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**IMPELLER, CENTRIFUGAL BLOWER, AND INDOOR UNIT**

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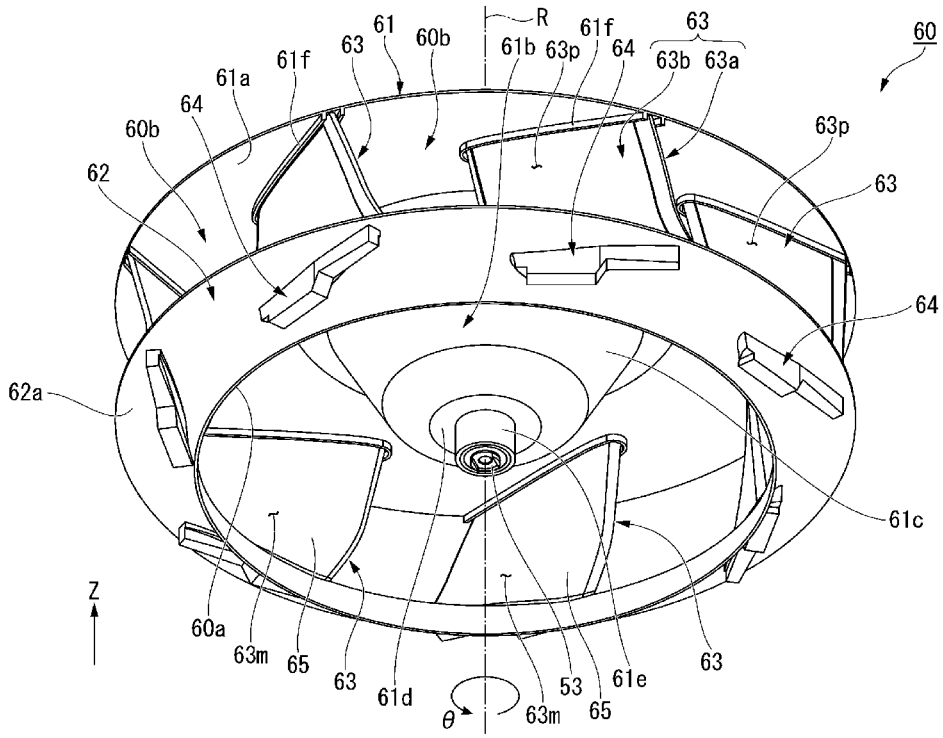


(57) **Abstract:** One embodiment of the impeller according to the present disclosure comprises a shroud positioned on a first side in the axial direction of a rotation axis with respect to a base, and a plurality of blades. The shroud has a plurality of protruding accommodating parts that open to a second side opposite to the first side in the axial direction, each of the plurality of blades has a protrusion protruding to the first side from a blade body, and the protrusions in the plurality of blades are respectively accommodated in the plurality of protruding accommodating parts. Each of the plurality of

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protruding accommodating parts has a first accommodating part and a second accommodating part connected to an end of the first accommodating part in the extension direction. The protrusions are accommodated in the first accommodating parts, and the protrusions each have a first projection fixed to the shroud and a second projection connected to the end of the first projection in the extension direction and accommodated in a second accommodating part. The first projections are fixed in contact with first-side surfaces of the inner surfaces of the first accommodating parts, and the second projections face first-side surfaces of the inner surfaces of the second accommodating parts across a gap.

(57) 要約:本開示に係る羽根車の一つの態様は、基部に対して回転軸の軸方向のうち第１側に位置するシュラウド部と、複数の羽根部と、を備え、シュラウド部は、軸方向のうち第１側と逆側の第２側に開口する複数の突出収容部を有し、複数の羽根部のそれぞれは、羽根本体部から第１側に突出する突出部を有し、複数の羽根部における突出部は、複数の突出収容部内にそれぞれ収容され、複数の突出収容部のそれぞれは、第１収容部と、第１収容部の延伸方向の端部に繋がる第２収容部と、を有し、突出部は、第１収容部内に収容され、シュラウド部に固定された第１凸部と、第１凸部の延伸方向の端部に繋がり、第２収容部内に収容された第２凸部と、を有し、第１凸部は、第１収容部の内面のうち第１側に位置する面に接触して固定され、第２凸部は、第２収容部の内面のうち第１側に位置する面と隙間を介して対向している。

[Technical Field]

[0001]

The present disclosure relates to an impeller, a centrifugal blower, and an indoor unit

[Background]

[0002]

A centrifugal blower having an impeller is known. For example, as in Patent Document 1, an impeller that includes a formed side plate to which a fitting recess of an end of a hollow blade is fitted to is mentioned.

[Patent Document]

[0003]

[Patent Document 1] Japanese Unexamined Application No. 2005-155510, First Publication

[0004]

As in the impeller above, to have an end of a hollow blade firmly contact an inner surface of a fitting recess so as to fix the hollow blade to a side plate, a gap is provided between a portion out of the hollow blade other than the portion that contacts the inner surface of the fitting recess and the side plate. Air flow from a positive pressure side of the hollow blade to a negative pressure side of the hollow blade forms via said gap, and a problem of a decrease in air blowing efficiency by the impeller exists.

[0005]

The present disclosure has been made in order to address the problem above, and an object is to provide a centrifugal blower that includes an impeller, the impeller having a configuration that suppresses decrease in air blowing efficiency, and an air conditioner that includes said blower.

[0005a]

It is desired to address or alleviate one or more disadvantages or limitations of the prior art, or to at least provide a useful alternative.

[Summary]

[0006]

One or more embodiments of the present invention comprise an impeller is rotatable around a rotation axis, and comprises a base; a shroud that is located on a first side out of an axial direction of the rotation axis with respect to the base, and a plurality of blades that are located between the base and the shroud in the axial direction, and are disposed with an interval therebetween in a direction of rotation of the impeller, wherein the shroud has a shroud main body, and a plurality of protruding accommodations that protrude from the shroud main body to the first side, and that open to a second side which is an opposite side to the first side out of the axial direction, each of the plurality of blades has a blade main body, and a protrusion that protrudes to the first side from the blade main body, a first end of the blade main body in an extension direction that the blade main body extends in, as seen from the axial direction, is located on an inside in a radial direction having a center be the rotation axis more than a second end of the blade main body in the extension direction, the protrusion in the plurality of blades is accommodated within each of the plurality of protruding accommodations, each of the protruding accommodations has a first accommodation, and a second accommodation that is connected to an end in the extension direction of the first accommodation, the protrusion has a first projection that is accommodated within the first accommodation, and is fixed to the shroud, and a second projection that is connected to an end in the extension direction of the first projection, and is accommodated within the second accommodation, and the first projection contacts and is fixed to a surface located on the first side out of an inner surface of the first accommodation, and the second projection

faces a surface located on the first side out of an inner surface of the second accommodation via a gap, and an end out of ends in the extension direction of the second projection, that is on an opposite side to the side to which the first projection is connected to, is connected to the first end in the extension direction of the blade main body with no step.

[0007]

A centrifugal blower according to an embodiment of the present disclosure may include the impeller mentioned above, and a drive portion that rotates the impeller around the rotation axis.

[0008]

An indoor unit according to an embodiment of the present disclosure may include the centrifugal blower mentioned above, and a heat exchanger that has air which is blown by the centrifugal blower.

[0009]

According to the present invention, it is possible to suppress decrease in air blowing efficiency if an impeller in a centrifugal blower.

[Brief Description of Drawings]

[0010]

One or more embodiments of the present invention are hereinafter described, by way of example only, with reference to the accompanying drawings in which:

[FIG. 1] A schematic view that shows an outline configuration of an air conditioner in a first embodiment.

[FIG. 2] A prospective view that shows the indoor unit in the first embodiment.

[FIG. 3] A cross-sectional view that shows the indoor unit in the first embodiment.

[FIG. 4] A perspective view that shows an impeller in the first embodiment.

[FIG. 5] A view that shows the impeller as seen from a bottom side in the first embodiment.

[FIG. 6] A cross-sectional view that shows a protruding accommodation and a protrusion in the first embodiment, taken from a cross-sectional line VI-VI in FIG. 5.

[FIG. 7] A perspective view that shows the protruding accommodation in the first embodiment.

[FIG. 8] A perspective view that shows a blade in the first embodiment.

[FIG. 9] A cross-sectional view that shows a part of the impeller in the first embodiment, taken from the cross-sectional line IX-IX in FIG. 5.

[FIG. 10] A cross-sectional view that shows a part of the impeller in the first embodiment, taken from the cross-sectional line X-X in FIG. 5.

[FIG. 11] A perspective view that shows a part of an impeller in a second embodiment.

[FIG. 12] A view that shows a part of the impeller as seen from the bottom side in the second embodiment.

[FIG. 13] A perspective view that shows a part of an impeller in a third embodiment.

[FIG. 14] A cross-sectional view that shows a part of the impeller in the third embodiment.

[FIG. 15] A perspective view that shows a part of the blade in the third embodiment.

[FIG. 16] A perspective view that shows a part of an impeller in a fourth embodiment.

[FIG. 17] A cross-sectional view that shows a part of an impeller in a comparative example.

[FIG. 18] A cross-sectional view that shows a part of the impeller in the comparative example, taken from a cross-sectional line XVIII-XVIII in FIG. 17.

[Detailed Description]

[0011]

Hereinafter, embodiments of the present disclosure are explained with reference to the drawings. The scope of the present disclosure is not limited to the embodiments below, and may be changed so long as the embodiments do not depart from the technical scope of the present disclosure. In the drawings below, scales and dimensions of various configurations may differ from scales and dimensions in the drawings below to facilitate better understanding of the various embodiments.

[0012]

The drawings show a Z axis where appropriate. The Z axis shows a vertical direction. A side out of a vertical direction Z in which an arrow of the Z axis points to (+Z side) is referred to as “top side”, and an opposite side out of the vertical direction Z which the arrow of the Z axis points to (-Z side) is a “bottom side”. In the embodiments below, the vertical direction Z corresponds to a rotation axis R, to be mentioned later on. The bottom side in an axial direction out of the rotation axis R corresponds to a “first side”, and the top side, which is an opposite side to the first side in the axial direction out of the rotation axis R corresponds to a “second side”.

[0013]

First Embodiment

FIG. 1 is a schematic view that shows an outline configuration of an air conditioner 100 in a first embodiment. As shown in FIG. 1, the air conditioner 100 includes an indoor unit 10, an outdoor unit 20, and a circulation pathway 30. The indoor unit 10 is disposed indoors. The outdoor unit 20 is disposed outdoors. The indoor unit 10 and

the outdoor unit 20 are connected via the circulation pathway 30 having a refrigerant 33 circulate therein. The indoor unit 10 and the outdoor unit 20 are heat exchange units that conduct heat exchange with the air.

[0014]

The air conditioner 100 adjusts a temperature of the indoors air by conducting heat exchange between the refrigerant 33 that flows within a circulation path 30, and indoors air where the indoor unit 10 is disposed. A refrigerant such as a fluorine based refrigerant with a low global warming potential (GWP: Global Warming Potential), or a hydrocarbon based refrigerant or the like may be mentioned as examples of the refrigerant 33.

[0015]

The outdoor unit 20 has a compressor 21, a heat exchanger 23, a flow adjustment valve 24, a blower 25, and a four-way valve 22. The compressor 21, the heat exchanger 23, the flow adjustment valve 24, and the four-way valve 22, are connected by the circulation pathway 30.

[0016]

Out of the circulation pathway 30, the four-way valve 22 is provided on a portion that is connected to a discharge of the compressor 21. By exchanging a part of the circulation pathway 30, it is possible for the four-way valve 22 to reverse a direction of flow of the refrigerant 33 within the circulation pathway 30. When the path connected by the four-way valve 22 is the path of the four-way valve 22 that is shown by solid lines in FIG. 1, the refrigerant 33 within the circulation pathway 30 flows in the direction shown by the solid line arrow in FIG. 1. On the other hand, when the path connected by the four-way valve 22 is the path of the four-way valve 22 that is shown by dashed lines in FIG. 1, the refrigerant 33 flows within the circulation pathway 30 in the direction

shown by the dashed line arrow in FIG. 1.

[0017]

The indoor unit 10 includes a housing 11, a heat exchanger 14, and a centrifugal blower 40. It is possible for the indoor unit 10 to have a cooling operation of the indoor air, where the indoor unit 10 is disposed, is cooled. It is possible to have a heating operation of the indoor air, where the indoor unit 10 is disposed, is heated.

[0018]

When the indoor unit 10 is operated in the cooling operation, the refrigerant 33 that flows within the circulation pathway 30 flows in the direction shown by the solid line in FIG. 1. In other words, when the indoor unit 10 is operated in the cooling operation, the refrigerant 33 that flows within the circulation pathway 30 circulates so as to return to the compressor 21 after passing through the compressor 21, the heat exchange device 23 of the outdoor unit 20, the flow adjustment valve 24, and the heat exchanger 14 of the indoor unit 10 in such an order. During the cooling operation, the heat exchange device 23 of the outdoor unit 20 functions as a condenser, and the heat exchanger 14 of the indoor unit 10 functions as an evaporator.

[0019]

On the other hand, when the indoor unit 10 is operated in the heating operation, the refrigerant 33 that flows within the circulation pathway 30 flows in the direction shown by the dashed line in FIG. 1. In other words, when the indoor unit 10 is operated in the heating operation, the refrigerant 33 that flows within the circulation pathway 30 circulates so as to return to the compressor 21 after passing through the compressor 21, the heat exchanger 14 of the indoor unit 10, the flow adjustment valve 24, and the heat exchange device 23 of the outdoor unit 20 in such an order. During the heating operation, the heat exchange device 23of the outdoor unit 20 functions as the evaporator,

and the heat exchanger 14 of the indoor unit 10 functions as the condenser.

[0020]

Next, the indoor unit 10 in the first embodiment is explained in further detail. FIG. 2 is a prospective view that shows the indoor unit 10. FIG. 3 is a cross-sectional view that shows the indoor unit 10. As shown in FIG. 2 and FIG. 3, the indoor unit 10 in the first embodiment is a ceiling-mounted indoor unit that is provided so as to be mounted within a ceiling. As shown in FIG. 3, the housing 11 houses the heat exchanger 14 and the centrifugal blower 40. The housing 11 has a housing main body 12 that houses the heat exchanger 14 and the centrifugal blower 40 housed on an inside thereof, and a decorative panel 13 that is attached below the housing main body 12. The housing main body 12 is installed so as to be embedded in the ceiling indoors where the indoor unit 10 is installed. The decorative panel 13 is exposed indoors where the indoor unit 10 is installed.

[0021]

The heat exchanger 14 is housed within the housing main body 12. Air is sent to the heat exchanger 14 by the centrifugal blower 40. The heat exchanger 14 is a frame shape that surrounds the centrifugal blower 40. The heat exchanger 14 is disposed so as to face an air exhaust port 60b to be mentioned later on.

