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(54) **AIR BLOWING UNIT FOR VEHICLE**

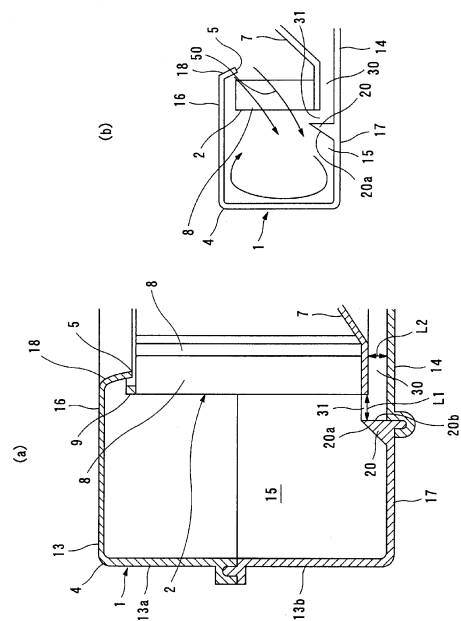
(57) [Problem]

Provided is an air blowing unit for a vehicle which, even when a backflow prevention means which prevents the flow of air which flows back through a gap formed between a bottom surface of an impeller and an upper surface of a motor flange is adopted, optimally maintains a size of the gap thus suppressing noises and the collection of moisture and, can suitably boost a pressure of air in a scroll case portion.

[Means for Resolution]

With respect to a case 4 of an air blowing unit 1, a projecting portion 20 is formed in a projecting manner on an inner side of a second wall portion 17 on a side opposite to a first wall portion 16 where an air suction port 5 is formed as an air backflow prevention means. The projecting portion 20 is positioned outside an impeller 2 in the radial direction with a predetermined gap between a radial outer end of the impeller 2 and the projecting portion 20. Further, a surface of the projecting portion 20 on a side opposite to the impeller 2 forms an inclined surface 20a which is arranged approximately parallel to the flow of air 50 which moves to the inside of an air blowing passage 15 from the impeller 2.

[Fig. 3]



Description

Technical Field

[0001] The present invention relates to an air blowing unit used for a vehicle such as a vehicle air conditioner or a cooling device of heat source for a vehicle.

Background Art

[0002] An air blowing unit used for a vehicle such as a vehicle air conditioner or a cooling device of heat source for a vehicle is basically constituted of, as disclosed in patent literature 1 and patent literature 2, for example, an impeller which generates an air flow by rotation, a motor which rotatably drives the impeller, a case (particularly, a scroll case portion which houses the impeller and is mainly constituted of a peripheral wall formed around a radial side of the impeller), and a motor flange on which the motor is mounted. As a function of such an air blowing unit, air is sucked into the inside of the scroll case portion through an air suction port formed in the scroll case portion by rotatably driving the impeller by the motor, a pressure of the air is boosted in the scroll case portion and, thereafter, the air is discharged from an air discharge port formed in the scroll case portion.

[0003] In the air blowing unit for a vehicle having the constitution and the function described above, as pointed out also in patent literature 1, there has been known a possibility that air flows back toward a portion (air suction port) where an atmospheric pressure becomes relatively low from a portion (air blowing passage) where an atmospheric pressure becomes relatively high in the inside of the scroll case portion in the form where air passes through a gap space formed between a bottom surface of the impeller and an upper surface of the motor flange which constitutes the case thus lowering air blowing efficiency of the air blowing unit.

[0004] It is desirable that the gap space formed between the bottom surface of the impeller and the upper surface of the motor flange is set as small as possible from a viewpoint of accelerating the boosting of discharged air. However, from a viewpoint of avoiding risk such as a collision between the impeller and the motor flange due to vibrations of the motor in the axial direction of a rotary shaft of the motor or the locking of the rotation of the impeller due to intrusion of a foreign material in the gap formed between the impeller and the motor, the gap space is required to ensure a size of a predetermined reference value.

[0005] Further, the air blowing unit for a vehicle is required to maintain a function of a vehicle air conditioner even when a vehicle is left for a long time under an environment where moisture such as rain and snow penetrates into the vehicle from the outside of the vehicle or an atmospheric temperature is below a freezing point. However, when a predetermined size is not ensured with respect to the gap space formed between the bottom

surface of the impeller and the upper surface of the motor flange or the gap space formed between the bottom surface of the impeller and the upper surface of the motor flange has a complicated shape, there is a possibility that moisture will collect in the gap space. In the case where the moisture is frozen, even when the motor is driven, the impeller is locked so that the impeller is not rotated, and there is also a possibility that the motor will catch fire depending on a situation. Also from a viewpoint of obviating risk of locking of rotation of the impeller caused by freezing of the moisture penetrating into the gap space in this manner, the gap space is required to ensure a size of predetermined reference value.

[0006] In this respect, in a centrifugal blower disclosed in patent literature 1, in an attempt to prevent the backflow of air, a cylindrical rib which is formed on the upper surface of the motor flange in a projecting manner toward an impeller, and a cylindrical rib which is formed on the bottom surface of the impeller in a projecting manner toward a motor flange such that an outer diameter size of the cylindrical rib is set smaller than an inner diameter size of the flange-side rib are combined with each other, and the gap space formed between the bottom surface of the impeller and the upper surface of the motor flange is formed into the labyrinth structure having a complicated zone from a radial outer side to a radial inner side of the impeller. On the other hand, in the centrifugal blower disclosed in patent literature 1, the gap space formed between the bottom surface of the impeller and the upper surface of the motor flange has the narrow and complicated structure due to the cylindrical rib formed on the motor flange side and the cylindrical rib formed on the impeller side and hence, risk such as a collision between the impeller and the motor flange due to vibrations or the locking of the rotation of the impeller is increased.

[0007] On the other hand, in a centrifugal blower disclosed in patent literature 2, a cylindrical rib is formed on an upper surface of a motor flange at a portion outside the impeller in the radial direction in a projecting manner toward an impeller thus preventing a gap space formed between a bottom surface of the impeller and the upper surface of the motor flange from having the complicated labyrinth structure. With such a structure, the centrifugal blower disclosed in patent literature 2 attempts to suppress risk of the locking of the rotation of the impeller by preventing the backflow of air while ensuring a size of a predetermined reference value with respect to the gap space formed between the bottom surface of the impeller and the upper surface of the motor flange. Also the centrifugal blower disclosed in patent literature 2 may be also constituted as shown in FIG. 8 of this specification where a cylindrical rib 102 which projects toward an impeller 101 is formed on an upper surface of a scroll case portion 100 at a portion outside the impeller 101 in the radial direction in place of the motor flange. With such a structure, it is possible to suppress risk of the locking of the rotation of the impeller 101 by preventing the backflow of air while ensuring a size of a predetermined reference

value with respect to a gap space 103 formed between a bottom surface of the impeller 101 and the upper surface of the scroll case portion 100.

Citation List

Patent Literature

[0008]

Patent Literature 1: Japanese patent No. 4185654

Patent Literature 2: JP-A-2006-46112

Summary of the Invention

Problems that the Invention is to Solve

[0009] However, in the constitution of the air blowing unit shown in FIG. 8B of this specification, the cylindrical rib 102 is formed in a projecting manner on a flow passage of air 104 which flows toward the outside of the impeller 101 in the radial direction from the impeller 101 and hence, the flow of air 105 generates a vortex outside the rib 102 in the radial direction of the impeller 101 thus giving rise to a possibility of the occurrence of drawbacks such as the increase of noises or the lowering of air blowing efficiency. These drawbacks occur also in the air blowing unit disclosed in patent literature 2 in the same manner.

[0010] Accordingly, it is an object of the invention to provide an air blowing unit for a vehicle which, while having a backflow prevention means which prevents a backflow of air to a gap space formed between a bottom surface of an impeller and an upper surface of a motor flange at a position where risk of the locking of the rotation of the impeller can be suppressed, can suppress the occurrence of noises and the collection of moisture caused by adopting the backflow prevention means and, further, can suitably boost a pressure of air in a scroll case portion. Means for Solving the Problems

[0011] The invention is directed to an air blowing unit for a vehicle which includes: an air blowing means which includes an impeller and a motor which rotatably drives the impeller by way of a rotary shaft; and a case which includes a scroll case portion which encases the impeller of the air blowing means, an air blowing passage which gradually expands toward the outside of the impeller in the radial direction from a winding start to a winding end of the scroll case portion being formed in the scroll case portion, an air suction port for sucking air into the case from the outside is formed in a first wall portion of the case positioned on one side in the axial direction of the impeller, and an air blow-off port for blowing off air to the outside of the case is formed in a winding-end-side portion of the scroll case portion, wherein an air backflow prevention means is provided to an inner side of a second wall portion of the case positioned on the other side in the axial direction of the impeller, and the air backflow

prevention means is positioned outside a radial outer end of the impeller in the radial direction of the impeller with a predetermined gap formed between the air backflow prevention means and the radial outer end of the impeller whereby the flow of air which moves into the air blowing passage from a radial outer side of the impeller is adjusted so as to allow the air which moves into the air blowing passage to smoothly flow toward the radial outer side of the impeller (claim 1). Here, the second wall portion may be a wall portion of the scroll case portion or a wall portion of a motor flange. Further, the second wall portion may be a wall portion of another member which constitutes the case.

[0012] Due to such a constitution, even when a gap space having a size of a predetermined reference value is formed between a bottom surface of the impeller and an upper surface of the second wall portion, due to the provision of the air backflow prevention means, the flow of air which intends to flow back to an air suction port from the air blowing passage through the gap can be dissipated. Further, when air moves into the air blowing passage, the generation of a vortex of air can be prevented due to the presence of the air backflow prevention means. Still further, even when the air backflow prevention means is provided, the gap space formed between the bottom surface of the impeller and the upper surface of the second wall portion such as the motor flange is not formed into a complicated configuration and hence, moisture hardly collects in the gap space whereby there is no possibility that the rotation of the impeller is locked by freezing of the moisture.

[0013] Here, the air blowing unit for a vehicle according to the invention is also characterized in that the air backflow prevention means includes a projecting portion which projects into the air blowing passage, and a surface of the projecting portion positioned on a side opposite to the impeller forms an inclined surface inclined in the direction approaching an inner surface of the second wall portion except for the projecting portion as the surface goes away from the rotary shaft (claim 2). The projecting portion may be formed such that a thickness of the projecting portion is increased with respect to the second wall portion in the air blowing passage or may be formed by bending the second wall portion in the air blowing passage.

