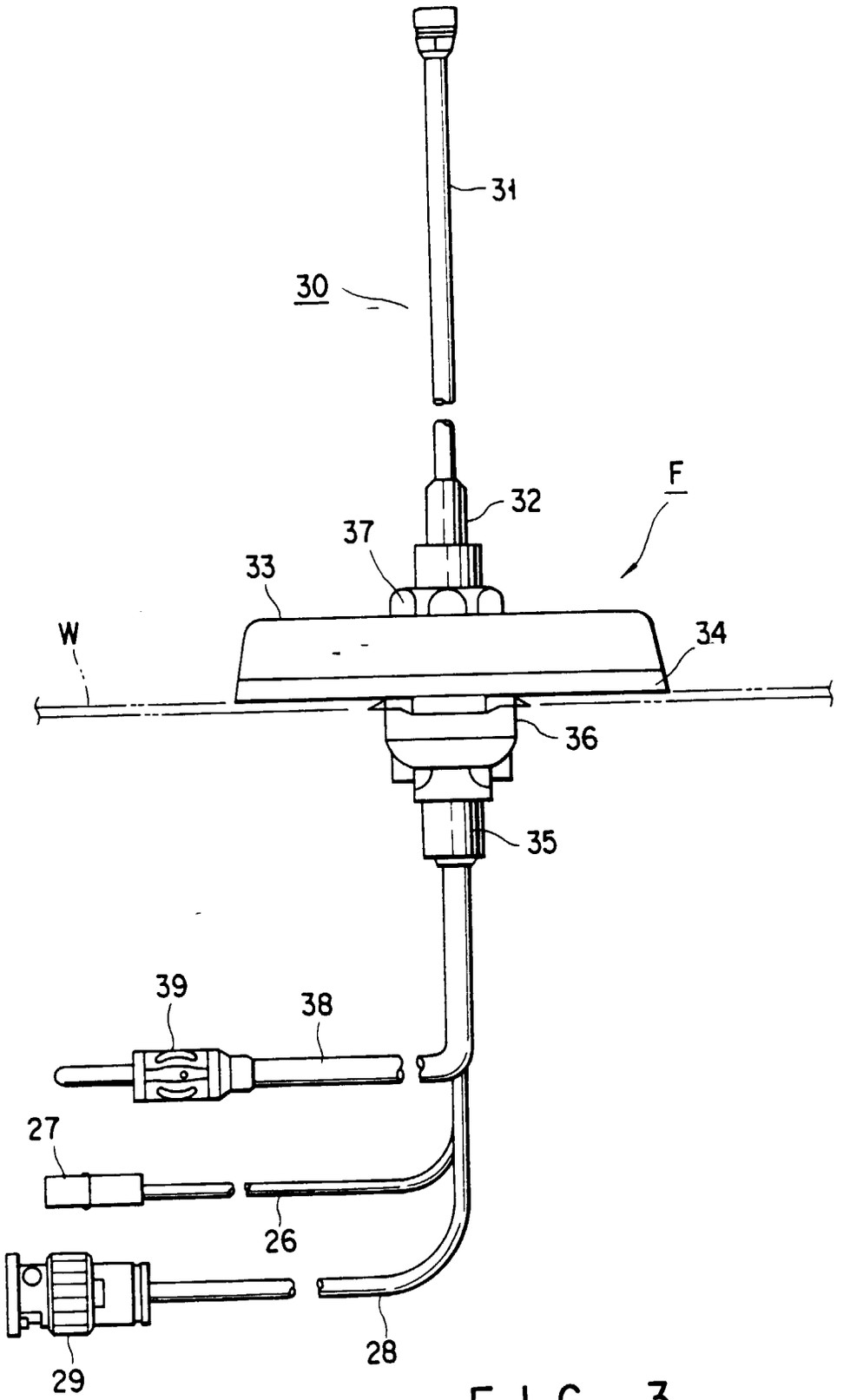

FIG. 3

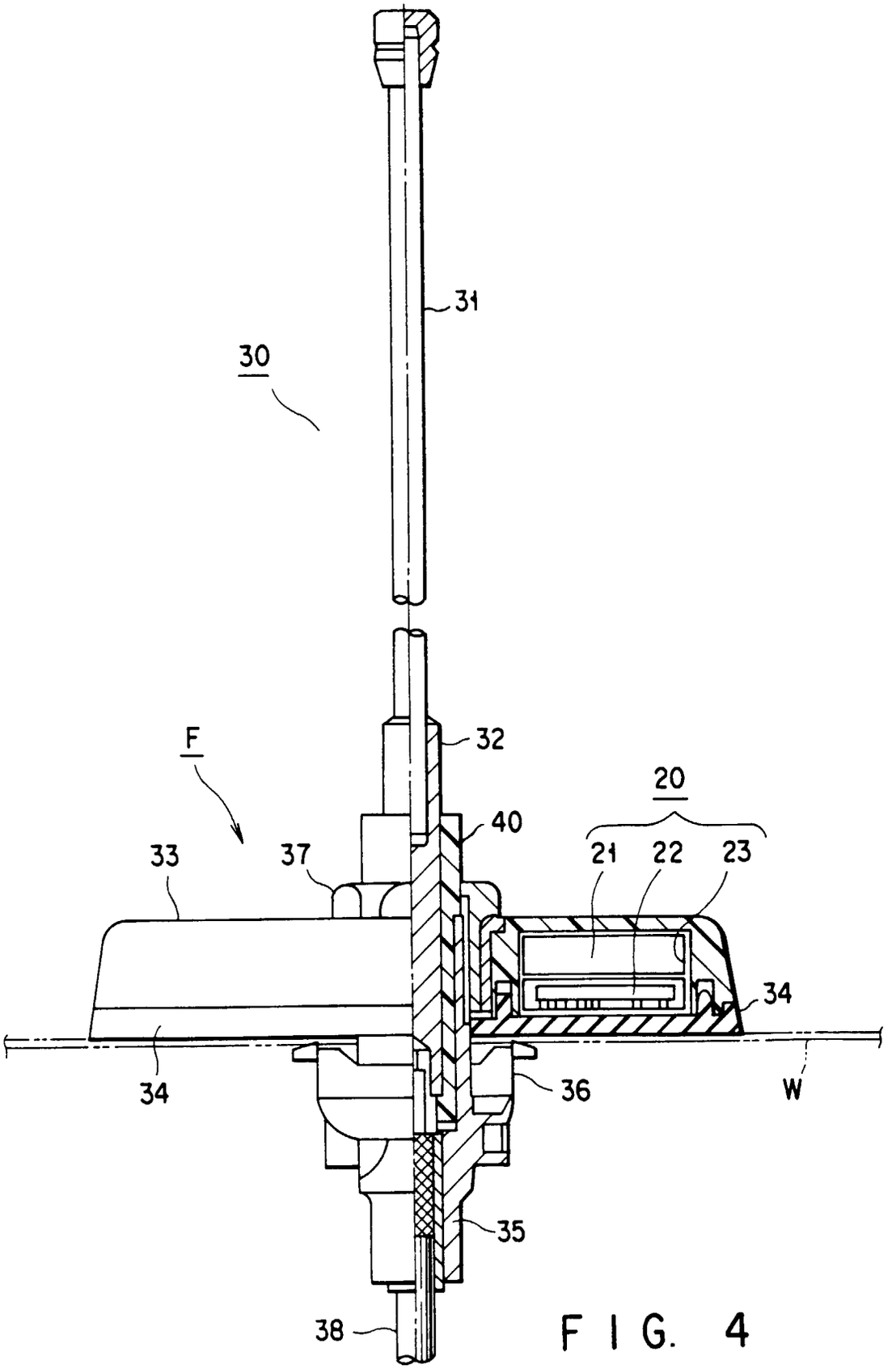