[0022]

The indoor unit 10 has an intake port 10a and an exhaust port 10b. The intake port 10a and the exhaust port 10b open to a bottom surface of the decorative panel 13. As shown in FIG. 2, the intake port 10a is located on a center of the indoor unit 10, as seen from the vertical direction Z. A plurality of exhaust ports 10b are provided. The plurality of exhaust ports 10b are disposed so as to surround the intake port 10a, as seen from the vertical direction Z. Four exhaust ports 10b are provided.

[0023]

The centrifugal blower 40 is a blower that sends air to the heat exchanger 14. By the centrifugal blower 40 operating, air flows to an inside of the indoor unit 10. Arrows AF in FIG. 3 show the air flow that is generated when the centrifugal blower 40 operates. As shown by the arrows AF in FIG. 3, when the centrifugal blower 40 operates, air is taken into the inside of the indoor unit 10 from the intake port 10a. Air that is taken into the inside of the indoor unit 10 from the intake port 10a passes through the heat exchanger 14, and is exhausted to the indoors from the four exhaust ports 10b.

[0024]

The centrifugal blower 40 is fixed to a bottom surface of a ceiling panel 12a of the housing 12. The centrifugal blower 40 includes a drive portion 50 and an impeller 60. The drive portion 50 causes the impeller 60 to rotate around the rotation axis R. The rotation axis R shown where appropriate in the drawings is a theoretical axis that extends in the vertical direction Z. In other words, the axial direction of the rotation axis R is the vertical direction Z. The rotation axis R passes through a center of the indoor unit 10 as seen from the vertical direction Z.

[0025]

Hereinafter, unless specified otherwise, a radial direction with a center being the rotation axis R is simply referred to as a “radial direction”, and a circumferential direction around the rotation axis R is referred to as a “circumferential direction”. Where appropriate, a direction of rotation is shown by an arrow θ in the drawings. The impeller 60 rotates in the direction that the arrow θ points to. A side (+θ side) out of the direction of rotation to which the arrow θ points to is a “front side”, and an opposite side (-θ side) out of the direction of rotation to which the arrow θ points to is a “rear side”. The front side in the direction of rotation (+θ side) is a side that progresses as said side

rotates counterclockwise with the rotation axis R as a center, as seen from the bottom side. The rear side in the direction of rotation (-θ side) is a side that progresses as said side rotates clockwise with the rotation axis R as the center, as seen from the bottom side.

[0026]

In the first embodiment, the drive portion 50 is a motor. The drive portion 50 has a drive portion main body 51 that is fixed to the bottom surface of the ceiling panel 12a, and a rotation shaft 52 that protrudes to the bottom side, more than the drive portion main body 51 from an inside of the drive portion main body 51. The rotation shaft 52 is a portion of a rotor in the drive portion 50. The rotation shaft 52 is rotatable around the rotation axis R. So long as it is possible to have the impeller 60 rotate around the rotation axis R, a configuration of the drive portion 50 is not limited to any particular configuration.

[0027]

The impeller 60 is rotatable around the rotation axis R. The impeller 60 for example, is made of resin. The impeller 60 is fixed via a connecting member 53 to a portion out of the rotation shaft 52 of the drive portion 50 that protrudes to the bottom side more than the drive portion main body 51. The connecting member 53 is a cylindrical shaped member having the rotation axis R as a center thereof. The connecting member 53 is fixed to an outer circumferential surface of the rotation shaft 52. FIG. 4 is a perspective view that shows the impeller 60. FIG. 5 is a view that shows the impeller 60 as seen from the bottom side. As shown in FIG. 3 to FIG. 5, the impeller 60 includes a base 61, a shroud 62, and a plurality of blades 63.

[0028]

The base 61 is fixed to the rotation shaft 52 via the connecting member 53. As shown in FIG. 4, the base 61 has a circular plate 61a, a bulge 61b, and a plurality of

guides 61f. The circular plate 61a is a circular plate shape with the rotation axis R as a center thereof. The bulge 61b protrudes from an inner circumferential edge in the radial direction of the circular plate 61a, to the bottom side. The bulge 61b is a tubular shape having the rotation axis R as a center. As shown in FIG. 3, the drive portion main body 51 is located on an inside of the bulge 61b. The bulge 61b has a circumferential wall 61c, a bottom plate 61d, and a cylinder 61e.

[0029]

The circumferential wall 61c opens to the top side, and is a cylindrical shape having the rotation axis R as a center thereof. An inner diameter of the circumferential wall 61c and an outer diameter of the circumferential wall 61c become smaller as diameters thereof approach the bottom side. The bottom plate 61d is connected to a bottom end of the circumferential wall 61c. The bottom plate 61d is a circular plate shape with the rotation axis R as a center thereof. The cylinder 61e protrudes to the bottom side from an inner circumferential edge in the radial direction of the bottom plate 61d. The cylinder 61e opens to the bottom side, and is a cylindrical shape having the rotation axis R as a center thereof. The connecting member 53 is fixed to an inner circumferential surface of the cylinder 61e. The cylinder 61e is fixed to the rotation shaft 52 via the connecting member 53.

[0030]

As shown in FIG. 4, the plurality of guides 61f are formed on a bottom surface of the circular plate 61a. The plurality of guides 61f extend so as to incline in the direction of rotation with respect to the radial direction, and are long thin semi-U shapes that open to an outside in the radial direction, as seen from the vertical direction Z. The plurality of guides 61f are located on the front side (+θ side) in the direction of rotation as an inside in the radial direction is approached. The plurality of guides 61f are mutually disposed

with an interval therebetween, over a circumference in the direction of rotation. Seven guides 61f are provided in the first embodiment. Intervals between each of the guides 61f may be of similar lengths, and may be of differing lengths.

[0031]

The shroud 62 is separately located on the bottom side of the circular plate 61a in the base 61. In other words, the shroud 62 is located on the bottom side (the first side) with respect to the base 61 out of directions in the axial direction of the rotation axis R. The shroud 62 is a circular shape with the rotation axis R as a center thereof. An inner edge in the radial direction of the shroud 62 is located to the outside in the radial direction more than the bulge 61b. The shroud 62 is a cylindrical shape that opens to both sides in the vertical direction Z, with the rotation axis R as a center thereof. An inner diameter of the shroud 62 and an outer diameter of the shroud 62 become smaller as diameters thereof approach the bottom side. The shroud 62 has a shroud main body 62a and a plurality of protruding accommodation 64.

[0032]

The shroud main body 62a is a cylindrical shape that opens to both sides in the vertical direction Z, with the rotation axis R as a center thereof. An inner diameter of the shroud main body 62a and an outer diameter of the shroud main body 62a become smaller as diameters thereof approach the bottom side. As shown in FIG. 3, in a cross-section that is orthogonal with the direction of rotation, a shape of the shroud main body 62a is an arc shape which protrudes towards the inside in the radial direction, and to an inclined top direction.

[0033]

An inner edge in the radial direction of the shroud main body 62a is a bottom end of the shroud main body 62a. The inner edge of the shroud main body 62a is an air intake

port 60a that opens to the bottom side. The air intake port 60a is separately located on the top side of the intake port 10a of the indoor unit 10.

[0034]

An outer edge in the radial direction of the shroud main body 62a is a top end of the shroud main body 62a. As shown in FIG. 4, a plurality of air exhaust ports 60b, that open to the outside in the radial direction, are formed by the plurality of blades 63 partitioning a space in the vertical direction Z, between the outer edge in the radial direction of the shroud main body 62a and an outer edge in the radial direction of the circular plate 61a. The plurality of air exhaust port 60b are mutually disposed over a circumference in the direction of rotation, with an interval therebetween. Seven air exhaust ports 60b are provided in the first embodiment. As shown in FIG. 3, the heat exchanger 14 is disposed so as to face each of the air exhaust ports 60b from the outside in the radial direction thereof. Intervals between each of the plurality of air exhaust ports 60b may be of similar lengths, and may be of differing lengths.

[0035]

When the impeller 60 is made to rotate around the rotation axis R by the drive portion 50, air that is taken into the indoor unit 10 from the intake port 10a flows to an inside of the impeller 60, from the air intake port 60a. The air that flows to the inside of the impeller 60 is discharged to the outside in the radial direction from the plurality of air exhaust ports 60b. The air that is discharged from the plurality of air exhaust port 60b passes through the heat exchanger 14, and is discharged to the indoors from a plurality of exhaust ports 10b.

[0036]

FIG. 6 is a cross-sectional view that shows a protruding accommodation 64 and a protrusion 66 to be mentioned later on, taken from the cross-sectional line VI-VI in FIG.

5. FIG. 7 is a perspective view that shows the protruding accommodation 64. As shown in FIG. 6 and FIG. 7, the plurality of the protruding accommodations 64 protrude from the shroud main body 62a to the bottom side. As shown in FIG. 6, the plurality of protruding accommodations 64 are hollow. The plurality of protruding accommodations 64 open to the top side. As shown in FIG. 5, each of the plurality of protruding accommodations 64 extend so as to incline in the direction of rotation with respect to the radial direction, as seen from the vertical direction Z. An inside end of each of the protruding accommodations 64 in the radial direction is located more to the front side (+θ side) in the direction of rotation than outside ends of each of the protruding accommodations 64 in the radial direction. Each of the protruding accommodations 64 extends in a straight line inclined towards a direction located on the front side in the direction of rotation, as said accommodations approach the inside in the radial direction, as seen from the vertical direction Z.

[0037]

As seen from the vertical direction Z, a direction in which each of the protruding accommodations 64 extend is a direction of extension that a blade main body 65, to be mentioned later on, extends in. In the explanations below, a direction to which the blade main body 65 extends in is referred to as the “extension direction”. A side which is the inside in the radial direction in the extension direction, is referred to as an “inside in the extension direction”. A side which is the outside in the radial direction in the extension direction, is referred to as an “outside in the extension direction”. The inside in the extension direction is a side which is the inside in the radial direction, and is the front side (+θ side) in the direction of rotation. The outside in the extension direction is a side which is the outside in the radial direction, and is the rear side (-θ side) in the direction of rotation. For example, the left side in FIG. 6 is the inside in the extension

direction, and the right side in FIG. 6 is the outside in the extension direction.

[0038]

As shown in FIG. 6 and FIG. 7, each of the plurality of protruding accommodations 64 has a first accommodation 64a. The first accommodation 64a is a semi-rectangular box that extends in the direction which the protruding accommodation 64 extends in. The first accommodation 64a has an outside portion 64c, and an inside portion 64d. The outside portion 64c is a portion out of the first accommodation 64a that extends to the outside in the extension direction. The inside portion 64d is a portion out of the first accommodation 64a that extends to the inside in the extension direction. An outside end in the extension direction of the outside portion 64c is an outside end in the extension direction of the first accommodation 64a. An inside end in the extension direction of the inside portion 64d is the inside end in the extension direction of the first accommodation 64a. The outside portion 64c is located to the outside in the radial direction more than the inside portion 64d. The inside portion 64d is connected to the inside end in the extension direction of the outside portion 64c.

[0039]

A bottom end of the outside portion 64c is located more to the top side than a bottom end of the inside portion 64d. The outside portion 64c is disposed in a location that is recessed to the top side with respect to the inside portion 64d. By having the outside portion 64c be recessed to the top side, it is possible to suppress interference between the protruding accommodation 64 and other parts disposed on the bottom side on the outside in the radial direction of the shroud 62. As shown in FIG. 6, a side wall portion 64e of the outside in the extension direction of the outside portion 64c extends in the vertical direction Z from the shroud main body 62a. A step wall portion 64g between the outside portion 64c and the inside portion 64d inclines in the vertical direction Z, towards

the extension direction in which the protruding accommodation 64 extends to. The step wall portion 64g is located on the inside in the extension direction as a bottom side thereof is approached.

[0040]

Each of the plurality of protruding accommodations 64 has the inner accommodation 64b. The inner accommodation 64b is a second accommodation that is connected to an end in the extension direction of the first accommodation 64a. The inner accommodation 64b is connected to an end in the extension direction of the first accommodation 64a on the inside. To be more specific, the inner accommodation 64b is connected to the end on an inside of the inside portion 64d in extension direction. As such, in the first embodiment, each of the plurality of protruding accommodations 64 has the inner accommodation 64b, as the second accommodation, connected to an end located on the inside in the radial direction out of both ends in the extension direction of the first accommodation 64a. An end on an inside in the extension direction of the inner accommodation 64b is an end on an inside in the extension direction of the protruding accommodation 64. The inner accommodation 64b is a box shape that opens to the top side. An inside of the inner accommodation 64b is connected to an inside of the first accommodation 64a.

[0041]

An end on the bottom side of the inner accommodation 64b is located more to the top side than the lowest portion located on the bottom side out of the first accommodation 64a. The lowest portion located on the bottom side out of the first accommodation 64a in the first embodiment is the bottom end of the inside portion 64d. A bottom end of the inner accommodation 64b is recessed to the top side more than the bottom end on an inside end in the extension direction of the inside portion 64d. A step wall portion 64h

between the inner accommodation 64b and the first accommodation 64a extends in the vertical direction Z.

[0042]

As shown in FIG. 5 and in FIG. 7, the inner accommodation 64b is a semi-triangular shape, as seen from the vertical direction Z. As shown in FIG.6, a side wall portion 64f of the inside in the extension direction of the inner accommodation 64b inclines to the extension direction, with respect to the vertical direction Z. The side wall portion 64f is located on the outside in the extension direction as a bottom side thereof is approached. The side wall portion 64f extends along an inner projection 66b to be mentioned later on.

[0043]

As shown in FIG. 4, the plurality of blades 63 are located between the base 61 and the shroud 62 in the vertical direction Z. More specifically, the plurality of blades 63 are located between the circular plate 61a and the shroud 62 in the vertical direction Z. The plurality of blades 63 are connected to the base 61 and to the shroud 62. The plurality of blades 63 are disposed with an interval therebetween in the direction of rotation of the impeller 60. The plurality of blades 63 are mutually disposed via an interval therebetween, over a circumference in the direction of rotation. Seven blades 63 are provided in the first embodiment. Intervals between each of the blades 63 may be of similar lengths, and may be of differing lengths.

[0044]

FIG. 8 is a perspective view that shows a blade 63. As shown in FIG. 8, the blade 63 is configured of a first blade member 63a and a second blade member 63b being combined in a direction that is orthogonal to the extension direction and to the vertical direction Z. The first blade member 63a is a flat box shape that opens to the outside in the radial direction. The second blade member 63b is a plate that blocks an opening of

the second blade member 63b on the outside in the radial direction. The first blade member 63a and the second blade member 63b are for example, mutually fixed to one another using ultra sonic welding. FIG. 9 is a cross-sectional view that shows a part of the impeller 60, taken from the cross-sectional line IX-IX in FIG. 5. As shown in FIG. 9, a gap is provided between the first blade member 63a and the second blade member 63b. In the first embodiment, the plurality of blades 63 are hollow blades. As in FIG. 9, a direction of air flow when the impeller 60 rotates is the direction shown by the arrows AF.