[0014] Due to such a constitution, the projecting portion of the air backflow prevention means has the inclined surface on a side opposite to the impeller and hence, even when the air backflow prevention means is provided in the inside of the air blowing passage, it is possible to prevent an air flow from the impeller from generating a vortex. Further, by adjusting the inclining direction of the inclined surface of the projecting portion in the same direction as the flow direction of air which flows to the outside of the impeller in the radial direction from the air suction port, the flow of the air which flows to the outside of the impeller in the radial direction and spreads into the air blowing passage using the inclined surface of the pro-

jecting portion as a guide is strengthened so that it is possible to suppress the air from flowing into the gap space formed between the bottom surface of the impeller and the upper surface of the second wall portion such as the motor flange from a gap between the projecting portion and the radial end portion of the impeller.

[0015] Further, the air blowing unit for a vehicle according to the invention is also characterized in that the projecting portion of the air backflow prevention means has a crest portion on a first wall portion side, and the crest portion is arranged at the substantially same position as an end portion of the impeller which is positioned on an outer side of the impeller in the radial direction and on a second wall portion side in the axial direction of the impeller as viewed from a radial direction side of the impeller (claim 3). Here, the crest portion of the projecting portion may be arranged at the same position as a first-wall-portion-side surface of the end portion of the impeller positioned on an outer side of the impeller in the radial direction and on a second-wall-portion side in the axial direction of the impeller. The crest portion of the projecting portion may be also arranged at the same position as a second-wall-portion-side surface of the end portion of the impeller positioned on an outer side of the impeller in the radial direction and on the second-wall-portion side in the axial direction of the impeller. The crest portion of the projecting portion may further be positioned between the first-wall-portion-side surface and the second-wall-portion-side surface. Due to such a constitution, it is possible to suppress air in the air blowing passage from flowing back through the gap space formed between the bottom surface of the impeller, that is, the second-wall-portion-side surface of the impeller and the inner side surface of the second wall portion. Further, when air which flows to the outside of the impeller in the radial direction from the air suction port is blown to the air blowing passage, the flow of air which flows along a cone portion particularly is not interrupted and hence, there is no possibility that air blowing efficiency of the air blowing unit is lowered.

[0016] Further, it is preferable that the projecting portion of the air backflow prevention means has a flat surface or a curved surface on the crest portion thereof (claim 4). Due to such a constitution, although there is a possibility that unintended wind noises are generated due to an airflow in the air blowing unit when the crest portion of the projecting portion is formed with an acute angle, such a drawback can be obviated by forming the crest portion of the projecting portion into a flat surface or a curved surface.

[0017] On the other hand, the air blowing unit for a vehicle according to the invention may have the constitution where an inner surface of a portion of the second wall portion which is positioned on a side opposite to the impeller by setting the projecting portion as a base point is arranged so as to be relatively away from an inner surface of the first wall portion thus forming an expanding portion in the air blowing passage (claim 5). Due to such a constitution, a cross-sectional area of the air blowing

passage can be relatively increased and hence, the air flow resistance of the air blowing passage can be decreased whereby there is no possibility that air blowing efficiency of the air blowing unit is lowered.

[0018] Further, the air backflow prevention means may have the constitution different from the constitution described in claim 2 which includes the projecting portion. That is, the air backflow prevention means may include a stepped portion which is constituted of a stepped surface which is formed by arranging an inner surface of a portion of the second wall portion positioned outside the impeller in the radial direction relatively close to the inner surface of the first wall portion and a elected surface which is contiguously joined to the stepped surface on an impeller side, and the stepped surface of the stepped portion and an end portion of the impeller which is positioned outside the impeller in the radial direction and on a second wall portion side in the axial direction of the impeller may be arranged at the substantially same position as viewed in an impeller radial direction side (claim 6). Here, as described previously, the crest portion of the projecting portion may be arranged at the same position as the first-wall-portion-side surface of the end portion of the impeller positioned on an outer side of the impeller in the radial direction and on a second-wall-portion side in the axial direction of the impeller. The crest portion of the projecting portion may be also arranged at the same position as the second-wall-portion-side surface of the end portion of the impeller positioned on an outer side of the impeller in the radial direction and on a second-wall-portion side in the axial direction of the impeller. The crest portion of the projecting portion may further be positioned between the first-wall-portion-side surface and the second-wall-portion-side surface. Due to such a constitution, it is possible to suppress air in the air blowing passage from flowing back through the gap space formed between the bottom surface of the impeller and the second wall portion. Further, the cross-sectional area of the air blowing passage is relatively decreased and hence, the pressure of air blown to the air blowing passage can be efficiently boosted.

[0019] Further, the air blowing unit is characterized in that the air backflow prevention means differs in constitution at least between a portion of the second wall portion corresponding to a winding start portion of the scroll case portion and a portion of the second wall portion corresponding to a winding end portion of the scroll case portion, the air backflow prevention means at the portion of the second wall portion corresponding to the winding start portion of the scroll case portion includes a stepped portion which is constituted of a stepped surface which is formed by arranging the inner surface of a portion of the second wall portion positioned outside the impeller in the radial direction relatively close to the inner surface of the first wall portion and a elected surface which is contiguously joined to the stepped surface on an impeller side, the air backflow prevention means at the portion of the second wall portion corresponding to the winding end

portion of the scroll case portion includes a projecting portion which projects into the air blowing passage, and an inner surface of a portion of the second wall portion which is positioned on a side opposite to the impeller by setting the projecting portion as a base point is arranged relatively away from the inner surface of the first wall portion thus forming an air blowing amount increasing portion having a larger cross-sectional area than a portion having the stepped portion in the air blowing passage (claim 7). Here, the air blowing amount increasing portion means all portions of the air blowing passage where a cross-sectional area of the portion is set relatively larger than the portion of the air blowing passage having the stepped portion by having the second wall positioned more away from the first wall portion than the stepped surface of the stepped portion is. The air blowing amount increasing portion includes not only the expanding portion described in claim 5 but also the portion of the air blowing passage having the inclined surface which extends in the direction away from the first wall portion from the crest portion of the projecting portion and outside the impeller in the radial direction described in claims 3, 4.

[0020] Due to such a constitution, the cross-sectional area of the air blowing passage is relatively decreased at the winding start portion of the scroll case portion and hence, the pressure of air blown to the air blowing passage can be efficiently boosted, while the cross-sectional area of the air blowing passage is relatively increased at the winding end portion of the scroll case portion and hence, the air flow resistance of the air blowing passage is decreased whereby the lowering of air blowing efficiency of the air blowing unit can be suppressed.

Advantage of the Invention

[0021] As described above, according to the inventions described in claim 1 to claim 7, even when a gap space having a size of a predetermined reference value is formed between the impeller and the second wall portion such as the motor flange, due to the provision of the air backflow prevention means, the flow of air which intends to flow back to an air suction port from the air blowing passage through the gap space can be dissipated or suppressed. Further, when air moves into the air blowing passage, the generation of a vortex of air can be prevented due to the presence of the air backflow prevention means. Further, even when the air backflow prevention means is provided, the gap space formed between the impeller and the second wall portion such as the motor flange is not defined in a complicated manner and hence, moisture hardly collects in the gap space thus preventing the rotation of the impeller from being locked by the freezing of the moisture.

[0022] Particularly, according to the invention described in claim 2, the projecting portion of the air backflow prevention means is configured to have the inclined surface on a side opposite to the impeller and hence, even when the air backflow prevention means is provided

in the inside of the air blowing passage, it is possible to prevent an air flow from the impeller from generating a vortex. Further, by adjusting the inclining direction of the inclined surface of the projecting portion in the same direction as the flow direction of air which flows to the outside of the impeller in the radial direction from the air suction port, the flow of the air which flows to the outside of the impeller in the radial direction and spreads into the air blowing passage using the inclined surface of the projecting portion as a guide is strengthened so that it is possible to suppress the air from flowing into the gap space formed between the bottom surface of the impeller and the upper surface of the second wall portion from a gap between the projecting portion and the radial end portion of the impeller.

[0023] Particularly, according to the invention described in claim 3, it is possible to suppress air in the air blowing passage from flowing back through the gap space formed between the bottom surface of the impeller and the second wall portion. Further, when air which flows to the outside of the impeller in the radial direction from the air suction port is blown to the air blowing passage, the flow of air which flows along the cone portion particularly is not interrupted and hence, it is possible to suppress the lowering of the air blowing efficiency of the air blowing unit.

[0024] Particularly, according to the invention described in claim 4, although there is a possibility that unintended wind noises are generated due to an airflow in the air blowing unit when the crest portion of the projecting portion of the air backflow prevention means is formed with an acute angle, such a drawback can be obviated by forming the crest portion of the projecting portion into a flat surface or a curved surface.

[0025] Particularly, according to the invention described in claim 5, a cross-sectional area of the air blowing passage can be relatively increased and hence, the air flow resistance of the air blowing passage can be decreased whereby it is possible to suppress the drawback that air blowing efficiency of the air blowing unit is lowered.

[0026] Particularly, according to the invention described in claim 6, it is possible to suppress air in the air blowing passage from flowing back through the gap space formed between the bottom surface of the impeller and the second wall portion. Further, the cross-sectional area of the air blowing passage can be relatively decreased and hence, the pressure of air blown to the air blowing passage can be efficiently boosted.

[0027] Particularly, according to the invention described in claim 7, the cross-sectional area of the air blowing passage can be relatively decreased at the winding start portion of the scroll case portion and hence, the pressure of air blown to the air blowing passage can be efficiently boosted, while the cross-sectional area of the air blowing passage can be relatively increased at the winding end portion of the scroll case portion and hence, the air flow resistance of the air blowing passage is de-

creased whereby the lowering of air blowing efficiency of the air blowing unit can be suppressed.

Brief Description of the Drawings

[0028]

[FIG. 1]

FIG. 1A is an explanatory view showing a state of the whole constitution of an air blowing unit as viewed from a side opposite to an opening of an air suction port, and FIG. 1B is an explanatory view showing a state of the whole constitution of the air blowing unit as viewed in the radial direction of the air suction port.

