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(54) **BLOWER DEVICE AND AIR CONDITIONING UNIT**

(57) The blowing device (101) includes an impeller (30) and a casing (10). The casing includes a tongue portion (71). The tongue portion extends in directions of an axis of the impeller and partitions a suction side (S1) and a blow-out side (S2) from each other. The tongue portion has a first end portion (71a) and a second end portion (71b), and a central portion (71c). The first end portion and the second end portion are positioned at both ends in the directions of the axis. The central portion is positioned between the first end portion and the second end portion. Regarding a width dimension of the tongue portion, which represents a length from an edge on the suction side to an edge on the blow-out side of the tongue portion, the width dimension on the first end portion of the tongue portion is smaller than the width dimension on the central portion of the tongue portion.

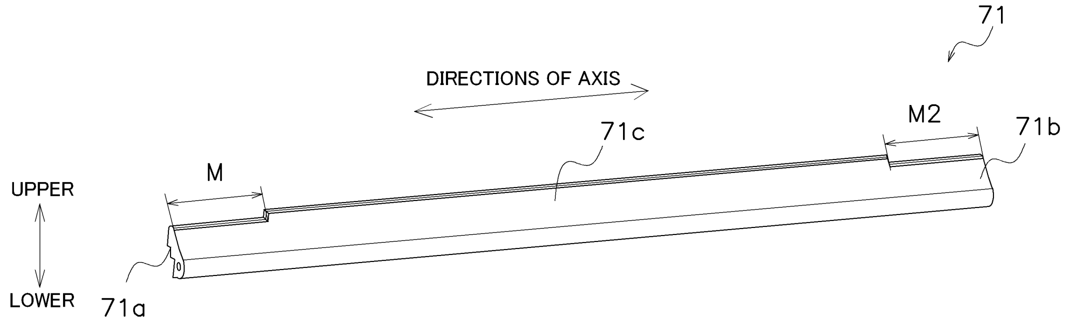

FIG. 3

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a blowing device and an air conditioning unit.

BACKGROUND ART

[0002] Conventionally, an indoor unit of an air conditioner (hereinafter referred to as an air conditioning unit), which is installed on a side wall of a room, instead of a ceiling, sucks air from a front surface or an upper surface, and blows out the air having undergone air conditioning from a blow-out port at a lower portion, has been widely used. As illustrated in PTL 1 (Japanese Unexamined Patent Application Publication No. 2016-50720), for example, a heat exchanger allowing heat to be exchanged between a refrigerant and air, and a blowing device are accommodated inside an air conditioning unit. The blowing device according to PTL 1 includes a cross-flow fan.

SUMMARY OF INVENTION

<Technical Problem>

[0003] The cross-flow fan involves an issue of an unstable phenomenon (so-called surging) in a blow-out flow, which occurs when air flow resistance increases due to clogging in a filter and frosting in a heat exchanger during cooling operation, for example.

<Solution to Problem>

[0004] A blowing device according to a first aspect includes an impeller and a casing. The casing includes a tongue portion. The tongue portion extends in directions of an axis of the impeller and partitions a suction side and a blow-out side from each other. The tongue portion has a first end portion and a second end portion, and a central portion. The first end portion and the second end portion are positioned at both ends in the directions of the axis. The central portion is positioned between the first end portion and the second end portion. Regarding a width dimension of the tongue portion, which represents a length from an edge on the suction side to an edge on the blow-out side of the tongue portion, the width dimension on the first end portion of the tongue portion is smaller than the width dimension on the central portion of the tongue portion.

[0005] Note herein that, since the width dimension on the first end portion of the tongue portion is smaller than the width dimension on the central portion of the tongue portion, it is possible to suppress surging.

[0006] A blowing device according to a second aspect is the blowing device according to the first aspect, in which the edge on the blow-out side of the central portion and the edge on the blow-out side of the first end portion are positioned at an identical position, when viewed in one of the directions of the axis.

[0007] A blowing device according to a third aspect is the blowing device according to the first aspect or the second aspect, in which the first end portion represents an end portion on which a wind speed decreases when the width dimension of the tongue portion is constant on the central portion, the first end portion, and the second end portion.

[0008] A blowing device according to a fourth aspect is the blowing device according to any one of the first aspect to the third aspect, in which each of the width dimension on the first end portion and the width dimension on the second end portion is smaller than the width dimension on the central portion.

[0009] A blowing device according to a fifth aspect is the blowing device according to any one of the first aspect to the fourth aspect, in which the width dimension on the first end portion is smaller than the width dimension on the second end portion.