[0045]

The first blade member 63a configures a surface that inclines to the inside in the radial direction out of surfaces of the blade 63. A surface that faces the inside in the radial direction out of the surfaces of the blade 63 in the first embodiment is a negative pressure surface 63m. As shown in FIG. 4, the negative pressure surface 63m faces the inside in the radial direction and the rear side (-θ side) in the direction of rotation. The second blade member 63b is located on the outside in the radial direction of the first blade member 63a. The second blade member 63b configures a part of the surface that faces the outside in the radial direction out of the surfaces of the blade 63. A surface that faces the outside in the radial direction out of the surfaces of the blade 63 in the first embodiment is the positive pressure surface 63p. The positive pressure surface 63p faces the outside in the radial direction and faces the front side (+θ side) in the direction of rotation.

[0046]

Each of the plurality of blades 63 has the blade main body 65. The blade main body 65 extends in a direction that inclines to the direction of rotation with respect to the radial direction, as seen from the vertical direction Z. As seen from the vertical direction Z,

the blade main body 65 is located on the front side (+θ side) in the direction of rotation as the inside thereof in the radial direction is approached. As previously explained, the direction in which the blade main body 65 extends in is the extension direction, as seen from the vertical direction Z.

[0047]

A first end in the extension direction of the blade main body 65 is located on an inside in the radial direction having the rotation axis R as a center thereof, and on the front side (+θ side) in the direction of rotation, more than a second end in the extension direction of the blade main body 65. The first end in the extension direction of the blade main body 65 in the first embodiment is an end in the radial direction of the blade main body 65 on the inside, and an end on the front side (+θ side) in the direction of rotation of the blade main body 65. The second end in the extension direction of the blade main body 65 in the first embodiment is an end of the blade main body 65 on the outside in the radial direction, and the end on the rear side (-θ side) in the direction of rotation of the blade main body 65.

[0048]

The blade main body 65 is located between the circular plate 61a of the base 61 and the shroud 62 in the vertical direction Z. As shown in FIG. 9, an upper end of the blade main body 65 is connected to a bottom surface of the circular plate 61a, and is fixed to the bottom surface of the circular plate 61a. The upper end of the blade main body 65 is for example, fixed to the bottom surface of the circular plate 61a by laser welding. The upper end of the blade main body 65 is located on an inside of the guide 61f. A side surface on the upper end in the blade main body 65 is disposed apart from an inside surface of the guide 61f. The upper end of the blade main body 65 is not in contact with the guide 61f.

[0049]

As shown in FIG. 8, each of the plurality of blades 63 has the protrusion 66 that protrudes to the bottom side from the blade main body 65. The protrusion 66 extends in the extension direction. More specifically, the protrusion 66 extends in a direction that a bottom end 65a of the blade main body 65 extends in, as seen from the vertical direction Z. The direction in which the protrusion 66 extends in, is the same direction that the protruding accommodation 64 extends in. As shown in FIG. 6, the protrusion 66 in each of the plurality of blades 63 is accommodated within each of the plurality of protruding accommodations 64.

[0050]

The protrusion 66 has a first projection 66a. The first projection 66a is housed within the first accommodation 64a. The first projection 66a is a semi-rectangular shape that extends in the extension direction. The first projection 66a is hollow. The first projection 66a contacts, and is fixed to a surface located on the bottom side out of the inner surfaces of the first accommodation 64a. As such, the first projection 66a is fixed to the shroud 62. The surface located on the bottom side out of the inner surfaces of the first accommodation 64a is a surface that faces the top side. A bottom surface of the first projection 66a is for example, fixed by laser welding to the surface located on the bottom side out of surfaces of the first accommodation 64a. In the first embodiment, the portion out of the first projection 66a that is fixed to the first accommodation 64a is a part of the first blade member 63a. The portion out of the first projection 66a that is fixed to the first accommodation 64a may be a part of the second blade member 63b.

[0051]

The first projection 66a has an outside portion 66c that is accommodated within the outside portion 64c of the first accommodation 64a, and an inside portion 66d that is

accommodated within the inside portion 64d of the first accommodation 64a. The outside portion 66c is a portion on the outside in the extension direction out of the first projection 66a. The inside portion 66d is a portion on the inside in the extension direction out of the first projection 66a. The inside portion 66d is connected to an end in the extension direction of the outside portion 66c on the inside. The end on the outside in the extension direction of the outside portion 66c is an end in the extension direction of the first projection 66a on the outside. The end on the inside in the extension direction of the inside portion 66d is an end on the inside in the extension direction of the first projection 66a. As shown in FIG. 8, the end on the outside in the extension direction of the outside portion 66c is separately located to the inside in the extension direction, more than the end on the outside in the extension direction of the bottom end 65a of the blade main body 65.

[0052]

As shown in FIG. 6, a bottom end of the outside portion 66c contacts, and is fixed to a surface located on the bottom side out of inner surface of the outside portion 64c in the first accommodation 64a. The bottom end of the outside portion 66c is located to the top side more than a bottom end of the inside portion 66d. The bottom end of the inside portion 66d contacts, and is fixed to a surface located on the bottom side out of the inner surface of the inside portion 64d in the first accommodation 64a.

[0053]

A side wall portion 66e of the outside in the extension direction of the outside portion 66c extends to the bottom side in the vertical direction Z, from the bottom end 65a of the blade main body 65. The side wall portion 66e is disposed on the inside in the extension direction of the side wall portion 64e in the protruding accommodation 64. The side wall portion 66e faces the side wall portion 64e via a gap. The side wall

portion 66e is not in contact with the side wall portion 64e.

[0054]

A step wall portion 66g between the outside portion 66c and the inside portion 66d extends in the vertical direction Z. The step wall portion 66g is disposed so as to extend to the inside on the extension direction of the step wall portion 64g of the protruding accommodation 64. The step wall portion 66g faces the step wall portion 64g via a gap. The step wall portion 66g is not in contact with the step wall portion 64g.

[0055]

A side wall portion 66h on the inside in the extension direction of the inside portion 66d extends to the bottom side of the vertical direction Z from the bottom end 65a blade main body 65. A bottom end of the side wall portion 66h is disposed on the outside in the extension direction of the step wall portion 64h of the protruding accommodation 64. The side wall portion 66h faces the step wall portion 64h via a gap. The side wall portion 66h is not in contact with the step wall portion 64h.

[0056]

Each of plurality of protrusions 66 has the inner projection 66b. The inner projection 66b is a second projection that is connected to an inside end in the extension direction of the first projection 66a. As shown in FIG. 8, the inner projection 66b is connected to an inside end in the extension direction of the first projection 66a. More specifically, the inner projection 66b is connected to an inside end of the inside portion 66d, in other words, is connected to the side wall portion 66h. As such, in the first embodiment, each of the plurality of protrusion 66 has the inner projection 66b, as the second projection, that connects to an end which is located on the inside in the radial direction out of both ends in the extension direction of the first projection 66a. The inside end in the extension direction of the inner projection 66b is the inside end in the extension direction

of the protrusion 66.

[0057]

The inner projection 66b protrudes to the bottom side from an outside edge in a bottom surface of an inside end portion 65b located on the inside in the radial direction, more than the first projection 66a out of the bottom end 65a of the blade main body 65. The inner projection 66b and the inside end portion 65b in the first embodiment are parts of the first blade member 63a. The inner projection 66b and the inside end portion 65b may be parts of the second blade member 63b. The inner projection 66b protrudes to the bottom side from an edge of the inside in the radial direction and an edge of the front side (+θ side) in the direction of rotation, out of the outside edge on the bottom surface of the inside end portion 65b. The inner projection 66b, is a shape that extends to the inside in the extension direction while curving towards the outside in the radial direction, from an edge of the inside in the radial direction on the side wall portion 66h of the first projection 66a, as seen from the vertical direction Z.

[0058]

An end on the bottom side of the inner projection 66b is located more to the top side than the lowest portion located on the bottom side out of the first projection 66a. In the first embodiment, the lowest portion located on the bottom side out of the first projection 66a is the bottom end of the inside portion 66d. The end on the bottom side of the inner projection 66b is located more to the bottom side than the bottom end of the outside portion 66c.

[0059]

An end out of ends in the extension direction of the inner projection 66b, that is on an opposite side to the side that the first projection 66a is connected to, in other words the end on the inside in the extension direction, is connected to an end on the inside in the

extension direction of the blade main body 65 with no step. A surface on the inside in the extension direction of the inner projection 66b is smoothly connected to a surface on the inside in the extension direction of the blade main body 65. A surface on the inside in the radial direction of the inner projection 66b is smoothly connected to the negative pressure surface 63m of the blade main body 65.

[0060]

As shown in FIG. 6, the inner projection 66b is accommodated within the inner accommodation 64b. The inner projection 66b is located so as to oppose a surface located on the bottom side out of inner surface of the inner accommodation 64b with a gap in between. A bottom end of the inner projection 66b is separately disposed on the top side from a surface located on the bottom side out of the inner surface of the inner accommodation 64b. The inner projection 66b is located on the outside in the extension direction side wall portion 64f on the inner accommodation 64b. The inner projection 66b is located so as to oppose the side wall portion 64f via a gap. The gap between the inner projection 66b and the side wall portion 64f is smaller than the gap located between the inner projection 66b and the surface located on the bottom side out of the inner surface of the inner accommodation 64b. An entirety of the inner projection 66b is separately disposed from the inner surface of the inner accommodation 64b. The inner projection 66b is not in contact with the inner surface of the inner accommodation 64b.

[0061]

FIG. 10 is a cross-sectional view that shows a part of the impeller 60, taken from the cross-sectional line X-X in FIG. 5. In FIG. 10, a flow of the air when the impeller 60 rotates, is shown by the arrows AF. As shown in FIG. 10, a gap G1 is provided between the inside end portion 65b of the blade main body 65 and the shroud 62. The gap G1 is connected to an interval of the positive pressure side that the positive pressure surface

63p faces, and to an interval of the negative pressure side that the negative pressure surface 63m faces. The gap G1 includes the gap between the inner projection 66b and an inner surface of the inner accommodation 64b, an inner space of the inner accommodation 64b, and the gap between the inside end portion 65b and the shroud main body 62a. By having the gap G1 be inserted between the inside of the inner accommodation 64b and the inner projection 66b, a labyrinth structure that penetrates in the vertical direction Z is formed.

[0062]

FIG. 17 is a cross-sectional view that shows a part of an impeller 560 in a comparative example. FIG. 18 is a cross-sectional view that shows a part of the impeller 560 in the comparative example, taken from a cross-sectional line XVIII-XVIII in FIG. 17. A direction of flow of the air when the impeller 560 rotates is shown in FIG. 18 by the arrows AF. As shown in FIG. 17 and in FIG. 18, With the exception of an aspect of a protruding accommodation 564 not having the inner accommodation 64b, a shroud 562 of the impeller 560 in the comparative example is the same as the shroud 62 of the impeller 60 of the first embodiment. With the exception of an aspect of a protrusion 566 not having the inner projection 66b, a blade 563 of the impeller 560 is the same as the blade 63 of the impeller 60 of the first embodiment.

[0063]

A gap G2 is provided between the inside end portion 65b of the blade main body 65 and an inner surface of the surface of the shroud main body 62a. As shown in FIG. 18, the gap G2 is provided so as to extend along an inner surface of the shroud main body 62a in the radial direction. The gap G2 opens to both sides in the radial direction, and is connected to the interval of the positive pressure side that the positive pressure surface 63p faces, and to the negative pressure side that the negative pressure surface 63m faces.

Therefore, as shown by the arrows AF in FIG. 18, there are cases in the impeller 560 of the comparative example where the air flows from the interval of the positive pressure side that the positive pressure surface 63p faces, to the interval of the negative pressure side that the negative pressure surface 63m faces, passing through the gap G2. As such, a problem of decrease in air blowing efficiency due to the impeller 560 exists.

[0064]

With respect to said problem, each of the plurality of protruding accommodations 64 in the shroud 62 according to the first embodiment has the first accommodation 64a, and the inner accommodation 64b that is connected to the end in the extension direction of the first accommodation 64a. The protrusion 66 in the blade 63 is accommodated within the first accommodation 64a, is connected to the first projection 66a that is fixed to the shroud 62 and an end in the extension direction of the first projection 66a, and has the inner projection 66b that is accommodated within the inner accommodation 64b. The first projection 66a contacts, and is fixed to a surface located on the bottom side out of the inner surfaces of the first accommodation 64a. The inner projection 66b opposes the surface located on the bottom side out of the inner surface of the inner accommodation 64b via a gap. As such, by providing the inner accommodation 64b and the inner projection 66b accommodated within the inner accommodation 64b, it is possible to have the gap G1 between the inside end portion 65b of the blade main body 65 and the shroud main body 62a be the previously mentioned penetrating shape. Accordingly, it is possible to have it to where it is difficult for air to pass through the gap G1. Accordingly, it is possible to suppress the air from flowing from the interval of the positive pressure side that the positive pressure surface 63p faces to the interval of the negative pressure side that the negative pressure surface 63m faces, via the gap G1. Therefore, it is possible to suppress the decrease in air blowing efficiency of the impeller

60 in the centrifugal blower 40. Since the inner projection 66b does not contact the surface located on a bottom side out of the inner surface of the inner accommodation 64b, it is possible to have the first projection 66a suitably contact the surface located on the bottom side out of the inner surface of the first accommodation 64a.

[0065]

According to the first embodiment, each of the plurality of protruding accommodation 64 has the inner accommodation 64b, as the second accommodation, connect to the end located on the inside in the radial direction out of both ends in the extension direction of the first accommodation 64a. The protrusion 66 has the inner projection 66b as the second projection that connects to an end located on the inside in the radial direction out of both ends in the extension direction of the first projection 66a. The inner projection 66b is accommodated within the inner accommodation 64b. As such, it is possible to suppress the flow of the air from the positive pressure side to the negative pressure side, on the inside in the extension direction of the first projection 66a. Since a part on the inside in the extension direction out of the blade 63 separates the air that is taken from the air intake port 60a, it is especially easy for the positive pressure to rise in the air of the positive pressure side. As such, by suppressing the air flow from the positive pressure side to the negative pressure side on the inside in the extension direction of the first projection 66a, it is possible suitably suppress the decrease in the air blowing efficiency of the impeller 60.

[0066]

According to the first embodiment, the end on the bottom side of the inner accommodation 64b is located to the top side more than the lowest portion located on the bottom side out of the first accommodation 64a. An end on the bottom side of the inner projection 66b is located to the top more than the lowest portion located on the bottom

side out of the first projection 66a. As such, even if the inner accommodation 64b and the inner projection 66b are provided, the inner accommodation 64b would not protrude to the bottom side more than the first accommodation 64a. As such, it is possible to suppress the inner accommodation 64b from becoming resistance to the air flow when the impeller 60 rotates. Also, when welding the first projection 66a and the first accommodation 64a for example, a glass plate or the like is pushed up against the first accommodation 64a from the bottom side, and the bottom surface of the first projection 66a and the surface located on the bottom side out of the inner surface of the first accommodation 64a are in close contact with one another. In such case, by the inner accommodation 64b not protruding to the bottom side more than the first accommodation 64a, it is possible to suitably push the glass plate or the like against the first accommodation 64a. Therefore, it is possible to suitably fix the first projection 66a and the first accommodation 64a using laser welding.