[FIG. 2]

FIG. 2A is a cross-sectional view showing the schematic constitution of the air blowing unit in a state where the air blowing unit is cut along the radial direction of a rotary shaft, and FIG. 2B is a cross-sectional view showing the schematic constitution of the air blowing unit in a state where the air blowing unit is cut along the axial direction of the rotary shaft.

[FIG. 3]

FIG. 3A is a view for explaining an embodiment 1 of the invention and is an enlarged view of an essential part showing a state where the constitution of a projecting portion is adopted, and FIG. 3B is an explanatory view showing an air flow when the projecting portion according to the embodiment 1 is used as an air backflow prevention means in a simplified manner.

[FIG. 4]

FIG. 4A is a view for explaining an embodiment 2 of the invention and is an enlarged view of an essential part showing a state where the constitution of a projecting portion different from the projecting portion of the embodiment 1 is adopted, and FIG. 4B is an explanatory view showing an air flow when the projecting portion according to the embodiment 2 is used as the air backflow prevention means in a simplified manner.

[FIG. 5]

FIG. 5A is a view for explaining an embodiment 3 of the invention and is an enlarged view of an essential part showing a state where the constitution of a projecting portion different from the projecting portions of the embodiments 1, 2 is adopted, and FIG. 5B is an explanatory view showing an air flow when a projecting portion according to the embodiment 3 is used as the air backflow prevention means in a simplified manner.

[FIG. 6]

FIG. 6A is a view for explaining an embodiment 4 of the invention and is an enlarged view of an essential part showing a state where the combination of the constitution of a projecting portion and the constitution where a lower surface on a side remoter from an impeller than the projecting portion is lowered is

adopted, and FIG. 6B is an explanatory view showing an air flow when the projecting portion according to the embodiment 4 is used as the air backflow prevention means in a simplified manner.

[FIG. 7]

FIG. 7A is a view for explaining an embodiment 5 of the invention and is an enlarged view of an essential part showing the constitution where a stepped portion is provided, and FIG. 7B is an explanatory view showing an air flow when the stepped portion according to the embodiment 5 is used as the air backflow prevention means in a simplified manner.

[FIG. 8]

FIG. 8A is a view for explaining one of the conventional examples and is an enlarged view of an essential part showing the constitution where a cylindrical rib which projects toward an impeller side is formed on a portion of an upper surface of a scroll case portion outside the impeller in the radial direction, and FIG. 8B is an explanatory view showing a drawback that air generates a vortex due to the provision of the rib. Mode for Carrying Out the Invention

[0029] Hereinafter, embodiments of the invention are explained in conjunction with attached drawings.

[0030] FIG. 1 and FIG. 2 show one example of an air blowing unit 1 to which the invention is applied. The air blowing unit 1 is used for a vehicle such that the air blowing unit 1 constitutes, for example, a part of a vehicle air conditioning device or the like. The air blowing unit 1 is constituted of an impeller 2, a motor 3 which rotatably drives the impeller 2, and a case 4 in which an air suction port 5 and an air blow-off port 6 are formed.

[0031] The impeller 2 is provided for generating an air flow by rotation and, in this embodiment, is of a centrifugal multi-blade type. That is, the impeller 2 faces the motor 3 in an opposed manner, and is constituted of a cone portion 7 having an approximately triangular pyramidal shape, a plurality of blade portions 8 which are formed in an erected manner along an outer periphery of the cone portion 7, and a ring-shaped opening peripheral surface portion 9 which faces the air suction port 5 described later in an opposed manner and is connected to air suction port-side ends of the respective blade portions 8. A cylindrical boss portion 10 is formed on a crest portion of the cone portion 7.

[0032] The motor 3 is constituted of a motor body 11 which houses an electromagnet, a rotor and the like therein, and a rotary shaft 12 which transmits a drive force generated in the motor body 11 to the outside as a rotational force. The rotary shaft 12 is suitably inserted into and connected to a boss portion 10 of the impeller 2 so that the motor 3 constitutes a drive source for rotating the impeller 2.

[0033] The case 4 is made of a material such as a resin. In this embodiment, the case 4 is constituted of a scroll case portion 13 which houses the impeller 2 and the most of the motor 3 therein and constitutes a peripheral wall

of a scroll-shaped air blowing passage 15 which gradually expands toward the outside of the impeller 2 in the radial direction from a winding start to a winding end, and a motor flange 14 to which the motor 3 is fixed. Further, the scroll case portion 13 is formed by combining a part 13a where the air suction port 5 opens on a wall portion 16 and a part 13b which is positioned on a side opposite to the air suction port 5 and includes a wall portion 17 connected to the motor flange 14 with each other. Further, as shown in FIG. 2B and FIG. 3 to FIG. 7, a bellmouth 18 is formed on the whole peripheral region of the air suction port 5 formed in the part 13a of the scroll case portion 13, and the air blow-off port 6 opens on a most downstream side of a scroll of the air blowing passage 15.

[0034] Due to such a constitution, by rotating the impeller 2 by driving the motor 3, air is sucked toward the impeller 2 from the air suction port 5 along the axial direction of the rotary shaft 12, and the sucked air is blown to the inside of the air blowing passage 15 along the approximately radial direction of the rotary shaft 12 through gaps formed between the blade portions 8 of the impeller 2 and, thereafter, the sucked air is pressurized during passing through the air blowing passage 15 and is blown off from the air blow-off port 6 toward an air blowing passage of another unit.

[0035] Next, an air backflow prevention means of the invention is explained in conjunction with an embodiment 1 to an embodiment 6 individually.

Embodiment 1

[0036] In the embodiment 1, as shown in FIG. 3, in the case 4, an inner surface of the wall portion 17 and an inner surface of the motor flange 14 are arranged on the substantially same line, and a projecting portion 20 is formed on a connecting portion between the wall portion 17 and the motor flange 14 as an air backflow prevention means which prevents air from flowing back to a gap space 30 formed between a flange-side surface of the impeller 2 and the inner surface of the motor flange 14.

[0037] The projecting portion 20 is formed in an annular shape outside a radial outer end of the impeller 2 in the radial direction, and is not positioned in the gap space 30 formed between the flange-side surface of the impeller 2 and the inner surface of the motor flange 14. Further, the projecting portion 20 projects in the inside of the air blowing passage 15 from the inner surface of the wall portion 17 in a state where the projecting portion 20 is integrally formed with the wall portion 17. A distal end of the projecting portion 20 projects to a surface of a radial outer end of the cone portion 7 on a side opposite to the wall portion 17. Further, the projecting portion 20 includes an inclined surface 20a which approaches the inner surface of the wall portion 17 as the inclined surface 20a extends toward a side opposite to the impeller 2 along the radial direction of the impeller 2, and the projecting portion 20 has a triangular cross section with a crest portion of an acute angle. Further, an inclined angle of the

inclined surface 20a of the projecting portion 20 is, as shown in FIG. 3B, set such that the inclined surface 20a is arranged substantially parallel to the flowing direction of air 50 which moves to the inside of the air blowing passage 15 from the impeller 2.

[0038] A surface 20b of the projecting portion 20 positioned on an impeller 2 side with respect to the inclined surface 20a is arranged substantially perpendicular to the wall portion 17 of the part 13b in this embodiment. However, the surface 20b is not always limited to such a constitution, and the surface 20b may be formed into any constitution provided that the surface 20b is suitable for housing the impeller 2 and the motor 3 in the case 4 and for assembling the part 13b and the motor flange 14.

[0039] Further, a size L1 from the surface 20b of the projecting portion 20 positioned on an impeller 2 side to the radial outer end of the impeller 2 is set to 4mm, for example.

[0040] Due to the provision of the projecting portion 20 which has the above-mentioned configuration and is arranged as described above, even when a size L2 of a gap space between the impeller 2 and the motor flange 14 is set to a predetermined reference value (for example, 6mm) required for avoiding risk such as a collision between the impeller 2 and the motor flange 14 due to vibrations of the motor 3 in the axial direction of the rotary shaft 12 of the motor 3 and the locking of the rotation of the impeller 2 caused by the intrusion of a foreign material into the gap space 30 formed between the impeller 2 and the motor flange 14, a backflow of air into the space formed between the impeller 2 and the motor flange 14 is suppressed.

[0041] That is, air 50 which moves to (is blown to) the inside of the air blowing passage 15 from the air suction port 5 through the gaps formed between the blade portions 8 of the impeller 2 while forming the flow in the oblique direction is smoothly blown to the air blowing passage 15 while being guided by the inclined surface 20a of the projecting portion 20 which is inclined along the flow of air. Further, the gap space 30 formed between the impeller 2 and the motor flange 14 is in a state where the gap space 30 is blocked by the projecting portion 20 as viewed from the outside in the radial direction of the rotary shaft 12. Further, a gap space 31 ranging from the surface 20b of the projecting portion 20 which is positioned on an impeller 2 side to a radial outer end of the impeller 2 which is communicated with the gap space 30 formed between the impeller 2 and the motor flange 14 opens upwardly in such a manner that the gap space 31 intersects with the flow direction of air 50 which moves to the inside of the air blowing passage 15 from the impeller 2. Accordingly, even when the size L2 of the gap space 30 formed between the impeller 2 and the motor flange 14 is set to a predetermined reference value (for example, 6mm), it is possible to suppress the air from flowing back to the inside of the gap space 30 from the air blowing passage 15.

[0042] Further, the projecting portion 20 has the

above-mentioned inclined surface 20a and hence, air 50 which moves to the inside of the air blowing passage 15 from the impeller 2 suppresses a drawback that the flow of air 105 described in FIG. 8B previously as the conventional example generates a vortex (generation of whirling air) outside the rib 102 in the radial direction of the impeller 101 in the vicinity of the inclined surface 20a.

Embodiment 2

[0043] Fig. 4 shows the embodiment 2 of the invention. Hereinafter, the embodiment 2 of the invention is explained in conjunction with FIG. 4. Since the basic constitution of an air blowing unit 1 is substantially equal to the basic constitution of the air blowing unit 1 of the embodiment 1 shown in FIG. 1 and FIG. 2, in principle, a point which makes the embodiment 2 differ from the embodiment 1 is mainly explained, and the constitution of the embodiment 2 equal to the constitution of the embodiment 1 is given the same symbol and the explanation of the constitution is omitted.

