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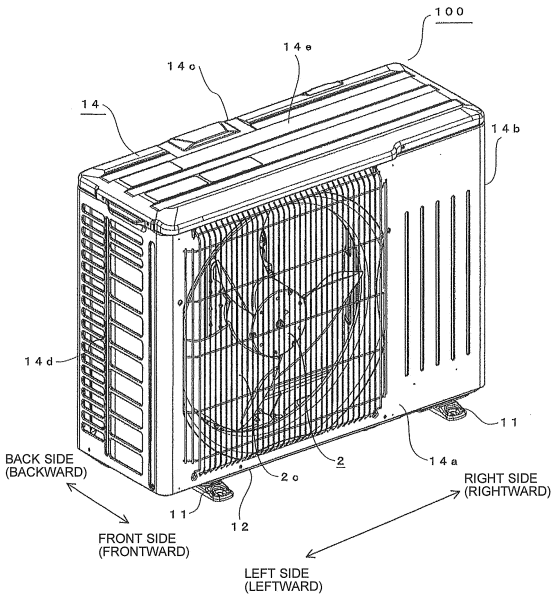
# (54) OUTDOOR UNIT FOR AIR CONDITIONER

(57) A fan motor support plate mounting portion 17 of a bottom plate 12 is provided with a fixing piece 15 formed by cutting and bending the bottom plate 12 upward from a front side toward a back side and a screw hole 16 extending through the fixing piece 15. In addition, a lower end portion of a fan motor support plate 4 which supports a fan motor 2a is provided with an engagement portion 26 having: a mounting surface 23 brought into contact with a front side surface of the fixing piece 15; and a mounting hole 24 opposed to the screw hole 16 and extending through the mounting surface 23, and a screw 13 is inserted into the mounting hole 24 from the front side within the casing 14 and coupled with the screw hole 16 in the fixing piece 15, whereby the fan motor support plate 4 is screw-fixed to the fan motor support plate mounting portion 17 of the bottom plate 12.

FIG. 1

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## Description

### Technical Field

**[0001]** The present invention relates to an outdoor unit for an air-conditioning apparatus, and particularly relates to a structure of mounting a fan motor support plate, which supports a fan motor which is a drive source for a blower device, to a casing bottom plate.

### Background Art

**[0002]** In an outdoor unit for an air-conditioning apparatus, the interior of a casing thereof is laterally divided by a partition plate provided upright on a bottom plate which forms a bottom portion of the casing, into a blower device chamber in which a blower fan and a heat exchanger are located and a machine chamber in which a compressor and a refrigerant pipe are located. An electrical component box in which an electrical and electric component for controlling an operation of the air-conditioning apparatus is housed is disposed mainly at an upper portion of the machine chamber.

**[0003]** The heat exchanger having a substantially L shape as a horizontal cross-sectional shape is disposed in the blower device chamber from a back side to a lateral side opposite to the machine chamber in the casing, and the blower fan is disposed in front of the heat exchanger which is located at the back side, namely, at a position close to the casing front. A fan motor which is a drive source for the blower fan is mounted and fixed to a fan motor support plate at a position in back of the blower fan and in front of the heat exchanger.

**[0004]** Similarly to the fan motor, the fan motor support plate is provided between the blower fan and the heat exchanger in a substantially upright state so as to extend in substantially the vertical direction from the bottom plate of the casing toward an upper surface of the casing. The fan motor support plate supports the fan motor at substantially a center thereof in the vertical direction. A motor rotation shaft projects frontward from the fan motor and is connected to the blower fan in order to transfer a rotational drive force of the fan motor to the blower fan. The fan motor support plate supports not only the fan motor but also the blower fan to which the fan motor is connected.

**[0005]** The fan motor support plate, which supports the fan motor and the blower fan, is screw-fixed at a lower end portion thereof to the bottom plate of the casing, and is fixed at an upper end thereof such that a hooking piece formed therein so as to extend backward is engaged with an upper portion of the heat exchanger.

**[0006]** There is an outdoor unit for an air-conditioning apparatus in which as for screw-fixing the lower end portion of the fan motor support plate to the bottom plate of the casing, a fixing piece is formed in the bottom plate made of metal, by cutting and bending the bottom plate, a screw hole is provided in the fixing piece, and a screw is inserted into a mount hole formed in the lower end portion of the fan motor support plate and is coupled with the screw hole in the fixing piece of the bottom plate, thereby screw-fixing the fan motor support plate to the bottom plate (e.g., see Patent Literature 1).

### Citation List

### Patent Literature

**[0007]** Patent Literature 1: Japanese Unexamined Patent Application Publication No. 10-96541 (0003 section, Fig. 2, Fig. 6, etc.)

## Summary of Invention

### Technical Problem

**[0008]** As for forming a fixing piece by cutting and bending a portion of the bottom plate, with a fixing piece as disclosed in Patent Literature 1, that is, a fixing piece in which a contact surface to be brought into contact with the lower end portion of the fan motor support plate is originally part of an upper surface of the bottom plate before cutting and bending, a leading end of a screw projects from the screw hole at a non-contact surface side of the fixing piece and is exposed to the outside of the casing at a lower surface side of the bottom plate through a cut-bent hole which is formed as a result of cutting and bending the fixing piece and has the same size as that of the fixing piece.

**[0009]** Therefore, in installing (mounting) such an outdoor unit at a predetermined outdoor location, for example, when an installation operator lifts or carries the outdoor unit, a finger of the operator may contact the exposed leading end of the screw.

**[0010]** In addition, in mounting the outdoor unit at a veranda of a mid-to-high-rise collective casing, there may be a case where the outdoor unit is not put on a floor in the veranda and is installed by being hanged from a ceiling in the veranda with a metal fitting. When the outdoor unit described in Patent Literature 1 is mounted in such a ceiling hanging manner, the leading end of the screw exposed from the lower surface side of the bottom plate is viewed by a user who has come out to the veranda, and thus an uncomfortable feeling may be provided to the user, for example, the appearance is poor or the leading end of the screw is felt as dangerous.

**[0011]** The invention has been made in order to solve the problems as described above, and an object of the invention is to provide an outdoor unit for an air-conditioning apparatus in which the leading end of a screw is not exposed to the outside of a casing even when a lower end portion of a fan motor support plate is screw-fixed to a bottom plate of the casing.

Solution to Problem

**[0012]** An outdoor unit for an air-conditioning apparatus according to the invention includes: a casing; a heat exchanger disposed at a back side within the casing; a blower fan disposed in front of the heat exchanger and configured to blow air from the back side of the casing to a front side of the casing; a fan motor disposed between the heat exchanger and the blower fan and configured to drive the blower fan; and a fan motor support plate provided so as to be fixed at a lower end portion thereof to a fan motor support plate mounting portion of a bottom plate forming a bottom portion of the casing and extend toward a top surface of the casing in a vertical direction and configured to support the fan motor at a middle portion thereof in the vertical direction, the fan motor support plate mounting portion of the bottom plate being provided with a fixing piece formed by cutting and bending the bottom plate upward and a screw hole extending through the fixing piece, the lower end portion of the fan motor support plate being provided with an engagement portion having a mounting surface mounted to the fixing piece and a mounting hole opposed to the screw hole and extending through the mounting surface, the fan motor support plate being screw-fixed to the fan motor support plate mounting portion of the bottom plate. The fixing piece is formed by cutting and bending the bottom plate upward from the front side toward the back side, and a back side surface of the mounting surface of the engagement portion is brought into contact with the front side of the fixing piece, and a screw is inserted into the mounting hole from the front side within the casing and coupled with the screw hole in the fixing piece, whereby a leading end of the screw is located between a surface of the bottom plate located at the back side of the fixing piece which surface is at an inner side of the casing and a back side surface of the fixing piece.