FIG. 4

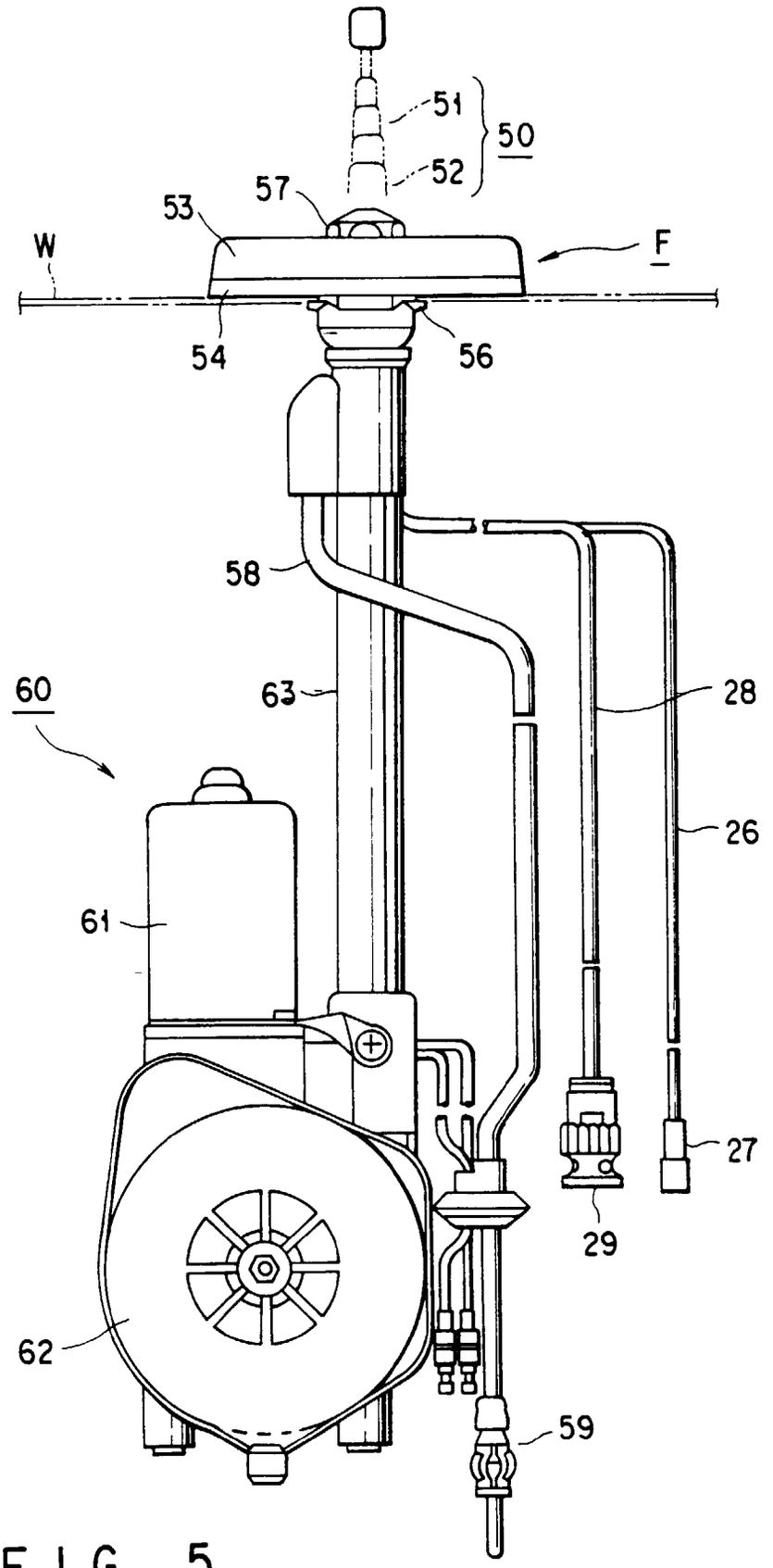

FIG. 5