[0010] A blowing device according to a sixth aspect is the blowing device according to any one of the first aspect to the fifth aspect, in which, on the first end portion, the width dimension of the tongue portion decreases in a stepwise manner as a distance from a portion closer to the central portion increases.

[0011] A blowing device according to a seventh aspect is the blowing device according to any one of the first aspect to the sixth aspect, in which a dimension of a gap between the central portion and the impeller is equal to a dimension of a gap between the first end portion and the impeller.

[0012] A blowing device according to an eighth aspect is the blowing device according to any one of the first aspect to the seventh aspect, in which, when a length dimension in the directions of the axis on the first end portion is defined as M, and an outer diameter of the impeller is defined as D, Formula (1) is satisfied.

$$\text{Formula (1): } 0.10 \leq M / D \leq 1.35$$

[0013] A blowing device according to a ninth aspect is the blowing device according to any one of the first aspect to the eighth aspect, in which, when an angle, when viewed in one of the directions of the axis, formed by a first straight line extending from the axis to the edge on the suction side ofthe central portion and a second straight line extending from the axis to the edge on the blow-out side of the central portion is defined as θa, and an angle, when viewed in the one of the directions of the axis, formed by a third straight line extending from the axis to the edge on the suction side of the first end portion and a fourth straight line extending from the axis to the edge on the blow-out side of the first end portion is defined as θb, Formula (2) is satisfied.

$$\text{Formula (2): } 0.39 \leq \theta b / \theta a \leq 0.98$$

[0014] A blowing device according to a tenth aspect is the blowing device according to any one of the first aspect to the ninth aspect, in which, when a length dimension in the directions of the axis on the first end portion is defined as M, an outer diameter of the impeller is defined as D, an angle, when viewed in one of the directions of the axis, formed by a first straight line extending from the axis to the edge on the suction side of the central portion and a second straight line extending from the axis to the edge on the blow-out side of the central portion is defined as θa, and an angle, when viewed in the one of the directions of the axis, formed by a third straight line extending from the axis to the edge on the suction side of the first end portion and a fourth straight line extending from the axis to the edge on the blow-out side of the first end portion is defined as θb, Formula (1) and Formula (2) are satisfied.

$$\text{Formula (1): } 0.10 \leq M / D \leq 1.35$$

$$\text{Formula (2): } 0.39 \leq \theta b / \theta a \leq 0.98$$

[0015] An air conditioning unit according to an eleventh aspect includes the blowing device according to any one of the first aspect to the tenth aspect.

[0016] An air conditioning unit according to a twelfth aspect includes the blowing device according to any one of the first aspect to the tenth aspect. A diameter of a fan of the impeller is equal to or greater than 126 mm.

[0017] An air conditioning unit according to a thirteenth aspect includes the blowing device according to any one of the first aspect to the tenth aspect. The air conditioning unit satisfies Formula (3).

(a diameter of a fan of the impeller / a height dimension of the air conditioning unit) ≥ (126 / 300)   Formula (3):

BRIEF DESCRIPTION OF DRAWINGS

[0018]

[Fig. 1] Fig. 1 is a configuration view of an air conditioning apparatus including an air conditioning outdoor unit and an air conditioning unit.
[Fig. 2] Fig. 2 is a vertical cross-sectional view of the air conditioning unit taken at a central portion (a cross-sectional view taken along an arrow II-II in Fig. 1).
[Fig. 3] Fig. 3 is a perspective view of a tongue portion.
[Fig. 4] Fig. 4 is a partially enlarged view of a cross section of the air conditioning unit.
[Fig. 5] Fig. 5 is a graph illustrating a relationship between M / D and an amount of increase in static pressure, when a length dimension in directions of an axis is defined as M and an outer diameter of impeller is defined as D.
[Fig. 6] Fig. 6 is another graph illustrating the relationship between M / D and the amount of increase in static pressure, when the length dimension in the directions of the axis is defined as M and the outer diameter of the impeller is defined as D.
[Fig. 7] Fig. 7 is a graph illustrating a relationship between an angular range of the tongue portion with respect to the axis and the amount of increase in static pressure.
[Fig. 8] Fig. 8 is a perspective view of a tongue portion according to a modification example.
[Fig. 9] Fig. 9 is a graph illustrating a relationship between M / D and an amount of increase in static pressure, when a length dimension in the directions of the axis is defined as M and an outer diameter of the impeller is defined as D, according to the modification example.
[Fig. 10] Fig. 10 is a perspective view of a tongue portion according to another modification example.

[Fig. 11] Fig. 11 is a perspective view of a tongue portion according to still another modification example.