Advantageous Effects of Invention

**[0013]** According to the invention, it is possible to obtain the outdoor unit for an air-conditioning apparatus in which the leading end of the screw with which the fan motor support plate is screw-fixed to the bottom plate of the casing is not exposed to the outside of the casing, an installation operator does not touch the leading end of the screw during an installation operation, and the appearance of the outdoor unit does not provide an uncomfortable feeling to the user in the case where the outdoor unit is installed in a ceiling hanging manner. Brief Description of Drawings

**[0014]**

[Fig. 1] Fig. 1 is an appearance perspective view showing an outdoor unit for an air-conditioning apparatus according to Embodiment 1 of the invention.
[Fig. 2] Fig. 2 is a perspective view showing the internal configuration of the outdoor unit for an air-conditioning apparatus according to Embodiment 1.
[Fig. 3] Fig. 3 is a perspective view showing a bottom plate according to Embodiment 1 from above.
[Fig. 4] Fig. 4 is a perspective view showing a fan motor support plate mounting portion of the bottom plate according to Embodiment 1 in an enlarged manner.
[Fig. 5] Fig. 5 is a perspective view showing a fan motor support plate according to Embodiment 1.
[Fig. 6] Fig. 6 is a perspective view showing, in an enlarged manner, a state where a lower end portion of the fan motor support plate is fixed to the bottom plate according to Embodiment 1.
[Fig. 7] Fig. 7 is a cross-sectional view of a screw-fixed portion taken along a Z-Z line in Fig. 6, as seen from the left side, according to Embodiment 1.
[Fig. 8] Fig. 8 is an explanatory diagram explaining a cutting-bending angle $\alpha$ of a fixing piece formed by cutting and bending the bottom plate, according to Embodiment 1.

Description of Embodiments

Embodiment 1

**[0015]** Hereinafter, Embodiment 1 of the invention will be described in detail with reference to Fig. 1 to Fig. 8.

**[0016]** Fig. 1 is an appearance perspective view of an outdoor unit 100 for an air-conditioning apparatus (hereinafter, sometimes written only as outdoor unit 100) according to Embodiment 1 of the invention, and Fig. 2 is a perspective view showing the internal configuration of the outdoor unit 100 of which a casing 14 is partially removed. The outdoor unit 100 is installed outdoor, and is connected to an indoor unit (not shown) installed indoor, via a refrigerant pipe to form a refrigerant circuit, thereby forming an air-conditioning apparatus which performs cooling or heating of an indoor space in which the indoor unit is mounted.

**[0017]** As shown in Fig. 1, the casing 14, of the outdoor unit 100, having substantially a rectangular parallelepiped shape is composed of a bottom plate 12 and a plurality of panels, for example, five panels, that is, a front panel 14a, side panels 14b and 14d, a back panel 14c, and a top panel 14e (see Fig. 2 for the details), and each of the respective panels 14a to 14e and the bottom plate 12 is made of a sheet metal. Leg portions 11 which support the casing 14 are provided at a lower portion of the casing 14. An blower fan 2c of a blower device 2 is provided inward of the front panel 14a. Fig. 2 shows the interior of the casing 14 from which the blower fan 2c and part of the casing 14, that is, the panels 14a, 14c, 14d, and 14e other than the bottom plate 12 and the side panel 14b, are removed.

**[0018]** As shown in Fig. 2, a partition plate 10 is provided upright on the bottom plate 12, which forms a bottom portion of the casing 14 of the outdoor unit 100, so as to laterally divide the interior of the outdoor unit 100

(the casing interior). The interior of the outdoor unit 100 is divided by the partition plate 10 into: a blower device chamber 5 including a heat exchanger 1 and the blower device 2; and a machine chamber 9 in which a compressor 6 and a refrigerant pipe 7 are disposed. When the outdoor unit 100 is seen from front, the blower device chamber 5 is located at the left side, and the machine chamber 9 is located at the right side.

**[0019]** The compressor 6 and the refrigerant pipe 7 are provided in the machine chamber 9. A refrigerant sent from the indoor unit (not shown) is compressed at the compressor 6 and sent through the refrigerant pipe 7 to the heat exchanger 1.

**[0020]** An electrical component box 8 is installed at an upper portion of the machine chamber 9 and a portion of the blower device chamber 5 over the partition plate 10. An electrical component housed within the electrical component box 8 performs power supply to each component, etc.

**[0021]** The heat exchanger 1 which is disposed at the back side and a fan motor support plate 4 which supports a fan motor 2a which rotationally drives the blower fan 2c (see Fig. 1) are provided in the blower device chamber 5, and the fan motor support plate 4 is fixed to the bottom plate 12 by means of screws 13. The heat exchanger 1 includes a lateral side flat portion 1 a, a corner portion 1 b, and a back side flat portion 1 c and has a substantially L shape as a horizontal cross-sectional shape.

**[0022]** In the blower device 2 of the outdoor unit 100, for example, a propeller fan is used as the blower fan 2c. The blower fan 2c is disposed in front of the heat exchanger 1, and the fan motor 2a, which drives the blower fan 2c, is disposed in back of the blower fan 2c, that is, between the heat exchanger 1 and the blower fan 2c. The blower fan 2c is fixed to a motor rotation shaft 2b of the fan motor 2a to form the blower device 2.

**[0023]** When the blower fan 2c is rotationally driven, outdoor air passes through the lateral side flat portion 1 a, the corner portion 1 b, and the back side flat portion 1 c of the heat exchanger 1 and flows into the casing 14 from the back side of the blower fan 2c. The outdoor air passes through the blower fan 2c, flows to the front of the outdoor unit 100, and flows to the outside through an air outlet formed in the front panel 14a at the front side. Thus, for example, during cooling operation, the refrigerant within the heat exchanger 1 is cooled by the outdoor air, and the outdoor air passing through the heat exchanger 1 is heated by exchanging heat with the refrigerant.

**[0024]** As an assembling order of each component, first, the heat exchanger 1 is fixed to the bottom plate 12, and then the compressor 6 and the refrigerant pipe 7 are fixed to each other. Thereafter, the fan motor support plate 4 is assembled to the bottom plate 12, the fan motor 2a is fixed to the fan motor support plate 4, and the blower fan 2c is fixed to the motor rotation shaft 2b. Next, the partition plate 10 is assembled to the bottom plate 12. Finally, the electrical component box 8 and the respective panels 14a to 14e, which form the casing 14, are fixed.

**[0025]** Here, as shown in Figs. 1 and 2, in the description of Embodiment, a direction in which the front panel 14a faces the outside is defined as a front side, and the opposite direction is defined as a back side, and a direction connecting the front side and the back side is referred to as a front-back direction. In addition, as seen from the front, a direction in which the machine chamber 9 is located is defined as a right side, and a direction in which the blower device chamber 5 is located is defined as a left side. Furthermore, sometimes, the front side is referred to as frontward, the back side is referred to as backward, the right side is referred to as rightward, and the left side is referred to as leftward.

**[0026]** Fig. 3 is a perspective view of the bottom plate 12, which forms the bottom surface of the casing 14 of the outdoor unit 100, as seen from an obliquely upward direction, and shows a state prior to assembling each component to be mounted inside. The bottom plate 12 is previously pressed such that a mounting portion for assembling each component to be mounted is formed therein. A fan motor support plate mounting portion 17 to which a lower end portion of the fan motor support plate 4 is to be fixed is formed in substantially a center portion, in the front-back direction and the right-left direction, of the bottom plate 12 which defines the blower device chamber 5. Fig. 4 is a perspective view showing the fan motor support plate mounting portion 17 in an enlarged manner.

**[0027]** Hereinafter, the fan motor support plate mounting portion 17 of the bottom plate 12 will be described in detail.

**[0028]** A plurality of fixing pieces 15 are formed in the fan motor support plate mounting portion 17 by cutting and bending the bottom plate 12. The fixing pieces 15 are formed as follows. The fan motor support plate mounting portion 17 of the bottom plate 12 made of metal has generally a flat surface, and a portion of the bottom plate 12 is cut and bent from the front side toward the back side. Next, the cut-bent piece is processed to form a plurality of, here, three fixing pieces 15. A screw hole 16 is provided in a center portion of each fixing piece 15 by, for example, burring, so as to extend through the fixing piece 15. In the bottom plate 12 and at the front side of the fixing pieces 15, an opening 19 is formed as a result of the cutting and bending for forming the fixing pieces 15. Here, each fixing piece 15 is formed by cutting and bending a portion of the bottom plate 12 upward from the front side toward the back side. The back side surface of each fixing piece 15 is formed by a surface of the bottom plate 12 at the inner side of the casing 14 before cutting and bending of the fixing piece 15, and the front side surface of each fixing piece 15 is formed by a surface of the bottom plate 12 at the outer side of the casing 14.

**[0029]** The fixing pieces 15 are composed of three small pieces, and but the number thereof may be any number. The fan motor support plate 4 is screw-fixed with the fixing pieces 15. The number of the fixing pieces 15

may be one as long as the fan motor support plate 4 is stably fixed. In addition, a plurality of screw holes may be provided in a single plate piece which has been cut and bent. That is, the fan motor support plate 4 may be stably fixed with a single large fixing piece provided with a plurality of fixing locations.