[0067]

According to the first embodiment, the entirety of the inner projection 66b is separately disposed from the inner surface of the inner accommodation 64b. In other words, the inner projection 66b is not in contact with the inner surface of the inner accommodation 64b. As such, when a small vibration is generated in the blade 63, it is possible to suppress contact of the vibrating inner projection 66b with the inner surface of the inner accommodation 64b. Accordingly, it is possible to suppress noise generation when the impeller 60 is rotating. In the first embodiment, portions out of the blade 63 that are not fixed by laser welding are not in contact with the shroud 62. As such, it is possible to more suitably suppress vibrating portions out of the blade 63 from contacting the shroud 62, and it is possible to more suitably suppress noise generation when the impeller 60 is rotating.

[0068]

According to the first embodiment, an end on the opposite side to the side to which the first projection 66a out of ends in the extension direction of the inner projection 66b is connected to the end in the extension direction of the blade main body 65 with no step. As such, no step forms between the inner projection 66b and the blade main body 65, and no gap forms between said step and the shroud main body 62a. Accordingly, the air does not flow from the positive pressure side to the negative pressure side via the gap between said step and the shroud main body 62a. Therefore, it is possible to suitably suppress a decrease in air blowing efficiency of the impeller 60.

[0069]

Second Embodiment

FIG. 11 is a perspective view that shows a part of an impeller 260 in a second embodiment. FIG. 12 is a view that shows the part of the impeller 260 as seen from the bottom side in the second embodiment. In the explanations below, configurations that are similar to configurations of embodiments previously mentioned have the same reference signs affixed thereto, with explanations thereof being omitted.

[0070]

As shown in FIG. 11 and in FIG. 12, a shroud 262 of an impeller 260 has a cover portion 267 that protrudes from the bottom side of the shroud main body 62a. The cover portion 267 extends while curving towards the inside in the radial direction, from the outside in the radial direction of the inner accommodation 64b, to the front side (+θ side) in the direction of rotation, and covers the inner accommodation 64b from the front side in the direction of rotation. An end in the rear side (-θ side) in the direction of rotation of the cover portion 267 is connected to an outside end in the radial direction of the inside end in the extension direction of the first accommodation 64a.

[0071]

As shown in FIG. 11, an end on the bottom side of the cover portion 267 is located to the bottom side more than the end on the bottom side of the inner accommodation 64b. The end on the bottom side of the cover portion 267 is disposed in the same location in the vertical direction Z as the end on the bottom side of the inside portion 64d in the first accommodation 64a. As shown in FIG. 12, the cover portion 267 is connected to the outside in the radial direction of the inner accommodation 64b. A portion of the cover portion 267 configures a wall of the outside in the radial direction of the inner accommodation 64b. An end on the top side of the cover portion 267 is located in the bottom side as an inside thereof in the radial direction is approached, along an outside surface of the shroud main body 62a. A dimension of the cover portion 267 in the vertical direction Z becomes smaller as the cover portion 267 faces the inside in the radial direction.

[0072]

Other configurations of the shroud 262 are the same as the other configurations of the shroud 62 in the first embodiment. Other configurations of the impeller 260 are the same as the other configurations of the impeller 60 in the first embodiment.

[0073]

According to the second embodiment, the shroud 262 has the cover portion 267 that protrudes to the bottom side from the shroud main body 62a. An end on the bottom side of the cover portion 267 is located to the bottom side more than the end on the bottom side of the inner accommodation 64b. The cover portion 267 extends while curving towards the inside in the radial direction, from the outside in the radial direction of the inner accommodation 64b, to the front side (+θ side) in the direction of rotation, and covers the inner accommodation 64b from the front side in the direction of rotation. As

such, when the impeller 260 rotates, it is possible to ward off the air from the front side in the direction of rotation using the cover portion 267, and it is possible to suppress the air from the front side in the direction of rotation from colliding with the inner accommodation 64b. Accordingly, it is also possible to suppress noise generation when the impeller 260 is rotating.

[0074]

According to the second embodiment, the cover portion 267 is connected to the outside in the radial direction of the inner accommodation 64b. Accordingly, compared to when the cover portion 267 is separately made from the inner accommodation 64b, making the cover portion 267 and the inner accommodation 64b together is easier. Accordingly, it is possible to easily make the cover portion 267.

[0075]

Third Embodiment

FIG. 13 is a perspective view that shows a part of an impeller 360 in a third embodiment. FIG. 14 is a cross-sectional view that shows the part of the impeller 360 in the third embodiment. FIG. 15 is a perspective view that shows a part of a blade 363 in the third embodiment. In the explanations below, configurations that are similar to configurations of embodiments previously mentioned have the same reference signs affixed thereto, with explanations thereof being omitted.

[0076]

As shown in FIG. 13 and FIG. 14, a protruding accommodation 364 in a shroud 362 of the third embodiment has an outer accommodation 364i that connects to an end located on the outside in the radial direction out of both ends in the extension direction of the first accommodation 64a, as a second accommodation. The outer accommodation 364i is connected to the end of the outside in the extension direction of the outside portion

64c. The outer accommodation 364i extends in the extension direction, and is a semi-rectangular box that opens to the top side. An end of a bottom side of the outer accommodation 364i is located to the top side more than the end on the bottom side in the outside portion 64c of the first accommodation 64a. Other configurations of the shroud 362 are the same as the other configurations of the shroud 62 in the first embodiment.

[0077]

As shown in FIG. 14 and FIG. 15, a protrusion 366 in the blade 363 of the third embodiment has an outer protrusion 366i that connects to an end located on the outside in the radial direction out of both ends in the extension direction of the first projection 66a, as a second projection. The outer protrusion 366i is connected to an end on the outside in the extension direction of the outside portion 66c. The outer protrusion 366i is a semi-rectangular shape that extends in the extension direction. The outer protrusion 366i in the third embodiment is a solid part.

[0078]

As shown in FIG. 14, the outer protrusion 366i is accommodated on an inside of the outer accommodation 364i. An end on a bottom side of the outer protrusion 366i is located more to the top side than an end on the bottom side in the outside portion 66c of the first projection 66a. The outer protrusion 366i faces a surface located on the bottom side out of an inner surface of the outer accommodation 364i via a gap. Other configurations of the blade 363 are the same as the other configurations of the blade 63 in the first embodiment. Other configurations of the impeller 360 are the same as the other configurations of the impeller 60 in the first embodiment.

[0079]

According to the third embodiment, the protruding accommodation 364 has the outer

accommodation 364i that connects to an end located on the outside in the radial direction out of both ends in the extension direction of the first accommodation 64a, as the second accommodation. The protrusion 366 has the outer protrusion 366i that connects to an end located on the outside in the radial direction out of both ends in the extension direction of the first projection 66a as a second projection. The outer protrusion 366i is accommodated on the inside of the outer accommodation 364i. As such, it is possible to suppress the air on the outside in the extension direction of the first projection 66a from flowing from the positive pressure side to the negative pressure side. Accordingly, it is possible to suitably suppress a decrease in the air blowing efficiency of the impeller 360.

[0080]

Fourth Embodiment

FIG. 16 is a perspective view that shows a part of an impeller 460 in a fourth embodiment. In the explanations below, configurations that are similar to configurations of embodiments previously mentioned have the same reference signs affixed thereto, with explanations thereof being omitted.

[0081]

As shown in FIG. 16, a shroud 462 of the impeller 460 in the fourth embodiment is a configuration having the cover portion 267 provided, with respect to the previously mentioned shroud 362 of the third embodiment. Although omitted from the drawings, a blade in the fourth embodiment is the same as the blade 363 in the third embodiment. Accordingly, various effects mentioned in the second embodiment and in the third embodiment are obtained by the fourth embodiment. Other configurations of the impeller 460 are the same as the other configurations of the impeller 60 of the first embodiment.

[0082]

Although embodiments of the present disclosure have been explained above, the present disclosure is not limited to configurations of the each of the embodiments and the configurations and methods below may be adopted.

[0083]

As a second accommodation, a protruding accommodation in a shroud may at least be one of an inner accommodation or an outer accommodation. In other words, the protruding accommodation in the shroud may only have an outer accommodation as the second accommodation. For example, in the aforementioned third and fourth embodiments, the inner accommodation 64b need not be provided. A protrusion height of the second accommodation is not particularly limited. An end of the first side (the bottom side) of the second accommodation is at the same location in the axial direction (the vertical direction Z) as the portion located furthest in the first side out of the first accommodation, or may be at the same location as a portion located before the portion located furthest in the first side out of the first accommodation. The second accommodation may be any shape so long as said shape is capable of accommodating a second projection.

[0084]

The first accommodation of the protruding accommodation may be any shape so long as it is possible to accommodate the first projection therein. Although the first accommodation 64a in the previously mentioned embodiments has configurations where heights of the outside portion 64c and the inside portion 64d differ from one another, the first accommodation 64a is not limited thereto. The first accommodation need not have a portion that has a differing height, and may have three or more portions that mutually have differing projection heights.

[0085]

The projection in the blade at least has one of an inner projection or an outer projection, as the second projection. In other words, the projection in the blade may only have the outer projection, as the second projection. For example, in the previously mentioned third and fourth embodiments, the inner projection 66b need not be provided. The height of the second projection is not particularly limited. An end of a first side (the bottom side) of the second projection is at the same location in the axial direction (the vertical direction Z) as the portion located furthest in the first side out of the first projection, or may be at the same location as a portion located before the portion located furthest in the first side out of the first projection. The second projection may be of any shape. For example, the shape of the inner projection 66b in the previously mentioned various embodiments may be the same shape as the outer protrusion 366i in the third embodiment. So long as the second projection faces a surface that is located on the first side out of the inner surface of the second accommodation via a gap, the second protrusion may have a portion that contacts the inner surface of the second accommodation.

[0086]

So long as the first projection of the first protrusion is fixed to the first accommodation, the first projection may be of any shape. Although the first projection 66a in the previously mentioned various embodiments has a configuration where projection heights of the outside portion 66c and of the inside portion 66d mutually differ, the first projection 66a is not limited thereto. The first projection may not have portions that mutually have differing projection heights, and may have three or more portions that have differing projection heights. Parts other than parts out of the first projection that are fixed to the first accommodation may be in contact with the inner

surface of the first accommodation. The first projection may be fixed to the shroud by methods other than laser welding.

[0087]

The cover portion of the shroud need not be connected to the inner accommodation, and need not be connected to the first accommodation. A number of blades and a number of protrusions of the shroud are not particularly limited. A shape of a blade main body is not particularly limited. The blade main body may extend in the axial direction (the vertical direction Z) in any way. A layout relationship between a first blade member and a second blade member that configure the blade may be an opposite layout relationship to the layout relationship of the previously mentioned embodiments. In other words, the second blade member may face a negative pressure side. Each blade may be an integrally formed solid blade. The axial direction of the direction of rotation of an impeller in the present disclosure is not limited in any way, and may extend in a direction other than the vertical direction. The impeller of the present disclosure may be mounted on any blower. A centrifugal blower of the present disclosure may be mounted on any device.

[0088]

The various configuration and various methods explained in the above specification may be combined as needed so long as no conflicts therebetween with technical scopes thereof occur.

[0088a]

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

[0088b]

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

[Reference Signs List]

[0089]

10…Indoor Unit, 14…Heat Exchanger, 40…Centrifugal Blower, 50…Drive Portion, 60, 260, 360, 460, 560…Impeller, 61…Base, 62, 262, 362, 462, 562…Shroud, 62a…Shroud Main Body, 63, 363, 563…Blade, 64, 364, 564…Protruding Accommodation, 64a…First Accommodation, 64b…Inner Accommodation (Second Accommodation), 65…Blade Main Body, 66, 366, 566…Protrusion, 66a…First Projection, 66b…Inner Projection (Second Projection), 100…Air Conditioner, 267…Cover Portion, 364i…Outer Accommodation, 366i…Outer Protrusion, R…Rotation Axis, Z…Vertical Direction (Axial Direction)

[THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:]

[Claim 1]

An impeller being rotatable around a rotation axis, the impeller comprises:

a base;

a shroud that is located on a first side out of an axial direction of the rotation axis with respect to the base, and

a plurality of blades that are located between the base and the shroud in the axial direction, and are disposed with an interval therebetween in a direction of rotation of the impeller, wherein

the shroud has

a shroud main body, and

a plurality of protruding accommodations that protrude from the shroud main body to the first side, and that open to a second side which is an opposite side to the first side out of the axial direction,

each of the plurality of blades has

a blade main body, and

a protrusion that protrudes to the first side from the blade main body,

a first end of the blade main body in an extension direction that the blade main body extends in, as seen from the axial direction, is located on an inside in a radial direction having a center be the rotation axis more than a second end of the blade main body in the extension direction,

the protrusion in the plurality of blades is accommodated within each of the plurality of protruding accommodations,

each of the protruding accommodations has

a first accommodation, and

a second accommodation that is connected to an end in the extension direction of the first accommodation,

the protrusion has

a first projection that is accommodated within the first accommodation, and is fixed to the shroud, and

a second projection that is connected to an end in the extension direction of the first projection, and is accommodated within the second accommodation, and

the first projection contacts and is fixed to a surface located on the first side out of an inner surface of the first accommodation, and

the second projection faces a surface located on the first side out of an inner surface of the second accommodation via a gap, and

an end out of ends in the extension direction of the second projection, that is on an opposite side to the side to which the first projection is connected to, is connected to the first end in the extension direction of the blade main body with no step.

[Claim 2]

The impeller according to claim 1, wherein

each of the plurality of protruding accommodations has an inner accommodation, as the second accommodation, that connects to an end located on an inside in the radial direction out of both ends in the extension direction of the first accommodation,

the protrusion has an inner projection as the second projection that connects to an end located on the inside in the radial direction out of both ends in the extension direction of the first projection, and

the inner projection is accommodated within the inner accommodation.

[Claim 3]

The impeller according to claim 2, wherein

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the first end in the extension direction of the blade main body is located on an inside in the radial direction, and on a front side in the direction of rotation, more than the second end in the extension direction of the blade main body,

the shroud has a cover portion that protrudes from the shroud main body to the first side,

an end of the first side of the cover portion is located more to the first side than the end of the first side of the inner accommodation, and

the cover portion extends while curving towards the inside in the radial direction, from an outside in the radial direction of the inner accommodation, to the front side in the direction of rotation, and covers the inner accommodation from the front side in the direction of rotation.