[0044] Also in this embodiment 2, in a case 4, an inner surface of a wall portion 17 and an inner surface of a motor flange 14 are arranged on the substantially same line, and a projecting portion 20 is formed on a connecting portion between the wall portion 17 and the motor flange 14 as an air backflow prevention means which prevents the air from flowing back to a gap space 30 formed between a flange-side surface of an impeller 2 and the inner surface of the motor flange 14.

[0045] The projecting portion 20 is integrally formed with the wall portion 17 by bending a portion of the wall portion 17 toward the inside of an air blowing passage 15, and is formed annularly outside a radial outer end of the impeller 2 in the radial direction. Further, with respect to the projecting portion 20, a distal end of a crest portion projects to a surface of a radial outer end of a cone portion 7 on a side opposite to the wall portion 17. Further, the projecting portion 20 includes an inclined surface 20a which approaches the inner surface of the wall portion 17 as the inclined surface 20a extends toward a side opposite to the impeller 2 along the radial direction of the impeller 2, and the projecting portion 20 has an approximately inverse V-shaped shape with the crest portion of an acute angle. Further, an inclined angle of the inclined surface 20a of the projecting portion 20 is, as shown in FIG. 4B, set such that the inclined surface 20a is arranged substantially parallel to the flowing direction of air 50 which moves to the inside of the air blowing passage 15 from the impeller 2.

[0046] In the same manner as the previously mentioned embodiment 1, a surface 20b of the projecting portion 20 positioned on an impeller 2 side may not be a surface described in the drawing perpendicular to the wall portion 17. Further, in the same manner as the previously mentioned embodiment 1, a size L1 from the surface 20b of the projecting portion 20 positioned on an impeller 2 side to the radial outer end of the impeller 2 is

set to 4mm, for example.

[0047] Due to the provision of the projecting portion 20 shown in FIG. 4, even when a size L2 of the gap space 30 formed between the impeller 2 and the motor flange 14 is set to a predetermined reference value (for example, 6mm), in the same manner as the embodiment 1, it is possible to suppress the backflow of air to the gap space 30 formed between the impeller 2 and the motor flange 14.

Embodiment 3

[0048] FIG. 5 shows the embodiment 3 of the invention. Hereinafter, the embodiment 3 of the invention is explained in conjunction with FIG. 5. Since the basic constitution of an air blowing unit 1 is substantially equal to the basic constitution of the air blowing unit 1 of the embodiment 1 shown in FIG. 1 and FIG. 2, in principle, a point which makes the embodiment 3 differ from the embodiment 1 is mainly explained, and the constitution of the embodiment 3 equal to the constitution of the embodiment 1 is given the same symbol and the explanation of the constitution is omitted.

[0049] Also in this embodiment 3, in the same manner as the embodiment 1 and the embodiment 2, an inner surface of a wall portion 17 and an inner surface of a motor flange 14 are arranged on the substantially same line, and a projecting portion 20 is formed on a connecting portion between the wall portion 17 and the motor flange 14 as an air backflow prevention means which prevents the air from flowing back to a gap space 30 formed between a flange-side surface of an impeller 2 and the inner surface of the motor flange 14.

[0050] In the same manner as the embodiment 1 and the embodiment 2, the projecting portion 20 is formed by bending a portion of the wall portion 17 toward the inside of an air blowing passage 15, and is formed annularly outside a radial outer end of the impeller 2 in the radial direction. Further, in the same manner as the embodiment 1 and the embodiment 2, the projecting portion 20 includes an inclined surface 20a which approaches the inner surface of the wall portion 17 as the inclined surface 20a extends toward a side opposite to the impeller 2 along the radial direction of the impeller 2, and an inclined angle of the inclined surface 20a of the projecting portion 20 is, as shown in FIG. 5B, set such that the inclined surface 20a is arranged substantially parallel to the flowing direction of air 50 which moves to the inside of the air blowing passage 15 from the impeller 2.

[0051] On the other hand, in this embodiment 3, as shown in FIG. 5, a crest portion of the projecting portion 20 has a flat surface 20c without having an acute angle so that a cross-sectional shape of the projecting portion 20 is an approximately trapezoidal shape. Further, the projecting portion 20 projects such that the flat surface 20c of the projecting portion 20 is at the same position as a surface of a radial outer end of the cone portion 7 on a side opposite to the wall portion 17, for example. In

the same manner as the previously mentioned embodiments 1, 2, a surface 20b of the projecting portion 20 positioned on an impeller 2 side may not be a surface described in the drawing perpendicular to the wall portion 17. Further, in the same manner as the previously mentioned embodiments 1, 2, a size L1 from the surface 20b of the projecting portion 20 positioned on an impeller 2 side to the radial outer end of the impeller 2 is set to 4mm, for example.

[0052] Due to the provision of the projecting portion 20 shown in FIG. 5, even when a size L2 of the gap space 30 formed between the impeller 2 and the motor flange 14 is set to a predetermined reference value (for example, 6mm), in the same manner as the embodiments 1, 2, it is possible to suppress the backflow of air to the gap space 30 formed between the impeller 2 and the motor flange 14. Further, the crest portion of the projecting portion 20 has the flat surface 20c and hence, compared to a case where the crest portion of the projecting portion 20 is formed with an acute angle, it is possible to suppress the generation of unintended wind noises.

[0053] As the explanation of the embodiment 3, in FIG. 5, the explanation has been made with respect to the case where the crest portion of the projecting portion 20 has the flat surface 20c, however, the shape of the projecting portion 20 is not limited to such a shape. Although not shown in the drawing, it may be possible to adopt the projecting portion 20 which has a curved surface bulging in a convex manner toward an air blowing passage 15 in a cross-sectional shape.

Embodiment 4

[0054] FIG. 6 shows the embodiment 4 of the invention. Hereinafter, the embodiment 4 of the invention is explained in conjunction with FIG. 6. Since the basic constitution of an air blowing unit 1 is substantially equal to the basic constitution shown in FIG. 1 and FIG. 2 of the embodiment 1, in principle, a point which makes the embodiment 4 differ from the embodiment 1 is mainly explained, and the constitution of the embodiment 4 equal to the constitution of the embodiment 1 is given the same symbol and the explanation of the constitution is omitted.

[0055] Also in this embodiment 4, in the same manner as the embodiments 1 to 3 explained heretofore, a projecting portion 20 is formed on a connecting portion between a part 13b and a motor flange 14 as an air backflow prevention means which prevents the air from flowing back to a gap space 30 formed between a flange-side surface of an impeller 2 and an inner surface of the motor flange 14. The projecting portion 20 has the constitution where a cross-sectional shape of the projecting portion 20 having a flat surface 20c on a crest portion thereof in the same manner as the projecting portion 20 shown in the embodiment 3 is an approximately trapezoidal shape. That is, the projecting portion 20 of the embodiment 4 has an inclined surface 20a which is set substantially parallel to the flow direction of air 50 which moves to the

inside of an air blowing passage 15 from the impeller 2, and the flat surface 20c which is at the same position as a surface of a radial outer end of a cone portion 7 on a side opposite to a wall portion 17, for example. Further, in the same manner as the previously mentioned embodiments 1 to 3, a surface 20b of the projecting portion 20 positioned on an impeller 2 side may not be arranged perpendicularly as described in the drawing. Further, in the same manner as the previously mentioned embodiments 1 to 3, a size L1 from the surface 20b of the projecting portion 20 positioned on an impeller 2 side to the radial outer end of the impeller 2 is set to 4mm, for example.

[0056] On the other hand, in this embodiment 4, an inner surface of the wall portion 17 of the part 13b is positioned more away from an air suction port 5 than the inner surface of the motor flange 14 is. Accordingly, an expanding portion 21 is formed in the air blowing passage 15 on a side opposite to the air suction port 5, and a cross-sectional area of the air blowing passage 15 is relatively increased.

[0057] Due to the provision of the projecting portion 20 shown in FIG. 6, even when a size L2 of the gap space 30 formed between the impeller 2 and the motor flange 14 is set to a predetermined reference value (for example, 6mm), in the same manner as the embodiments 1 to 3, it is possible to suppress the backflow of air to the gap space 30 formed between the impeller 2 and the motor flange 14. Further, the crest portion of the projecting portion 20 has the flat surface 20c and hence, in the same manner as the embodiment 3, compared to a case where the crest portion of the projecting portion 20 is formed with an acute angle, it is possible to suppress the generation of unintended wind noises.

[0058] Further, a cross-sectional area of the air blowing passage 15 is relatively increased due to the presence of the expanding portion 21 and hence, the air flow resistance of the air blowing passage 15 is lowered whereby suitable air blowing efficiency can be acquired.

[0059] Also in the embodiment 4, the explanation has been made with respect to the case where the crest portion of the projecting portion 20 has the flat surface 20c in conjunction with FIG. 6, however, the shape of the projecting portion 20 is not limited to such a shape. Although not shown in the drawing, in the same manner as the embodiment 3, it may be possible to adopt the projecting portion 20 where a cross-sectional shape of the projecting portion 20 has a curved surface which bulges in a convex manner toward the air blowing passage 15.

Embodiment 5

[0060] FIG. 7 shows the embodiment 5 of the invention. Hereinafter, the embodiment 5 of the invention is explained in conjunction with FIG. 7. Since the basic constitution of an air blowing unit 1 is substantially equal to the basic constitution shown in FIG. 1 and FIG. 2 of the embodiment 1, in principle, a point which makes the em-

bodiment 4 differ from the embodiment 1 is mainly explained, and the constitution of the embodiment 4 equal to the constitution of the embodiment 1 is given the same symbol and the explanation of the constitution is omitted.

[0061] In this embodiment 5, as an air backflow prevention means, the air blowing unit 1 is not provided with the projecting portion 20 shown in the embodiments 1 to 4, and is provided with a stepped portion 24 having a stepped surface 22 and an erected surface 23 instead. That is, by arranging the whole wall portion 17 of a part 13b of a scroll case portion 13 on a more air suction port 5 side than a motor flange 14 such that the wall portion 17 is arranged at the same position as a surface of a radial outer end of a cone portion 7 on a side opposite to the wall portion 17, on a boundary between the part 13b and the motor flange 14, the stepped portion 24 having the stepped surface 22 and the erected surface 23 which extends toward the motor flange 14 from a periphery of the stepped surface 22 on an impeller 2 side is formed. Also a cross-sectional area of an air blowing passage 15 is made relatively small. The erected surface 23 of the stepped portion 24 linearly extends along the axial direction of the impeller 2, for example, and a size L1 from the erected surface 23 of the stepped portion 24 to the radial outer end of the impeller 2 is set to 4mm, for example.