**[0030]** In addition, positioning pieces 20a and 20b are provided at both sides of the opening 19 for positioning the fan motor support plate 4 in the front-back direction and the right-left direction in mounting the fan motor support plate 4 to the fan motor support plate mounting portion 17. The positioning pieces 20a and 20b are formed by cutting and bending the bottom plate 12 upward from the back side toward the front side. Openings 18a and 18b are formed at the back side of the positioning pieces 20a and 20b as a result of forming the positioning pieces 20a and 20b, and are smaller than the opening 19.

**[0031]** Fig. 5 is a perspective view showing the fan motor support plate 4 which supports the fan motor 2a.

**[0032]** The fan motor support plate 4 is fixed within the casing 14, is provided substantially upright in substantially the vertical direction so as to extend from the bottom plate 12 toward the top panel 14e, and has, at substantially a center position in the vertical direction, a fan motor fixing surface 3 to which the fan motor 2a is to be mounted. The fan motor 2a shown in Fig. 2 is mounted to the fan motor fixing surface 3, and the blower fan 2c is connected to the motor rotation shaft 2b which projects frontward from the fan motor 2a, so that a rotational drive force of the fan motor 2a is transferred to the blower fan 2c. As described above, the fan motor support plate 4 supports not only the fan motor 2a but also the blower fan 2c to which the fan motor 2a is connected via the motor rotation shaft 2b.

**[0033]** The lower end portion of the fan motor support plate 4 is screw-fixed to the fan motor support plate mounting portion 17 of the bottom plate 12 of the casing 14. In the lower end portion of the fan motor support plate 4, an engagement portion 26 is formed which is to be fixed to the bottom plate 12. Specifically, the engagement portion 26 has a flat surface 21 opposed to the bottom plate 12, and has cuts 22a and 22b at both end portions of the flat surface 21 in the right-left direction. The cuts 22a and 22b may be formed at both end portions of the flat surface 21 in the right-left direction by cutting corners at the front side into square shapes, or by pressing the flat surface 21 so as to include the cuts 22a and 22b. Furthermore, the engagement portion 26 has a mounting surface 23 which is located at the back side of the flat surface 21 and extends from the flat surface 21 toward the back side so as to be tilted upward. The mounting surface 23 is tilted so as to contact the front side surface of each cut and bent fixing piece 15 shown in Fig. 4 (the lower surface of the bottom plate 12 in the thickness direction thereof which is a surface facing the outside of the casing 14 if not cut and bent). That is, the mounting surface 23 contacts the front side of each fixing piece 15 at its back side. The mounting surface 23 is provided with mounting holes 24 which extend through the mounting surface 23 and are opposed to the screw holes 16 provided in the fixing pieces 15 when being brought into contact with the fixing pieces 15.

**[0034]** Furthermore, a heat exchanger contact portion 25 is provided in the fan motor support plate 4 and at the back side of the engagement portion 26. By bringing the heat exchanger contact portion 25 into contact with the back side flat portion 1 c of the heat exchanger 1, which is located within the casing 14 and at the back side, from the front side, the fan motor support plate 4 is positioned in the front-back direction.

**[0035]** In addition, an upper end portion of the fan motor support plate 4 has a hooking portion 27 which projects toward the back side further than the fan motor fixing surface 3. By hooking the hooking portion 27 at an upper portion of the back side flat portion 1 c of the heat exchanger 1, the upper end portion of the fan motor support plate 4 is fixed.

**[0036]** Fig. 6 is a perspective view showing, in an enlarged manner, a state where the engagement portion 26 of the fan motor support plate 4 is screw-fixed to the fan motor support plate mounting portion 17 of the bottom plate 12. The heat exchanger contact portion 25 is brought into contact with the back side flat portion 1 c of the heat exchanger 1 from the front side such that the positioning pieces 20a and 20b for assembling the fan motor support plate 4 enter the cuts 22a and 22b of the fan motor support plate 4, respectively. Accordingly, the fan motor support plate 4 is positioned in the front-back direction and the right-left direction. In this state, the fan motor support plate 4 is positioned such that: the mounting surface 23 of the fan motor support plate 4 contacts the front side of the fixing pieces 15; and the mounting holes 24 in the mounting surface 23 and the screw holes 16 of the fixing pieces 15 are opposed to each other. In this state, the screws 13 are inserted into the mounting holes 24 from the front side and coupled with the screw holes 16 in the fixing pieces 15 formed in the bottom plate 12. Specifically, the screw holes 16 are provided in the fixing pieces 15 by burring, and the screws 13 are inserted into the mounting holes 24 in the mounting surface 23, and are inserted into the screw holes 16 of the fixing pieces 15 while being rotated. Accordingly, simultaneously with the insertion of the screws 13, the screws 13 and the screw holes 16 are coupled to each other by screwing thereof. When self-tapping screws are used as the screws 13 to fix the fan motor support plate 4 to the bottom plate 12, even if thread grooves are not formed on the screw holes 16 provided in the fixing pieces 15, thread grooves are formed while the screws 13 are rotated, so that the fan motor support plate 4 is fixed to the bottom plate 12.

**[0037]** In Fig. 6, the opening 19 formed in the bottom plate 12 in order to form the fixing pieces 15 and the openings 18a and 18b formed in the bottom plate 12 in order to form the positioning pieces 20a and 20b are shown by dotted lines. The opening 19 formed as a result

of forming the fixing pieces 15 are covered with the flat surface 21 of the fan motor support plate 4 from above. Furthermore, almost the entireties of the openings 18a and 18b formed as a result of forming the positioning pieces 20a and 20b, except for the gaps between the cuts 22a and 22b and the positioning pieces 20a and 20b, are also covered with the flat surface 21 of the fan motor support plate 4 from above.

**[0038]** In Embodiment, the three screw holes 16 are formed in total in the fixing pieces 15, respectively, of the bottom plate 12 (see Fig. 4), but the fixing pieces 15 are fixed to the mounting surface 23 of the fan motor support plate 4 by using the two screw holes 16 at both ends without using the middle screw hole 16. When the bottom plate 12 is commonalized and used to fix a fan motor support plate having a weight greater than that of the fan motor support plate 4 according to Embodiment, all of the three screw holes 16 are used.

**[0039]** Fig. 7 is a cross-sectional view of a screw-fixed portion taken along a line Z-Z in Fig. 6, as seen from the left side. As described above, each fixing piece 15 is formed by cutting and bending the bottom plate 12 upward from the front side toward the back side of the outdoor unit 100. When a cutting-bending angle at that time is defined as $\alpha$, the cutting-bending angle is set as $\alpha \geq$ 90 degrees, and here is set as $\alpha$ = 110 degrees. In addition, in the thickness direction of the bottom plate 12, the surface of the bottom plate 12 at the inner side of the casing 14 of the outdoor unit 100 is referred to as an upper surface 12a, and the surface of the bottom plate 12 at the outer side of the casing 14 is referred to as a lower surface 12b. Since each fixing piece 15 is formed by cutting and bending the bottom plate 12 upward from the front side toward the back side, the front side surface of each fixing piece 15 is originally part of the lower surface 12b of the bottom plate 12, namely, the surface of the bottom plate 12 at the outer side of the casing 14, before cutting and bending, and the back side surface of each fixing piece 15 is originally part of the upper surface 12a of the bottom plate 12, namely, the surface of the bottom plate 12 at the inner side of the casing 14, before cutting and bending. In a state where the back side surface of the mounting surface 23 of the fan motor support plate 4 is in contact with the front side surface (the lower surface 12b) of each fixing piece 15 which is originally part of the lower surface 12b before cutting and bending, the fan motor support plate 4 is fixed with the screws 13.

**[0040]** In the step of assembling the outdoor unit 100, the bottom plate 12 and the components to be assembled are transferred such that the front side thereof faces an assembly operator. Thus, in general, the assembly operator performs an assembly operation starting from the front side of the outdoor unit 100. In an operation of assembling the fan motor support plate 4 to the bottom plate 12, the screws 13 are inserted into the mounting holes 24 provided in the fan motor support plate 4 located at the front side, and then are coupled with the screw holes 16 as described above. As shown by an outline arrow 28, the screws 13 are inserted into the screw holes 16 in the fixing pieces 15 from the front side (the lower surface 12b) to the back side (the upper surface 12a), and thus leading ends 13a of the screws are fixed at a position surrounded by the upper surface 12a of the bottom plate 12. When each fixing piece 15 is cut and bent upward from the front side toward the back side and is further screw-fixed from the front side, the leading end 13a of each screw is fixed in a state of being located within the casing 14 without projecting outside the casing 14. Thus, the leading end 13a of each screw with which the fan motor support plate 4 is screw-fixed to the bottom plate 12 of the casing 14 is not exposed to the outside of the casing 14, it is possible to prevent an installation operator from touching the leading end 13a of the screw during an installation operation, and it is possible to prevent the appearance from providing an uncomfortable feeling to the user in the case of installation in a ceiling hanging manner.

