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(54) ANTENNA DEVICE AND METHOD FOR MANUFACTURING THE SAME

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Description

Technical Field

[0001] The present invention relates to an antenna device including a film antenna. The present invention also relates to a method for manufacturing such an antenna device.

Background Art

[0002] Conventionally, in a case where a three-dimensional antenna is formed by use of a flexible film antenna, a three-dimensional structure of an antenna conductor is maintained by attaching/winding the film antenna to/around a highly rigid support. This is because unless the film antenna is attached/wound to/around the highly rigid support, a change in three-dimensional structure of the antenna conductor occurs, and the change results in a change in antenna characteristic.

[0003] Note that a high-frequency current is supplied to/from a film antenna via a cable (e.g., a coaxial cable) that is connected to the film antenna. The film antenna and the cable are normally connected by soldering a hot side conductor and a cold side conductor of the cable (an inner conductor and an outer conductor of the coaxial cable) to respective two feed points provided in an antenna conductor of the film antenna. Thus, in order that the film antenna and the cable are not disconnected from each other even in a case where the cable is pulled, it is important to achieve greater durability (connection reliability) with respect to pulling of the cable.

[0004] Known examples of a technique for achieving greater durability with respect to pulling of the cable include a technique in which by arranging, in a middle of a wiring path for a cable, a holding member providing and holding the cable while bending the cable, a force by which to pull the cable is made difficult to transmit to a connection between an antenna and the cable (see, for example, Patent Literature 1).

Citation List

[Patent Literature]

[0005]

[Patent Literature 1]

Specification of European Patent No. 2403327 (Publication Date: January 4, 2012)

[Patent Literature 2]

Japanese Patent Application JP 2010/258544 A

[Patent Literature 3]

US Patent Application US 2006/071856 A1

[Patent Literature 4]

US Patent Application US 2007/057850 A1

Summary of Invention

Technical Problem

[0006] Note, however, that use of two three-dimensional structures, which are (i) a support for maintaining a three-dimensional structure of a flexible film antenna and (ii) a holding member providing and holding a cable while bending the cable, for an antenna device in combination causes a problem of causing the antenna device to have a structure that is more complicated or made larger.

[0007] The present invention has been made in view of the problem, and an object of the present invention is to (i) prevent an antenna device including a flexible film antenna from having a structure that is more complicated or made larger and (ii) allow the antenna device to have a more stable antenna characteristic and greater durability with respect to pulling of a cable.

Solution to Problem

[0008] In order to attain the object, an antenna device in accordance with an aspect of the present invention includes: a film antenna; a cable which has a tip part connected to a feed section of the film antenna; and a support around which the film antenna is wound and which has a plurality of holding parts holding the cable in a state in which the cable is bent, the support including a first member and a second member attached to the first member, the first member having (i) a first holding part holding a bent part and/or a vicinity thereof, the bent part being closest to the tip part of the cable, and (ii) an indentation provided in a part of the first member in which part a connection between the cable and the film antenna is arranged, the second member having a recess in which the connection arranged in the indentation of the first member is contained, and the film antenna being wound around the support so as to close the recess, and the recess being filled with a resin.

[0009] In order to attain the object, an antenna device manufacturing method in accordance with an aspect of the present invention for manufacturing an antenna device including: a film antenna; a cable; and a support around which the film antenna is wound and which has a plurality of holding parts holding the cable, the support including a first member and a second member, the first member having (i) a first holding part of the plurality of holding parts and (ii) an indentation provided in a part of the first member in which part a connection between the cable and the film antenna is arranged, and the second member having a recess in which the connection arranged in the indentation of the first member is contained, the method includes: a first holding step of arranging a tip part of the cable in the indentation of the first member and causing the first holding part of the first member to hold a bent part and/or a vicinity thereof, the bent part being closest to the tip part of the cable; a connecting

step of, after the first holding step, connecting the tip part of the cable to a feed section of the film antenna; an attaching step of, after the connecting step, attaching the second member to the first member so that the connection between the film antenna and the cable is arranged in the recess; a winding step of, after the attaching step, winding the film antenna around the support so as to close the recess; an injecting step of, after the winding step, injecting a fluid resin into the recess; and a curing step of, after the injecting step, curing the fluid resin.

Advantageous Effects of Invention

[0010] The present invention makes it possible to (i) prevent an antenna device including a film antenna from having a structure that is more complicated or made larger and (ii) allow the antenna device to have a more stable antenna characteristic and greater durability with respect to pulling of a cable.

Brief Description of Drawings

[0011]

(a) of Fig. 1 is a perspective view illustrating an upper surface side of an antenna device in accordance with Embodiment 1 of the present invention. (b) of Fig. 1 is a perspective view illustrating a lower surface side of the antenna device. (c) of Fig. 1 is a cross-sectional view of the antenna device taken along a line A-A. (d) of Fig. 1 is an enlarged cross-sectional view illustrating a feed section and its vicinity (a region B). Fig. 2 is a development view of a film antenna included in the antenna device illustrated in Fig. 1.

(a) of Fig. 3 is a perspective view illustrating an upper surface side of a first member of a support included in the antenna device illustrated in Fig. 1. (b) of Fig. 3 is a perspective view illustrating a lower surface side of the first member.

(a) of Fig. 4 is a perspective view illustrating an upper surface side of a second member of the support included in the antenna device illustrated in Fig. 1. (b) of Fig. 4 is a perspective view illustrating a lower surface side of the second member.

Fig. 5 is a flowchart of a method for manufacturing the antenna device illustrated in Fig. 1.

Fig. 6 is a perspective view illustrating the antenna device which is being manufactured in accordance with the method shown in Fig. 5. (a) of Fig. 6 illustrates the antenna device which has been subjected to a first holding step. (b) of Fig. 6 illustrates the antenna device which is being subjected to a connecting step. (c) of Fig. 6 illustrates the antenna device which has been subjected to a second holding step. (d) of Fig. 6 illustrates the antenna device which is being subjected to an injecting step.

(a) of Fig. 7 is a perspective view illustrating an upper surface side of an antenna device in accordance with

Embodiment 2 of the present invention. (b) of Fig. 7 is a perspective view illustrating a lower surface side of the antenna device. (c) of Fig. 7 is a cross-sectional view of the antenna device taken along a line C-C. (d) of Fig. 7 is an enlarged cross-sectional view illustrating a feed section and its vicinity (a region D). (a) of Fig. 8 is a perspective view illustrating an upper surface side of a first member of a support included in the antenna device illustrated in Fig. 7. (b) of Fig. 8 is a perspective view illustrating a lower surface side of the first member.

(a) of Fig. 9 is a perspective view illustrating an upper surface side of a second member of the support included in the antenna device illustrated in Fig. 7. (b) of Fig. 9 is a perspective view illustrating a lower surface side of the second member.

Fig. 10 is a flowchart of a method for manufacturing the antenna device illustrated in Fig. 7.

Fig. 11 is a perspective view illustrating the antenna device which is being manufactured in accordance with the method shown in Fig. 10. (a) of Fig. 11 illustrates the antenna device which has been subjected to a holding step.

(b) of Fig. 11 illustrates the antenna device which is being subjected to a connecting step. (c) of Fig. 11 illustrates the antenna device which is being subjected to an attaching step. (d) of Fig. 11 illustrates the antenna device which has been subjected to an injecting step. (e) of Fig. 11 illustrates the antenna device which has been subjected to a second winding step.

Fig. 12 illustrates a method for providing, inside a spoiler, the antenna device illustrated in Fig. 1.

(a) of Fig. 13 is a perspective view illustrating an upper surface side of an antenna device in accordance with Embodiment 3 of the present invention. (b) of Fig. 13 is a perspective view illustrating a lower surface side of the antenna device. (c) of Fig. 13 is a cross-sectional view of the antenna device taken along a line E-E. (d) of Fig. 13 is an enlarged cross-sectional view illustrating a feed section and its vicinity (a region F).

(a) of Fig. 14 is a plan view illustrating a first member of a support included in the antenna device illustrated in Fig. 13. (b) of Fig. 14 is a bottom view illustrating the first member. (c) of Fig. 14 is a rear view illustrating the first member.

(a) of Fig. 15 is a plan view illustrating a second member of the support included in the antenna device illustrated in Fig. 13. (b) of Fig. 15 is a bottom view illustrating the second member. (c) of Fig. 15 is a rear view illustrating the second member.

Fig. 16 illustrates a method for providing, inside a spoiler, the antenna device illustrated in Fig. 13.

Description of Embodiments

[Embodiment 1]

(Configuration of antenna device)

[0012] A configuration of an antenna device 1 in accordance with Embodiment 1 of the present invention is described below with reference to Figs. 1 through 6.

[0013] Fig. 1 is a view illustrating the antenna device 1 in accordance with Embodiment 1. (a) of Fig. 1 is a perspective view illustrating an upper surface side of the antenna device 1. (b) of Fig. 1 is a perspective view illustrating a lower surface side of the antenna device 1. (c) of Fig. 1 is a cross-sectional view of the antenna device 1 illustrated in (a) of Fig. 1, taken along a line A-A. (d) of Fig. 1 is an enlarged cross-sectional view of a feed section and its vicinity (a region B illustrated in (c) of Fig. 1).

[0014] As illustrated in Fig. 1, the antenna device 1 includes a film antenna 11 that is flexible, a coaxial cable 12 connected to the film antenna 11, and a support 13 for supporting the film antenna 11 and holding the coaxial cable 12. In the antenna device 1 in accordance with Embodiment 1, the film antenna 11 is wound around the support 13 which has a box shape (i.e., substantially a rectangular parallelepiped shape) as an external shape and is made of a resin having rigidity, so that a three-dimensional structure of the film antenna 11 (antenna conductors) is maintained.

[0015] The antenna device 1 in accordance with Embodiment 1 can be used as, for example, an on-vehicle antenna which is to be incorporated in a resin-made spoiler that is mounted at a rear end of a roof of a vehicle body such as an automobile. In such a case, the antenna device 1 is provided at the rear end of the roof of the vehicle body in a state in which, in the drawings, a positive direction of an x-axis (hereinafter, referred to as an x-axis positive direction) is a rightward direction, a negative direction of the x-axis (hereinafter, referred to as an x-axis negative direction) is a leftward direction, a positive direction of a y-axis (hereinafter, referred to as a y-axis positive direction) is a forward direction, a negative direction of the y-axis (hereinafter, referred to as a y-axis negative direction) is a backward direction, a positive direction of a z-axis (hereinafter, referred to as a z-axis positive direction) is an upward direction, and a negative direction of the z-axis (hereinafter, referred to as a z-axis negative direction) is a downward direction. Note that, in the descriptions below, the x-axis positive direction, the x-axis negative direction, the y-axis positive direction, the y-axis negative direction, the z-axis positive direction, and the z-axis negative direction are sometimes expressed as right, left, front, rear, up, and down, respectively.

[0016] Fig. 2 is a development view of the film antenna 11 included in the antenna device 1 illustrated in Fig. 1. As illustrated in Fig. 2, the film antenna 11 which is flexible is made up of a dielectric film 111 which is flexible and a

first antenna conductor 112 and a second antenna conductor 113 which are provided on a surface of the dielectric film 111. The first antenna conductor 112 and the second antenna conductor 113 constitute a dipole antenna in which the first antenna conductor 112 and the second antenna conductor 113 serve as respective antenna elements. Alternatively, the first antenna conductor 112 and the second antenna conductor 113 constitute a monopole antenna in which the first antenna conductor 112 and the second antenna conductor 113 serve as an antenna element and a ground plane, respectively. The film antenna 11 which is flexible is bent along a line V-V and a line W-W, which are illustrated in Fig. 2, such that folds come to an inner side, and is wound around the support 13. Moreover, the film antenna 11 which is flexible is wound around the support 13 which has a three-dimensional shape such that each of the first antenna conductor 112 and the second antenna conductor 113 has a predetermined three-dimensional structure.

[0017] Specifically, as illustrated in Figs. 1 and 2, a third portion J3 of the film antenna 11 is arranged along a third supporting surface (i.e., portion I3 in Fig. 1) of an upper surface of the support 13 so that the second antenna conductor 113 extends from a feed section 114 in a y-axis direction. Moreover, a second portion J2 of the film antenna 11 is arranged along a second supporting surface (i.e., portion I2 in Fig. 1) which is perpendicular to the third supporting surface, and a first portion J1 of the film antenna 11 is arranged along a first supporting surface (i.e., portion I1 in Fig. 1) which is perpendicular to the second supporting surface. As such, the first antenna conductor 112 extending from the feed section 114 in a z-axis direction is bent so as to extend in the y-axis direction while facing the second antenna conductor 113. As described earlier, in the antenna device 1 in accordance with Embodiment 1, the film antenna 11 which is flexible is supported by the support 13 which is rigid, so that the three-dimensional structure of the antenna conductors is maintained, and thus an antenna characteristic is stabilized.

[0018] The coaxial cable 12 which is connected to the feed section 114 of the film antenna 11 has at least any of a function to transmit a high-frequency current which has been outputted from the film antenna 11 upon reception and a function to transmit a high-frequency current which is to be inputted to the film antenna 11 for transmission. The coaxial cable 12 is made up of an inner conductor, an insulator covering the inner conductor, an outer conductor covering the insulator, and a jacket covering the outer conductor. A tip part of the coaxial cable 12, from which tip part the jacket is removed, is connected to the feed section 114 (feed points 114a and 114b) of the film antenna 11 by soldering or the like. Specifically, the inner conductor of the coaxial cable 12 is connected to the feed point 114a of the first antenna conductor 112, and the outer conductor of the coaxial cable 12 is connected to the feed point 114b of the second antenna conductor 113.

[0019] Note that, as illustrated in (b) of Fig. 1, the coaxial cable 12 that is connected to the film antenna 11 is held, while being bent, by a plurality of holding parts provided in the support 13. From this, in the antenna device 1 in accordance with Embodiment 1, even in a case where the coaxial cable 12 is pulled, a pulling force is hardly exerted on a connection between the film antenna 11 and the coaxial cable 12, and it is thus possible to increase durability with respect to pulling of the coaxial cable 12.

[0020] Moreover, as illustrated in (c) and (d) of Fig. 1, the connection between the film antenna 11 and the coaxial cable 12 (specifically, the feed section 114 of the film antenna 11, the tip part of the coaxial cable 12, and solder for connecting these) is contained in a recess which is open to a third supporting surface side of the support 13, and is sealed with a resin 14 that is obtained by curing a fluid resin injected into the recess. From this, in the antenna device 1 in accordance with Embodiment 1, it is possible to prevent the connection between the film antenna 11 and the coaxial cable 12 from deteriorating due to, for example, moisture.

[0021] Further, the antenna device 1 of Embodiment 1 employs the support 13 which is divided into a first member 131 and a second member 132 (in Fig. 1, a surface of the first member 131 is hatched). This allows a lighter load to be applied to the connection between the film antenna 11 and the coaxial cable 12 during manufacture of the antenna device 1, and consequently allows the connection to have greater connection reliability.

(Structure of support)

[0022] The support 13 included in the antenna device 1 in accordance with Embodiment 1 includes the first member 131 and the second member 132 which is attached to the first member 131. An upper surface of the first member 131 functions as a third supporting surface I3 which supports the third portion J3 of the film antenna 11. The second member 132 is attached to the first member 131 on a lower surface side of the first member 131. A lower surface of the second member 132 functions as a first supporting surface I1 which supports the first portion J1 of the film antenna 11. The first member 131 is attached to the second member 132 on an upper surface side of the second member 132.

[0023] The first member 131 and the second member 132 of the support 13 will be described below with reference to Figs. 3 and 4. (a) of Fig. 3 is a perspective view illustrating an upper surface side of the first member 131. (b) of Fig. 3 is a perspective view illustrating a lower surface side of the first member 131. (a) of Fig. 4 is a perspective view illustrating an upper surface side of the second member 132. (b) of Fig. 4 is a perspective view illustrating a lower surface side of the second member 132. Figs. 3 and 4 each also illustrate the coaxial cable 12 which is held by the support 13.

[0024] First, a structure of the first member 131 of Em-

bodiment 1 will be described below with reference to Fig. 3. The first member 131 of Embodiment 1 is U-shaped in a plan view. The first member 131 is a plate-shaped molded resin product, and has a size small in the z-axis direction.

[0025] Specifically, the first member 131 has (i) a main part 13M having a rectangular shape in a plan view and (ii) a left arm part 13L and a right arm part 13R each having a rectangular shape in a plan view and each extending in the y-axis negative direction from the main part 13M. The first member 131 further has an indentation 13D between the left arm part 13L and the right arm part 13R which are arranged so as to be apart from each other. That is, the first member 131 has, at its end located in the y-axis negative direction, the indentation 13D which is surrounded by the left arm part 13L, the main part 13M, and the right arm part 13R on three sides. Thus, in a case where the film antenna 11 is wound around the support 13 and the third portion J3 of the film antenna 11 is arranged so as to extend along the upper surface (third supporting surface 13) of the first member 131, the feed section 114 of the film antenna 11 is arranged in the indentation 13D. An angular range of direction in which the feed section 114 arranged in the indentation 13D is surrounded by the first member 131 is larger than 180 degrees.

[0026] Note that the first member 131 further has, on its x-axis positive direction side, an extending part 13S extending in the x-axis positive direction from a region extending over the main part 13M and the right arm part 13R.

[0027] The first member 131 further has a guide ring 13G at an end of its upper surface which end is located in the y-axis positive direction (see (a) of Fig. 3). By causing the film antenna 11, wound around the support 13, to pass through the guide ring 13G, a contact between the third portion J3 of the film antenna 11 and the third supporting surface I3 of the support 13 is maintained.