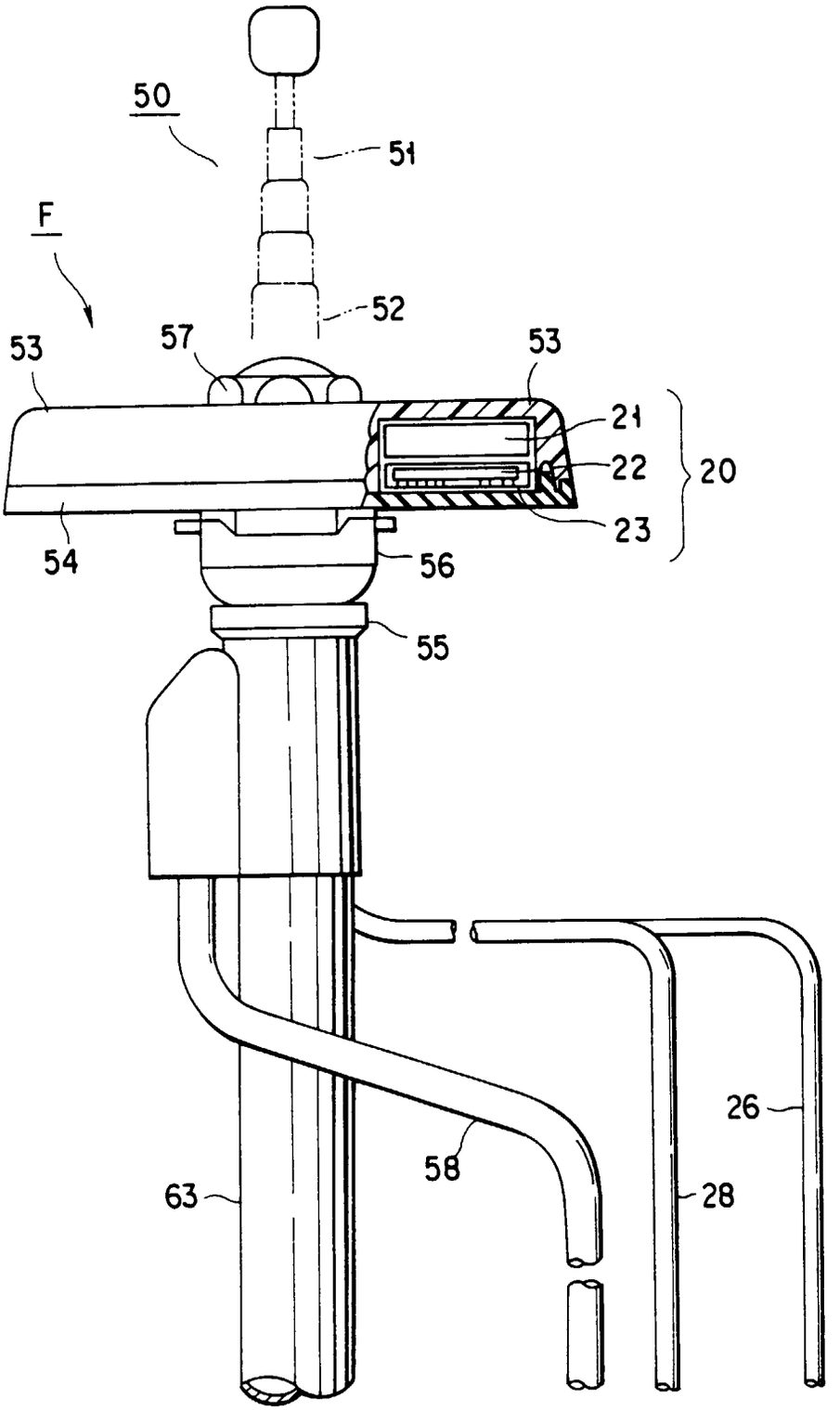

FIG. 6

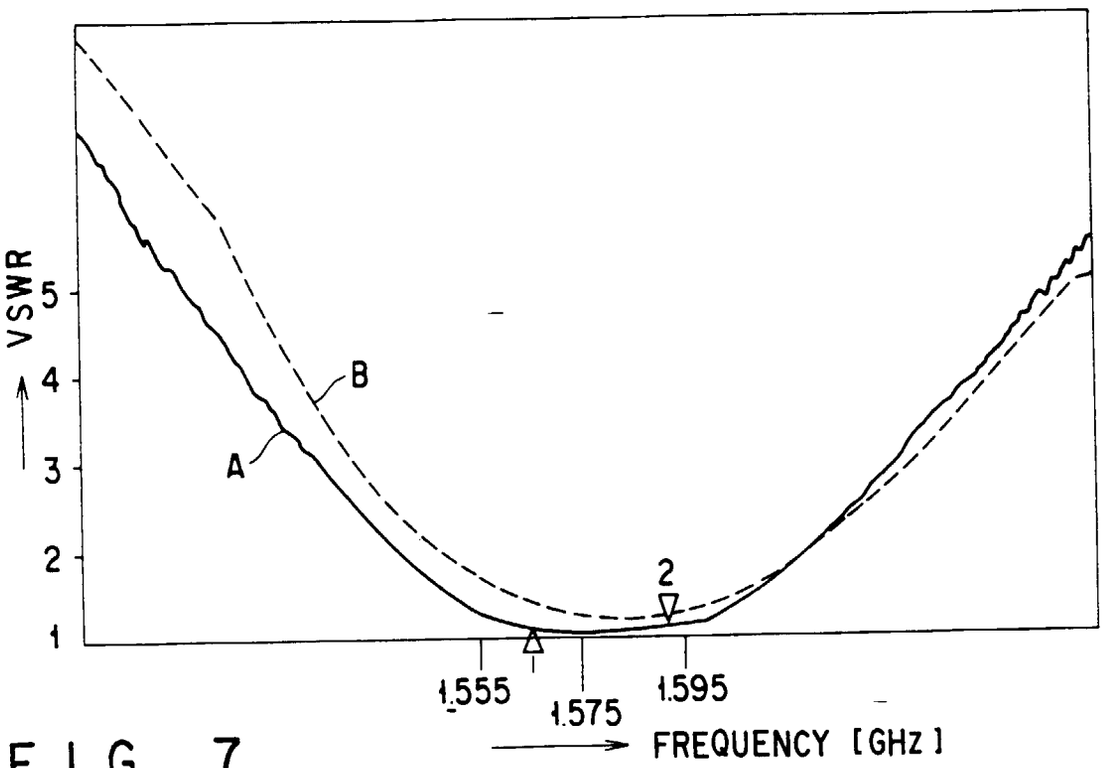
VSWR