**[0041]** In addition, since the leading end 13a of each screw is located in a space surrounded by the upper surface 12a of the bottom plate 12, which is located at the back side of the fixing pieces 15, and the back side surface of the fixing piece 15 (the upper surface 12a), exposure of the leading end 13a within the casing 14 is suppressed, and it is possible to reduce a possibility of contact of the assembly operator with the leading end 13a of each screw.

**[0042]** Furthermore, if the openings 18a, 18b, and 19, which are formed as a result of cutting and bending the bottom plate 12, are kept opened, a finger may enter into the opening 18a, 18b, or 19 when the installation operator performs an installation operation or when the user is near the outdoor unit 100.

**[0043]** In Embodiment, the fan motor support plate 4 is assembled to the front side of the fixing pieces 15 in a state where the flat surface 21, which is formed in the engagement portion 26 of the fan motor support plate 4 so as to be opposed to the flat surface of the bottom plate 12, covers the entirety of the opening 19, which is formed at the front side of the fixing pieces 15 as a result of cutting and bending the fixing pieces 15. That is, the opening 19, which is formed in forming the fixing pieces 15, is not kept opened and is closed by the flat surface 21. Since the opening 19 is closed by the flat surface 21, in the case of installation in a ceiling hanging manner, it is possible to obtain an outdoor unit for an air-conditioning apparatus with which, in the case of installation in a ceiling hanging manner, the casing interior is prevented from being viewed through the opening and the appearance of the outdoor unit does not provide an uncomfortable feeling to the user. In addition, since the opening 19 is covered, it is possible to assuredly prevent a finger from entering from the outside of the casing 14 of the outdoor unit into the interior of the casing 14, and it is possible to improve the safety.

**[0044]** Moreover, the openings 18a and 18b are also substantially closed by the flat surface 21 of the engage-

ment portion 26 (see Fig. 6). Although the openings 18a and 18b are smaller than the opening 19, if a small child mischievously puts his/her thin finger thereinto, the finger may not be pulled out therefrom. Since the openings 18a and 18b are closed, it is possible to assuredly prevent a finger or the like from entering from the outside of the casing 14 into the interior of the casing 14, and a further highly safe outdoor unit for an air-conditioning apparatus is obtained.

**[0045]** Furthermore, since the cutting-bending angle $\alpha$ of each fixing piece 15 is equal to or greater than 90 degrees and is set to, for example, 110 degrees, when the product is assembled, the assembly operator inserts the screws 13 from a screw insertion direction 28. For example, the assembly operator inserts the screws 13 from the direction of a screw insertion angle $\theta$ = 20 degrees which is an oblique upward direction, for fixing. The screw insertion angle $\theta$ indicates an angle relative to the horizontal line. Because of the configuration in which the screws 13 are inserted from an oblique upward direction relative to the horizontal line, the assembly operator at the front side easily performs an operation and is allowed to easily and assuredly perform screw fixing, and the productivity is good. Since the cutting-bending angle $\alpha$ of each fixing piece 15 is set to at least 90 degrees or greater, it is established that the screw insertion angle $\theta \geq 0$ degrees, and the assembly operator easily performs an operation.

**[0046]** Fig. 8 is an explanatory diagram explaining the cutting-bending angle $\alpha$ of the fixing piece formed by cutting and bending the bottom plate. Fig. 8(a) shows a fixing piece 31 in the case with the cutting-bending angle $\alpha$ < 90 degrees, and a screw insertion direction is shown by an outline arrow B1. The drawing is shown with $\alpha 1$ = 45 degrees. With the cutting-bending angle $\alpha$ < 90 degrees, for example, with a cutting-bending angle $\alpha$ of 45 degrees, it is difficult to assemble the fan motor support plate 4 to the fixing piece 31 from the front side in terms of space. In addition, it is also difficult to fix with the screw 13 from the B1 direction. In this case, it is possible to dispose the fan motor support plate 4 at the back side of the fixing piece 31 in terms of space and fix with the screw 13 from the back side as shown by an arrow A. However, when the screw 13 is inserted from the back side to the front side of the fixing piece 31, it is difficult for the assembly operator to perform an operation, and the insertion direction of the screw 13 is directed from the upper surface 12a of the bottom plate 12 toward the lower surface 12b of the bottom plate 12. Thus, the leading end 13a of the screw 13 is located at the lower surface 12b of the bottom plate 12 and exposed to the outside of the casing 14 of the outdoor unit from the opening 19 formed as a result of cutting and bending. In this case, similarly to the existing device, a finger of the installation operator for an air-conditioning apparatus may contact the leading end 13a, and the leading end 13a of the screw is viewed by the user in the case of installation by hanging from a ceiling.

**[0047]** Fig. 8(b) shows a fixing piece 32 in the case with a cutting-bending angle $\alpha 2$ = 90 degrees, and the screw insertion direction is shown by an outline arrow B2. In this case, it is possible to assemble the fan motor support plate 4 to the fixing piece 32 from the front side in terms of space. In addition, it is also possible to fix with the screw 13 from the B2 direction. By setting the cutting-bending angle $\alpha \geq$ 90 degrees as described above, in fixing the fan motor support plate 4 to the fixing piece 32 with the screw 13, the leading end 13a of the screw 13 is located within the casing 14 of the outdoor unit so as to be surrounded by the upper surface 12a of the bottom plate 12, and is not exposed to the outside of the casing 14. Thus, it is possible to provide an outdoor unit for an air-conditioning apparatus which gives no concern about contact of a finger of the installation operator, is safe, and does not provide an uncomfortable feeling to the user.

**[0048]** Fig. 8(c) shows fixing pieces 33 and 34 in the case of a cutting-bending angle $\alpha 3$ = 110 degrees and a cutting-bending angle $\alpha 4$ = 130 degrees, and the screw insertion direction is shown by outline arrows B3 and B4. The screw insertion directions B3 and B4 are, for example, oblique upward directions with a screw insertion angle $\theta$ = 20 degrees to 40 degrees relative to the horizontal line. Thus, the assembly operator in a production line easily inserts the screws 13, and the operability is good. Since the operability is good, it is possible to assuredly perform screw fixing, and thus it is possible to improve the productivity. In addition, with $\alpha$ > 130 degrees, during cutting and bending, there is a possibility that the strength of a corner portion 35 is decreased. When the operability and the processibility for fixing the fan motor support plate 4 to the fixing piece 33 or 34 with the screw 13 are considered as described above, the cutting-bending angle $\alpha$ is preferably 110 degrees $\leq \alpha \leq$ 130 degrees.

**[0049]** In addition, as shown in Fig. 6, since the positioning pieces 20a and 20b for assembling the fan motor support plate are provided in the fan motor support plate mounting portion 17 of the bottom plate 12 by cutting and bending and are caused to enter the cuts 22a and 22b of the fan motor support plate 4, respectively, the fixing position of the fan motor support plate 4 with respect to the bottom plate 12 is determined. The positioning pieces 20a and 20b are cut and bent so as to correspond to the positions of the cuts 22a and 22b such that the screw holes 16 provided in the bottom plate 12 and the mounting holes 24 provided in the fan motor support plate 4 join together. Thus, in assembling the fan motor support plate 4, by assembling the fan motor support plate 4 at such a position that the positioning pieces 20a and 20b enter the cuts 22a and 22b, the fan motor support plate 4 is positioned in the front-back direction and the right-left direction, and it is possible to accurately join the screw holes 16 and the mounting holes 24 together. During the assembly operation, the assembly operator is allowed to assemble the fan motor support plate 4 without misaligning the screw holes, and it is possible to improve the operability.

**[0050]** Furthermore, the cuts 22a and 22b provided in the fan motor support plate 4 are formed at both ends of the flat surface 21 in the right-left direction as square recesses provided in the corners at the front side. Thus, each of the cuts 22a and 22b has two sides. When the two sides of each of the cuts 22a and 22b are brought into contact with each of the positioning pieces 20a and 20b, the fan motor support plate 4 is positioned further accurately in the two directions, that is, the front-back direction and the right-left direction.

**[0051]** There is an existing device in which an insertion hole into which a positioning piece is to be inserted is provided so as to correspond to the positioning piece, for positioning. However, in Embodiment, it is possible to assuredly perform positioning with a simple configuration like a square recess provided in the corner portion.