[0028] Further, a first holding part and a second holding part are provided on respective lower surfaces of the right arm part 13R and the extending part 13S of the first member 131 (see (b) of Fig. 3). In order that the coaxial cable 12 is bent between the first holding part and the second holding part, the first holding part provided on the right arm part 13R holds the coaxial cable 12 which extends in the x-axis direction, and the second holding part provided on the extending part 13S holds the coaxial cable 12 which extends in the y-axis direction.

[0029] Specifically, a projecting part 13R1 having a rectangular parallelepiped shape is provided on the lower surface of the right arm part 13R, and the projecting part 13R1 has a recessed groove 13R2 extending in the x-axis direction. The recessed groove 13R2 functions as the first holding part, and holds the coaxial cable 12 which extends in the x-axis direction from the indentation 13D. Further, a projecting part 13S1 having a rectangular parallelepiped shape is provided on the lower surface of the extending part 13S, and the projecting part 13S1 has a

recessed groove 13S2 extending in the y-axis direction. The recessed groove 13S2 functions as the second holding part. The recessed groove 13S2 causes the coaxial cable 12 which extends in the x-axis positive direction from the recessed groove 13R2 (first holding part) to be bent in the y-axis positive direction, and holds the coaxial cable 12 which extends in the y-axis positive direction. That is, by causing the second holding part (recessed groove 13S2) to hold the coaxial cable 12 which is held by the first holding part (recessed groove 13R2), the coaxial cable 12 is bent in a vicinity of the first holding part. In such a way, a part of the coaxial cable 12 which part is in a vicinity of a bent part of the coaxial cable 12 which bent part is closest to the tip part of the coaxial cable 12 is held by the first holding part.

[0030] Next, a structure of the second member 132 of Embodiment 1 will be described below with reference to Fig. 4. The second member 132 of Embodiment 1 is a molded resin product, and has a box shape as an external shape.

[0031] The second member 132 has, on its upper surface, (i) a recess 13C1 in which the connection between the film antenna 11 and the coaxial cable 12 is contained and (ii) a first recessed groove 13C2 and a second recessed groove 13C3 each of which communicates with the recess 13C1 and each of which extends toward an end of the second member 132 which end is located in the x-axis positive direction (see (a) of Fig. 4).

[0032] In a case where the second member 132 is attached to the first member 131, the recess 13C1 is arranged so as to correspond to the indentation 13D of the first member 131. Therefore, in a case where the film antenna 11 is wound around the support 13, the connection between the film antenna 11 and the coaxial cable 12 is contained in the recess 13C1, and the recess 13C1 is covered with the film antenna 11 so as to be closed. The connection between the film antenna 11 and the coaxial cable 12 is sealed with the resin 14 which is obtained by curing a fluid resin injected in the recess 13C1. Note that a volumetric capacity of the recess 13C1 is preferably as small as possible so that an amount of the resin, necessary to seal the connection between the film antenna 11 and the coaxial cable 12, is reduced.

[0033] The first recessed groove 13C2, which communicates with the recess 13C1, functions as a passage through which the coaxial cable 12 is drawn out of the recess 13C1. The second recessed groove 13C3, which communicates with the recess 13C1, functions as an exhaust hole through which a gas, contained in the recess 13C1 during injection of the fluid resin into the recess 13C1, is let out.

[0034] The second member 132 further has, on its lower surface, a third holding part which holds the coaxial cable 12 (see (b) of Fig. 4). The second member 132 has, on its lower surface, a recessed groove 13B which passes through the second member 132 in the x-axis direction. The recessed groove 13B is located on a y-axis positive direction side of the first supporting surface

11 on which the first portion J1 of the film antenna 11 is arranged. The recessed groove 13B functions as the third holding part which holds the coaxial cable 12. By providing, in the recessed groove 13B, the coaxial cable 12 which is held by the foregoing recessed groove 13S2 (second holding part), the coaxial cable 12 is bent between the recessed groove 13S2 and the recessed groove 13B.

[0035] The recessed groove 13B has (i) a pair of groove walls 13B1 and 13B2 each of which extends in the x-axis direction and (ii) standing walls 13B3 through 13B7 each of which is provided between the pair of groove walls 13B1 and 13B2 and each of which extends in the y-axis direction. Out of the standing walls 13B3 through 13B7, the standing walls 13B3 through 13B6 have respective slits 13B8 through 13B11 in which the coaxial cable 12 can be pressed. By causing the coaxial cable 12 to be through the recessed groove 13B having such standing walls 13B3 through 13B7, it is possible to firmly hold the coaxial cable 12 in a state in which the coaxial cable 12 meanders.

[0036] The second member 132 further has a fourth holding part which holds the coaxial cable 12 that is held by the third holding part. In Embodiment 1, the second member 132 has, on its x-axis negative direction side, an extending part 13T1 which extends in the x-axis negative direction. The extending part 13T1 has, on its upper surface, a recessed groove 13T2 which extends in the y-axis direction. The recessed groove 13T2 functions as the fourth holding part which holds the coaxial cable 12. By causing the coaxial cable 12 which is held by the foregoing recessed groove 13B (third holding part) to be through the recessed groove 13T2, the coaxial cable 12 is bent between the recessed groove 13B and the recessed groove 13T2.

[0037] Furthermore, in Embodiment 1, the second member 132 has, on its x-axis positive direction side, an extending part 13S3 which extends in the x-axis positive direction and which corresponds to the extending part 13S of the first member 131. Therefore, in a case where the second member 132 is attached to the first member 131, the coaxial cable 12 which is through the recessed groove 13S2 is covered with the extending part 13S3 of the second member 132. This makes it possible to prevent the coaxial cable 12 from falling off the recessed groove 13S2 (second holding part).

[0038] In Embodiment 1, the second member 132 has (i) on its side surface located in the x-axis positive direction, an elastic tongue 13P1 which has a protrusion 13Q1 at its end and which extends in the z-axis negative direction and (ii) on its side surface located in the x-axis negative direction, an elastic tongue 13P2 which has a protrusion 13Q2 at its end and which extends in the z-axis negative direction. The protrusions 13Q1 and 13Q2 provided at the respective ends of the elastic tongues 13P1 and 13P2 are used to fix the antenna device 1 to an object in which to incorporate the antenna device 1 (for example, a spoiler of an automobile) (later described).

[0039] As has been described, according to the support 13 of Embodiment 1, the first member 131 of support 13 has (1) the indentation 13D at a position where the feed section 114 of the film antenna 11 wound around the support 13 is arranged and (2) the first holding part (recessed groove 13R2) and the second holding part (recessed groove 13S2) which hold respective parts of the coaxial cable 12 which parts are in a vicinity of the bent part of the coaxial cable 12 which bent part is closest to the tip part of the coaxial cable 12, out of a plurality of holding parts which hold the coaxial cable 12, connected to the feed section 114 of the film antenna 11, in a state in which the coaxial cable 12 is bent. Meanwhile, the second member 132 of the support 13 has (1) the recess 13C1 in which the connection between the film antenna 11 and the coaxial cable 12 is contained and (2) the third holding part (recessed groove 13B) and the fourth holding part (recessed groove 13T2) out of the plurality of holding parts.

(Method for manufacturing antenna device)

[0040] Next, the following description will discuss a method for manufacturing the antenna device 1 in accordance with Embodiment 1, with reference to Fig. 5 and Fig. 6. Fig. 5 is a flowchart of a method for manufacturing the antenna device 1. Fig. 6 is a perspective view illustrating the antenna device 1 in each manufacturing step.

[0041] As illustrated in Fig. 5, the antenna device 1 of Embodiment 1 is manufactured by carrying out a first holding step S11, a connecting step S12, an attaching step S13, a second holding step S14, a winding step S15, an injecting step S16, and a curing step S17. Each of those steps will be described below.

(1) First holding step S11

[0042] The first holding part (recessed groove 13R2) provided to the first member 131 is caused to hold the coaxial cable 12 so that the tip part of the coaxial cable 12 is arranged in the indentation 13D provided to the first member 131. Further, the second holding part (recessed groove 13S2) provided to the first member 131 is caused to hold the coaxial cable 12 so that the coaxial cable 12 which is held by the first holding part (recessed groove 13R2) is bent. Thus, even in a case where the coaxial cable 12 is pulled in the steps subsequent to the first holding step S11, the coaxial cable 12 is held by the first holding part and the second holding part while being bent. From this, a pulling force is hardly exerted on the connection between the film antenna 11 and the coaxial cable 12, and it is thus possible to reduce a load on the connection, and accordingly possible to improve connection reliability of the connection. (a) of Fig. 6 illustrates the antenna device 1 which has been subjected to the first holding step S11.

(2) Connecting step S12

[0043] The first member 131 is placed on the film antenna 11 in a state in which the third supporting surface I3 of the first member 131 faces in the downward direction. In so doing, the third supporting surface I3 of the first member 131 is brought into contact with the third portion J3 of the film antenna 11 so that the feed section 114 of the film antenna 11 is arranged in the indentation 13D of the first member 131. Then, the tip part of the coaxial cable 12 which has been provided on the first member 131 is connected (by soldering in Embodiment 1) to the feed section 114 of the film antenna 11. Note that, in Embodiment 1, since the first member 131 is a plate-shaped member, it is possible to secure, around the feed section 114 of the film antenna 11, a wide space for carrying out connection work in the connecting step S12. (b) of Fig. 6 illustrates the antenna device 1 which is being subjected to the connecting step S12.

(3) Attaching step S13

[0044] The second member 132 is attached to the first member 131. In so doing, the connection between the feed section 114 of the film antenna 11 and the tip part of the coaxial cable 12 is contained in the recess 13C1 provided to the second member 132.

(4) Second holding step S14

[0045] The third holding part (recessed groove 13B) and the fourth holding part (recessed groove 13T2) each provided to the second member 132 are caused to hold the coaxial cable 12. (c) of Fig. 6 illustrates the antenna device 1 which has been subjected to the second holding step S14.

(5) Winding step S15

[0046] The film antenna 11 is wound around the support 13. In so doing, the film antenna 11 is bent along the support 13 so that the second portion J2 of the film antenna 11 is arranged along the second supporting surface I2 of the support 13, and the film antenna 11 is further bent along the support 13 so that the first portion J1 of the film antenna 11 is arranged along the first supporting surface I1 of the support 13.

(6) Injecting step S16

[0047] The antenna device 1 is arranged so that the first recessed groove 13C2 is arranged above the recess 13C1, and the fluid resin is injected into the recess 13C1 through the first recessed groove 13C2. The fluid resin is injected until the recess 13C1 is filled with the fluid resin. (d) of Fig. 6 illustrates the antenna device 1 which is being subjected to the injecting step S16.

(7) Curing step S17

[0048] The antenna device 1 is left to stand, and the fluid resin which has been injected into the recess 13C1 in the injecting step S16 is cured. For example, in a case where the fluid resin injected into the recess 13C1 in the injecting step S16 is a thermoplastic resin, the fluid resin is cooled (e.g., by natural cooling).

[0049] As described above, in a case where the antenna device 1 in accordance with Embodiment 1 is manufactured, the connecting step of connecting the tip part of the coaxial cable 12 to the feed section 114 of the film antenna 11, which feed section 114 is arranged in the indentation 13D, is carried out after the first holding step of causing the first holding part and the second holding part, each of which is provided to the first member 131, to hold the coaxial cable 12 in advance. This allows a lighter load to be applied to the connection between the film antenna 11 and the coaxial cable 12 during manufacture of the antenna device 1, and consequently allows the connection to have greater connection reliability.

[Embodiment 2]

(Configuration of antenna device)

[0050] A configuration of an antenna device 2 in accordance with Embodiment 2 of the present invention is described below with reference to Figs. 7 through 11.

[0051] As with the case of Embodiment 1, in a case where the antenna device 2 in accordance with Embodiment 2 is used as an on-vehicle antenna that is incorporated in a spoiler, the antenna device 2 is provided at a rear end of a roof of a vehicle body in a state in which, in the drawings, a positive direction of an x-axis (hereinafter, referred to as an x-axis positive direction) is a rightward direction, a negative direction of the x-axis (hereinafter, referred to as an x-axis negative direction) is a leftward direction, a positive direction of a y-axis (hereinafter, referred to as a y-axis positive direction) is a forward direction, a negative direction of the y-axis (hereinafter, referred to as a y-axis negative direction) is a backward direction, a positive direction of a z-axis (hereinafter, referred to as a z-axis positive direction) is an upward direction, and a negative direction of the z-axis (hereinafter, referred to as a z-axis negative direction) is a downward direction. Note that, in the descriptions below, the x-axis positive direction, the x-axis negative direction, the y-axis positive direction, the y-axis negative direction, the z-axis positive direction, and the z-axis negative direction are sometimes expressed as right, left, front, rear, up, and down, respectively.

[0052] Fig. 7 is a view illustrating the antenna device 2 in accordance with Embodiment 2. (a) of Fig. 7 is a perspective view illustrating an upper surface side of the antenna device 2. (b) of Fig. 7 is a perspective view illustrating a lower surface side of the antenna device 2. (c) of Fig. 7 is a cross-sectional view of the antenna device

2 illustrated in (a) of Fig. 7, taken along a line C-C. (d) of Fig. 7 is an enlarged cross-sectional view of a feed section and its vicinity (a region D illustrated in (c) of Fig. 7).

[0053] As illustrated in (a) and (b) of Fig. 7, the antenna device 2 of Embodiment 2 includes a film antenna 21, a coaxial cable 22, and a support 23. As with the case of Embodiment 1, the antenna device 2 includes the support 23 which has (i) a function of causing a three-dimensional structure of the film antenna 21 to be maintained and (ii) a function of holding the coaxial cable 22 in a state in which the coaxial cable 22 is bent. According to the antenna device 2, since the film antenna 21 is wound around the support 23, the film antenna 21 has a highly stable antenna characteristic. Further, since the coaxial cable 22 is held by the support 23, the coaxial cable 22 has high durability with respect to pulling of the coaxial cable 22. Further, according to the antenna device 2, a connection between the film antenna 21 and the coaxial cable 22 (specifically, a feed section 214 of the film antenna 21, a tip part of the coaxial cable 22, and solder for connecting these) is contained in a recess of the support 23, and is sealed with a resin 24. This makes it possible to prevent the connection from deteriorating due to, for example, moisture (see (c) and (d) of Fig. 7).

[0054] Functions and structures of the film antenna 21 and the coaxial cable 22 which are included in the antenna device 2 of Embodiment 2 are similar to those of the film antenna 11 and the coaxial cable 12 which are included in the antenna device 1 in accordance with Embodiment 1. Therefore, the functions and the structures of the film antenna 21 and the coaxial cable 22 which are included in the antenna device 2 are not described here.

(Structure of support)

[0055] As with the case of Embodiment 1, the antenna device 2 in accordance with Embodiment 2 employs the support 23 which is divided into a first member 231 and a second member 232 (in Fig. 7, a surface of the first member 231 is hatched). This allows a lighter load to be applied to the connection between the film antenna 21 and the coaxial cable 22 during manufacture of the antenna device 2, and consequently allows the connection to have greater connection reliability.

[0056] Respective structures of the first member 231 and the second member 232 of the support 23 will be described below with reference to Figs. 8 and 9. (a) of Fig. 8 is a perspective view illustrating an upper surface side of the first member 231. (b) of Fig. 8 is a perspective view illustrating a lower surface side of the first member 231. (a) of Fig. 9 is a perspective view illustrating an upper surface side of the second member 232. (b) of Fig. 9 is a perspective view illustrating a lower surface side of the second member 232. Figs. 8 and 9 each also illustrate the coaxial cable 22.

[0057] The support 23 of Embodiment 2 is different from the support 13 of Embodiment 1 in that (1) the first member 231 is a three-dimensional molded resin prod-

uct, and has a size large in a z-axis direction, (2) the first member 231 has all of holding parts each of which holds the coaxial cable 22, (3) the second member 232 has a projecting part 23C which is arranged in an indentation 23D of the first member 231, and the projecting part 23C has, on its upper surface, a recess 23C1 in which the connection between the film antenna 21 and the coaxial cable 22 is contained, (4) the coaxial cable 22 which is through a recessed groove 23B is provided between the first member 231 and the second member 232, and (5) the second member 232 do not have, on its x-axis positive direction side, a part corresponding to the extending part 13R3 of Embodiment 1.

[0058] First, a structure of the first member 231 will be described below with reference to Fig. 8. The first member 231 of Embodiment 2 is U-shaped in a plan view. The first member 231 is a three-dimensional molded resin product, and has a size large in the z-axis direction.

[0059] Specifically, the first member 231 has (i) a main body part 23M having a three-dimensional shape and having a rectangular shape in a plan view and (ii) a left arm part 23L and a right arm part 23R each having a three-dimensional shape and having a rectangular shape in a plan view. The left arm part 23L and the right arm part 23R each extend in the y-axis negative direction from the main body part 23M. The first member 231 further has the indentation 23D between the left arm part 23L and the right arm part 23R which are arranged so as to be apart from each other. That is, the first member 231 has, at its end located in the y-axis negative direction, the indentation 23D which is surrounded by the left arm part 23L, the main body part 23M, and the right arm part 23R on three sides. With the configuration, in a case where the film antenna 21 is wound around the support 23, a third portion J3 of the film antenna 21 is arranged so as to extend along an upper surface (third supporting surface 13) of the first member 231, and the feed section 214 of the film antenna 21 is arranged in the indentation 23D.

[0060] The first member 231 further has, on its x-axis positive direction side, an extending part 23S extending in the x-axis positive direction from a region extending over the main part 23M and the right arm part 23R.