5
4
3
2
1
B
A
2
1.555
1.575
1.595
FREQUENCY [GHz]

FIG. 7

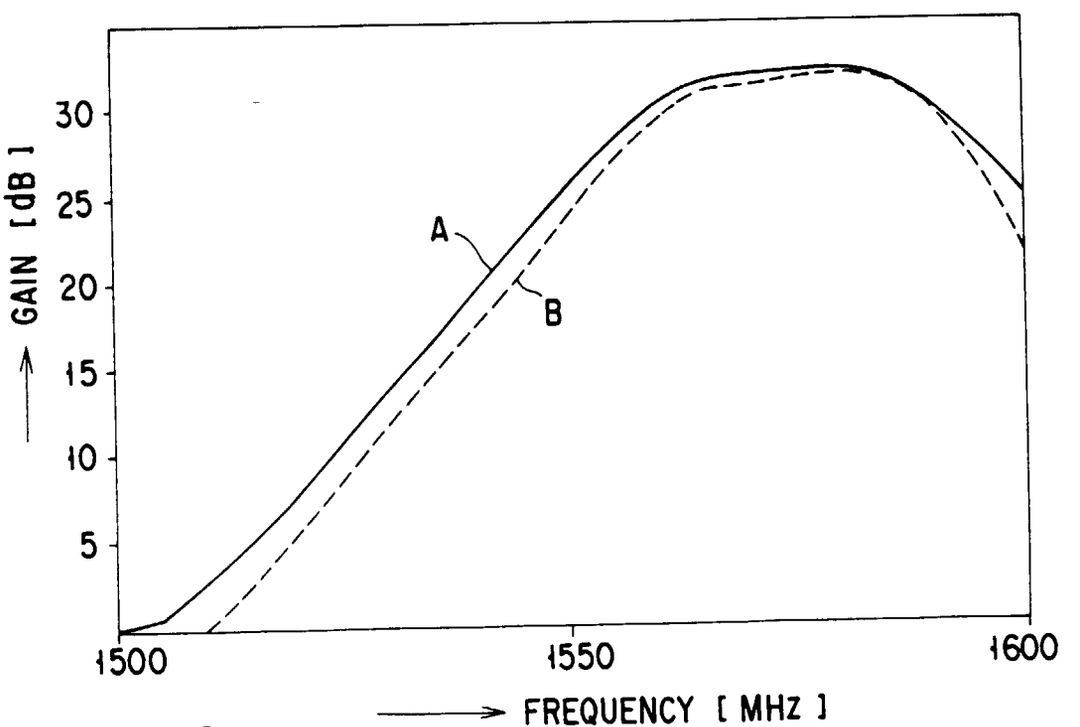
GAIN [dB]
30
25
20
15
10
5
A
B
1500
1550
1600
FREQUENCY [MHz]