[Claim 4]

The impeller according to claim 3, wherein

the cover portion is connected to the outside in the radial direction of the inner accommodation.

[Claim 5]

The impeller according to any one of claims 1 to 4, wherein

the protruding accommodation has an outer accommodation that connects to an end located on an outside in the radial direction out of both ends in the extension direction of the first accommodation, as a second accommodation,

the protrusion has an outer protrusion that connects to an end located on the outside in the radial direction out of both ends in the extension direction of the first projection, as a second projection, and

the outer protrusion is accommodated within the outer accommodation.

[Claim 6]

The impeller according to any one of claims 1 to 5, wherein

an end of the first side of the second accommodation is located in the second side more than a portion located furthest in the first side out of the first accommodation, and

an end of the first side of the second projection is located in the second side more than a portion located furthest in the first side out of the first projection.

[Claim 7]

The impeller according to any one of claims 1 to 6, wherein

an entirety of the second projection is separately disposed from an inner surface of the second accommodation.

[Claim 8]

A centrifugal blower further comprising:

the impeller according to any one of claims 1 to 7, and

a drive portion that rotates the impeller around the rotation axis.

[Claim 9]

An indoor unit further comprising:

the centrifugal blower according to claim 8, and

a heat exchanger that has air which is blown by the centrifugal blower.

FIG. 1

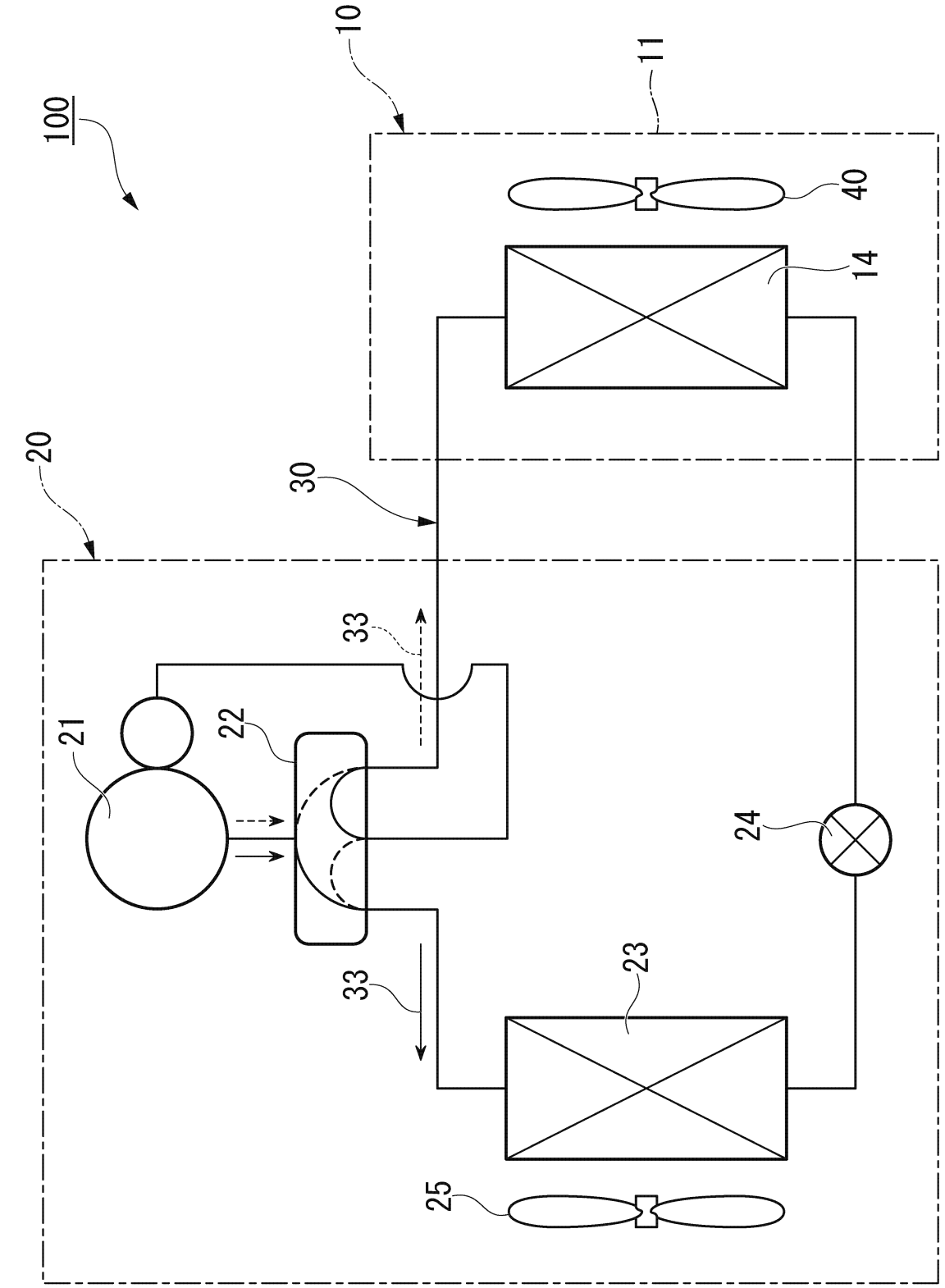


FIG. 2

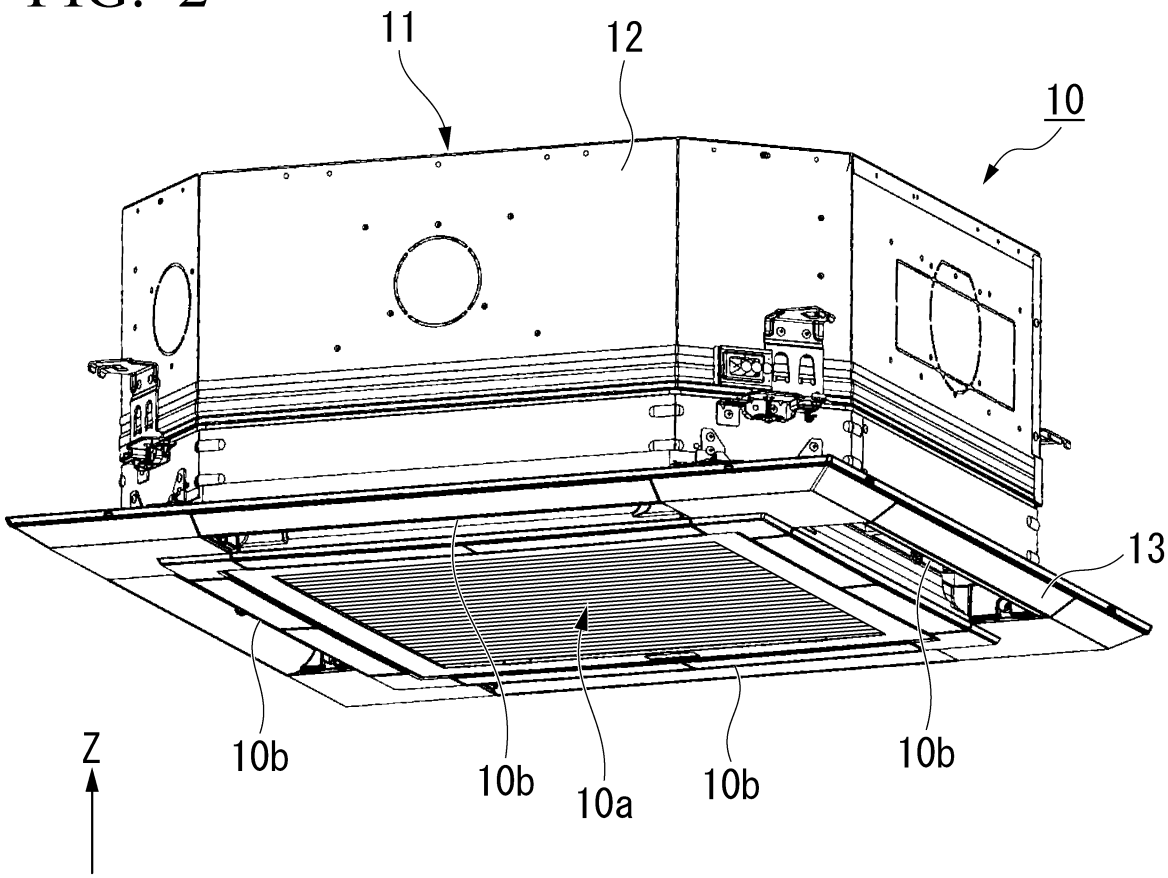


FIG. 3

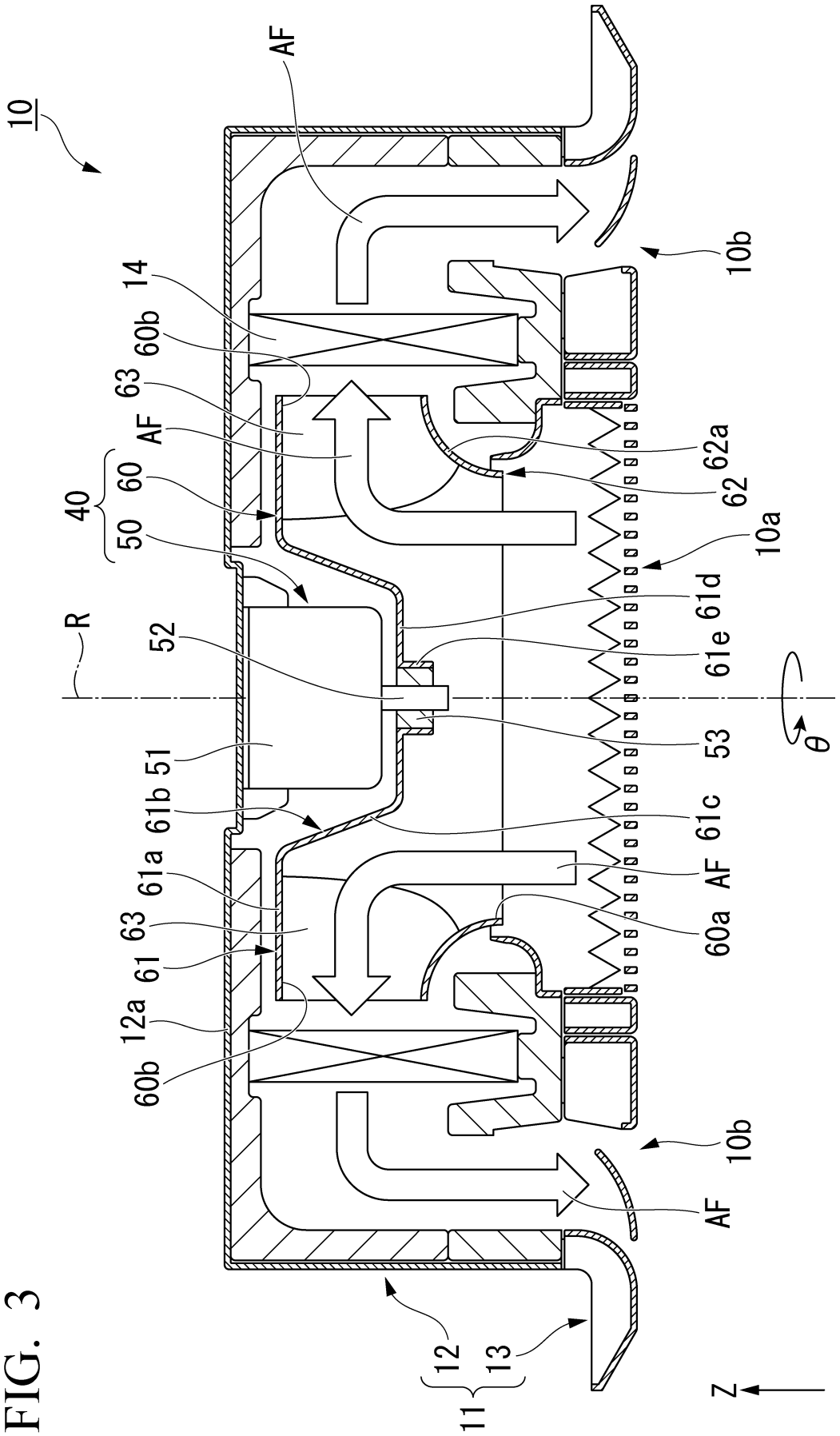

10
AF
14
60b
63
AF
40
60
50
R
52
51
61b
61a
63
61
12a
60b
10b
62a
62
10a
61d
61e
53
θ
61c
AF
60a
10b
AF
12
13
11
Z

FIG. 4

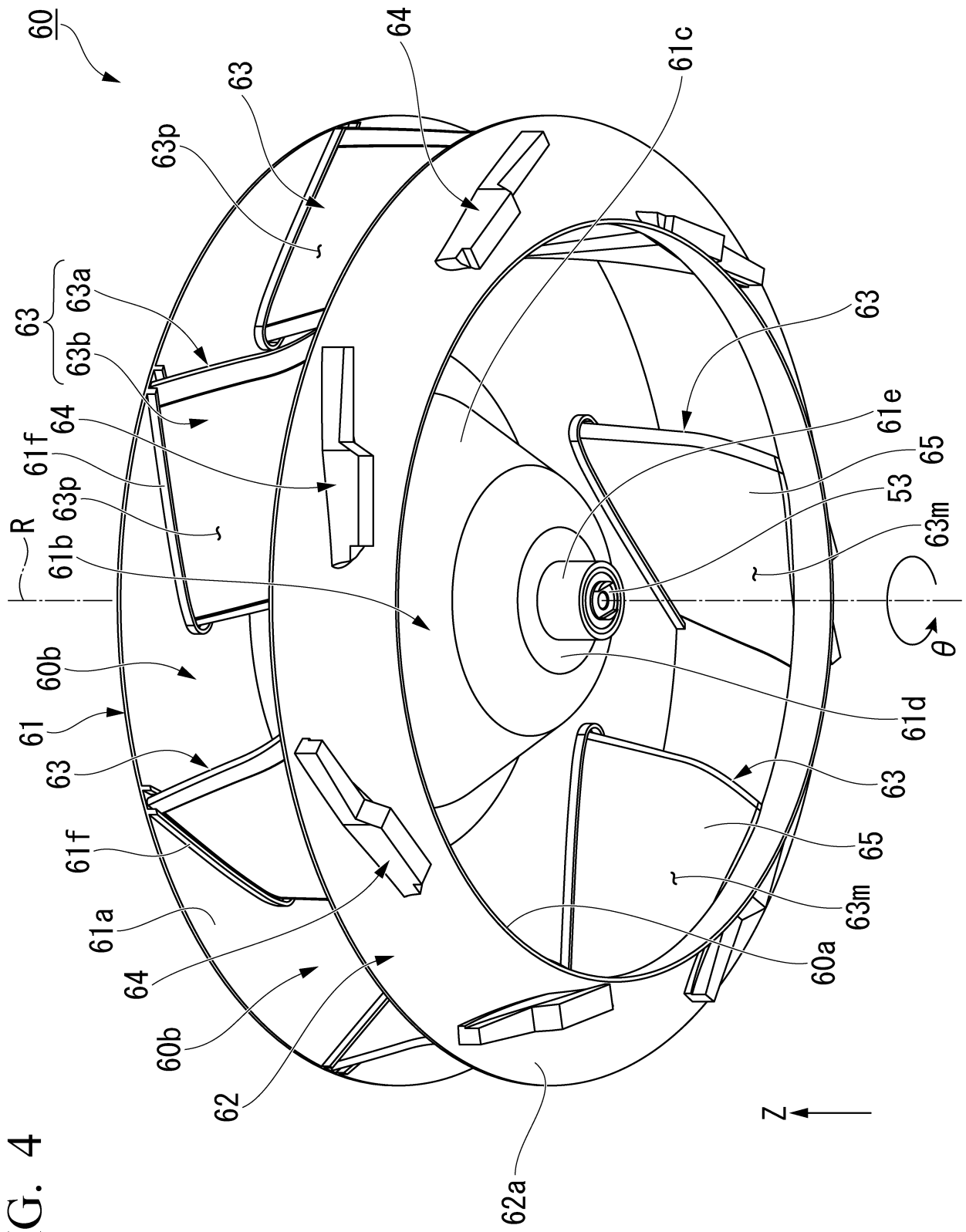

60
64
63
63p
61c
63
63a
63b
64
61f
63p
R
61b
60b
61
63
61f
61a
64
60b
62
62a
63
61e
65
53
63m
θ
61d
63
65
63m
60a
Z