[0061] The first member 231 of Embodiment 2 further has, on its upper surface and on its lower surface, the holding parts which hold the coaxial cable 22.

[0062] A first holding part and a second holding part are provided on respective upper surfaces of the right arm part 23R and the extending part 23S of the first member 231 (see (a) of Fig. 8). In order that the coaxial cable 22 is bent between the first holding part and the second holding part, the first holding part holds the coaxial cable 22 which extends in an x-axis direction, and the second holding part holds the coaxial cable 22 which extends in the y-axis direction.

[0063] Specifically, the right arm part 23R has, on its upper surface, a recessed groove 23R2 which extends in the x-axis direction. The recessed groove 23R2 func-

tions as the first holding part, and holds the coaxial cable 22 which extends in the x-axis direction from the indentation 23D. Further, the extending part 23S has, on its upper surface, a recessed groove 23S2 which extends in the y-axis direction. The recessed groove 23S2 functions as the second holding part. The recessed groove 23S2 causes the coaxial cable 22 which extends in the x-axis direction from the recessed groove 23R2 (first holding part) to be bent in the y-axis direction, and holds the coaxial cable 22 which extends in the y-axis direction. That is, by causing the second holding part (recessed groove 23S2) to hold the coaxial cable 22 which is held by the first holding part (recessed groove 23R2), the coaxial cable 22 is bent in a vicinity of the first holding part. In such a way, part of the coaxial cable 22 which part is in a vicinity of a bent part of the coaxial cable 22 which bent part is closest to the tip part of the coaxial cable 22 is held by the first holding part.

[0064] Furthermore, a third holding part which holds the coaxial cable 22 is provided on a lower surface of the main body part 23M of the first member 231 (see (b) of Fig. 8). The main body part 23M has, on a y-axis positive direction side of its lower surface, a recessed groove 23B which passes through the main body part 23M in the x-axis direction. The recessed groove 23B functions as the third holding part which holds the coaxial cable 22. By providing, in the recessed groove 23B, the coaxial cable 22 which is held by the foregoing recessed groove 23S2 (second holding part), the coaxial cable 22 is bent between the recessed groove 23S2 and the recessed groove 23B.

[0065] The recessed groove 23B has (i) a pair of groove walls 23B1 and 23B2 each of which extends in the x-axis direction and (ii) standing walls 23B3 through 23B7 each of which is provided between the pair of groove walls 23B1 and 23B2 and each of which extends in the y-axis direction. Out of the standing walls 23B3 through 23B7, the standing walls 23B3 through 23B6 have respective slits 23B8 through 23B11 in which the coaxial cable 22 can be pressed. By causing the coaxial cable 22 to be through the recessed groove 23B having such standing walls 23B3 through 23B7, it is possible to firmly hold the coaxial cable 22 in a state in which the coaxial cable 22 meanders.

[0066] The first member 231 further has a fourth holding part which holds the coaxial cable 22 that is held by the third holding part. In Embodiment 2, the first member 231 has, on its x-axis negative direction side, an extending part 23T1 which extends in the x-axis negative direction. The extending part 23T1 has, on its upper surface, a recessed groove 23T2 which extends in the y-axis direction. The recessed groove 23T2 functions as the fourth holding part which holds the coaxial cable 22. By providing, in the recessed groove 23T2, the coaxial cable 22 which is held by the foregoing recessed groove 23B (third holding part), the coaxial cable 22 is bent between the recessed groove 23B and the recessed groove 23T2.

[0067] Next, the structure of the second member 232

will be described below with reference to Fig. 9. The second member 232 is a molded resin product, and has a box shape as an external shape. The second member 232 has, on its upper surface, the projecting part 23C having a rectangular parallelepiped shape and being complementary to the indentation 23D of the first member 231.

[0068] In a case where the second member 232 is attached to the first member 231, the projecting part 23C is fitted in the indentation 23D of the first member 231. The projecting part 23C has, on its upper surface, (i) the recess 23C1 in which the connection between the film antenna 21 and the coaxial cable 22 is contained, (ii) a recessed groove 23C2 (cable through passage) which communicates with the recess 23C1, and (iii) a recessed groove 23C3 (exhaust hole) which communicates with the recess 23C1. In a case where the second member 232 is attached to the first member 231, the recess 23C1 is arranged in the indentation 23D of the first member 231. In a case where the film antenna 21 is then wound around the support 23, the connection between the film antenna 21 and the coaxial cable 22 is contained in the recess 23C1, and the recess 23C1 is covered with the film antenna 21 so as to be closed.

[0069] Furthermore, in Embodiment 2, in a case where the second member 232 is attached to the first member 231, the coaxial cable 22 which is through the recessed groove 23B of the first member 231 is provided so as to be sandwiched between the recessed groove 23B and the second member 232.

[0070] The antenna device 1 in accordance with Embodiment 1 is known to deteriorate in antenna characteristic in a case where the coaxial cable 12 which is pressed in the slits 13B8 through 13B11 of the recessed groove 13B moves to a first supporting surface side so as to be in proximity to the first antenna conductor 112. In contrast, according to Embodiment 2, the antenna device 2 is configured such that the coaxial cable 22 which is through the recessed groove 23B of the first member 231 is pressed by the second member 232 so as not to move to a first supporting surface side of the second member 232. Therefore, even in a case where the coaxial cable 22 is pulled, the coaxial cable 22 does not move to the first supporting surface side and is, accordingly, not in proximity to the first antenna conductor 112. This makes it possible to prevent a deterioration in antenna characteristic which deterioration is caused by a change in position of the coaxial cable 22 which is through the recessed groove 23B.

[0071] Note that, in Embodiment 2, as with the case of Embodiment 1, the first member 231 has a guide ring 23G at an end of its upper surface which end is located in the y-axis positive direction. Furthermore, the second member 232 has (i) on its side surface located in the x-axis positive direction, an elastic tongue 23P1 which has a protrusion 23Q1 at its end and which extends in the z-axis negative direction and (ii) on its side surface located in the x-axis negative direction, an elastic tongue 23P2

which has a protrusion 23Q2 at its end and which extends in the z-axis negative direction.

(Method for manufacturing antenna device)

[0072] Next, the following description will discuss a method for manufacturing the antenna device 2 in accordance with Embodiment 2, with reference to Fig. 10 and Fig. 11. Fig. 10 is a flowchart of a method for manufacturing the antenna device 2. Fig. 11 is a perspective view illustrating the antenna device 2 in each manufacturing step.

[0073] As illustrated in Fig. 10, the antenna device 2 of Embodiment 2 is manufactured by carrying out a holding step S21, a connecting step S22, an attaching step S23, a winding step S24, an injecting step S25, and a curing step S26. The method of Embodiment 2 is different from that of Embodiment 1 in that merely a single holding step needs to be carried out so as to cause the support 23 to hold the coaxial cable 22. Each of those steps will be described below.

(1) Holding step S21

[0074] The first holding part (recessed groove 23R2), the second holding part (recessed groove 23S2), the third holding part (recessed groove 23B), and the fourth holding part (recessed groove 23T2), each provided to the first member 231, are caused to hold the coaxial cable 22 so that the tip part of the coaxial cable 22 is arranged in the indentation 23D provided to the first member 231. In so doing, each of those holding parts of the first member 231 is caused to hold the coaxial cable 22 while the coaxial cable 22 is being bent. Thus, even in a case where the coaxial cable 22 is pulled in the steps subsequent to the holding step S21, the coaxial cable 22 is held by the first holding part through the fourth holding part while being bent. From this, a pulling force is hardly exerted on the connection between the film antenna 21 and the coaxial cable 22, and it is thus possible to reduce a load on the connection, and accordingly possible to improve connection reliability of the connection. Furthermore, since all of the holding parts for holding the coaxial cable 22 are provided to the first member 231, it is possible to cause the support 23 to hold the coaxial cable 22 at a time. (a) of Fig. 11 illustrates the antenna device 2 which has been subjected to the holding step S21.

(2) Connecting step S22

[0075] The first member 231 is placed on the film antenna 21 in a state in which the third supporting surface I3 of the first member 231 faces in the downward direction. In so doing, the third supporting surface I3 of the first member 231 is brought into contact with the third portion J3 of the film antenna 21 so that the feed section 214 of the film antenna 21 is arranged in the indentation 23D of the first member 231. Then, the tip part of the

coaxial cable 22 which has been provided on the first member 231 is connected (by soldering in Embodiment 2) to the feed section 214 of the film antenna 21. (b) of Fig. 11 illustrates the antenna device 2 which is being subjected to the connecting step S22.

(3) Attaching step S23

[0076] The second member 232 is attached to the first member 231. In so doing, the connection between the feed section 214 of the film antenna 21 and the tip part of the coaxial cable 22 is contained in the recess 23C1 provided to the second member 232. (c) of Fig. 11 illustrates the antenna device 2 which is being subjected to the attaching step S23.

(4) Winding step S24

[0077] The film antenna 21 is wound around the support 23. In so doing, the film antenna 21 is bent along the support 23 so that a second portion J2 of the film antenna 21 is arranged along a second supporting surface I2 of the support 23, and the film antenna 21 is further bent along the support 23 so that a first portion J1 of the film antenna 21 is arranged along a first supporting surface I1 of the support 23.

(5) Injecting step S25

[0078] The antenna device 2 is arranged so that the recessed groove 23C2 is arranged above the recess 23C1, and the fluid resin is injected into the recess 23C1 through the recessed groove 23C2. The fluid resin is injected until the recess 23C1 is filled with the fluid resin. (d) of Fig. 11 illustrates the antenna device 2 which is being subjected to the injecting step S25.

(6) Curing step S26

[0079] The antenna device 2 is left to stand, and the fluid resin which has been injected into the recess 23C1 in the injecting step S25 is cured. For example, in a case where the fluid resin injected into the recess 23C1 in the injecting step S25 is a thermoplastic resin, the fluid resin is cooled (e.g., by natural cooling).

[0080] As described above, in a case where the antenna device 2 in accordance with Embodiment 2 is manufactured, the connecting step of connecting the tip part of the coaxial cable 22 to the feed section 114 of the film antenna 21, which feed section 114 is arranged in the indentation 23D, is carried out after the holding step of causing the first holding part through the fourth holding part, each of which is provided to the first member 231, to hold the coaxial cable 22 in advance. This allows a lighter load to be applied to the connection between the film antenna 21 and the coaxial cable 22 during manufacture of the antenna device 2, and consequently allows the connection to have greater connection reliability.

[Method for providing each of antenna devices in accordance with Embodiments 1 and 2 inside spoiler]

[0081] The following description will discuss a method for providing the antenna device 1 in accordance with Embodiment 1 inside a spoiler 5, with reference to Fig. 12.

[0082] The spoiler 5 in which the antenna device 1 is to be incorporated has an opening 51a which is provided in an upper surface of a housing 51 so that the antenna device 1 can be provided inside the housing 51 (see Fig. 12). Note that, in Fig. 12, shapes of the antenna device 1 and the spoiler 5 are schematically drawn in order to simply illustrate the method for providing the antenna device 1 inside the spoiler 5.

[0083] The spoiler 5 in accordance with Embodiment 1 includes (i) the housing 51 having an opening provided in the upper surface and (ii) a lid 52 for closing the opening 51a of the housing 51 (see (a) of Fig. 12). The housing 51 has (i) a first containing space 511 which is arranged at a part protruding from a rear end of a vehicle body in the backward direction in a case where the spoiler 5 is mounted at the rear end of the roof and (ii) a second containing space 512 which is arranged along the roof. The first containing space 511 and the second containing space 512 communicate with each other, and the first containing space 511 has a space for containing the support 13. Moreover, the first containing space 511 is provided with a pair of supporting plates 513 and 514 for supporting the support 13 of the antenna device 1.

[0084] In Embodiment 1, as illustrated in (b) of Fig. 12, the antenna device 1 is inserted into the housing 51 via the opening 51a provided in the upper surface of the housing 51, and the protrusions 13Q1 and 13Q2 provided in the support 13 of the antenna device 1 are engaged with respective engagement holes provided in the respective supporting plates 513 and 514, so that the antenna device 1 is fixed to the supporting plates 513 and 514. Then, as illustrated in (c) of Fig. 12, the opening 51a of the housing 51 is closed with the lid 52, and thus the spoiler 5 in which the antenna device 1 is incorporated is provided. In this manner, the antenna device 1 is attached to the spoiler 5 in a state in which the support 13 is contained in the first containing space 511 and the film antenna 11 wound around the support 13 partially extends in the second containing space 512. Note that the coaxial cable 12 connected to the film antenna 11 is drawn out to an outside of the housing 51 via a through hole (not illustrated) provided in the housing 51.

[0085] Note that the antenna device 2 in accordance with Embodiment 2 can also be provided inside the spoiler 5 by a method identical with the method for providing the antenna device 1 in accordance with Embodiment 1 inside the spoiler 5.

[Embodiment 3]

(Configuration of antenna device)

[0086] A configuration of an antenna device 3 in accordance with Embodiment 3 of the present invention is described below with reference to Figs. 13 through 15.

[0087] As with the case of each of the embodiments described earlier, in a case where the antenna device 3 in accordance with Embodiment 3 is used as an on-vehicle antenna that is incorporated in a spoiler, the antenna device 3 is provided at a rear end of a roof of a vehicle body in a state in which, in the drawings, a positive direction of an x-axis (hereinafter, referred to as an x-axis positive direction) is a rightward direction, a negative direction of the x-axis (hereinafter, referred to as an x-axis negative direction) is a leftward direction, a positive direction of a y-axis (hereinafter, referred to as a y-axis positive direction) is a forward direction, a negative direction of the y-axis (hereinafter, referred to as a y-axis negative direction) is a backward direction, a positive direction of a z-axis (hereinafter, referred to as a z-axis positive direction) is an upward direction, and a negative direction of the z-axis (hereinafter, referred to as a z-axis negative direction) is a downward direction. Note that, in the descriptions below, the x-axis positive direction, the x-axis negative direction, the y-axis positive direction, the y-axis negative direction, the z-axis positive direction, and the z-axis negative direction are sometimes expressed as right, left, front, rear, up, and down, respectively.

[0088] Fig. 13 is a view illustrating the antenna device 3 in accordance with Embodiment 3. (a) of Fig. 13 is a perspective view illustrating an upper surface side of the antenna device 3. (b) of Fig. 13 is a perspective view illustrating a lower surface side of the antenna device 3. (c) of Fig. 13 is a cross-sectional view of the antenna device 3 illustrated in (a) of Fig. 13, taken along a line E-E. (d) of Fig. 13 is an enlarged cross-sectional view of a feed section and its vicinity (a region F illustrated in (c) of Fig. 13).

[0089] As illustrated in (a) and (b) of Fig. 13, the antenna device 3 of Embodiment 3 includes a film antenna 31, a coaxial cable 32, and a support 33. As with the case of Embodiment 1, the antenna device 3 includes the support 33 which has (i) a function of causing a three-dimensional structure of the film antenna 31 to be maintained and (ii) a function of holding the coaxial cable 32 in a state in which the coaxial cable 32 is bent. According to the antenna device 3, since the film antenna 31 is wound around the support 33, the film antenna 31 has a highly stable antenna characteristic. Further, since the coaxial cable 32 is held by the support 33, the coaxial cable 32 has high durability with respect to pulling of the coaxial cable 32. Further, according to the antenna device 3, a connection between the film antenna 31 and the coaxial cable 32 (specifically, a feed section 314 of the film antenna 31, a tip part of the coaxial cable 32, and solder

for connecting these) is contained in a recess of the support 33, and is sealed with a resin 34. This makes it possible to prevent the connection from deteriorating due to, for example, moisture (see (c) and (d) of Fig. 13).

[0090] Functions and structures of the film antenna 31 and the coaxial cable 32 which are included in the antenna device 3 of Embodiment 3 are similar to those of the film antenna 11 and the coaxial cable 12 which are included in the antenna device 1 in accordance with Embodiment 1. Therefore, the functions and the structures of the film antenna 31 and the coaxial cable 32 which are included in the antenna device 3 are not described here.

(Structure of support)

[0091] As with the case of Embodiments 1 and 2, the antenna device 3 in accordance with Embodiment 3 employs the support 33 which is divided into a first member 331 and a second member 332 (in Fig. 13, a surface of the first member 331 is hatched). This allows a lighter load to be applied to the connection between the film antenna 31 and the coaxial cable 32 during manufacture of the antenna device 3, and consequently allows the connection to have greater connection reliability.

[0092] Respective structures of the first member 331 and the second member 332 of the support 33 will be described below with reference to Figs. 14 and 15. (a) of Fig. 14 is a plan view of the first member 331. (b) of Fig. 14 is a bottom view of the first member 331. (a) of Fig. 15 is a plan view of the second member 332. (b) of Fig. 15 is a bottom view of the second member 332. Figs. 14 and 15 each also illustrate the coaxial cable 32.

[0093] The support 33 of Embodiment 3 is different from the support 23 of Embodiment 2 in that (1) the first member 331 has a supporting plate 33S which extends in the y-axis positive direction from a main body part 33M, and does not have a part corresponding to the guide ring 23G of Embodiment 2, (2) the first member 331 does not have, on its x-axis positive direction side, a part corresponding to any of the extending part 23S and the recessed groove 23S2 of Embodiment 2, and also does not have, on its x-axis negative direction side, a part corresponding to any of the extending part 23T1 and the recessed groove 23T2 of Embodiment 2, (3) the first member 331 has a right arm part 33R which has, on its upper surface, a recessed groove (bent recessed groove) 33R2 that holds the coaxial cable 32 in a state in which the coaxial cable 32 is bent, (4) the main body part 33M of the first member 331 has, on its lower surface, a recessed groove 33B which causes the coaxial cable 32 to extend out in the y-axis positive direction from the middle of the recessed groove 33B (from the middle in an x-axis direction), and (5) protrusions 33Q1 and 33Q2 each of which is used to fix the antenna device 3 to an object in which to incorporate the antenna device 3 are provided at respective ends of elastic pieces 33P1 and 33P2 each of which extends in the y-axis positive direction.