**[0052]** In Embodiment, as seen from front, the machine chamber 9 is disposed at the right side, and the blower device chamber 5 is disposed at the left side. However, Embodiment is not limited thereto, and the machine chamber 9 and the blower device chamber 5 may be disposed reversely.

**[0053]** As described above, according to the invention, it is possible to obtain an outdoor unit 100 for an air-conditioning apparatus which includes: a heat exchanger 1 disposed at a back side within a casing 14 having substantially a rectangular parallelepiped shape; a blower fan 2c disposed in front of the heat exchanger 1 and configured to blow air from the back side of the casing 14 to a front side of the casing 14; a fan motor 2a disposed between the heat exchanger 1 and the blower fan 2c and configured to drive the blower fan 2c; and a fan motor support plate 4 provided so as to be fixed at a lower end portion thereof to a fan motor support plate mounting portion 17 of a bottom plate 12 forming a bottom portion of the casing 14 and extend toward a top panel 14e of the casing 14 substantially in a vertical direction and configured to support the fan motor 2a at a middle portion thereof in the vertical direction, the fan motor support plate mounting portion of the bottom plate 1217 being provided with a fixing piece 15 formed by cutting and bending the bottom plate 12 upward and a screw hole 16 extending through the fixing piece 15, the lower end portion of the fan motor support plate 4 being provided with an engagement portion 26 having: a mounting surface 23 mounted to the fixing piece 15; and a mounting hole 24 opposed to the screw hole 16 and extending through the mounting surface 23, the fan motor support plate 4 being screw-fixed to the fan motor support plate mounting portion 17 of the bottom plate 12, wherein the fixing piece 15 is formed by cutting and bending the bottom plate 12 upward from the front side toward the back side, a back side surface of the mounting surface 23 of the engagement portion 26 is brought into contact with the front side of the fixing piece 15, and a screw 13 is inserted into the mounting hole 24 from the front side within the casing 14 and coupled with the screw hole 16 in the fixing piece 15, whereby a leading end 13a of the screw is not exposed to the outside of the casing 14, an installation operator does not touch the leading end 13a of the screw during an installation operation, and the appearance of the outdoor unit does not provide an uncomfortable feeling to a user in the case where the outdoor unit is installed in a ceiling hanging manner.

**[0054]** In addition, the fixing piece 15 is formed by cutting and bending the bottom plate 12 upward from the front side toward the back side at an angle of 90 degrees or greater, whereby it is possible to obtain an outdoor unit 100 for an air-conditioning apparatus for which it is easy for an assembly operator to perform a screw-fixing operation, and it is possible to improve the productivity.

**[0055]** In particular, the fixing piece 15 is formed by cutting and bending the bottom plate 12 upward from the front side toward the back side at an angle of 110 degrees to 130 degrees, whereby it is possible to ensure the strength of the cut and bent corner portion 35, it is possible to obtain an outdoor unit 100 for an air-conditioning apparatus for which it is easy for an assembly operator to perform a screw-fixing operation, and it is possible to improve the productivity.

**[0056]** Moreover, the engagement portion 26 provided in the lower end portion of the fan motor support plate 4 has a flat surface 21 which covers an opening 19 formed at the front side of the fixing piece 15 of the bottom plate 12 as a result of forming the fixing piece 15 by cutting and bending the bottom plate 12, whereby the opening 19 formed in the bottom plate 12 kept cut and bent is closed, it is possible to assuredly prevent a finger or the like from entering the casing 14 through the opening 19, for example, when an installation operator performs an installation operation or when a user is near the outdoor unit 100, and it is possible to obtain a highly safe outdoor unit 100 for an air-conditioning apparatus.

Reference Signs List

**[0057]** 1 heat exchanger 1a lateral side flat portion 1b corner portion 1c back side flat portion 2 blower device 2a fan motor 2b motor rotation shaft 2c blower fan 3 fan motor fixing surface 4 fan motor support plate 5 blower device chamber 6 compressor 7 refrigerant pipe 8 electrical component box 9 machine chamber 10 partition plate 11 leg portion 12 bottom plate 12a upper surface 12b lower surface 13 screw 13a leading end of screw 14 casing 14a front panel 14b side panel 14c back panel 14d side panel 14e top panel 15 fixing piece 16 screw hole 17 fan motor support plate mounting portion 18a, 18b opening 19 opening 20a, 20b positioning piece 21 flat surface 22a, 22b cut 23 mounting surface 24 mounting hole 25 heat exchanger contact portion 26 engagement portion 27 hooking portion 28 screw insertion direction 31, 32, 33, 34 fixing piece 35 corner portion 100 outdoor unit for air-conditioning apparatus $\alpha$, $\alpha 1$, $\alpha 2$, $\alpha 3$, $\alpha 4$ cutting-bending angle $\theta$ screw insertion angle