[0062] In this manner, a gap space 31 ranging from the erected surface of the stepped portion 24 to the radial outer end of the impeller 2 which is communicated with a gap space 30 formed between the impeller 2 and the motor flange 14 opens toward the air suction port 5 in such a manner that the gap space 31 intersects with the flow direction of air 50 which moves to the inside of the air blowing passage 15 from the impeller 2. Accordingly, even when a size L2 of the gap space 30 formed between the impeller 2 and the motor flange 14 is set to a predetermined reference value (for example, 6mm), it is possible to suppress the air from flowing back to the gap space 30 from the air blowing passage 15. Further, the cross-sectional area of the air blowing passage 15 is relatively decreased and hence, boosting of the pressure of air which flows in the air blowing passage 15 can be performed efficiently. Further, a size of the air blowing passage 15 in the axial direction of the rotary shaft 12 is relatively decreased and hence, the air blowing unit 1 can be miniaturized.

Embodiment 6

[0063] A case 4 of an air blowing unit 1 is not limited to the cases where the projecting portion 20 which constitutes the backflow prevention means shown in the embodiment 1 to the embodiment 4 explained heretofore, the stepped portion 24 shown in the embodiment 5, and the expanding portion 21 of the air blowing passage 15 shown in the embodiment 4 are individually used respectively, and the case 4 of the air blowing unit 1 may be formed by suitably combining these embodiments.

[0064] That is, in a winding start portion of a scroll case portion 13 of the case 4, as shown in FIG. 7, a stepped portion 24 which is formed of a stepped surface 22 where the whole wall portion 17 is arranged more on an air suction port 5 side than a motor flange 14 is and an erected surface 23 which is contiguously joined to an impeller 2 side end of the stepped surface 22 is provided. Further, in a winding end portion of the scroll case portion 13 of the case 4, as shown in FIG. 3 to Fig. 6, a projecting portion 20 is formed on the wall portion 17, an inner surface of the wall portion 17 which is positioned outside the projecting portion 20 in the radial direction with respect to the impeller 2 is arranged more away from the air suction port 5 than the stepped surface 22 of the stepped portion 24 is thus forming an air blowing amount increasing portion having a larger cross-sectional area than a portion of a blowing air passage 15 having the stepped portion 24. To be more specific, the air blowing amount increasing portion is formed by arranging the inner surface of the wall portion 17 positioned outside the projecting portion 20 in the radial direction with respect to the impeller 2 is at the approximately same position as an inner surface of the motor flange 14 as shown in FIG. 3 to FIG. 5, or by forming an expanding portion 21 arranged more away from the air suction port 5 than the motor flange 14 shown in FIG. 6.

[0065] Due to such a constitution, the cross-sectional area of the air blowing passage 15 is relatively decreased at a portion corresponding to the winding start portion of the scroll case portion 13 and hence, the pressure of air blown to the air blowing passage 15 can be efficiently boosted. Further, a portion corresponding to the winding end portion of the scroll case portion 13 has the air blowing amount increasing portion such as the expanding portion 21 as described above so that the cross-sectional area of the air blowing passage 15 is relatively increased and hence, the air flow resistance is decreased whereby the lowering of air blowing efficiency of the air blowing unit can be suppressed. Accordingly, it is possible to enhance performance of the air blowing unit 1.

[0066] The whole structure of the case 4 of the air blowing unit 1 is not limited to the structures explained heretofore, and any case may be used provided that the case has the wall portion 17 on which the projecting portion 20 or the stepped portion 24 can be formed outside the impeller 2 in the radial direction.

Description of the Reference Numerals and Signs

[0067]

- 1: air blowing unit
- 2: impeller
- 3: motor
- 4: case
- 5: air suction port
- 6: air blow-off port
- 7: cone portion

12: rotary shaft
 13: scroll case portion
 14: motor flange
 15: air blowing passage
 16: wall portion (first wall portion)
 17: wall portion (second wall portion)
 20: projecting portion
 20a: inclined surface
 20b: surface positioned on a side opposite to flange side
 20c: flat surface
 21: expanding portion
 22: stepped surface
 23: erected surface
 24: stepped portion

Claims

1. An air blowing unit(1) for a vehicle comprising:

an air blowing means which includes an impeller(2) and a motor(3) which rotatably drives the impeller(2) by way of a rotary shaft(12); and a case (4) which includes a scroll case portion (13) which encases the impeller (2) of the air blowing means, an air blowing passage (15) which gradually expands toward the outside of the impeller(2) in the radial direction from a winding start to a winding end of the scroll case portion(13) being formed in the scroll case portion (13), wherein

an air suction port (5) for sucking air into the case (4) from the outside is formed in a first wall portion(16) of the case(4) positioned on one side in the axial direction of the impeller(2), and an air blow-off port(6) for blowing off air to the outside of the case(4) is formed in a winding-end-side portion of the scroll case portion(13), wherein

an air backflow prevention means is provided to an inner side of a second wall portion(17) of the case(4) positioned on the other side in the axial direction of the impeller(2), and

the air backflow prevention means is positioned outside a radial outer end of the impeller(2) in the radial direction with a predetermined gap formed between the air backflow prevention means and a radial outer end of the impeller(2) whereby the flow of air which moves into the air blowing passage(15) from a radial outer side of the impeller(2) is adjusted so as to allow the air which moves into the air blowing passage(15) to smoothly flow toward the radial outer side of the impeller(2).

2. The air blowing unit(1) for a vehicle according to claim 1, wherein the air backflow prevention means

includes a projecting portion(20) which projects into the air blowing passage(15), and a surface of the projecting portion(20) positioned on a side opposite to the impeller(2) forms an inclined surface(20a) inclined in the direction approaching an inner surface of the second wall portion (17) except for the projecting portion as the surface goes away from the rotary shaft(12).

3. The air blowing unit(1) for a vehicle according to claim 2, wherein the projecting portion (20) of the air backflow prevention means has a crest portion on a first wall portion (16) side, and the crest portion is arranged at the substantially same position as an end portion of the impeller(2) which is positioned on an outer side of the impeller(2) in the radial direction and on a second wall portion(17) side in the axial direction of the impeller(2) as viewed from a radial direction side of the impeller(2).

4. The air blowing unit(1) for a vehicle according to claim 3, wherein the projecting portion (20) of the air backflow prevention means has a flat surface (20c) or a curved surface on the crest portion thereof.

5. The air blowing unit(1) for a vehicle according to claim 2, 3 or 4, wherein an inner surface of a portion of the second wall portion (17) which is positioned on a side opposite to the impeller(2) by setting the projecting portion(20) as a base point is arranged so as to be relatively away from an inner surface of the first wall portion(16) thus forming an expanding portion(21) in the air blowing passage(15).

6. The air blowing unit(1) for a vehicle according to claim 1, wherein the air backflow prevention means includes a stepped portion (24) which is constituted of a stepped surface (22) which is formed by arranging an inner surface of a portion of the second wall portion (17) positioned outside the impeller (2) in the radial direction relatively close to the inner surface of the first wall portion (16) and a elected surface (23) which is contiguously joined to the stepped surface (22) on an impeller(2) side, and the stepped surface (22) of the stepped portion(24) and an end portion of the impeller(2) which is positioned outside the impeller (2) in the radial direction and on a second wall portion(17) side in the axial direction of the impeller(2) are arranged at the substantially same position as viewed in an impeller radial direction side.

7. The air blowing unit(1) for a vehicle according to claim 1, wherein the air backflow prevention means differs in constitution at least between a portion of the second wall portion(17) corresponding to a winding start portion of the scroll case portion (13) and a portion of the second wall portion (17) corresponding to a winding

end portion of the scroll case portion(13),
the air backflow prevention means at the portion of
the second wall portion(17) corresponding to the
winding start portion of the scroll case portion(13)
includes a stepped portion(24) which is constituted 5
of a stepped surface(22) which is formed by arrang-
ing an inner surface of a portion of the second wall
portion(17) positioned outside the impeller (2) in the
radial direction relatively close to the inner surface 10
of the first wall portion (16) and a erected surface
(23) which is contiguously joined to the stepped sur-
face (22) on an impeller(2) side,
the air backflow prevention means at the portion of
the second wall portion(17) corresponding to the 15
winding end portion of the scroll case portion(13) in-
cludes a projecting portion which projects into the air
blowing passage(15), and
an inner surface of a portion of the second wall por-
tion(17) which is positioned on a side opposite to the 20
impeller(2) by setting the projecting portion(20) as a
base point is arranged relatively away from the inner
surface of the first wall portion (16) thus forming an
air blowing amount increasing portion having a larger
cross-sectional area than a portion having the 25
stepped portion(24) in the air blowing passage(15).