[0094] First, the structure of the first member 331 will be described below with reference to Fig. 14.

[0095] The first member 331 of Embodiment 3 has (i) the main body part 33M having a three-dimensional shape and having a rectangular shape in a plan view and (ii) a left arm part 33L and the right arm part 33R each having a three-dimensional shape and having a rectangular shape in a plan view. The left arm part 33L and the right arm part 33R each extend in the y-axis negative direction from the main body part 33M. The first member 331 further has the indentation 33D between the left arm part 33L and the right arm part 33R which are arranged so as to be apart from each other. That is, the first member 331 has, at its end located in the y-axis negative direction, the indentation 33D which is surrounded by the left arm part 33L, the main body part 33M, and the right arm part 33R on three sides. The first member 331 of Embodiment 3 further has the supporting plate 33S which has a plate shape and which extends in the y-axis positive direction from the main body part 33M. The supporting plate 33S and a third supporting surface are arranged so as to be flush with each other. In a case where the film antenna 31 is wound around the support 33, a second antenna conductor 313 of the film antenna 31 is arranged so as to extend along an upper surface of the first member 331, and the feed section 314 of film antenna 31 is arranged in the indentation 33D.

[0096] In Embodiment 3, the film antenna 31 is attached to the support 33 with use of double-sided adhesive tapes 34 through 36. Figs. 14 and 15 each illustrate an outline of each of the double-sided adhesive tapes 34 through 36 with use of a dotted line. The double-sided adhesive tape 34 has an opening 341. In order that an electrically conductive connection between the tip part of the coaxial cable 32 and the feed section 314 of the film antenna 31 is not blocked, the opening 341 is formed in a region of the double-sided adhesive tape 34, which region corresponds to the tip part of the coaxial cable 32 that is arranged in the indentation 33D (see (a) of Fig. 14).

[0097] Note that the first member 331 of Embodiment 3 does not have a part corresponding to the guide ring 23G of Embodiment 2. Furthermore, the first member 331 does not have, on its x-axis positive direction side, a part corresponding to any of the extending part 23S and the recessed groove 23S2 of Embodiment 2. Moreover, the first member 331 does not have, on its x-axis negative direction side, a part corresponding to any of the extending part 23T1 and the recessed groove 23T2 of Embodiment 2.

[0098] The first member 331 of Embodiment 3 has, on its respective upper and lower surfaces, holding parts each of which holds the coaxial cable 32.

[0099] In Embodiment 3, the bent recessed groove 33R2 is formed in the upper surface of the right arm part 33R of the first member 331 (see (a) of Fig. 14). The bent recessed groove 33R2 functions as a first holding part. Specifically, the bent recessed groove 33R2 holds the coaxial cable 32 which extends in the x-axis positive di-

rection from the indentation 33D, and holds the coaxial cable 32 so that the coaxial cable 32 is bent so as to extend in the y-axis positive direction. That is, the first holding part (bent recessed groove 33R2) holds a bent part and its vicinity of the coaxial cable 32 which bent part is closest to the tip part of the coaxial cable 32.

[0100] Further, in Embodiment 3, the recessed groove 33B which extends in the x-axis direction is formed in the lower surface of the main body part 33M of the first member 331 (see (b) of Fig. 14). The recessed groove 33B functions as a holding part. The recessed groove 33B holds the coaxial cable 32 which extends from the bent recessed groove 33R2 (first holding part), in a state in which the coaxial cable 32 is bent.

[0101] The recessed groove 33B has (i) a pair of groove walls 33B1 and 33B2 each of which extends in the x-axis direction and (ii) standing walls 33B5 through 33B7 each of which is provided between the pair of groove walls 33B1 and 33B2 and each of which extends in a y-axis direction. The groove wall 33B1 has, at its end located in the x-axis positive direction, a notch 33B3 which guides, into the recessed groove 33B, the coaxial cable 32 that extends from the first holding part. Meanwhile, the groove wall 33B2 has, in its middle in the x-axis direction, a notch 33B4 which causes the coaxial cable 32 that is provided inside the recessed groove 33B to extend out in the y-axis positive direction. The standing walls 33B5 through 33B7 have respective slits 33B8 through 33B10 in which the coaxial cable 32 can be pressed. By (i) providing the coaxial cable 32 inside the recessed groove 33B having the standing walls 33B5 through 33B7 and (ii) causing the coaxial cable 32 to extend out in the y-axis positive direction through the notch 33B4 of the groove wall 33B2, it is possible to firmly hold the coaxial cable 32 in a state in which the coaxial cable 32 meanders.

[0102] Note that the first member 331 of Embodiment 3 has a through hole through which the coaxial cable 32 is provided so that the coaxial cable 32 extends from the bent recessed groove 33R2, which is formed in the upper surface of the right arm part 33R, to the recessed groove 33B, which is formed in the lower surface of the main body part 33M. In Embodiment 3, as with the case of Embodiment 2, in a case where the second member 332 is attached to the first member 331, the coaxial cable 32 which is through the recessed groove 33B is provided between the first member 331 and the second member 332.

[0103] Further, according to the first member 331 of Embodiment 3, the main body part 33M has the elastic pieces 33P1 and 33P2 which extend in the y-axis positive direction from respective right and left side surfaces of the main body part 33M. The protrusions 33Q1 and 33Q2 are provided at the respective ends of the elastic pieces 33P1 and 33P2. Meanwhile, the supporting plate 33S has, in its end region, expanded parts 33S1 and 33S2 which project rightward and leftward, respectively, in a width direction. The protrusions 33Q1 and 33Q2, provid-

ed at the respective ends of the elastic pieces 33P1 and 33P2, and the expanded parts 33S1 and 33S2, provided in the end region of the supporting plate 33S, are used to fix the antenna device 3 to an object in which to incorporate the antenna device 3 (for example, a spoiler of an automobile) (later described).

[0104] Next, the structure of the second member 332 will be described with reference to Fig. 15.

[0105] The second member 332 has, on its upper surface, a projecting part 33C having a rectangular parallel-piped shape and being complementary to the indentation 33D of the first member 331. The projecting part 33C has, on its upper surface, (i) a recess 33C1 in which the connection between the film antenna 31 and the coaxial cable 32 is contained, (ii) a recessed groove 33C2 (cable through passage) which communicates with the recess 33C1, and (iii) a recessed groove 33C3 (exhaust hole) which communicates with the recess 33C1. In a case where the second member 332 is attached to the first member 331, the recess 33C1 is arranged in the indentation 33D of the first member 331. In a case where the film antenna 31 is then wound around the support 33, the connection between the film antenna 31 and the coaxial cable 32 is contained in the recess 33C1, and the recess 33C1 is covered with the film antenna 31 so as to be closed.

[Method for providing antenna device in Embodiment 3 inside spoiler]

[0106] The following description will discuss a method for providing the antenna device 3 in accordance with Embodiment 3 inside a spoiler 6, with reference to Fig. 16.

[0107] The spoiler 6 in which the antenna device 3 is to be incorporated has an opening 61a which is provided in a lateral surface (i.e., a lateral surface in the forward direction) of a housing 61 so that the antenna device 3 can be provided inside the housing 61 (see Fig. 16). Note that, in Fig. 16, shapes of the antenna device 3 and the spoiler 6 are schematically drawn in order to simply illustrate the method for providing the antenna device 3 inside the spoiler 6.

[0108] As illustrated in (a) of Fig. 16, the spoiler 6 in accordance with Embodiment 3 includes (i) the housing 61 which is arranged at a part protruding from a rear end of a roof of a vehicle body in the backward direction in a case where the spoiler 6 is mounted at the rear end of the roof and (ii) a top board 62 which is arranged along the roof. The housing 61 has therein a space for containing the support 33 of the antenna device 3. In the lateral surface (i.e., the lateral surface in the forward direction) of the housing 61, the opening 61a is provided via which the support 33 of the antenna device 3 is to be inserted into the housing 61. The top board 62 is provided with L-shaped protrusions 621 and 622 for holding the supporting plate 33S of the antenna device 3.

[0109] In Embodiment 3, as illustrated in (b) of Fig. 16, the antenna device 3 is arranged along the top board 62

such that the expanded parts 33S1 and 33S2 projecting in the respective left and right (width) directions in an end region of the supporting plate 33S of the antenna device 3 are supported by the respective L-shaped protrusions 621 and 622 of the top board 62 of the spoiler 6, and then the antenna device 3 is slid along the top board 62 such that the support 33 of the antenna device 3 is inserted into the housing 61 of the spoiler 6 via the opening 61a. In this case, the elastic pieces 33P1 and 33P2 extending from the support 33 of the antenna device 3 is warped to the inner side so that the protrusions 33Q1 and 33Q2 at the respective ends of the elastic pieces 33P1 and 33P2 enter the housing 61, and the protrusions 33Q1 and 33Q2 are engaged with a surrounding wall of the opening 61a. With the configuration, the support 33 of the antenna device 3 is fixed inside the housing 61, and it is therefore possible to prevent the antenna device 3 from accidentally falling off the spoiler 6.

[0110] Note that the support 33 can be taken out from inside of the housing 61 by warping the elastic pieces 33P1 and 33P2 to the inner side so as to cancel the engagement between the surrounding wall of the opening 61a and the protrusions 33Q1 and 33Q2. As such, the antenna device 3 can be detached from the spoiler 6.

<<Conclusion>>

[0111] In order to attain the object, an antenna device in accordance with an aspect of the present invention includes: a film antenna; a cable which has a tip part connected to a feed section of the film antenna; and a support around which the film antenna is wound and which has a plurality of holding parts holding the cable in a state in which the cable is bent, the support including a first member and a second member attached to the first member, the first member having (i) a first holding part holding a bent part and/or a vicinity thereof, the bent part being closest to the tip part of the cable, and (ii) an indentation provided in a part of the first member in which part a connection between the cable and the film antenna is arranged, the second member having a recess in which the connection arranged in the indentation of the first member is contained, and the film antenna being wound around the support so as to close the recess, and the recess being filled with a resin.

[0112] With the configuration, since the film antenna is wound around the support, it is possible to maintain a three-dimensional structure of an antenna conductor of the film antenna. This allows the antenna to have a stable characteristic. Further, with the configuration, since the cable is held by the support while being bent, it is possible to increase durability with respect to pulling of the cable.

[0113] Furthermore, with the configuration, since the recess in which the connection between the film antenna and the cable is contained is filled with the resin and the connection is sealed with the resin, it is possible to prevent the connection from deteriorating due to, for example, moisture.

[0114] Moreover, with the configuration, the support includes the first member and the second member attached to the first member, the first member has (i) a first holding part holding a bent part and/or a vicinity thereof, the bent part being closest to the tip part of the cable, and (ii) an indentation provided in a part of the first member in which part the connection between the cable and the film antenna is arranged. This makes it possible to cause the first member to hold, in advance, the cable which is bent, and thereafter connect the cable and the film antenna and wind the film antenna around the support. This allows a lighter load to be applied to the connection between the film antenna and the coaxial cable during manufacture of the antenna device, and consequently allows the connection to have greater connection reliability.

[0115] The antenna device in accordance with an aspect of the present invention may be configured such that: the first member is a plate-shaped member; and the second member has a holding part, which is different from the first holding part, of the plurality of holding parts.

[0116] With the configuration, since the first member is a plate-shaped member, it is possible to secure, around the feed section, a wide work space for connecting the film antenna and the cable.

[0117] The antenna device in accordance with an aspect of the present invention may be configured such that the first member has a holding part, which is different from the first holding part, of the plurality of holding parts.

[0118] With the configuration, the cable is firmly held by the first member. This allows a lighter load to be applied to the connection between the film antenna and the coaxial cable during manufacture of the antenna device, and consequently allows the connection to have greater connection reliability.

[0119] The antenna device in accordance with an aspect of the present invention may be configured such that at least a part of the cable is arranged between the first member and the second member.

[0120] The configuration allows the cable to be firmly held by the support. Further, since the configuration makes it difficult to change a position of the cable with respect to the film antenna, the antenna device can have a more stable characteristic.

[0121] The antenna device in accordance with an aspect of the present invention may be configured such that: the first member is U-shaped in a plan view; and an angular range of direction in which the connection is surrounded by the first member is larger than 180 degrees.

[0122] With the configuration, the feed section is surrounded and supported by the first member. This allows a lighter load to be applied to the connection between the film antenna and the coaxial cable during manufacture of the antenna device, and consequently allows the connection to have greater connection reliability.

[0123] In order to attain the object, an antenna device manufacturing method in accordance with an aspect of the present invention for manufacturing an antenna de-

vice including: a film antenna; a cable; and a support around which the film antenna is wound and which has a plurality of holding parts holding the cable, the support including a first member and a second member, the first member having (i) a first holding part of the plurality of holding parts and (ii) an indentation provided in a part of the first member in which part a connection between the cable and the film antenna is arranged, and the second member having a recess in which the connection arranged in the indentation of the first member is contained, the antenna device manufacturing method includes: a first holding step of arranging a tip part of the cable in the indentation of the first member and causing the first holding part of the first member to hold a bent part and/or a vicinity thereof, the bent part being closest to the tip part of the cable; a connecting step of, after the first holding step, connecting the tip part of the cable to a feed section of the film antenna; an attaching step of, after the connecting step, attaching the second member to the first member so that the connection between the film antenna and the cable is arranged in the recess; a winding step of, after the attaching step, winding the film antenna around the support so as to close the recess; an injecting step of, after the winding step, injecting a fluid resin into the recess; and a curing step of, after the injecting step, curing the fluid resin.

[0124] According to the antenna device manufacturing method, the holding step is carried out before the connecting step. This allows a lighter load to be applied to the connection between the film antenna and the coaxial cable during manufacture of the antenna device, and consequently allows the connection to have greater connection reliability.

[0125] The antenna device manufacturing method in accordance with an aspect of the present invention may be configured such that: the first member is a plate-shaped member; and the second member has a holding part, which is different from the first holding part, of the plurality of holding parts, the antenna device manufacturing method further includes: a second holding step of, in and after the attaching step, causing the holding part, which is different from the first holding part, of the second member to hold the cable.

[0126] According to the antenna device manufacturing method, since the first member is a plate-shaped member, it is possible to secure, around the feed section, a wide work space for connecting the film antenna and the cable. This makes it possible to easily carry out the connecting step.

[0127] The antenna device manufacturing method in accordance with an aspect of the present invention may be configured such that: the first member further has a holding part, which is different from the first holding part, of the plurality of holding parts; and in the first holding step, the cable is held by the holding part, which is different from the first holding part, of the first member.

[0128] According to the antenna device manufacturing method, the cable is firmly held by the first member. This

,33B) and an indentation (13D,23D,33D) provided in a part of the first member (131,231,331) in which part of a connection between the cable (12,22,32) and the film antenna (11,21,31) is arranged, and the second member (132,232,332) having a recess (13C1,23C1,33C1) in which the connection arranged in the indentation (13D,23D,33D) of the first member (131,231,331) is contained, said antenna device (1,2,3) manufacturing method comprising:

a first holding step of arranging a tip part of the cable (12,22,32) in the indentation (13D,23D,33D) of the first member (131,231,331) and causing the first holding part (13R2,23R2,33R2) of the first member (131,231,331) to hold a bent part and/or a vicinity thereof, the bent part being closest to the tip part of the cable (12,22,32);

a connecting step of, after the first holding step, connecting the tip part of the cable (12,22,32) to a feed section (114,214,314) of the film antenna (11,21,31);

an attaching step of, after the connecting step, attaching the second member (132,232,332) to the first member (131,231,331) so that the connection between the film antenna (11,21,31) and the cable (12,22,32) is arranged in the recess (13C1,23C1,33C1);

a winding step of, after the attaching step, winding the film antenna (11,21,31) around the support (13,23,33) so as to close the recess (13C1,23C1,33C1);

an injecting step of, after the winding step, injecting a fluid resin into the recess (13C1,23C1,33C1); and

a curing step of, after the injecting step, curing the fluid resin.

7. The antenna device (1) manufacturing method as set forth in claim 6, wherein:

the first member (131) is a plate-shaped member; and

the second member (132) has a holding part (13S2,13B,13T2), which is different from the first holding part (13R2), of the plurality of holding parts (13R2,13S2,13B,13T2),

said antenna device (1) manufacturing method further comprising:

a second holding step of, in and after the attaching step, causing the holding part (13S2,13B,13T2), which is different from the first holding part (13R2), of the second member (132) to hold the cable (12,22,32).

8. The antenna device (2,3) manufacturing method as set forth in claim 6, wherein:

the first member (231,331) further has a holding part (23S2,23B,23T2,33B), which is different from the first holding part (23R2,33R2), of the plurality of holding parts (23R2,23S2,23B,23T2,33R2,33B); and in the first holding step, the cable (22,32) is held by the holding part (23S2,23B,23T2,33B), which is different from the first holding part (23R2,33R2), of the first member (231,331).