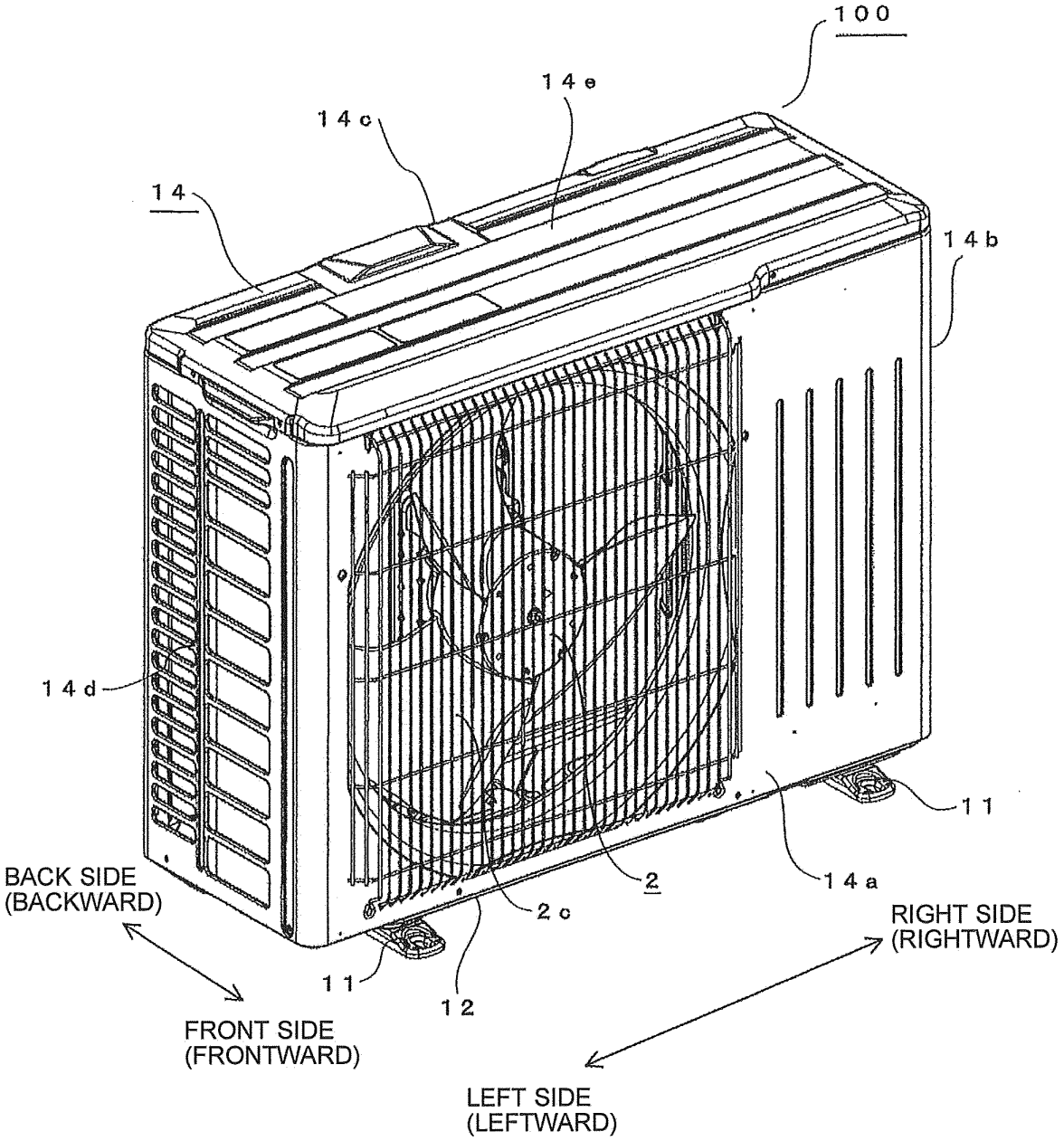
## Claims

1. An outdoor unit for an air-conditioning apparatus, including: a casing; a heat exchanger disposed at a back side within the casing; a blower fan disposed in front of the heat exchanger and configured to blow air from the back side of the casing to a front side of the casing; a fan motor disposed between the heat exchanger and the blower fan and configured to drive the blower fan; and a fan motor support plate provided so as to be fixed at a lower end portion thereof to a fan motor support plate mounting portion of a bottom plate forming a bottom portion of the casing and extend toward a top surface of the casing in a vertical direction and configured to support the fan motor at a middle portion thereof in the vertical direction, the fan motor support plate mounting portion of the bottom plate being provided with a fixing piece formed by cutting and bending the bottom plate upward and a screw hole extending through the fixing piece, the lower end portion of the fan motor support plate being provided with an engagement portion having a mounting surface mounted to the fixing piece and a mounting hole opposed to the screw hole and extending through the mounting surface, the fan motor support plate being screw-fixed to the fan motor support plate mounting portion of the bottom plate, wherein
   the fixing piece is formed by cutting and bending the bottom plate upward from the front side toward the back side, and
   a back side surface of the mounting surface of the engagement portion is brought into contact with the front side of the fixing piece, and a screw is inserted into the mounting hole from the front side within the casing and coupled with the screw hole in the fixing piece, whereby a leading end of the screw is located between a surface of the bottom plate located at the back side of the fixing piece which surface is at an inner side of the casing and a back side surface of the fixing piece.

2. The outdoor unit for an air-conditioning apparatus of claim 1, wherein the fixing piece is formed by cutting and bending the bottom plate upward from the front side toward the back side at an angle of 90 degrees or greater.

3. The outdoor unit for an air-conditioning apparatus of claim 1 or 2, wherein the engagement portion provided in the lower end portion of the fan motor support plate has a flat surface which covers an opening formed at the front side of the fixing piece of the bottom plate as a result of forming the fixing piece by cutting and bending the bottom plate.

FIG. 1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14c
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14b
14d
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14a
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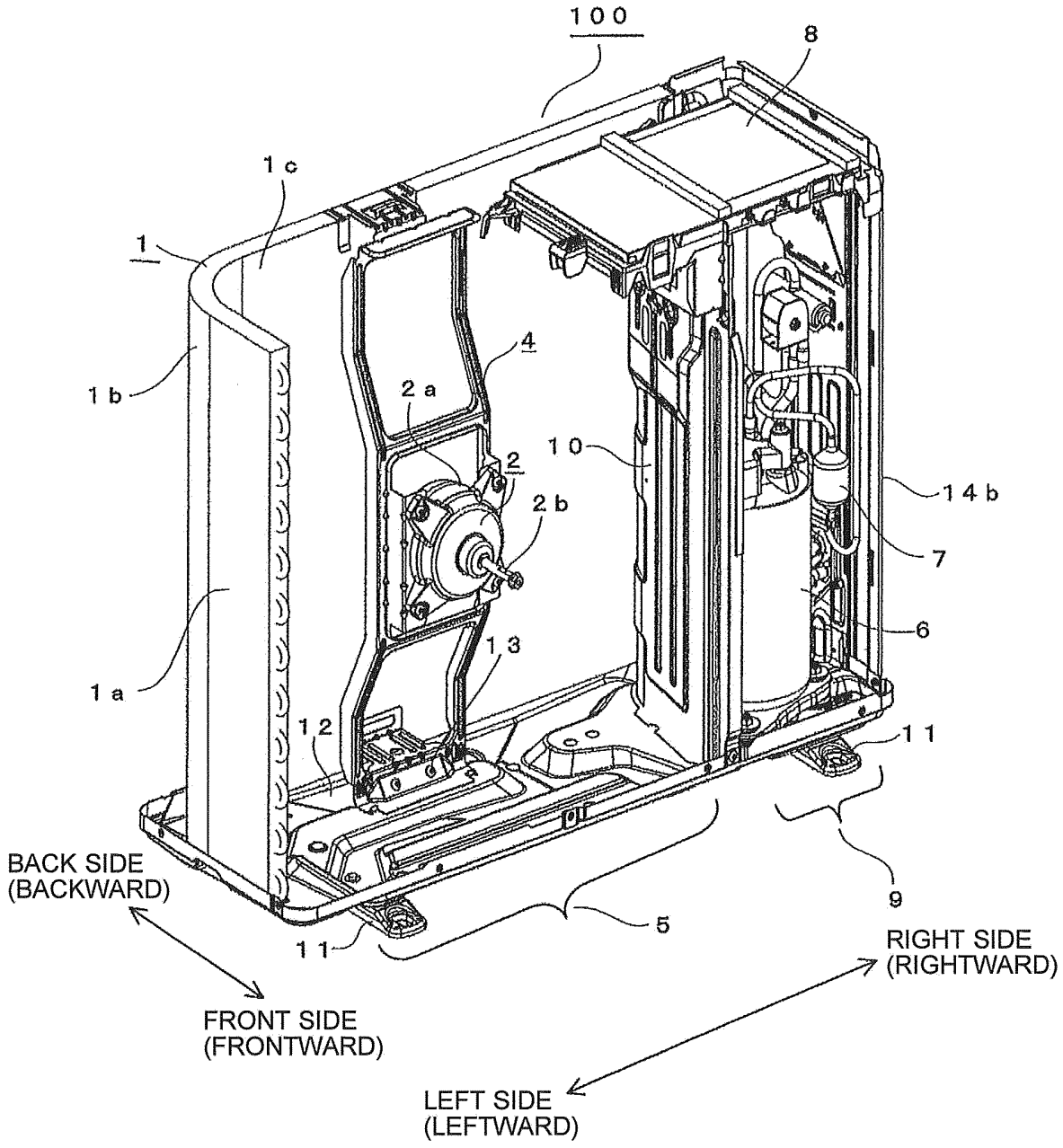
(LEFTWARD)

FIG. 2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(LEFTWARD)

FIG. 3

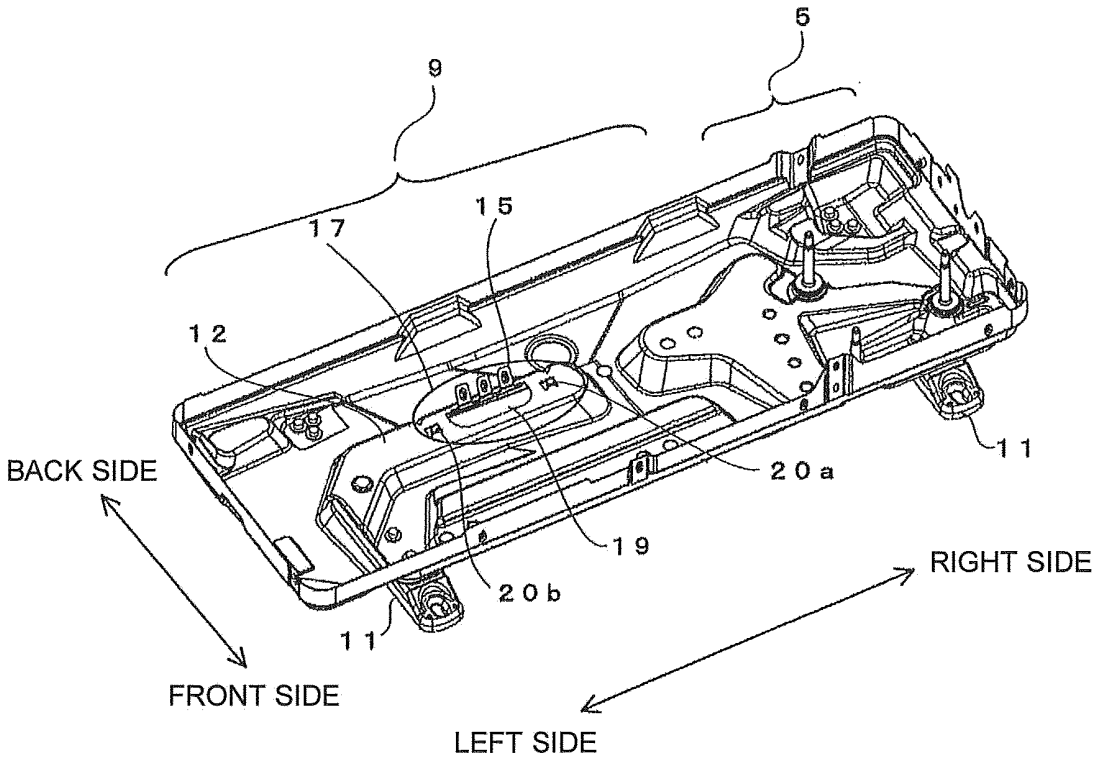
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FIG. 4