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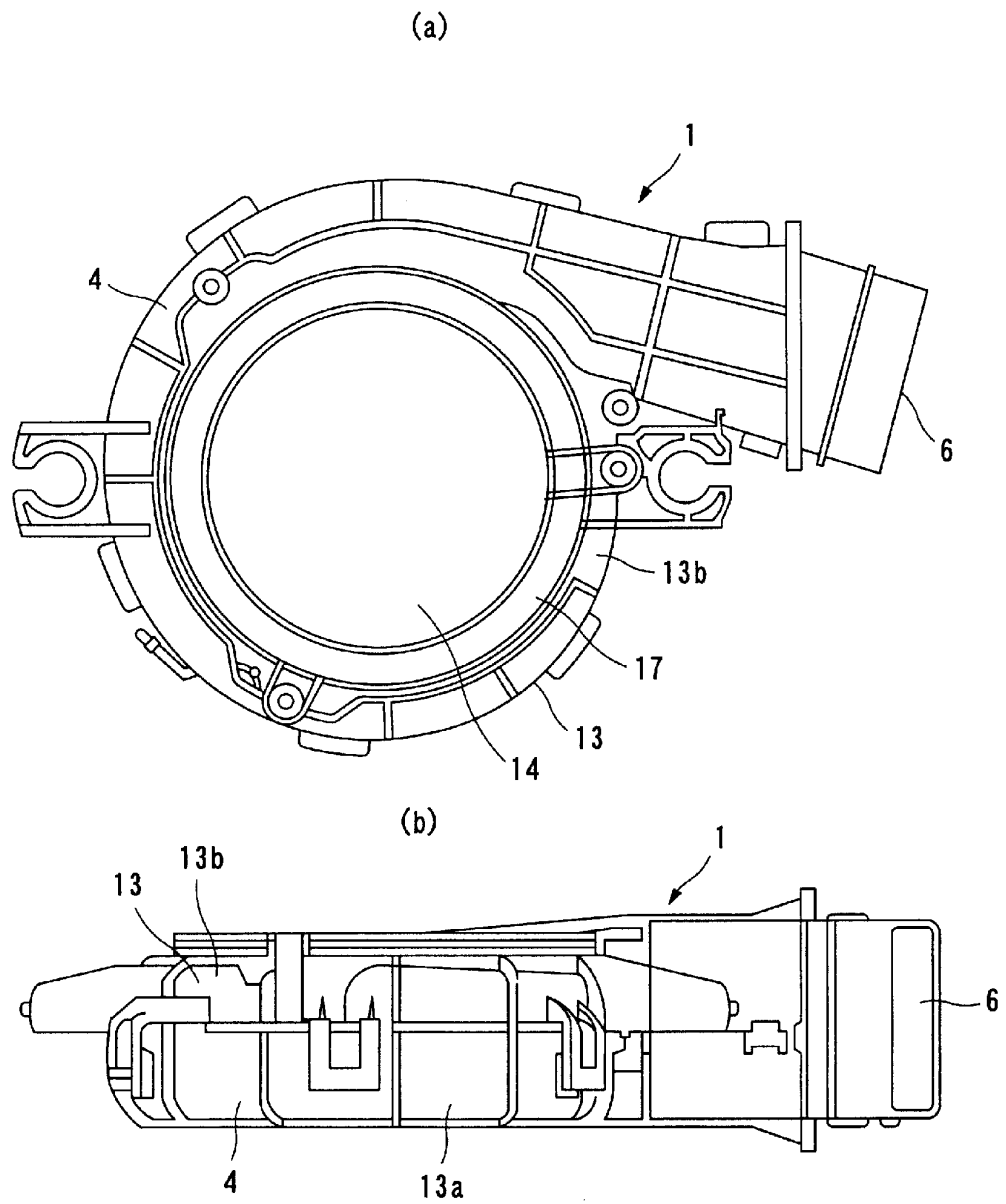
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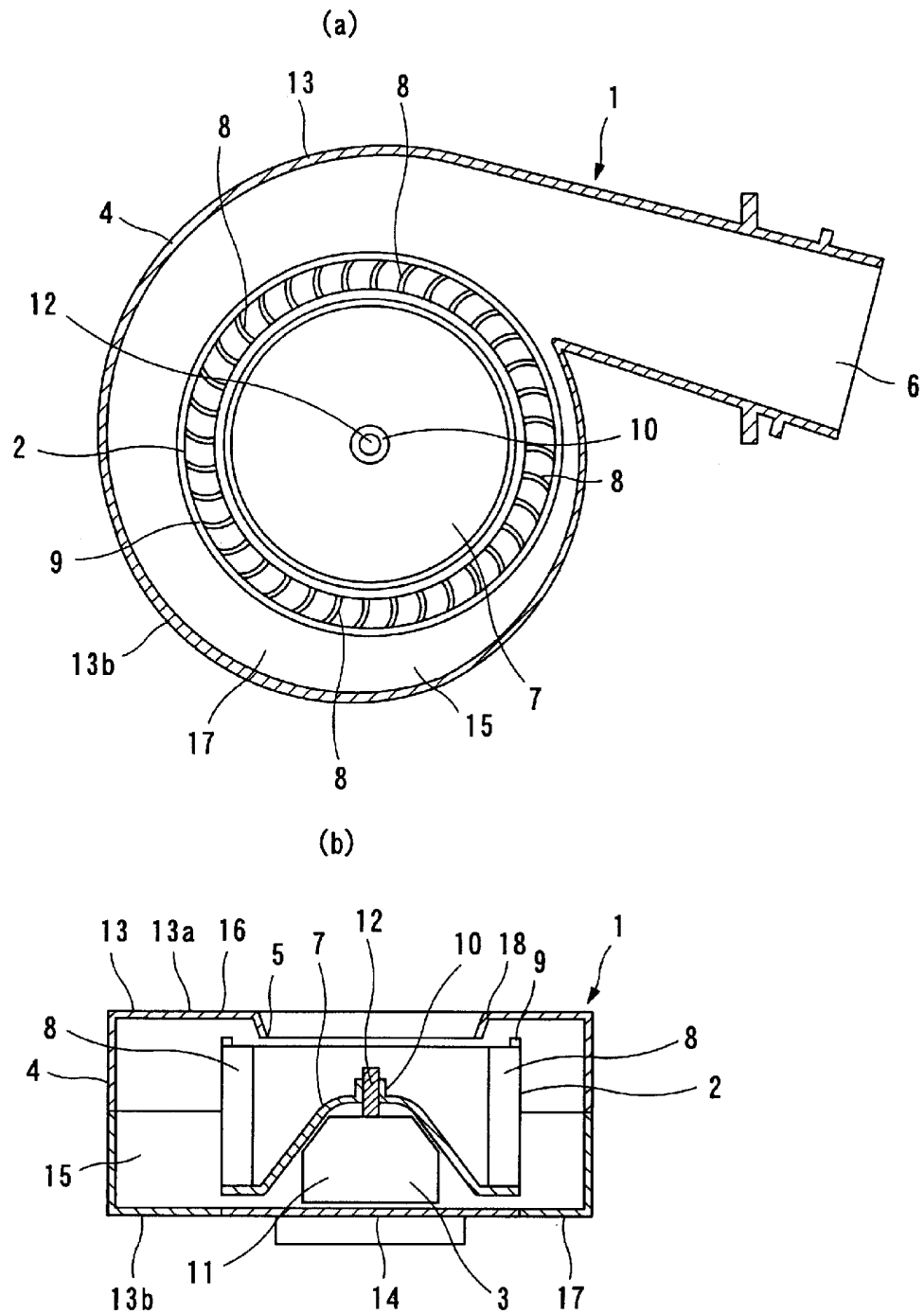
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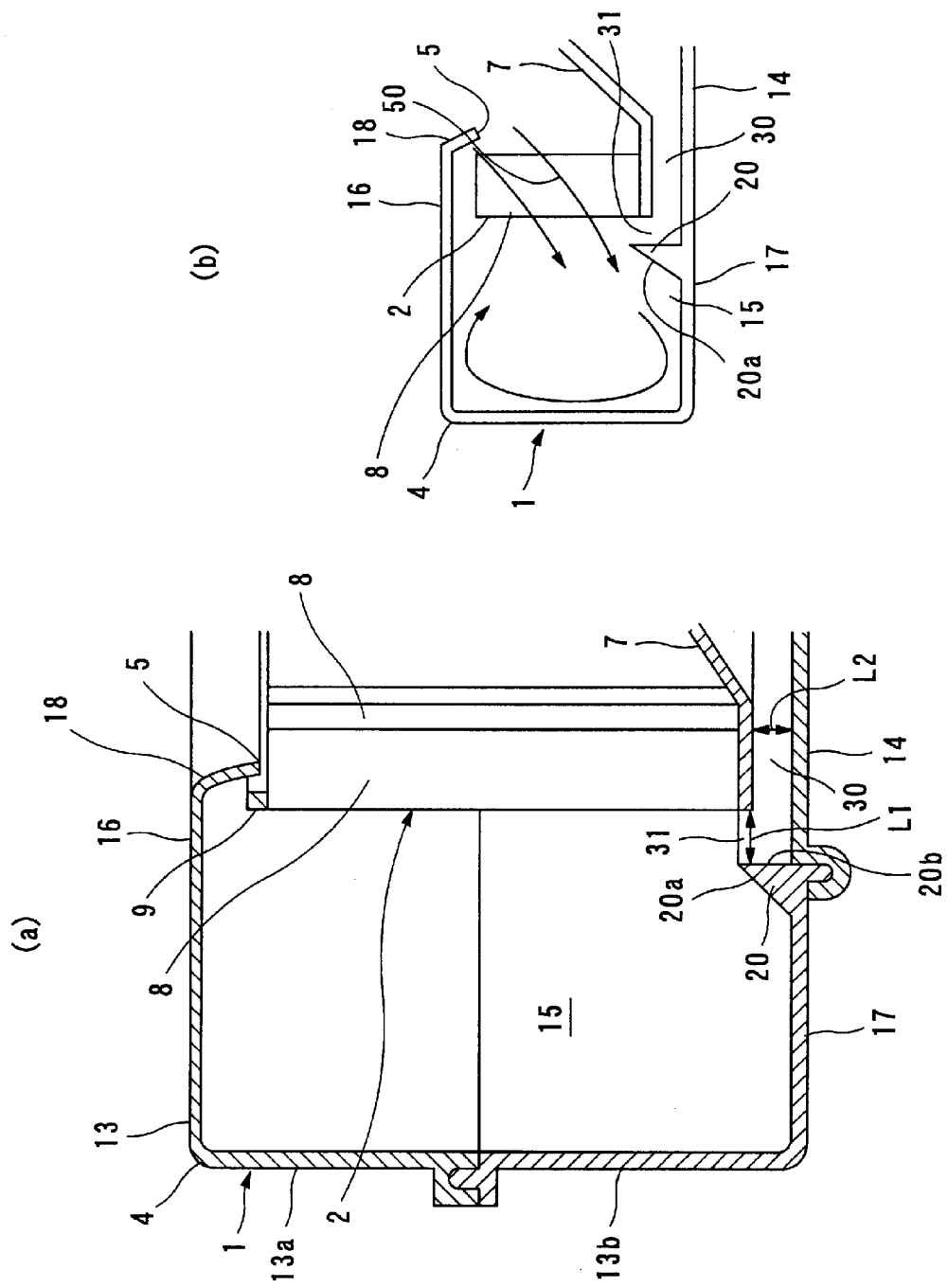
[Fig.1]