FIG. 5

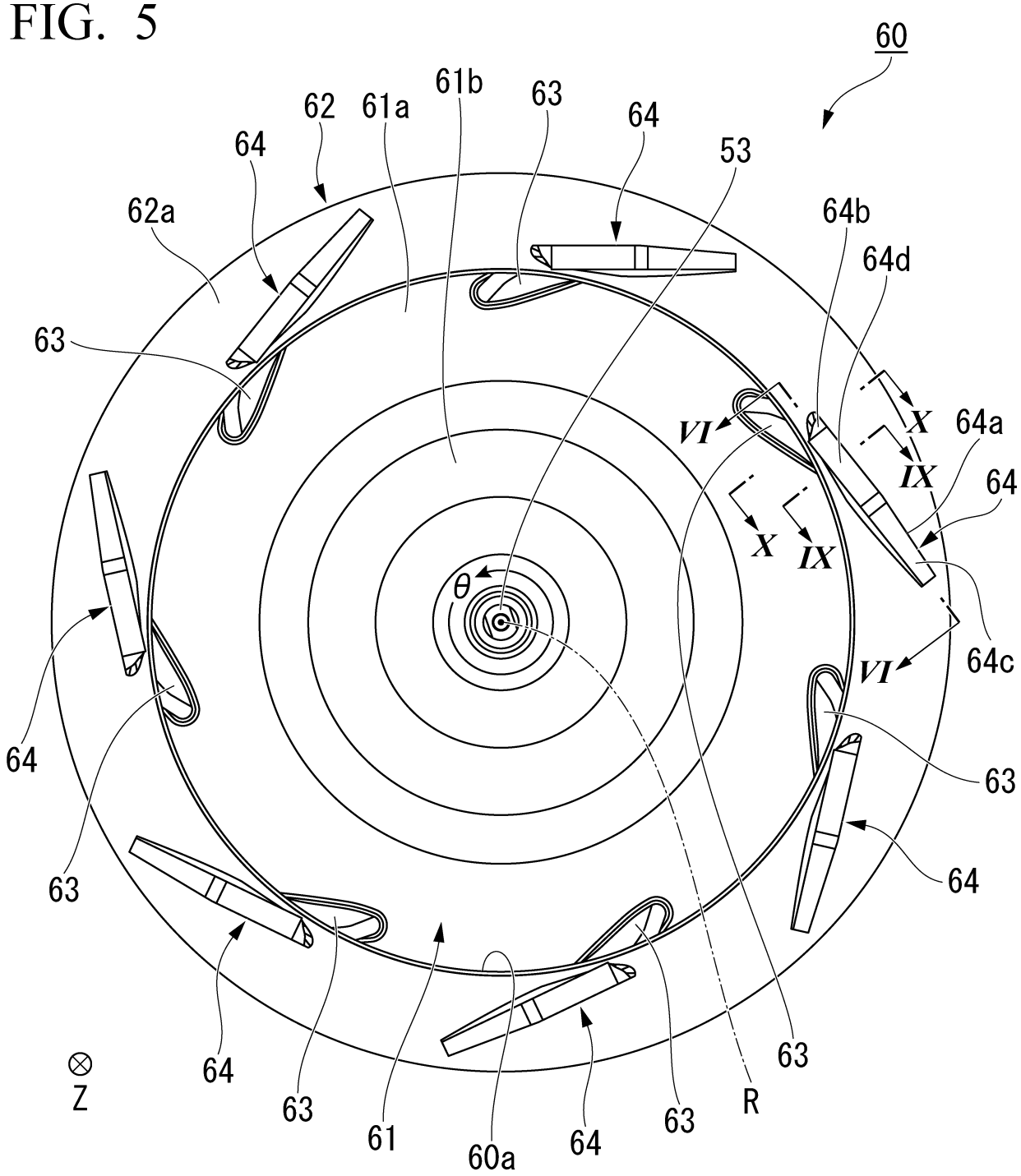
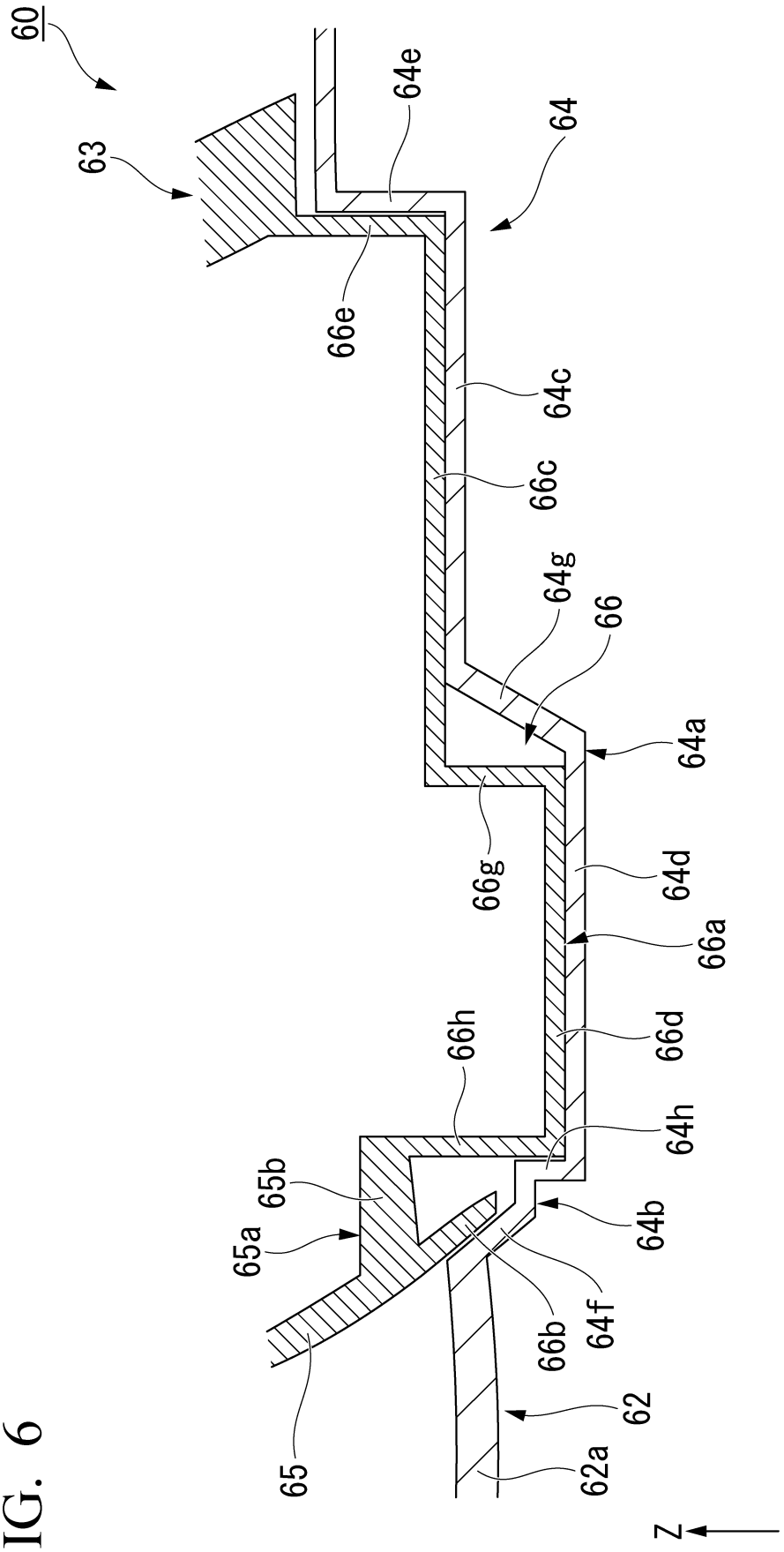

60
62
61a
61b
63
64
53
64
62a
64b
64d
63
VI
X
64a
IX
64
X
IX
θ
64c
VI
64
63
63
64
64
63
61
60a
64
63
63
R
Z

FIG. 6


60
63
64e
64
66e
64c
66c
64g
66
64a
66g
64d
66a
66h
66d
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64b
66b
64f
62
65
62a
Z