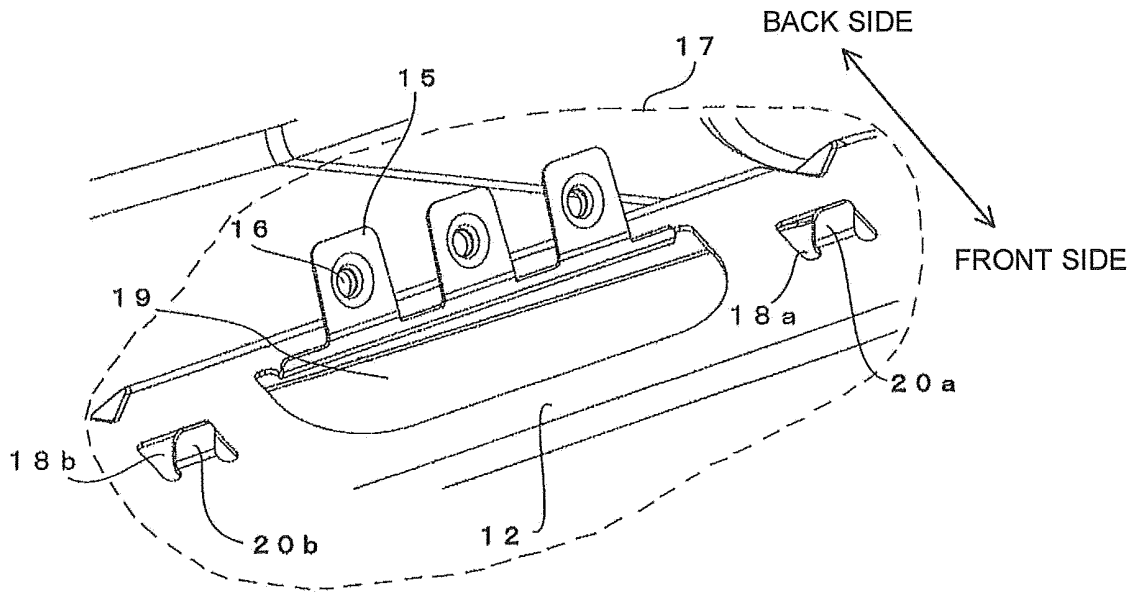
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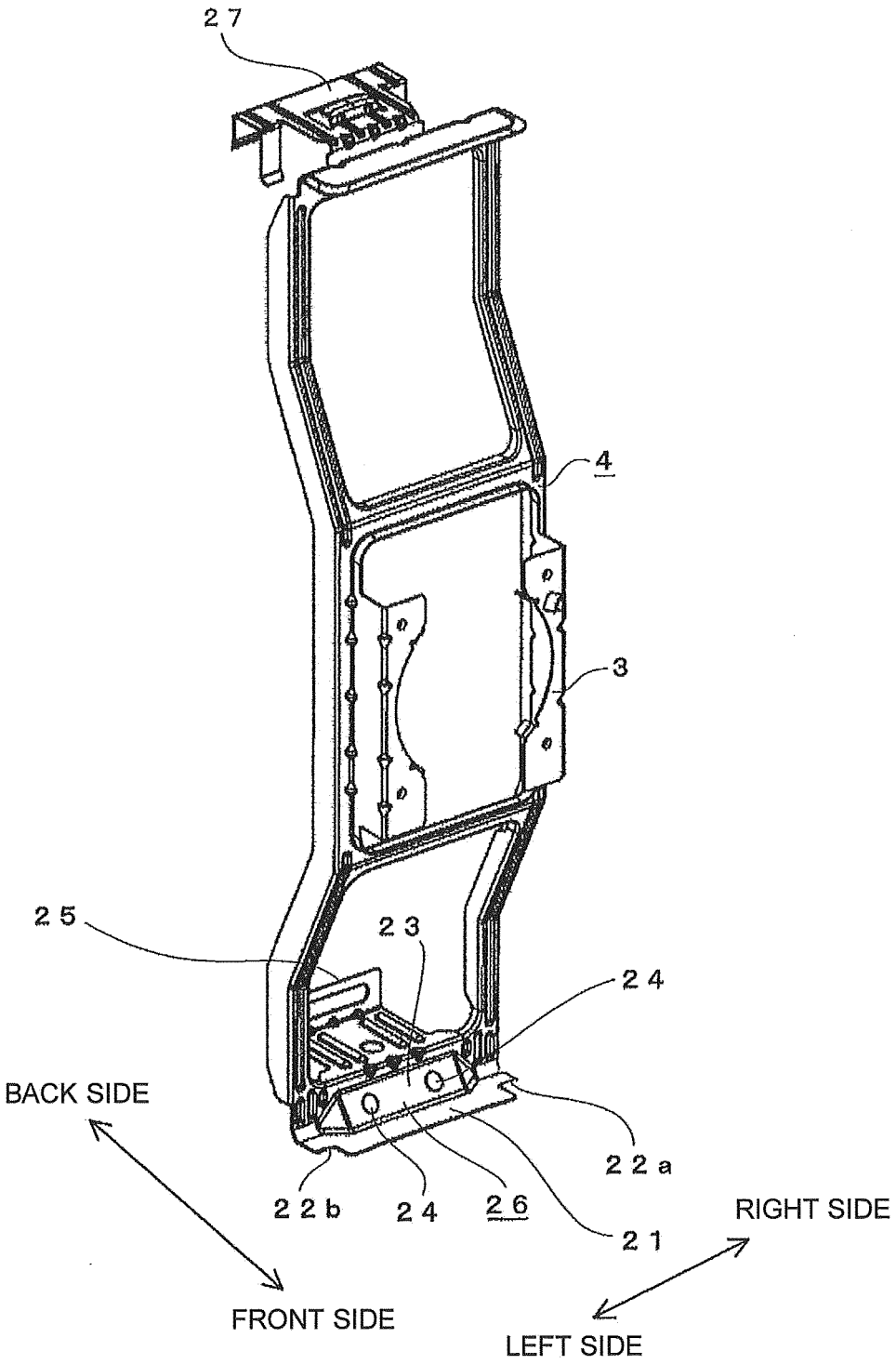
FIG. 5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4
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BACK SIDE
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22b
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21
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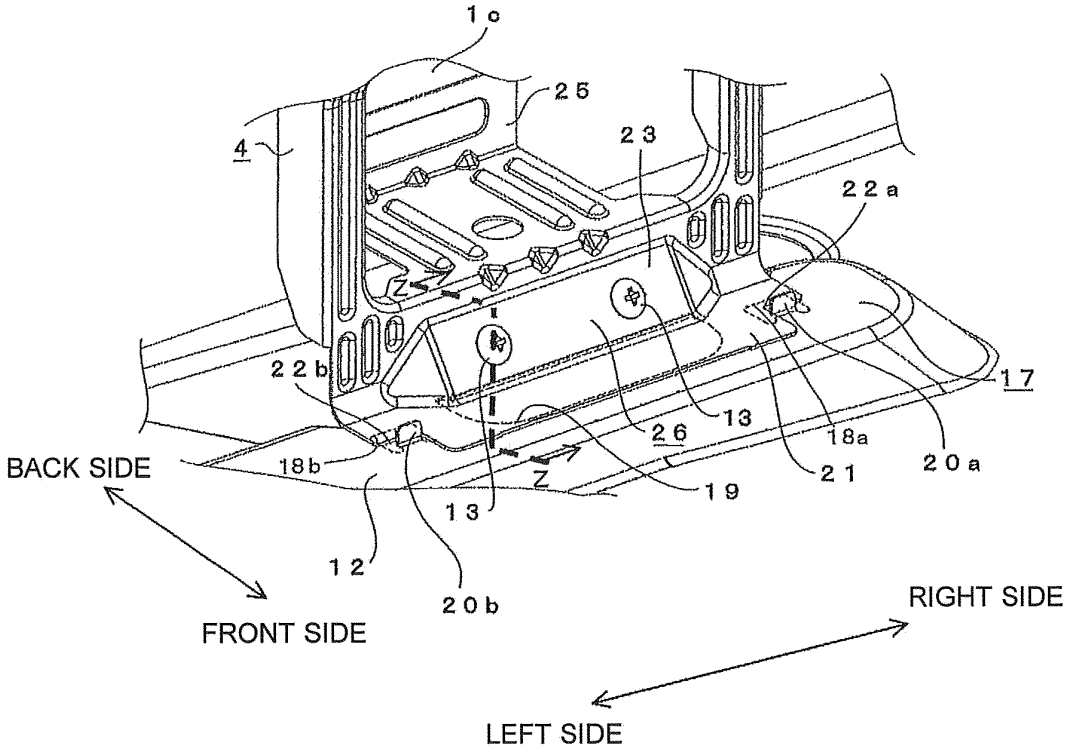
LEFT SIDE