Patentansprüche

1. Antennenvorrichtung (1, 2, 3), umfassend:

eine Filmantenne (11, 21, 31);
ein Kabel (12, 22, 32), das einen Spitzenteil aufweist, der mit einem Versorgungsabschnitt (114, 214, 314) der Filmantenne (11, 21, 31) verbunden ist; und

eine Halterung (13, 23, 33), um welche die Filmantenne (11, 21, 31) gewickelt ist und die mehrere Halteteile (13R2, 13S2, 13B, 13T2, 23R2, 23S2, 23B, 23T2, 33R2, 33B) aufweist, die das Kabel (12, 22, 32) in einem Zustand halten, in dem das Kabel (12, 22, 32) gebogen ist, wobei die Halterung (13, 23, 33) ein erstes Element (131, 231, 331) und ein zweites Element (132, 232, 332) beinhaltet, das an dem ersten Element (131, 231, 331) befestigt ist, wobei das erste Element (131, 231, 331) einen ersten Halteteil (13R2, 23R2, 33R2), der einen gebogenen Teil und/oder eine Nähe davon hält, wobei sich der gebogene Teil am nächsten zum Spitzenteil des Kabels (12, 22, 32) befindet, und eine in einem Teil des ersten Elements (131, 231, 331) vorgesehene Einbuchtung (13D, 23D, 33D) aufweist, in der ein Teil einer Verbindung zwischen dem Kabel (12, 22, 32) und der Filmantenne (11, 21, 31) angeordnet ist, wobei das zweite Element (132, 232, 332) eine Vertiefung (13C1, 23C1, 33C1) aufweist, in der die in der Einbuchtung (13D, 23D, 33D) des ersten Elements (131, 231, 331) angeordnete Verbindung enthalten ist, und wobei die Filmantenne (11, 21, 31) derart um die Halterung (13, 23, 33) gewickelt ist, dass sie die Vertiefung (13C1, 23C1, 33C1) verschließt, und wobei die Vertiefung (13C1, 23C1, 33C1) mit einem Harz (14, 24, 34) gefüllt ist.

2. Antennenvorrichtung (1) nach Anspruch 1, wobei:

das erste Element (131) ein plattenförmiges Element ist; und
das zweite Element (132) einen Halteteil (13S2, 13B, 13T2) aufweist, der von dem ersten Halteteil (13R2) der mehreren Halteteile (13R2,

13S2, 13B, 13T2) verschieden ist.

3. Antennenvorrichtung (2, 3) nach Anspruch 1, wobei das erste Element (231, 331) einen Halteteil (23S2, 23B, 23T2, 33B) aufweist, der von dem ersten Halteteil (23R2, 33R2) der mehreren Halteteile (23R2, 23S2, 23B, 23T2, 33R2, 33B) verschieden ist. 5
4. Antennenvorrichtung (1, 2, 3) nach einem der Ansprüche 1 bis 3, wobei wenigstens ein Teil des Kabels (12, 22, 32) zwischen dem ersten Element (131, 231, 331) und dem zweiten Element (132, 232, 332) angeordnet ist. 10
5. Antennenvorrichtung (1, 2, 3) nach einem der Ansprüche 1 bis 4, wobei: 15
 - das erste Element (131, 231, 331) in einer Draufsicht U-förmig ist; und
 - ein Winkelbereich der Richtung, in der die Verbindung durch das erste Element (131, 231, 331) umgeben ist, größer als 180 Grad ist. 20
6. Herstellungsverfahren für eine Antennenvorrichtung (1, 2, 3) zum Herstellen einer Antennenvorrichtung (1, 2, 3), beinhaltend: eine Filmantenne (11, 21, 31); ein Kabel (12, 22, 32); und eine Halterung (13, 23, 33), um welche die Filmantenne (11, 21, 31) gewickelt ist und die mehrere Halteteile (13R2, 13S2, 13B, 13T2, 23R2, 23S2, 23B, 23T2, 33R2, 33B) aufweist, die das Kabel (12, 22, 32) halten, wobei die Halterung (13, 23, 33) ein erstes Element (131, 231, 331) und ein zweites Element (132, 232, 332) beinhaltet, wobei das erste Element (131, 231, 331) einen ersten Halteteil (13R2, 23R2, 33R2) der mehreren Halteteile (13R2, 13S2, 13B, 13T2, 23R2, 23S2, 23B, 23T2, 33R2, 33B) und eine in einem Teil des ersten Elements (131, 231, 331) vorgesehene Einbuchtung (13D, 23D, 33D) aufweist, in der ein Teil einer Verbindung zwischen dem Kabel (12, 22, 32) und der Filmantenne (11, 21, 31) angeordnet ist, und wobei das zweite Element (132, 232, 332) eine Vertiefung (13C1, 23C1, 33C1) aufweist, in der die in der Einbuchtung (13D, 23D, 33D) des ersten Elements (131, 231, 331) angeordnete Verbindung enthalten ist, 30
 - wobei das Herstellungsverfahren für eine Antennenvorrichtung (1, 2, 3) umfasst: 35
 - einen ersten Halteschritt des Anordnens eines Spitzenteils des Kabels (12, 22, 32) in der Einbuchtung (13D, 23D, 33D) des ersten Elements (131, 231, 331) und des Bewirkens, dass der erste Halteteil (13R2, 23R2, 33R2) des ersten Elements (131, 231, 331) einen gebogenen Teil und/oder eine Nähe davon hält, wobei sich der gebogene Teil am nächsten zum Spitzenteil des Kabels (12, 22, 32) befindet; 40

einen Verbindungsschritt, nach dem ersten Halteschritt, des Verbindens des Spitzenteils des Kabels (12, 22, 32) mit einem Versorgungsabschnitt (114, 214, 314) der Filmantenne (11, 21, 31);
 einen Befestigungsschritt, nach dem Verbindungsschritt, des Befestigens des zweiten Elements (132, 232, 332) am ersten Element (131, 231, 331), sodass die Verbindung zwischen der Filmantenne (11, 21, 31) und dem Kabel (12, 22, 32) in der Vertiefung (13C1, 23C1, 33C1) angeordnet ist;
 einen Wickelschritt, nach dem Befestigungsschritt, des Wickelns der Filmantenne (11, 21, 31) um die Halterung (13, 23, 33), sodass die Vertiefung (13C1, 23C1, 33C1) geschlossen wird;
 einen Einspritzschritt, nach dem Wickelschritt, des Einspritzens eines flüssigen Harzes in die Vertiefung (13C1, 23C1, 33C1); und
 einen Aushärtungsschritt, nach dem Einspritzschritt, des Aushärtens des flüssigen Harzes.

7. Herstellungsverfahren für eine Antennenvorrichtung (1) nach Anspruch 6, wobei: 25
 - das erste Element (131) ein plattenförmiges Element ist; und
 - das zweite Element (132) einen Halteteil (13S2, 13B, 13T2) aufweist, der von dem ersten Halteteil (13R2) der mehreren Halteteile (13R2, 13S2, 13B, 13T2) verschieden ist, wobei das Herstellungsverfahren für eine Antennenvorrichtung (1) ferner umfasst: 30
 - einen zweiten Halteschritt, bei und nach dem Befestigungsschritt, des Bewirkens, dass der Halteteil (13S2, 13B, 13T2), der von dem ersten Halteteil (13R2) des zweiten Elements (132) verschieden ist, das Kabel (12, 22, 32) hält. 35
8. Herstellungsverfahren für eine Antennenvorrichtung (2, 3) nach Anspruch 6, wobei: 45
 - das erste Element (231, 331) ferner einen Halteteil (23S2, 23B, 23T2, 33B) aufweist, der von dem ersten Halteteil (23R2, 33R2) der mehreren Halteteile (23R2, 23S2, 23B, 23T2, 33R2, 33B) verschieden ist; und 50
 - bei dem ersten Halteschritt das Kabel (22, 32) durch den Halteteil (23S2, 23B, 23T2, 33B), der von dem ersten Halteteil (23R2, 33R2) des ersten Elements (231, 331) verschieden ist, gehalten wird. 55

Revendications

1. Dispositif d'antenne (1, 2, 3) comprenant :

- une antenne film (11, 21, 31) ;
 un câble (12, 22, 32) qui a une partie d'extrémité connectée à une section d'alimentation (114, 214, 314) de l'antenne film (11, 21, 31) ; et
 un support (13, 23, 33) autour duquel l'antenne film (11, 21, 31) est enroulée et qui a une pluralité de parties de maintien (13R2, 13S2, 13B, 13T2, 23R2, 23S2, 23B, 23T2, 33R2, 33B) maintenant le câble (12, 22, 32) dans un état dans lequel le câble (12, 22, 32) est courbé,
 le support (13, 23, 33) incluant un premier élément (131, 231, 331) et un second élément (132, 232, 332) fixé au premier élément (131, 231, 331),
 le premier élément (131, 231, 331) ayant une première partie de maintien (13R2, 23R2, 33R2) maintenant une partie courbée et/ou une proximité de celle-ci, la partie courbée étant la plus proche de la partie d'extrémité du câble (12, 22, 32), et une indentation (13D, 23D, 33D) fournie dans une partie du premier élément (131, 231, 331) dans laquelle une partie d'une connexion entre le câble (12, 22, 32) et l'antenne film (11, 21, 31) est agencée,
 le second élément (132, 232, 332) ayant un évidement (13C1, 23C1, 33C1) dans lequel la connexion agencée dans l'indentation (13D, 23D, 33D) du premier élément (131, 231, 331) est présente, et
 l'antenne film (11, 21, 31) étant enroulée autour du support (13, 23, 33) de manière à fermer l'évidement (13C1, 23C1, 33C1), et l'évidement (13C1, 23C1, 33C1) étant rempli d'une résine (14, 24, 34).
2. Dispositif d'antenne (1) selon la revendication 1, dans lequel :
- le premier élément (131) est un élément en forme de plaque ; et
 le second élément (132) a une partie de maintien (13S2, 13B, 13T2), qui est différente de la première partie de maintien (13R2), de la pluralité de parties de maintien (13R2, 13S2, 13B, 13T2).
3. Dispositif d'antenne (2, 3) selon la revendication 1, dans lequel le premier élément (231, 331) a une partie de maintien (23S2, 23B, 23T2, 33B), qui est différente de la première partie de maintien (23R2, 33R2), de la pluralité de parties de maintien (23R2, 23S2, 23B, 23T2, 33R2, 33B).
4. Dispositif d'antenne (1, 2, 3) selon l'une quelconque des revendications 1 à 3, dans lequel au moins une partie du câble (12, 22, 32) est agencée entre le premier élément (131, 231, 331) et le second élément (132, 232, 332).

5. Dispositif d'antenne (1, 2, 3) selon l'une quelconque des revendications 1 à 4, dans lequel :

le premier élément (131, 231, 331) est en forme de U dans une vue en plan ; et
 une plage angulaire de direction dans laquelle la connexion est entourée par le premier élément (131, 231, 331) est supérieure à 180 degrés.

6. Procédé de fabrication de dispositif d'antenne (1, 2, 3) pour fabriquer un dispositif d'antenne (1, 2, 3) incluant : une antenne film (11, 21, 31) ; un câble (12, 22, 32) ; et un support (13, 23, 33) autour duquel l'antenne film (11, 21, 31) est enroulée et qui a une pluralité de parties de maintien (13R2, 13S2, 13B, 13T2, 23R2, 23S2, 23B, 23T2, 33R2, 33B) maintenant le câble (12, 22, 32), le support (13, 23, 33) incluant un premier élément (131, 231, 331) et un second élément (132, 232, 332), le premier élément (131, 231, 331) ayant une première partie de maintien (13R2, 23R2, 33R2) de la pluralité de parties de maintien (13R2, 13S2, 13B, 13T2, 23R2, 23S2, 23B, 23T2, 33R2, 33B) et une indentation (13D, 23D, 33D) fournie dans une partie du premier élément (131, 231, 331) dans laquelle une partie d'une connexion entre le câble (12, 22, 32) et l'antenne film (11, 21, 31) est agencée, et le second élément (132, 232, 332) ayant un évidement (13C1, 23C1, 33C1) dans lequel la connexion agencée dans l'indentation (13D, 23D, 33D) du premier élément (131, 231, 331) est présente,
 ledit procédé de fabrication de dispositif d'antenne (1, 2, 3) comprenant :

une première étape de maintien consistant à agencer une partie d'extrémité du câble (12, 22, 32) dans l'indentation (13D, 23D, 33D) du premier élément (131, 231, 331) et amenant la première partie de maintien (13R2, 23R2, 33R2) du premier élément (131, 231, 331) à maintenir une partie courbée et/ou une proximité de celle-ci, la partie courbée étant plus proche de la partie d'extrémité du câble (12, 22, 32) ;
 une étape de connexion consistant à, après la première étape de maintien, connecter la partie d'extrémité du câble (12, 22, 32) à une section d'alimentation (114, 214, 314) de l'antenne film (11, 21, 31) ;
 une étape de fixation consistant à, après l'étape de connexion, fixer le second élément (132, 232, 332) au premier élément (131, 231, 331) de sorte que la connexion entre l'antenne film (11, 21, 31) et le câble (12, 22, 32) soit agencée dans l'évidement (13C1, 23C1, 33C1) ;
 une étape d'enroulement consistant à, après l'étape de fixation, enrouler l'antenne film (11, 21, 31) autour du support (13, 23, 33) de manière

à fermer l'évidement (13C1, 23C1, 33C1) ;
 une étape d'injection consistant à, après l'étape
 d'enroulement, injecter une résine fluide dans
 l'évidement (13C1, 23C1, 33C1) ; et
 une étape de durcissement consistant à, après 5
 l'étape d'injection, durcir la résine fluide.

7. Procédé de fabrication de dispositif d'antenne (1)
 selon la revendication 6, dans lequel :

le premier élément (131) est un élément en forme de plaque ; et
 le second élément (132) a une partie de maintien (13S2, 13B, 13T2), qui est différente de la première partie de maintien (13R2), de la pluralité 10
 de parties de maintien (13R2, 13S2, 13B, 13T2), ledit procédé de fabrication de dispositif d'antenne (1) comprenant en outre :
 une seconde étape de maintien consistant à, pendant et après l'étape de fixation, amener la 20
 partie de maintien (13S2, 13B, 13T2), qui est différente de la première partie de maintien (13R2), du second élément (132) à maintenir le câble (12, 22, 32).

8. Procédé de fabrication de dispositif d'antenne (2, 3)
 selon la revendication 6, dans lequel :

le premier élément (231, 331) a en outre une partie de maintien (23S2, 23B, 23T2, 33B), qui 30
 est différente de la première partie de maintien (23R2, 33R2), de la pluralité de parties de maintien (23R2, 23S2, 23B, 23T2, 33R2, 33B) ; et
 dans la première étape de maintien, le câble (22, 32) est maintenu par la partie de maintien (23S2, 23B, 23T2, 33B), qui est différente de la première 35
 partie de maintien (23R2, 33R2), du premier élément (231, 331).