DESCRIPTION OF EMBODIMENTS

[0019] In a following description, an axis refers to an axis of an impeller 30. Directions of the axis refer to directions in which the axis of the impeller 30 extends. Furthermore, although expressions indicating directions such as "upper", "lower", and "front" are used as appropriate, these expressions indicate respective directions in a state where an air conditioning unit 100 is attached and is used normally. For example, upper-and-lower directions refer to vertical directions. Furthermore, although an expression such as "parallel" is used in some cases similarly or identically, cases in which the expression is used include not only a case where one is in "parallel" completely identically, but also a case where one is in "parallel" substantially identically.

(1) Overall Configuration

[0020] As illustrated in Fig. 1, the air conditioning unit 100 is a wall-mounted type indoor unit attached to a wall surface in a room. Furthermore, the air conditioning unit 100 is coupled to an air conditioning outdoor unit 91 disposed outside the room via a refrigerant pipe 93 to constitute an air conditioner 90. The air conditioning unit 100 performs cooling operation and heating operation in the room in response to an operation performed via a remote controller, for example.

[0021] As illustrated in Fig. 2, the air conditioning unit 100 includes a blowing device 101, a heat exchanger 20, and a filter 40.

(2) Blowing Device

[0022] The blowing device 101 includes a cross-flow fan including the impeller 30, and a casing 10.

(2-1) Cross-flow Fan

[0023] The cross-flow fan includes the impeller 30 having a cylindrical shape extending long in horizontal directions, and a motor for rotating the impeller 30. The impeller 30 has a plurality of fan blades 31 arranged along its circumference. The impeller 30 rotates to generate a flow of air flowing from a side where the heat exchanger 20 is present to a side where a blow-out port 10b is present.

[0024] As the impeller 30 rotates, air flows from inside the room to the heat exchanger 20 via the filter 40. The air that has passed through the heat exchanger 20 is blown into the room.

[0025] Although a diameter of the fan of the impeller 30 is not limited, the diameter is, for example, 126 mm or greater. The diameter of the fan of the impeller 30 corresponds to a diameter of a virtual circle coupling outer ends of the plurality of fan blades 31, when viewed in one of the directions of the axis (see a circle 30a indicated by a dotted line in Fig. 2. The circle will be hereinafter referred to as a virtual circumscribed circle). The diameter of the fan of the impeller 30 is preferably equal to or greater than 130 mm, and more preferably equal to or greater than 135 mm.

[0026] The diameter of the fan of the impeller 30 and a height dimension of the air conditioning unit 100 satisfy Formula (3).

(the diameter of the fan of the impeller 30 / the height dimension of the air conditioning unit) ≥ (126 / 300) Formula (3):

[0027] A number of rotations of the motor of the impeller 30 is changed by a non-illustrated control device. The control device incorporated in the air conditioning unit 100 changes the number of rotations of the motor based on an operation input provided by a user via the remote controller, for example.

(2-2) Casing

[0028] The casing 10 is an assembly of members forming an outer contour and a frame of the air conditioning unit 100. The casing 10 supports and houses the filter 40, the heat exchanger 20, and the impeller 30.

[0029] On an upper portion of the casing 10, a suction port 10a for taking air inside the room is formed. On a lower portion of the casing 10, the blow-out port 10b through which the air having undergone air conditioning is blown into the room is formed. The suction port 10a is positioned higher than an axis O serving as a rotation center of the impeller 30. More specifically, the suction port 10a is formed on a top surface (an upper surface) of the casing 10, through which air inside the room is sucked from a space above the air conditioning unit 100. The blow-out port 10b is positioned lower than the axis O.

More specifically, the blow-out port 10b is formed on a front-side portion of a bottom surface of the casing 10, through which air is blown into a space in front of and below the air conditioning unit 100.

[0030] The casing 10 includes a front panel 15, a rear guider 18, and a stabilizer 17. The stabilizer 17 and the rear guider 18 form a blow-out air flow path 10c through which air flowing from the impeller 30 to the blow-out port 10b is formed in a scroll shape. An upper portion of the rear guider 18 is positioned higher than the axis O. The front panel 15 is disposed on a front side of the filter 40. The stabilizer 17 is disposed closer to the front side than the rear guider 18. The stabilizer 17 includes a tongue portion 71 and support portions 73. The support portions 73 support the tongue portion 71.

[0031] As the impeller 30 rotates, air flows from inside the room to the heat exchanger 20 via the suction port 10a and the filter 40. The air that has passed through the heat exchanger 20 flows to the blow-out air flow path 10c and is blown into the room from the blow-out port 10b.