F I G. 6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18b
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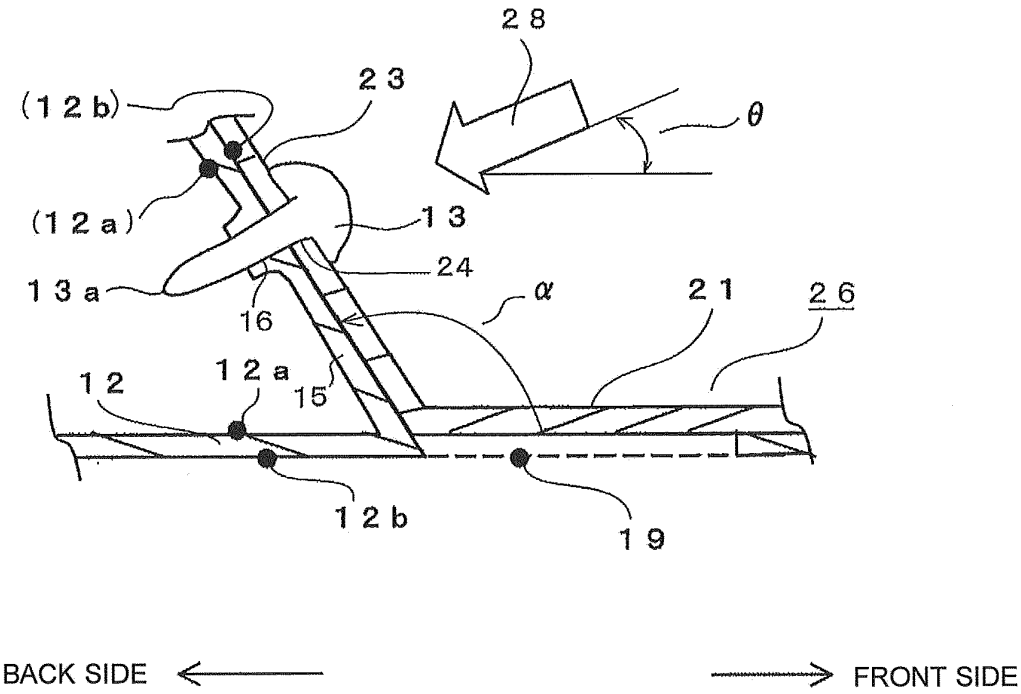
RIGHT SIDE
LEFT SIDE

F I G. 7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23
(12b)
θ
(12a)
13
13a
24
α
21
26
16
12
12a
15
12b
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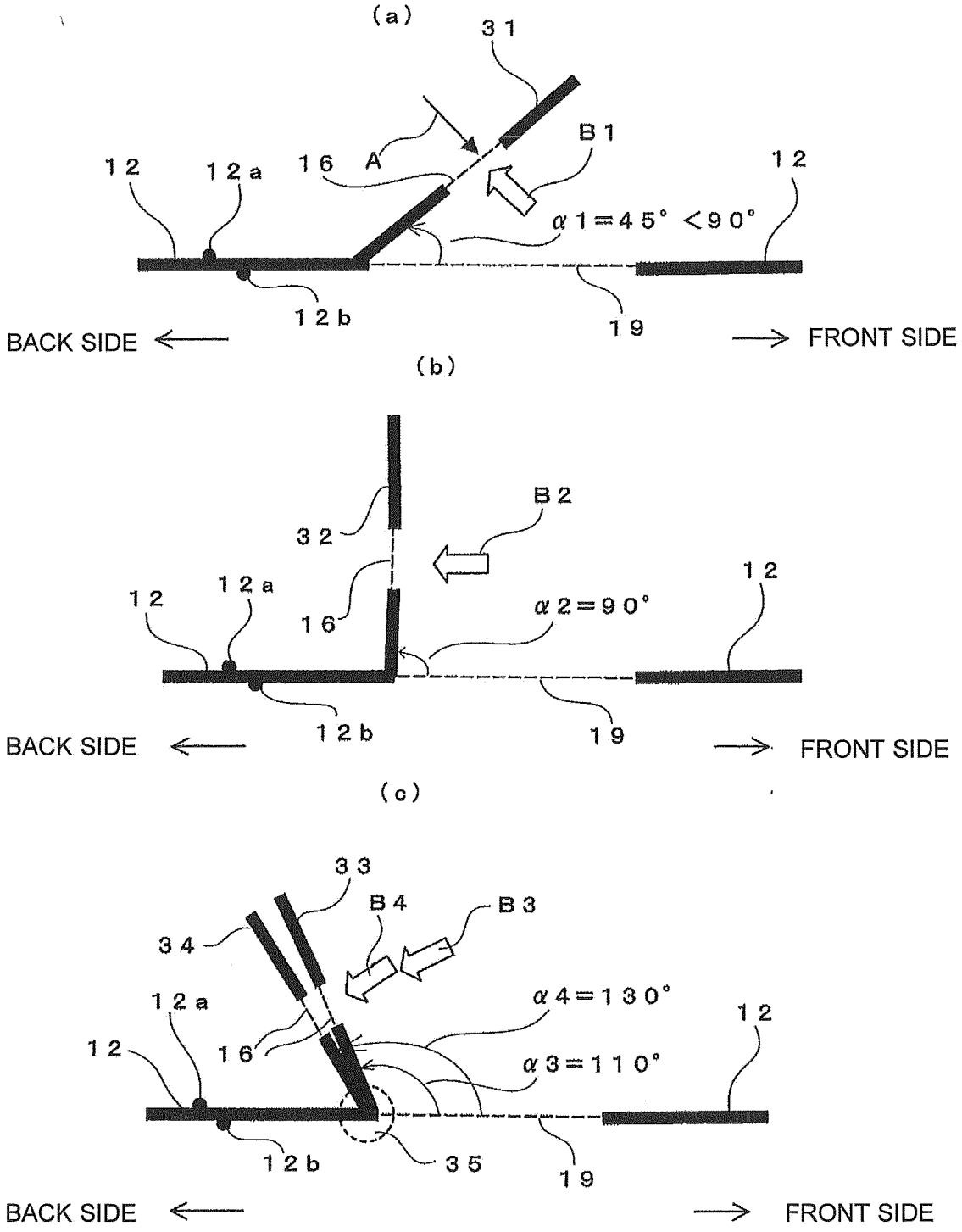
FRONT SIDE

FIG. 8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(b)
B2
32
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12a
16
12
α2=90°
12b
19
BACK SIDE
FRONT SIDE
(c)
33
B4
B3
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12a
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12
12
16
α3=110°
12b
35
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BACK SIDE
FRONT SIDE

**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2013/073873

A. CLASSIFICATION OF SUBJECT MATTER
*F24F1/38*(2011.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F1/38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2013
Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | JP 2011-106758 A (Daikin Industries, Ltd.), 02 June 2011 (02.06.2011), entire text (Family: none) | 1-3 |
| X | JP 2010-181099 A (Panasonic Corp.), 19 August 2010 (19.08.2010), entire text (Family: none) | 1-3 |
| A | JP 8-136006 A (Mitsubishi Electric Corp.), 31 May 1996 (31.05.1996), entire text (Family: none) | 1 |

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

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"P" document published prior to the international filing date but later than the priority date claimed
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"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 22 November, 2013 (22.11.13) | 03 December, 2013 (03.12.13) |
| Name and mailing address of the ISA/ Japanese Patent Office | Authorized officer |
| Facsimile No. | Telephone No. |

Form PCT/ISA/210 (second sheet) (July 2009)

**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2013/073873

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 10787/1990(Laid-open No. 103928/1991) (Mitsubishi Electric Corp.), 29 October 1991 (29.10.1991), entire text (Family: none) | 1 |
| A | JP 2006-170556 A (Matsushita Electric Industrial Co., Ltd.), 29 June 2006 (29.06.2006), paragraphs [0015] to [0021]; fig. 1 to 4 (Family: none) | 1 |

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## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- JP 10096541 A **[0007]**