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FIG. 1

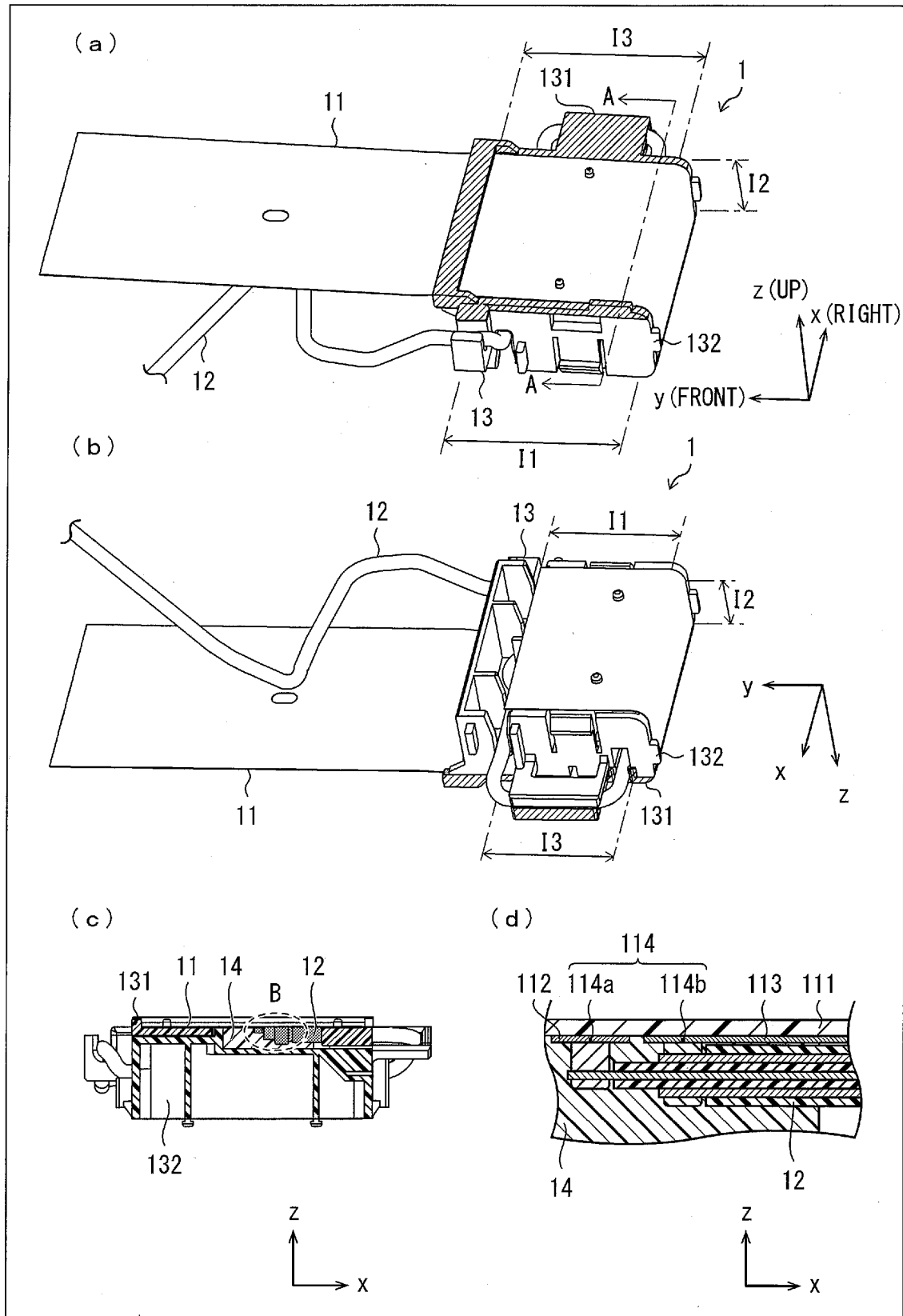


FIG. 2

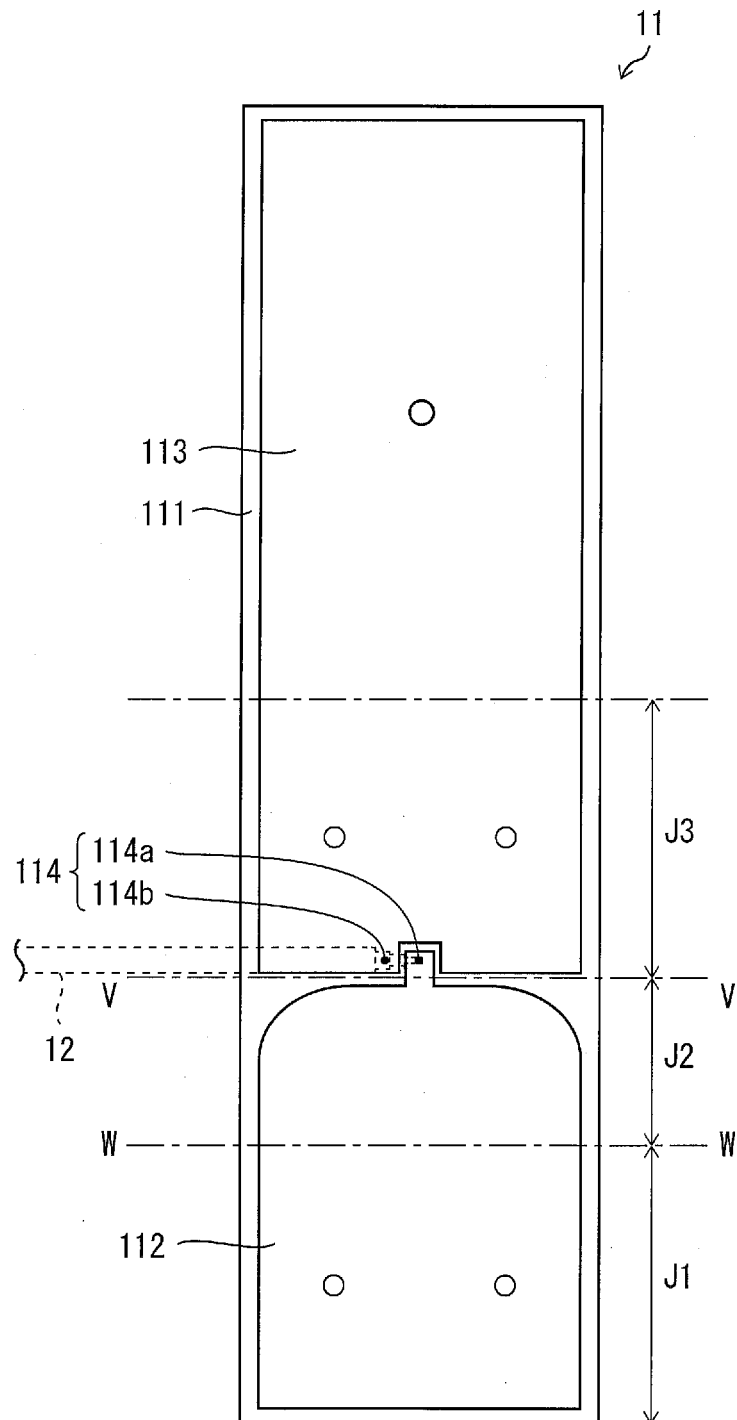


FIG. 3

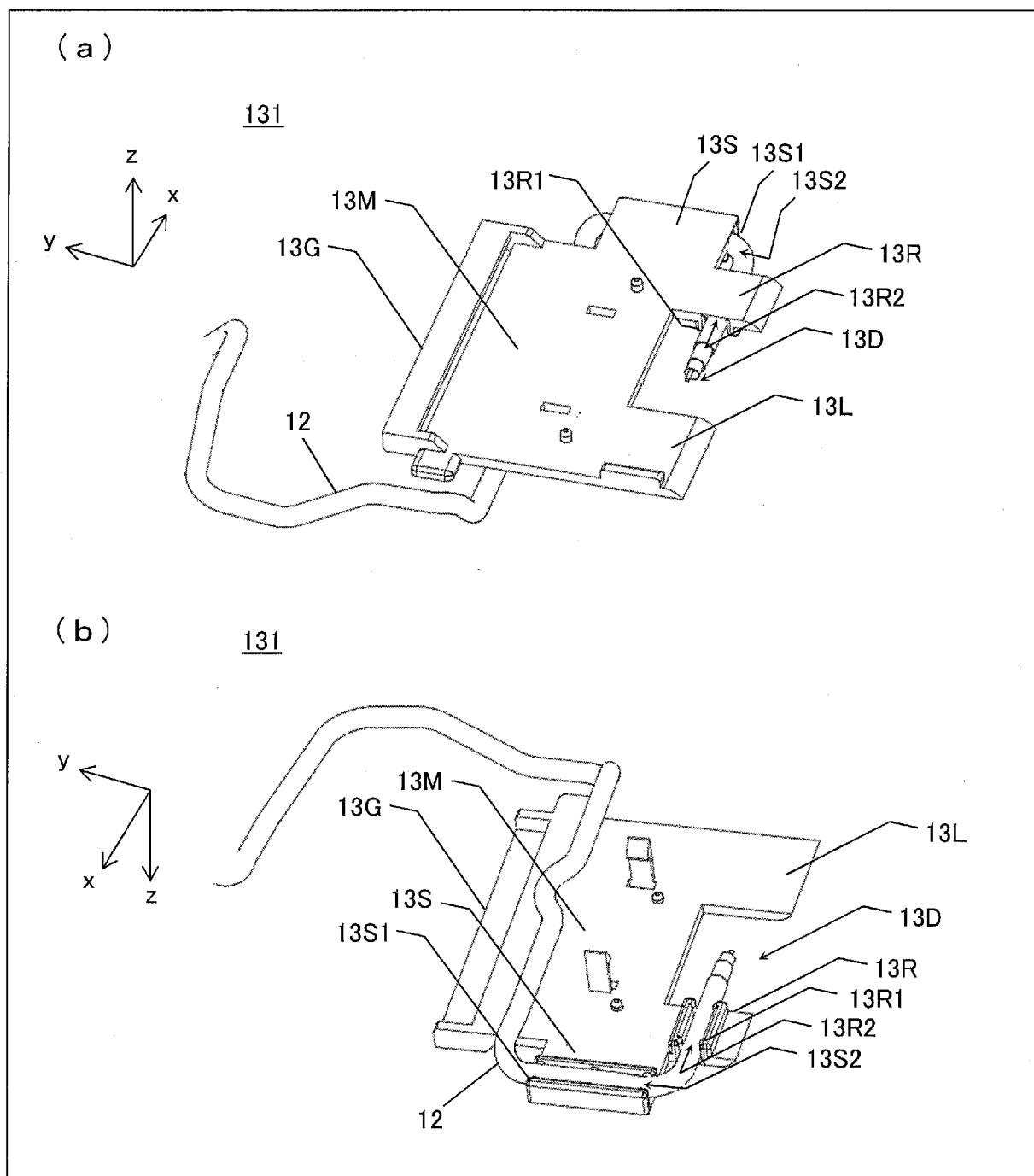


FIG. 4

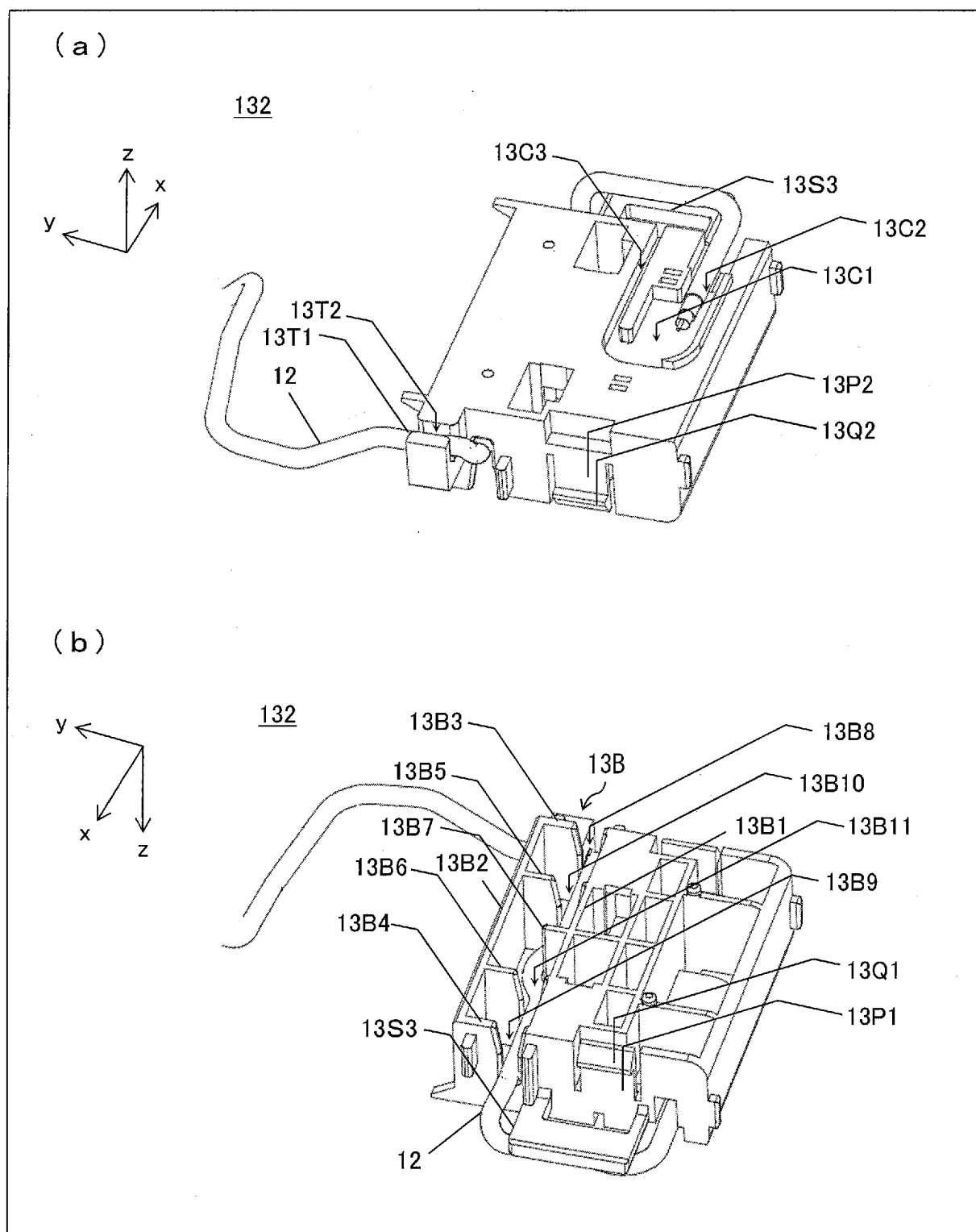


FIG. 5

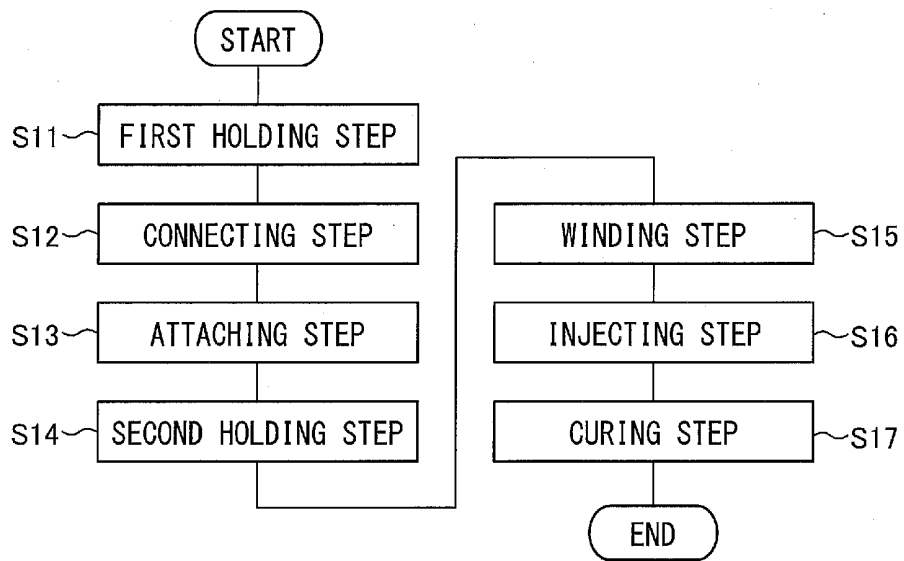


FIG. 6