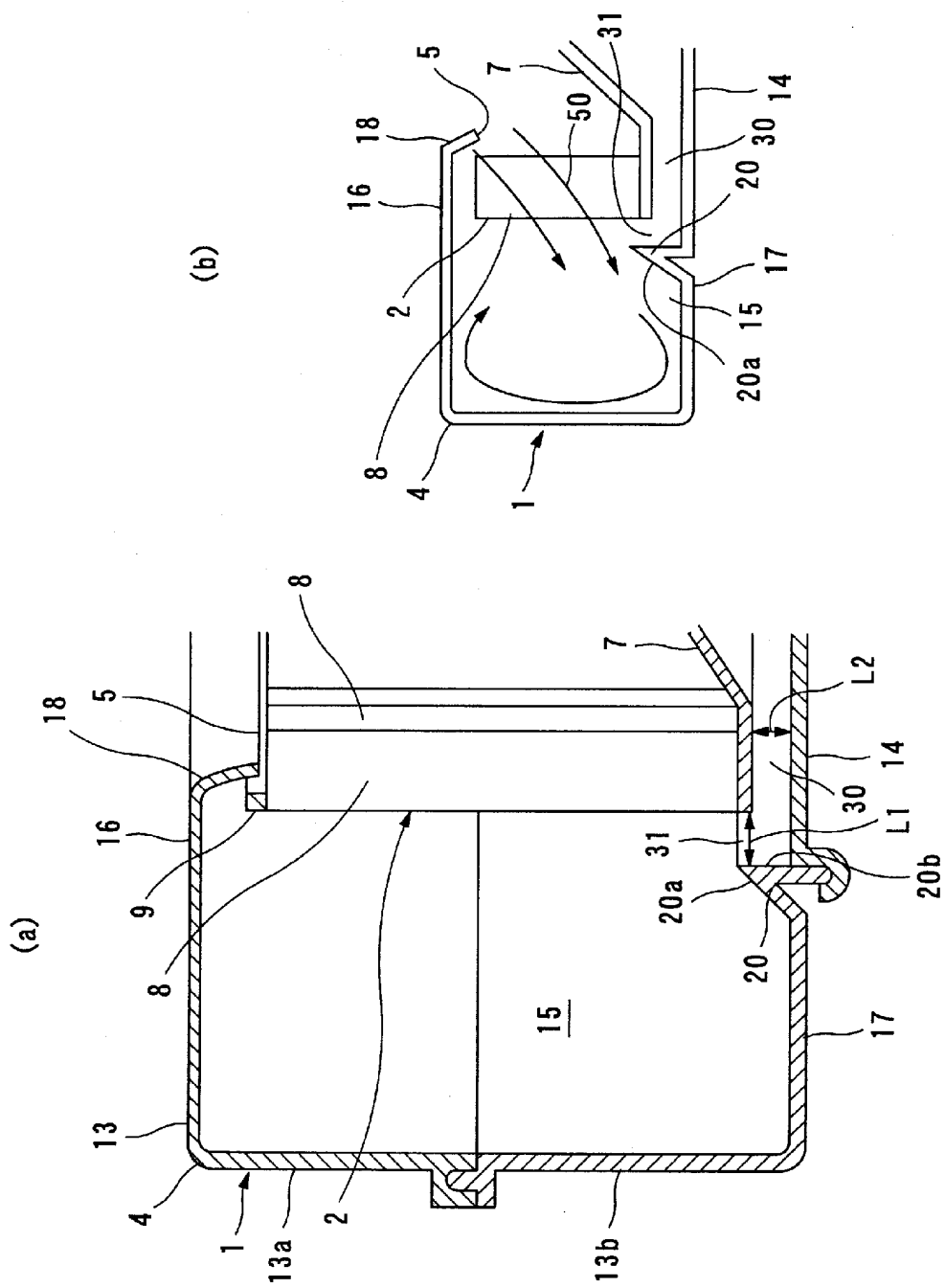
[Fig.2]



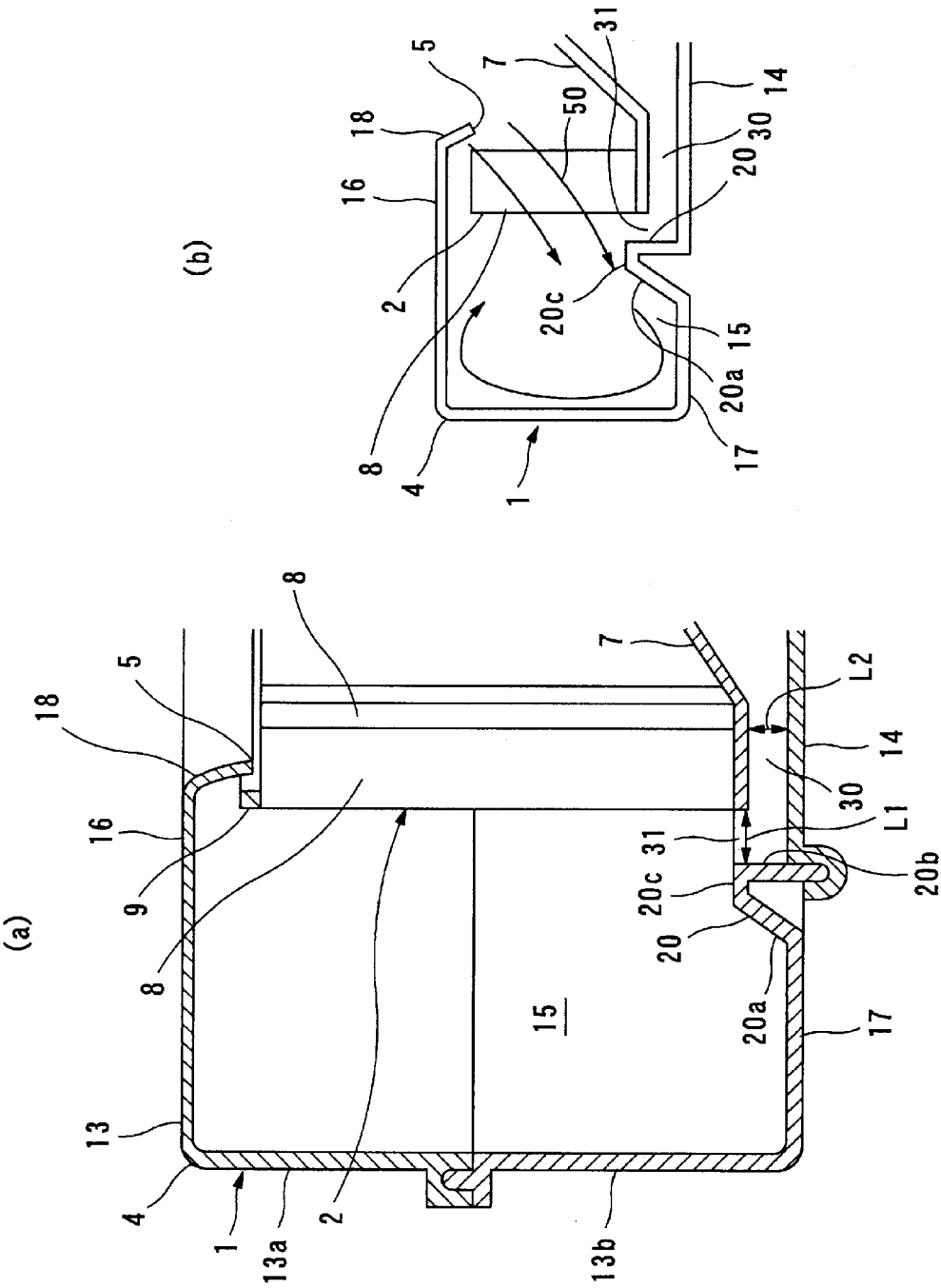
[Fig. 3]



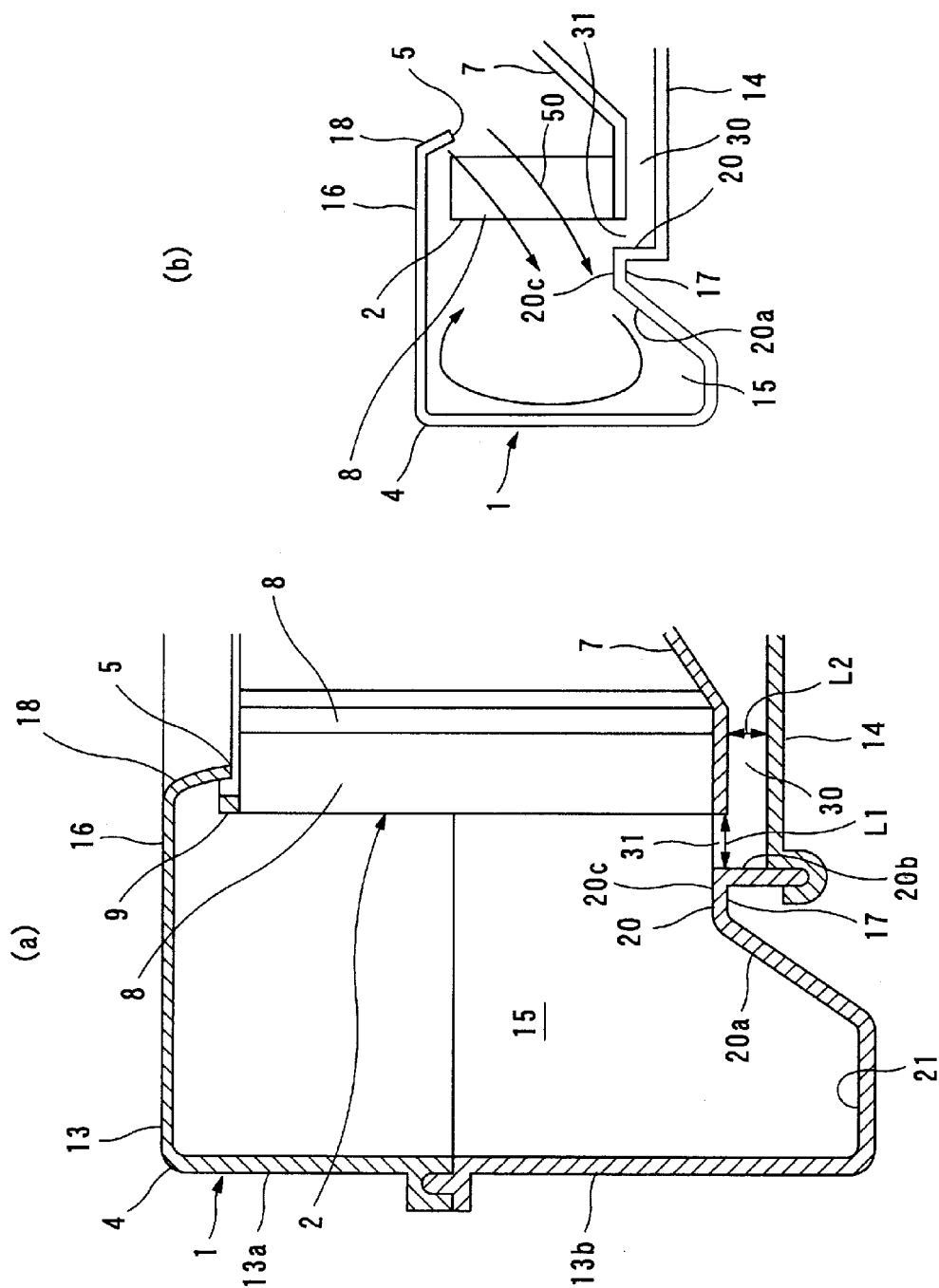
[Fig. 4]