FIG. 7

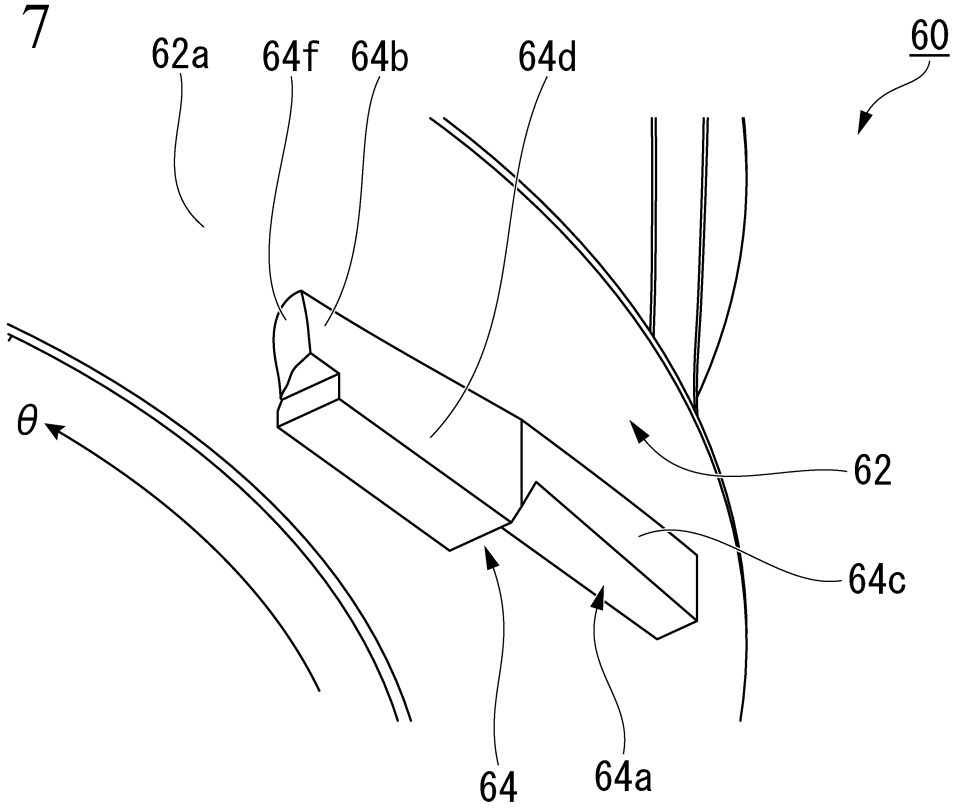

62a
64f
64b
64d
60
θ
62
64c
Z
64
64a

FIG. 8

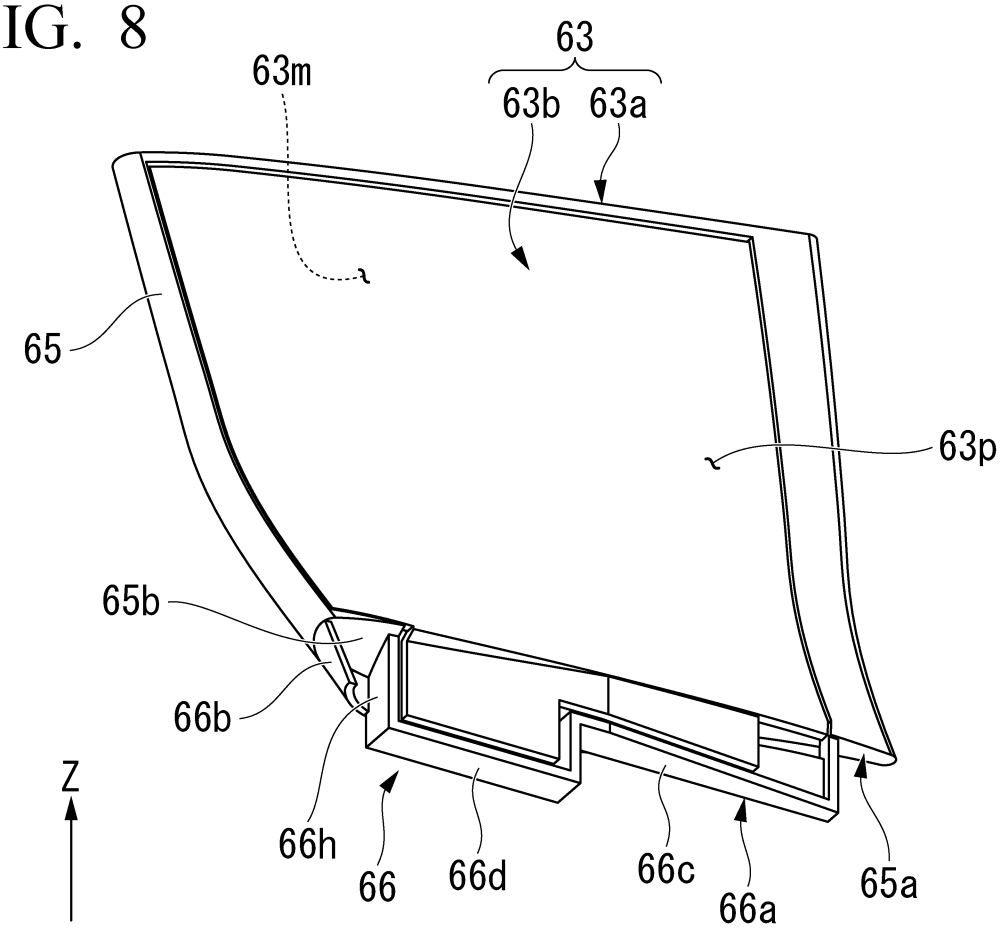

63
63m
63b
63a
65
63p
65b
66b
Z
66h
66
66d
66c
66a
65a

FIG. 9

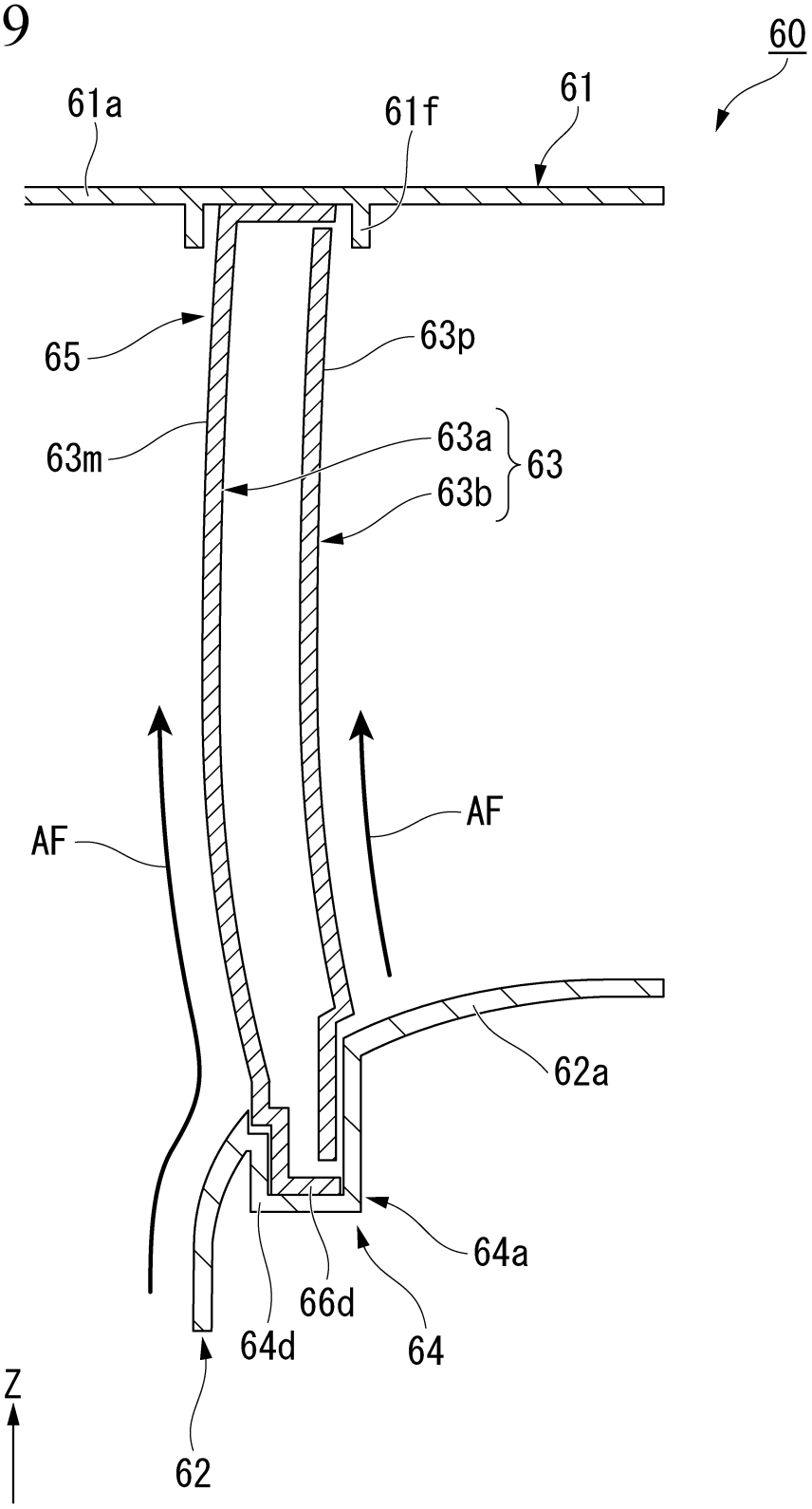


FIG. 10

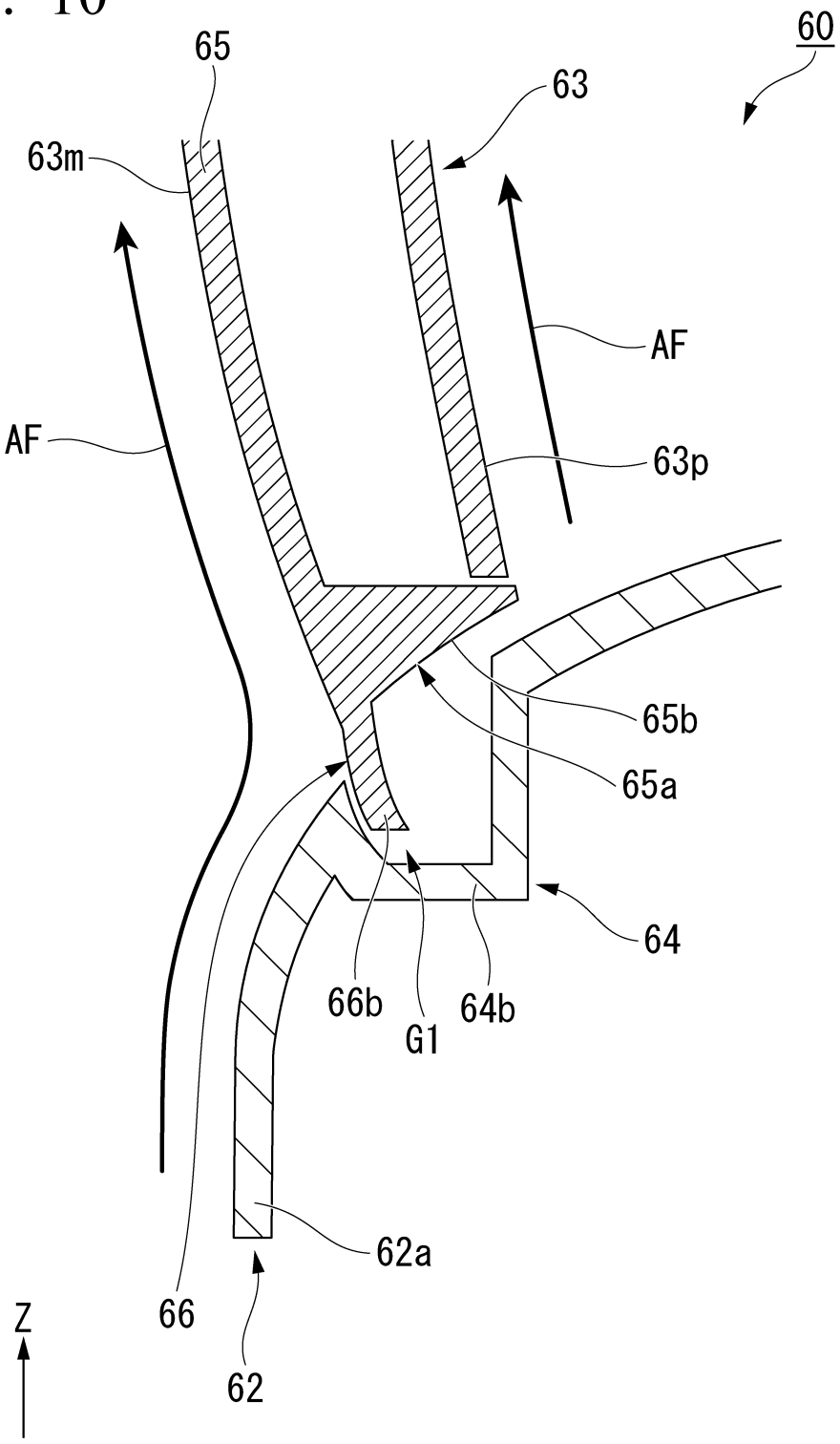


FIG. 11

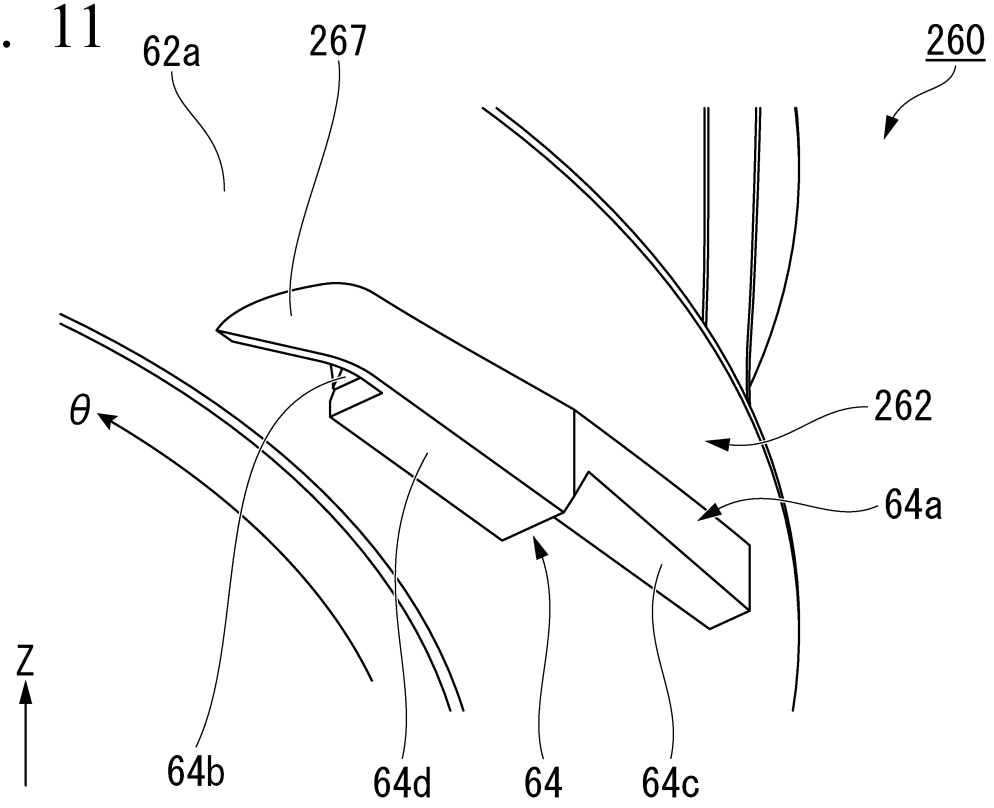

62a
267
260
θ
262
64a
Z
64b
64d
64
64c

FIG. 12

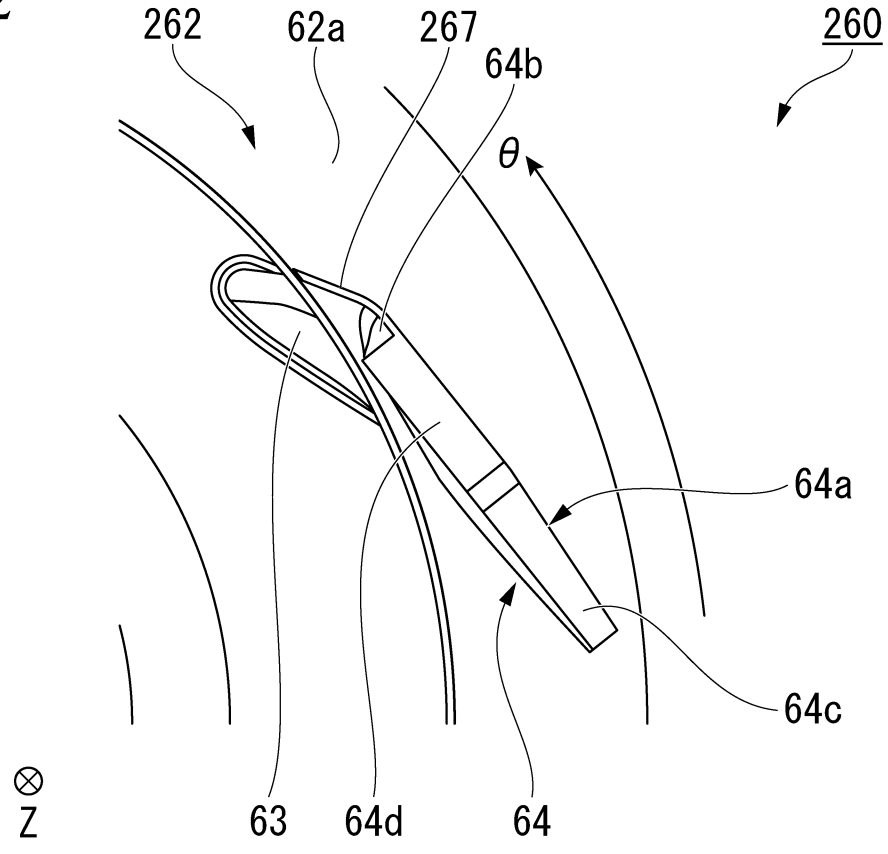

262
62a
267
64b
260
θ
64a
64c
⊗
Z
63
64d
64

FIG. 13

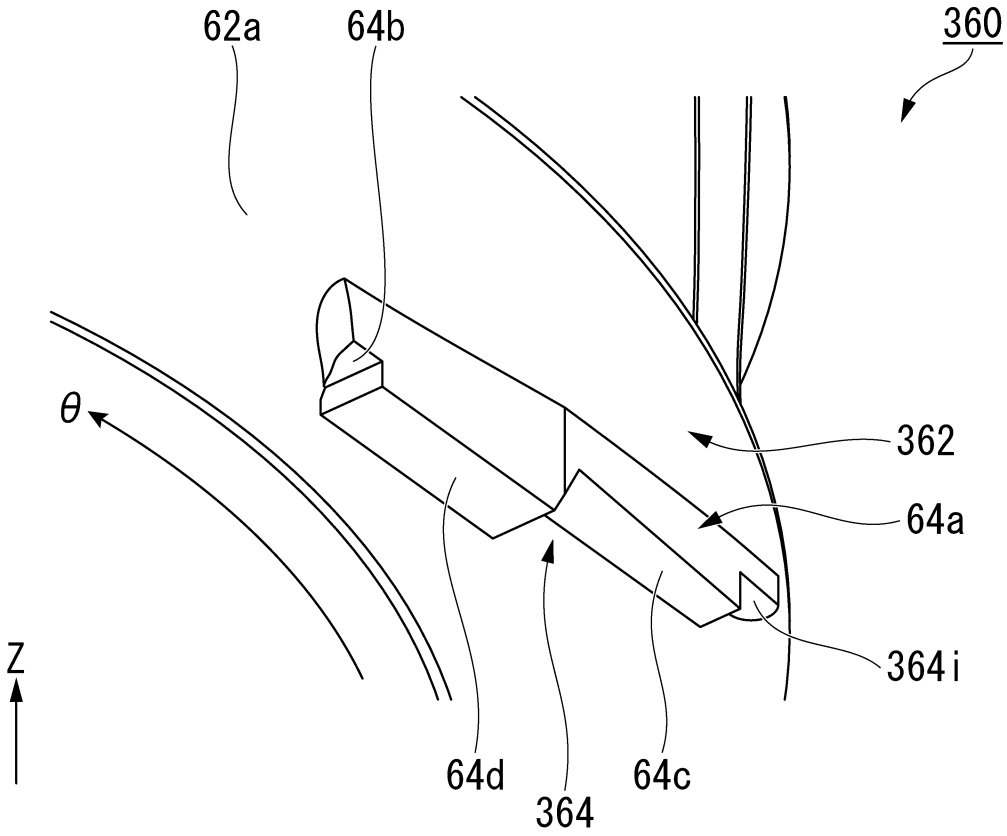