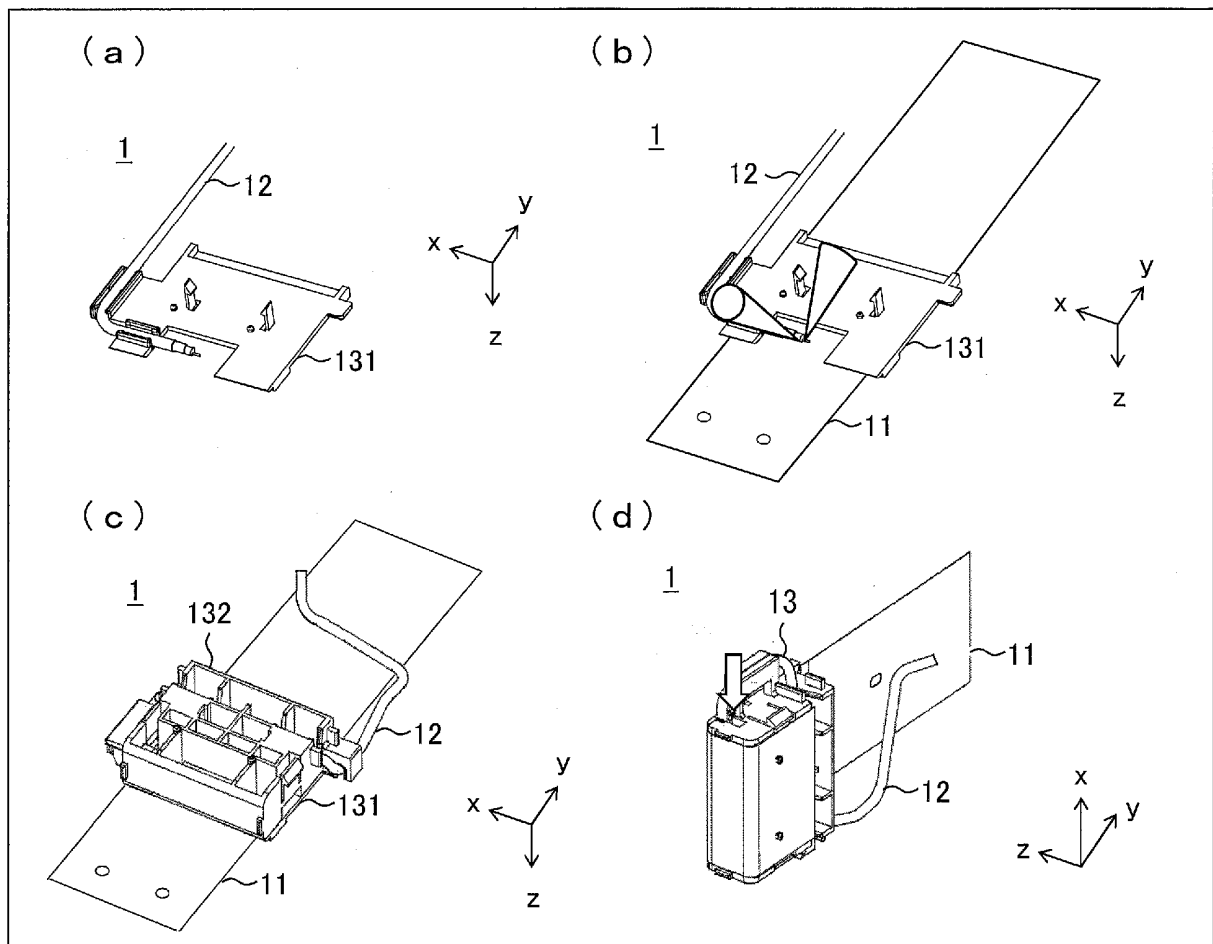


FIG. 7

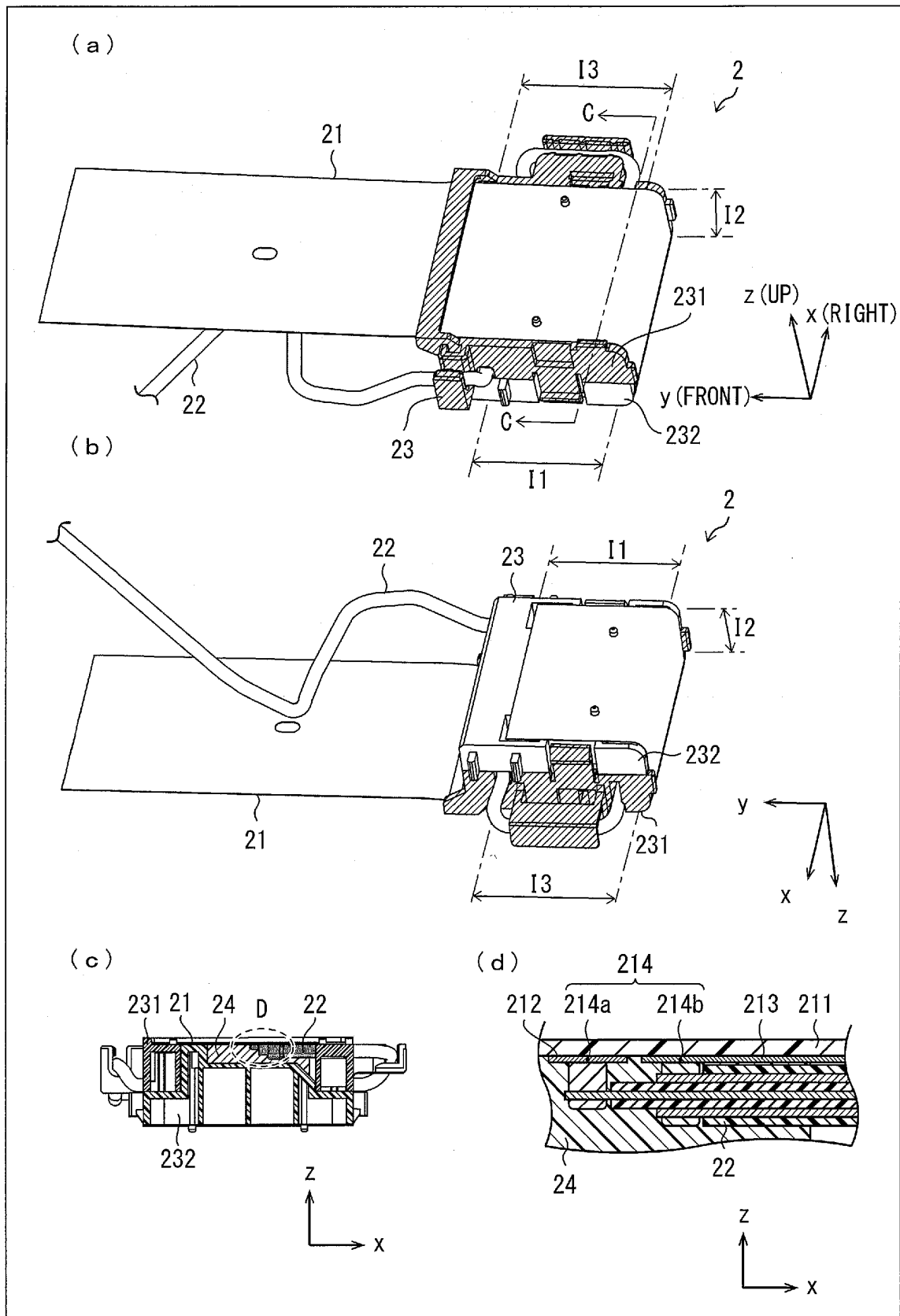


FIG. 8

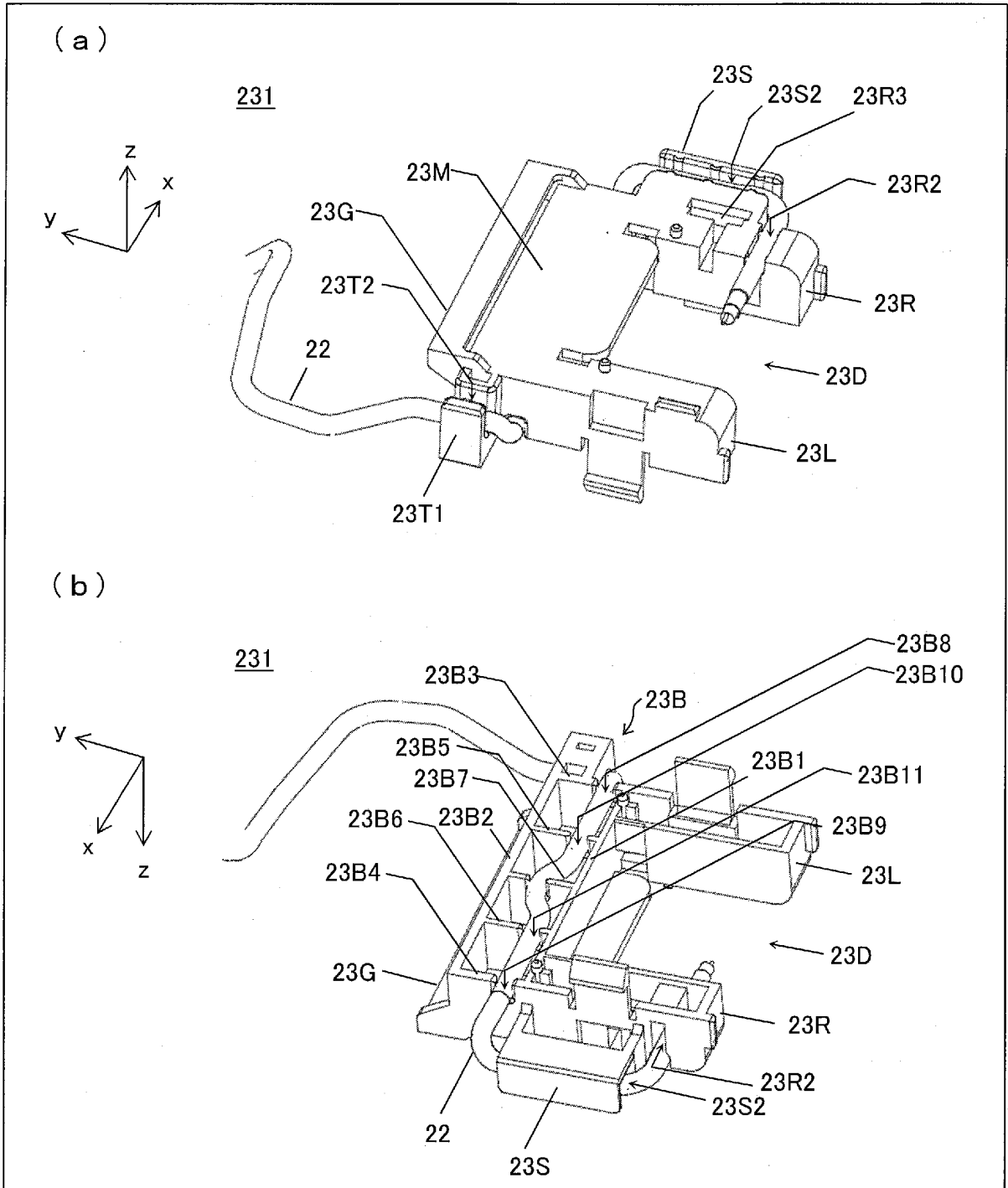


FIG. 9

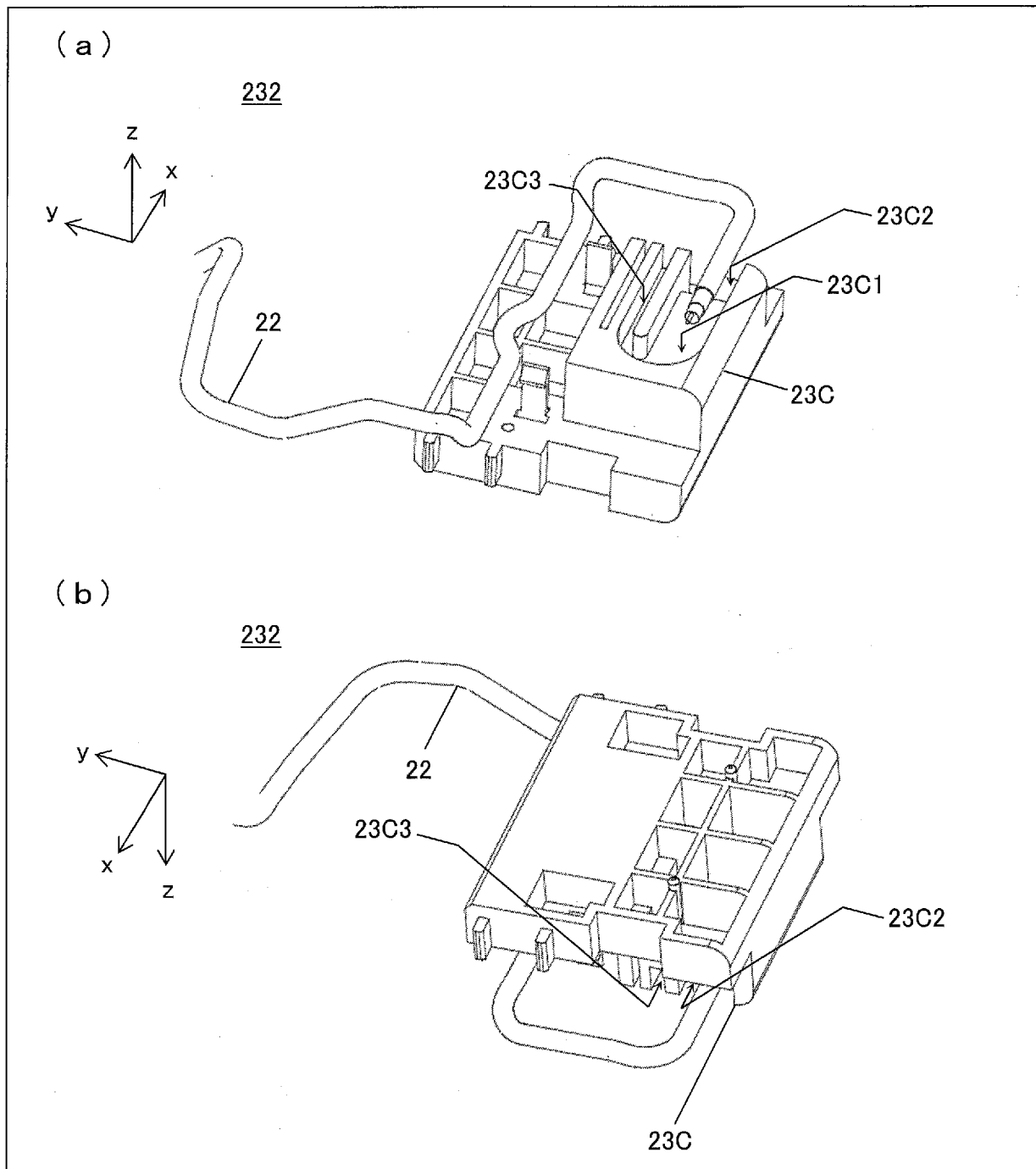


FIG. 10

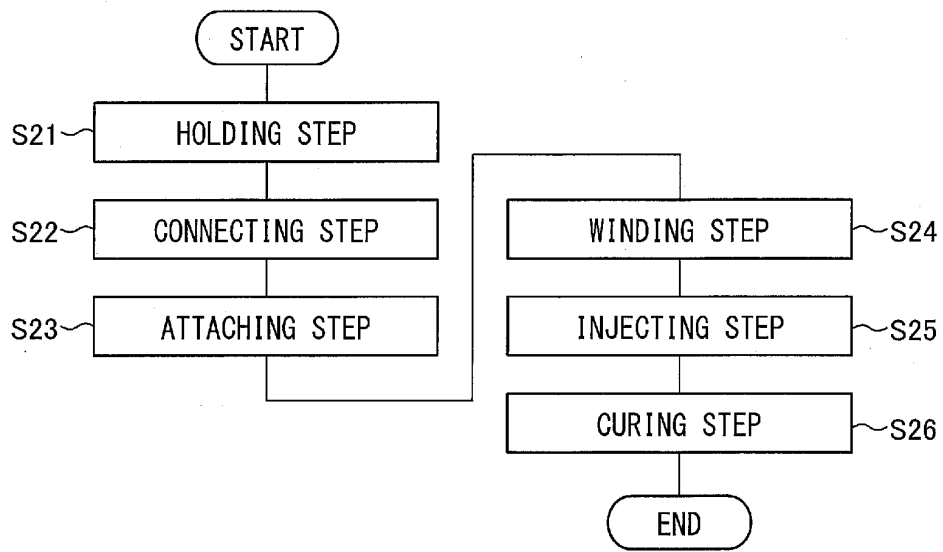


FIG. 11

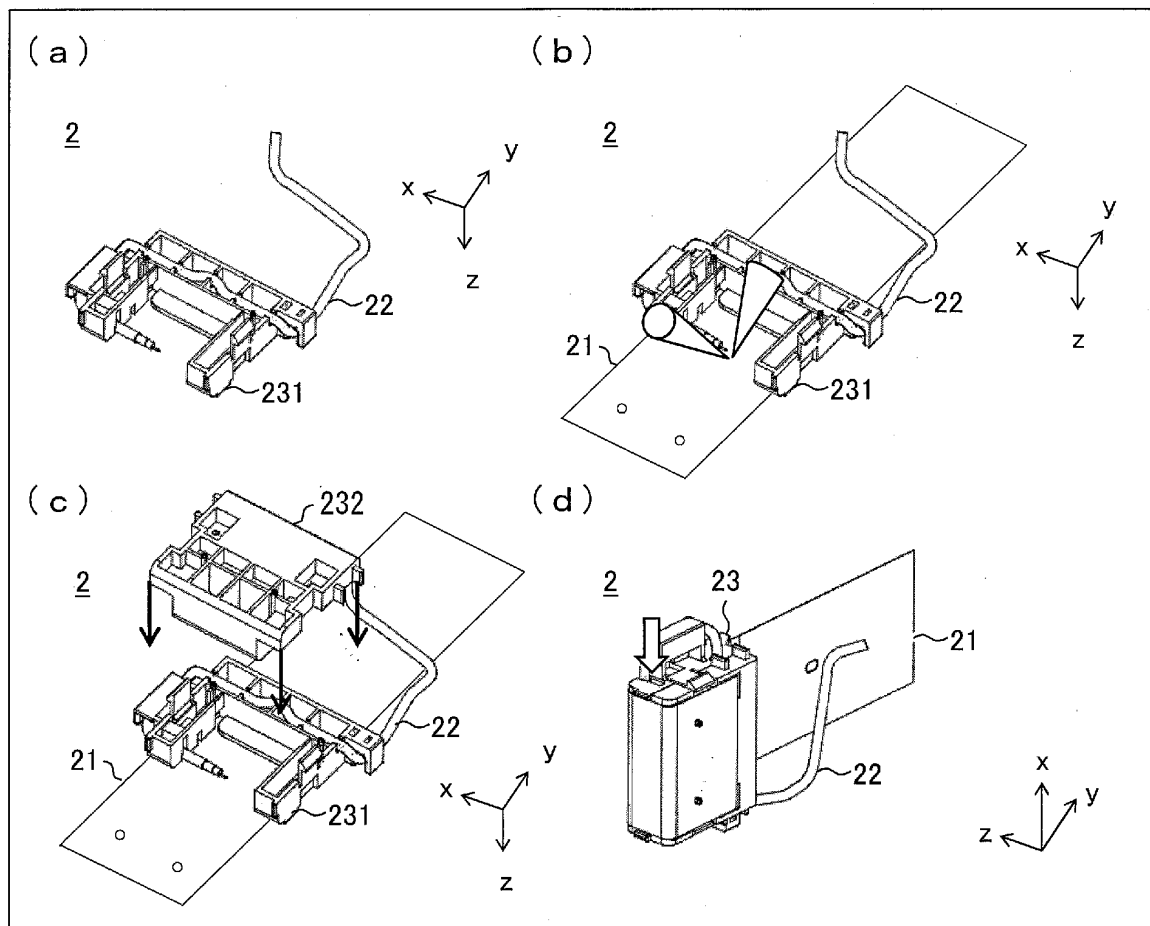


FIG. 12