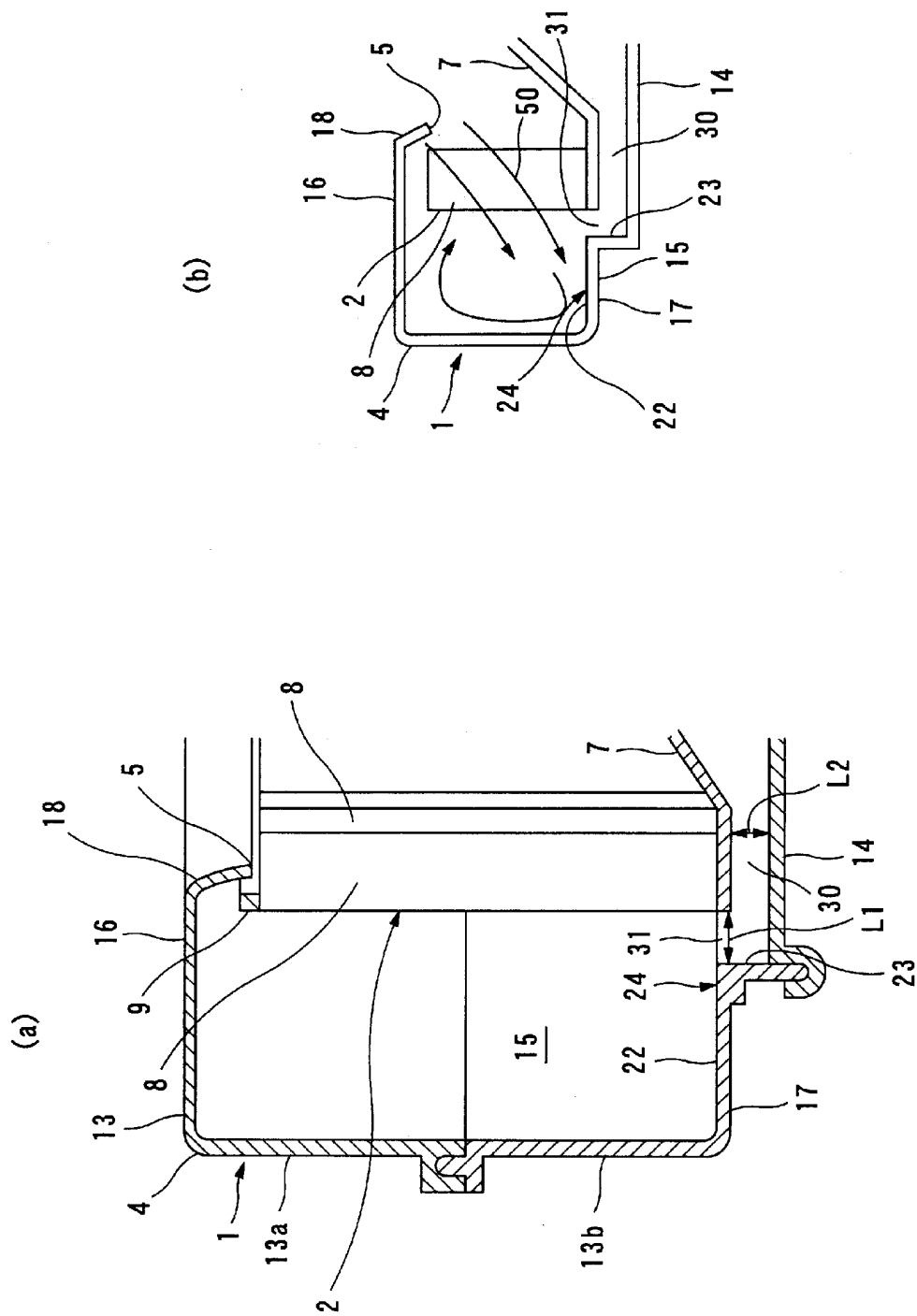
[Fig. 5]



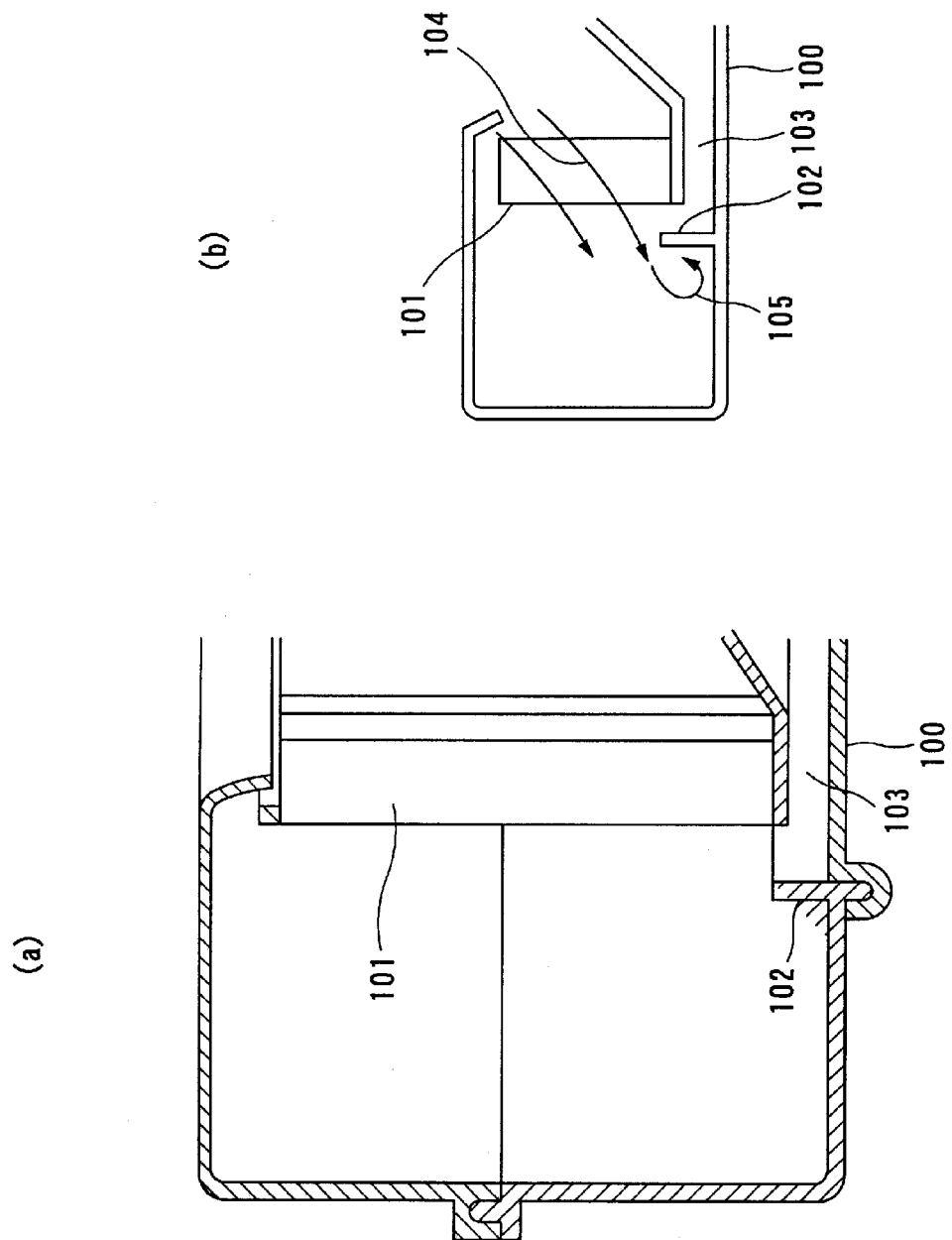
[Fig. 6]



[Fig. 7]



[Fig. 8]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/002584

A. CLASSIFICATION OF SUBJECT MATTER

F04D29/44 (2006.01) i, F04D29/66 (2006.01) 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)

F04D29/44, F04D29/66

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	1996-2011
Kokai Jitsuyo Shinan Koho	1971-2011	Toroku Jitsuyo Shinan Koho	1994-2011

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 A	US 2004/0219013 A1 (Reinhold HOPFENSBERGER), 04 November 2004 (04.11.2004), paragraphs [0057], [0058]; fig. 4a & EP 1462658 A2 & DE 10313054 A1	1-5 6, 7
X A	WO 2009/150717 A1 (Mitsubishi Electric Corp.), 17 December 2009 (17.12.2009), paragraphs [0020] to [0021]; fig. 2 to 10 (Family: none)	1-3, 5, 6 4, 7
A	DE 102005012557 A1 (VISTEON GLOBAL TECHNOLOGIES, INC.), 14 September 2006 (14.09.2006), entire text; all drawings (Family: none)	1-7

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

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search
02 August, 2011 (02.08.11)Date of mailing of the international search report
09 August, 2011 (09.08.11)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/002584

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2010-65616 A (Panasonic Corp.), 25 March 2010 (25.03.2010), entire text; all drawings (Family: none)	1-7
A	JP 2009-13924 A (Denso Corp.), 22 January 2009 (22.01.2009), entire text; all drawings (Family: none)	1-7

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

REFERENCES CITED IN THE DESCRIPTION

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- JP 2006046112 A [0008]