FIG. 8

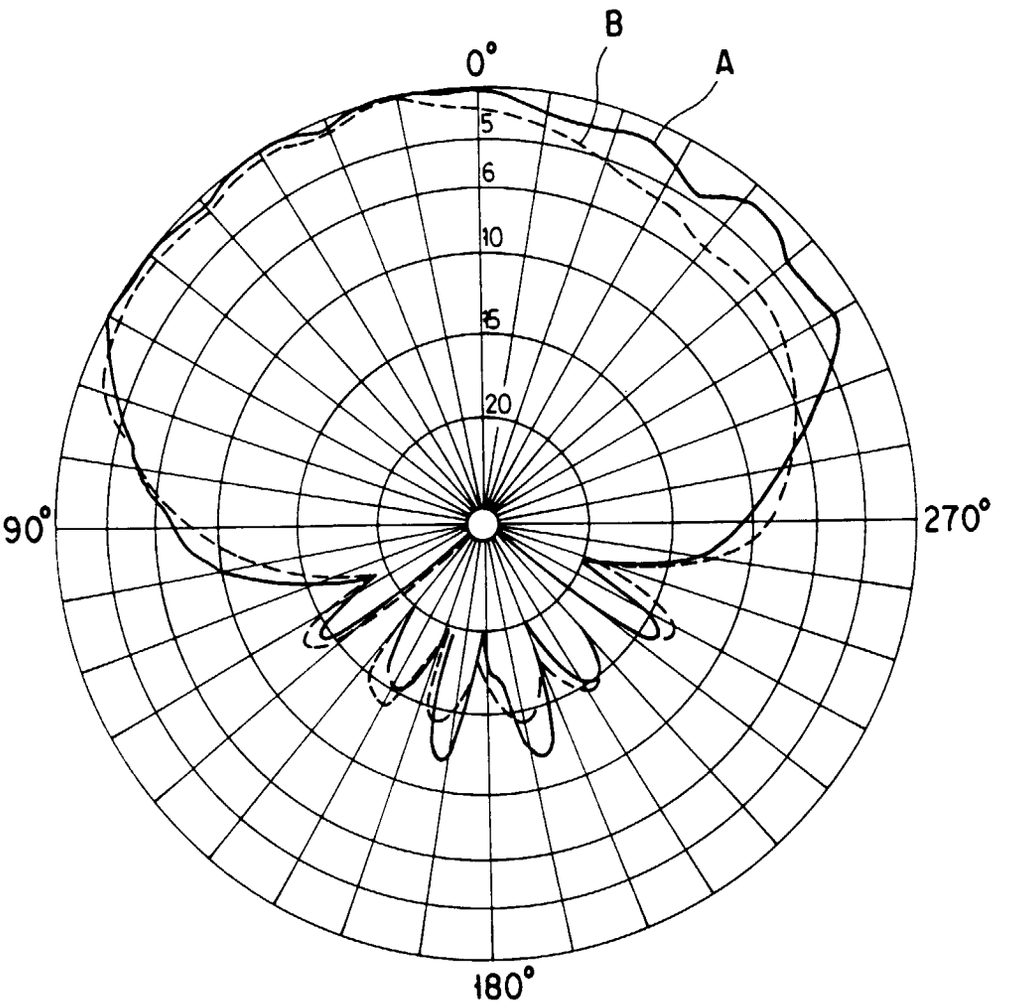

FIG. 9