FIG. 14

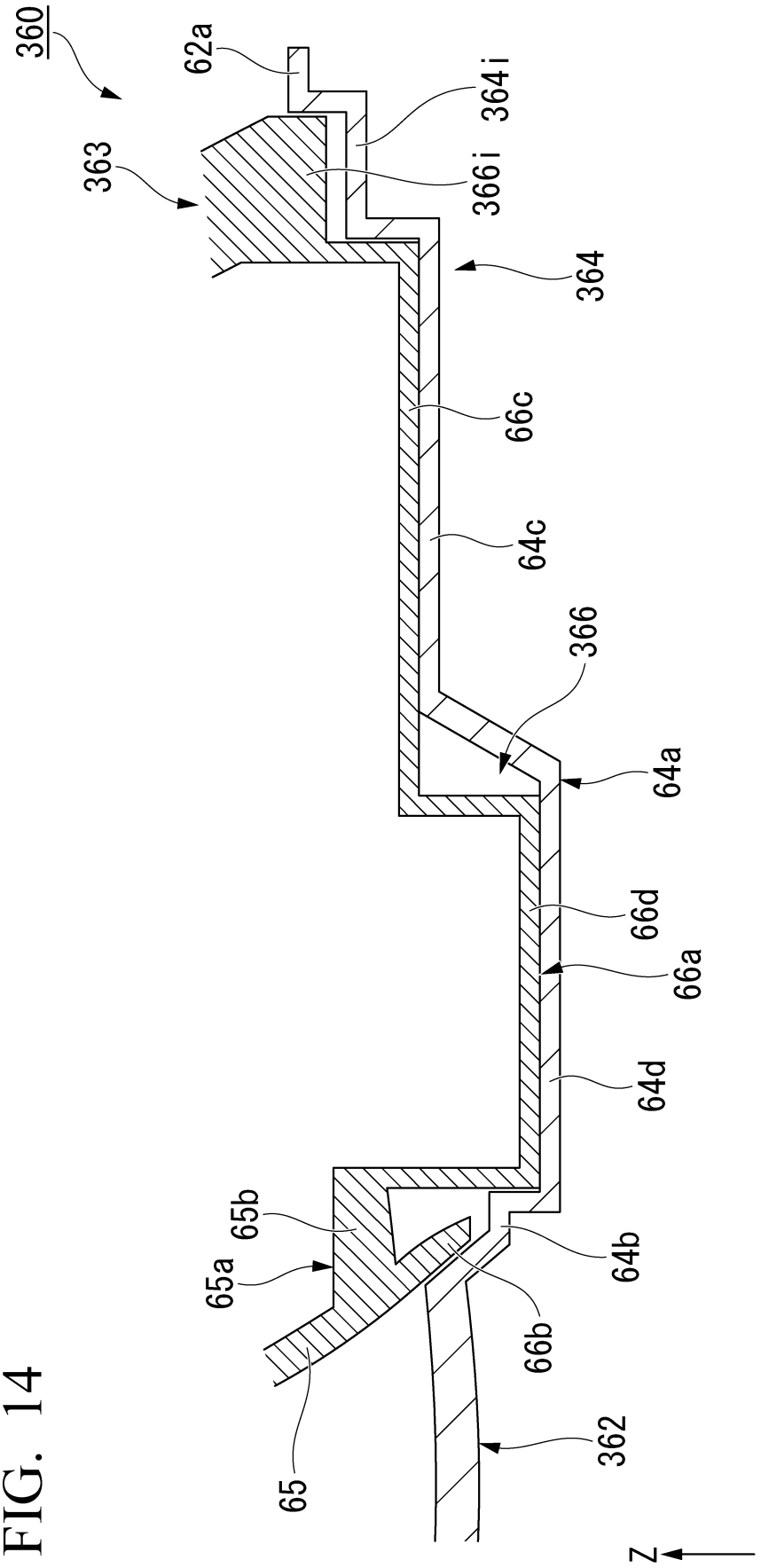
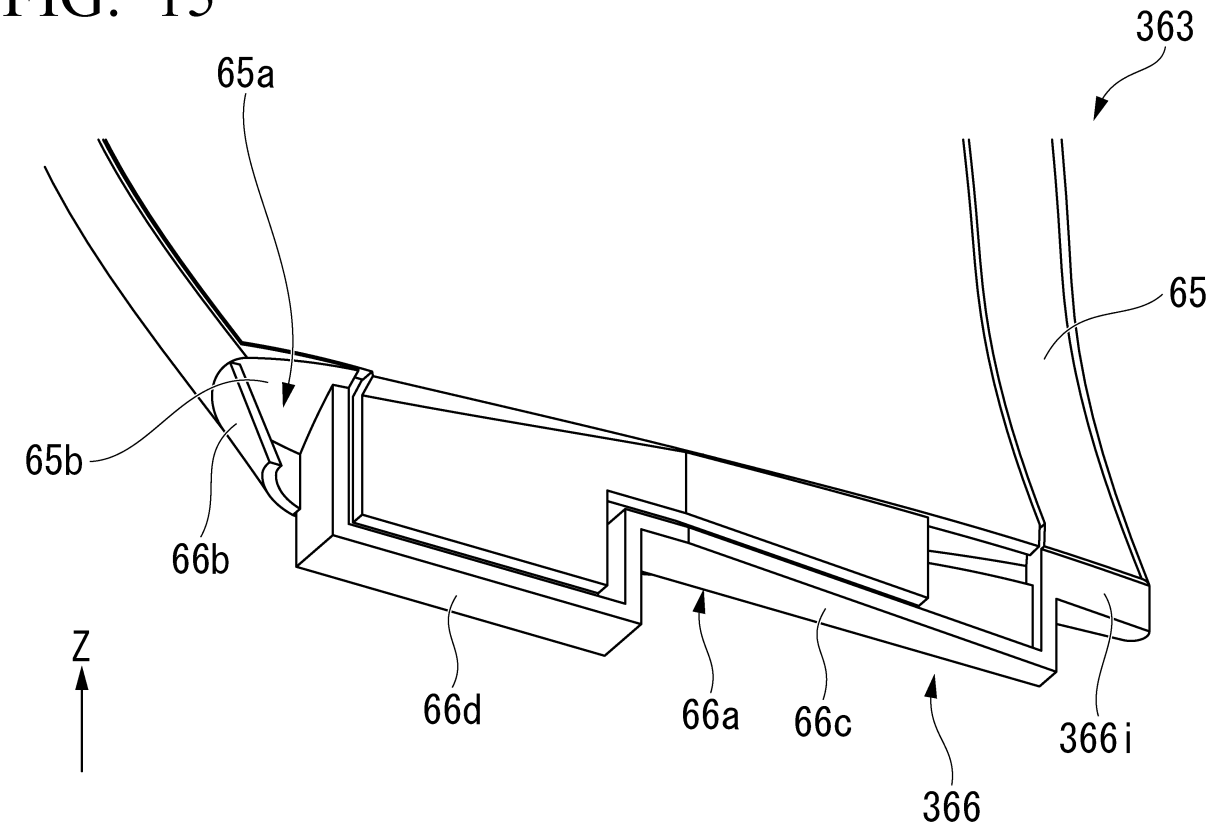

360
62a
364i
363
366i
364
66c
64c
366
64a
66d
66a
64d
65b
65a
64b
66b
65
362
Z

FIG. 15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65a
65
65b
66b
Z
66d
66a
66c
366
366i

FIG. 16

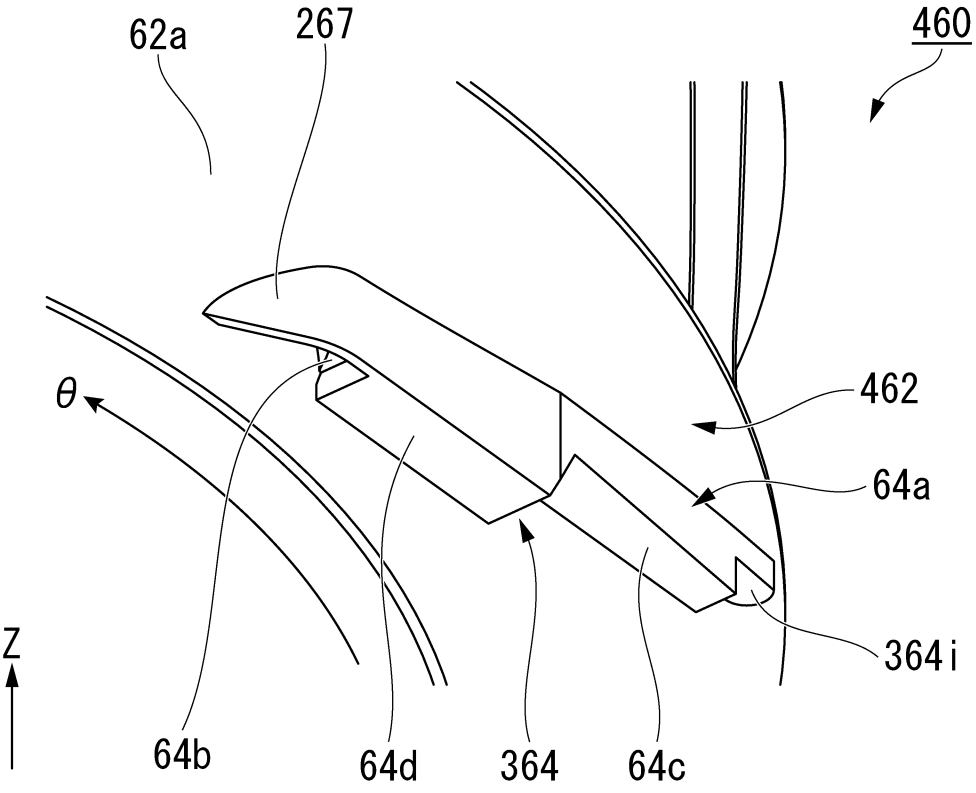
62a
267
460
θ
462
64a
Z
364i
64b
64d
364
64c

FIG. 17

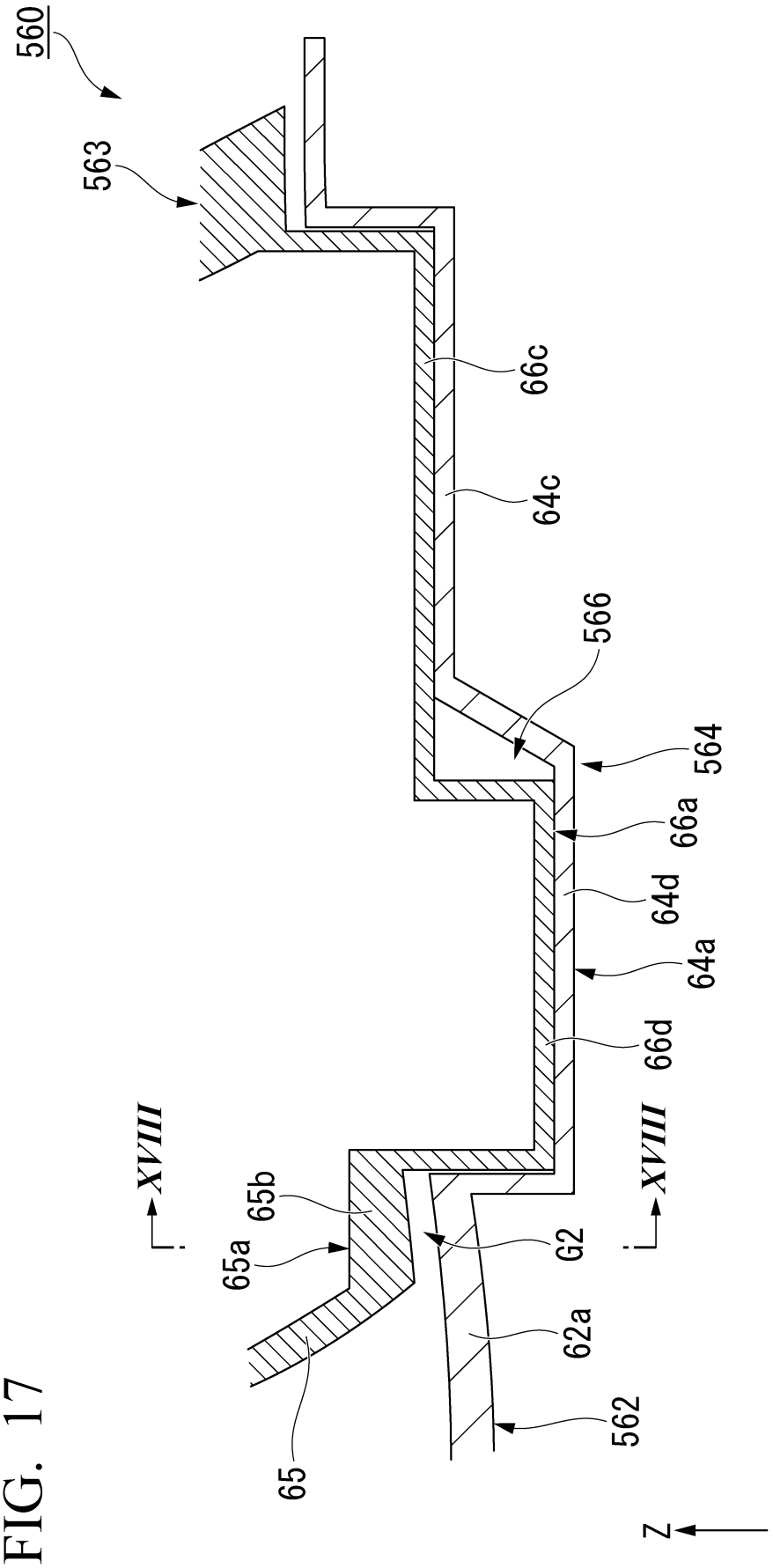
560
563
66c
64c
566
564
66a
64d
64a
66d
XVIII
XVIII
65b
65a
G2
62a
562
65
Z

FIG. 18