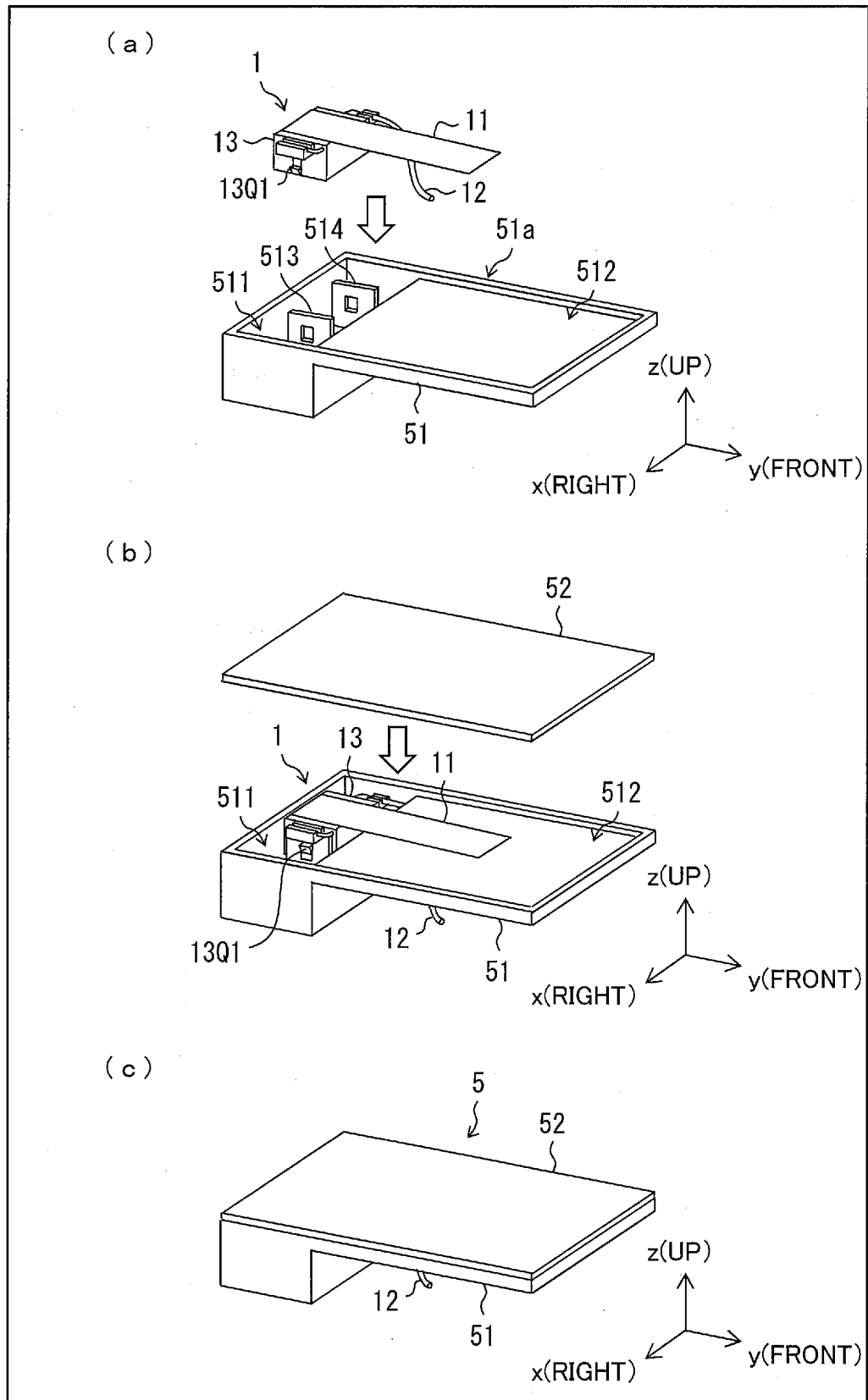


FIG. 13

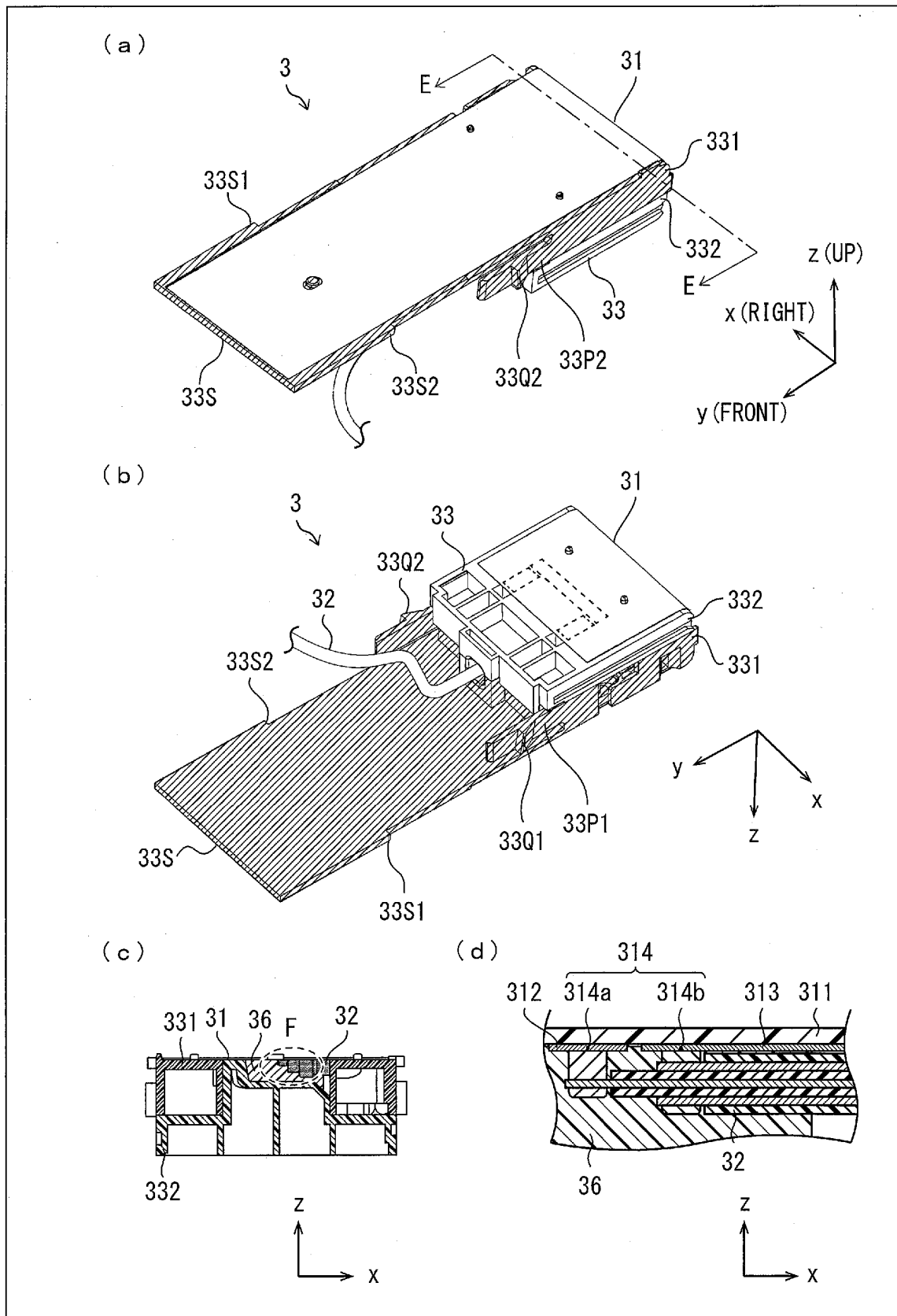


FIG. 14

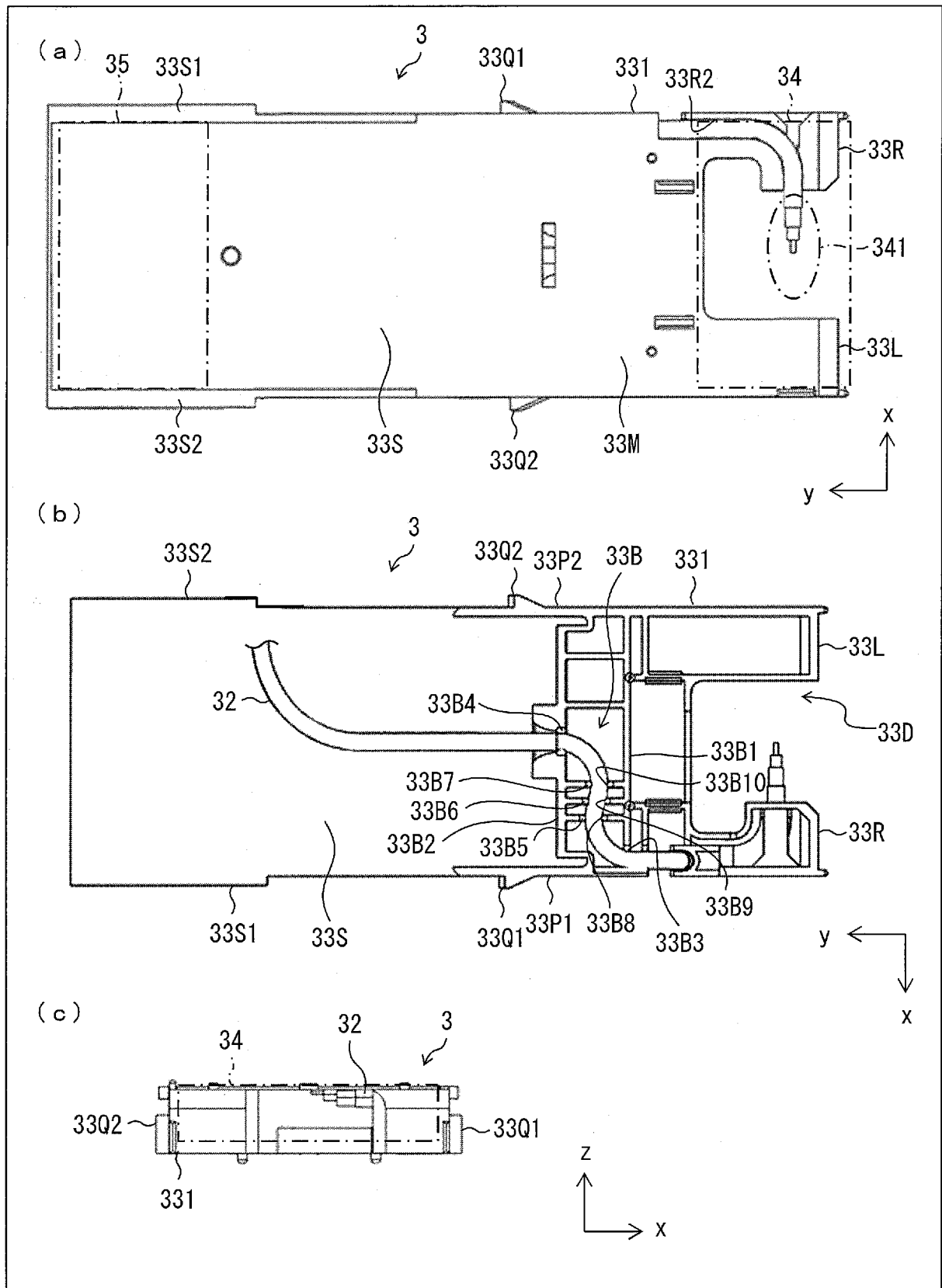


FIG. 15

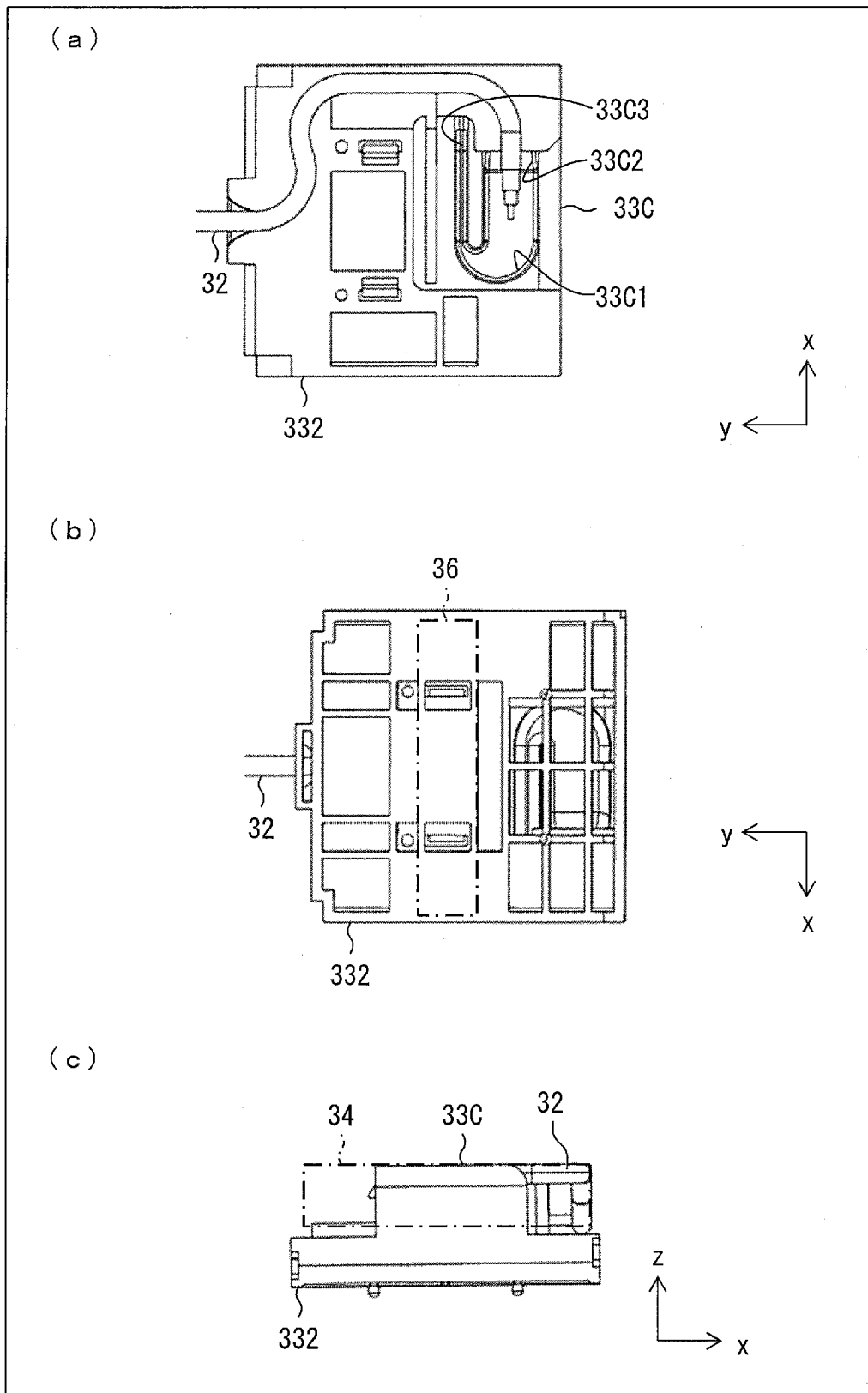
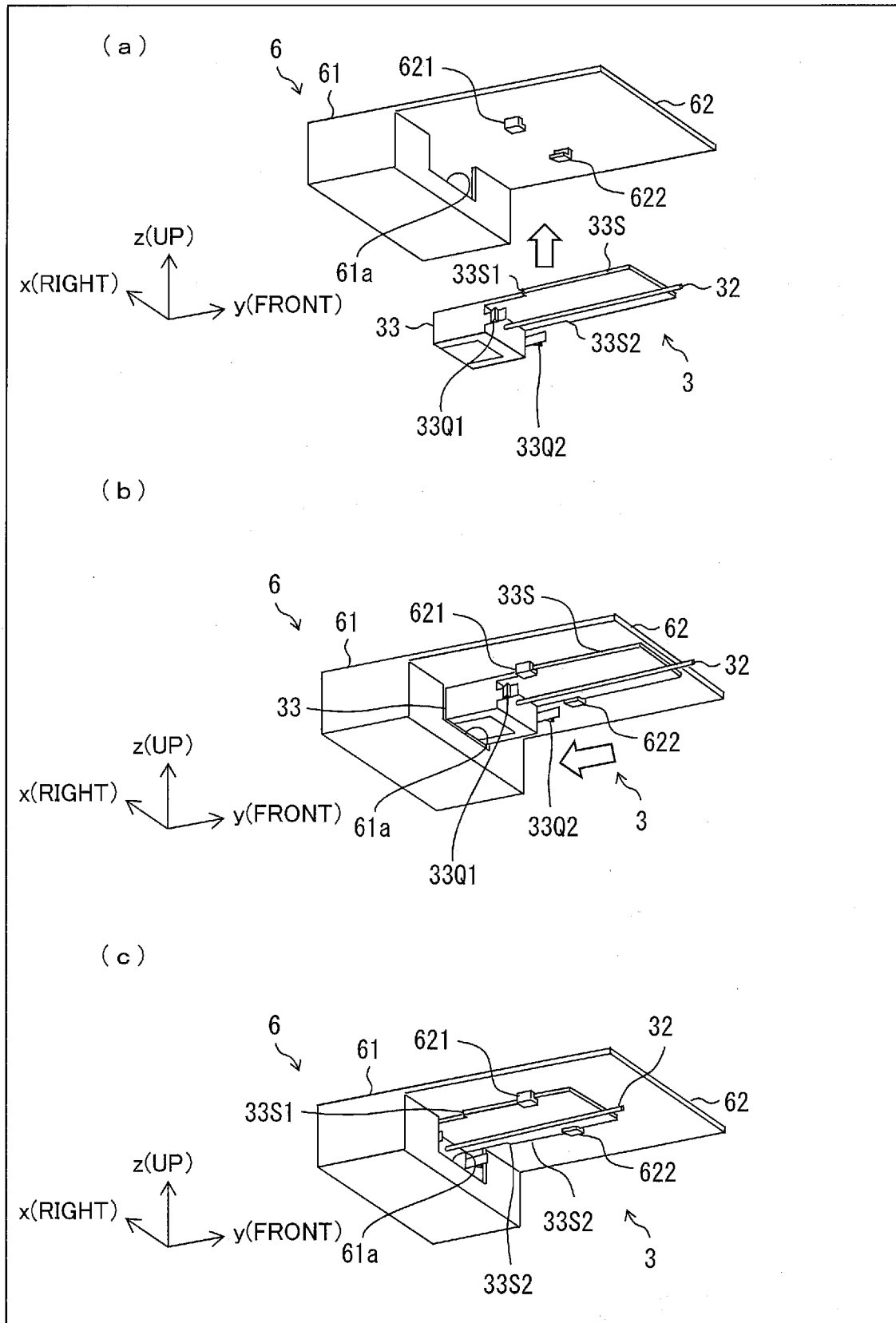


FIG. 16



REFERENCES CITED IN THE DESCRIPTION

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