[0032] As illustrated in Fig. 3, the tongue portion 71 extends in the directions of the axis of the impeller 30. That is, longitudinal directions of the tongue portion 71 are in parallel to the directions of the axis of the impeller 30. In an internal space of the blowing device 101, the tongue portion 71 partitions a suction side S1 and a blow-out side S2 from each other. The tongue portion 71 has a curved surface facing the impeller 30.

[0033] The tongue portion 71 has a first end portion 71a and a second end portion 71b, and a central portion 71c. The first end portion 71a and the second end portion 71b are positioned at both ends in the directions of the axis. The first end portion 71a represents an end portion on which a wind speed decreases when a width dimension of the tongue portion 71 is constant on the central portion 71c, the first end portion 71a, and the second end portion 71b. The central portion 71c is positioned between the first end portion 71a and the second end portion 71b.

[0034] A dimension of a gap between the tongue portion 71 and the impeller 30 does not change from the suction side S1 to the blow-out side S2 of the tongue portion 71. However, the dimension of the gap between the tongue portion 71 and the impeller 30 is not limited to this case, and may vary from the suction side S1 to the blow-out side S2. Specifically, the dimension of the gap between the tongue portion 71 and the impeller 30 may increase from the blow-out side S2 to the suction side S1, or may decrease from the blow-out side S2 to the suction side S1.

[0035] Regarding a width dimension of the tongue portion 71, the width dimension on the first end portion 71a of the tongue portion 71 is smaller than the width dimension on the central portion 71c of the tongue portion 71. The width dimension of the tongue portion 71 refers to a length from an edge on the suction side S1 to an edge on the blow-out side S2 of the tongue portion 71.

[0036] The width dimension on the first end portion 71a does not change in the directions of the axis.

[0037] On the edge on the suction side S1, there is a step between the first end portion 71a and the central portion 71c.

[0038] When viewed in one of the directions of the axis, the edge on the blow-out side 71c of the central portion S2 and the edge on the blow-out side 71a of the first end portion S2 are positioned at an identical position. That is, a shape of the edge on the blow-out side S2 of the tongue portion 71 does not change in the directions of the axis.

[0039] A dimension of a gap between the first end portion 71a and the impeller 30 is equal to a dimension of a gap between the central portion 71c and the impeller 30. More specifically, a shortest distance from the edge on the blow-out side S2 of the first end portion 71a to the virtual circumscribed circle of the impeller 30 is equal to a shortest distance from the edge on the blow-out side S2 of the central portion 71c to the virtual circumscribed circle of the impeller 30.

[0040] When a length dimension in the directions of the axis on the first end portion 71a is defined as M, and an outer diameter of the impeller 30 is defined as D, M / D satisfies Formula (1).

$$\text{Formula (1)}: 0.10 \leq M / D \leq 1.35$$

[0041] A range of M / D is preferably from 0.25 to 1.25, and more preferably from 0.40 to 1.15.

[0042] As illustrated in Fig. 4, an angle, when viewed in one of the directions of the axis, formed by a first straight line L1 extending from the axis O to the edge on the suction side S1 of the central portion 71c and a second straight line L2 extending from the axis O to the edge on the blow-out side 71c of the central portion S2 is defined as θa. An angle, when viewed in the one of the directions of the axis, formed by a third straight line L3 extending from the axis O to the edge on the suction side S1 of the first end portion 71a and a fourth straight line L4 extending from the axis O to the edge on the blow-out side S2 of the first end portion 71a is defined as θb. The angle θa is greater than the angle θb. Specifically, $\theta b / \theta a$ satisfies Formula (2).

$$\text{Formula (2)}: 0.39 \leq \theta b / \theta a \leq 0.98$$

[0043] A range of $\theta b / \theta a$ is preferably from 0.42 to 0.95, and more preferably from 0.47 to 0.90.

[0044] The width dimension on the second end portion 71b of the tongue portion 71 is smaller than the width dimension on the central portion 71c of the tongue portion 71. The width dimension on the second end portion 71b of the tongue portion 71 is identical to the width dimension on the first end portion 71a of the tongue portion 71.

[0045] The width dimension on the second end portion 71b does not change in the directions of the axis. A length dimension M2 in the directions of the axis on the second end portion 71b is identical to a length dimension M in the directions of the axis on the first end portion 71a.
[0046] On the edge on the suction side S1, there is a step between the second end portion 71b and the central portion 71c.
[0047] When viewed in one of the directions of the axis, the edge on the blow-out side S2 of the central portion 71c and the edge on the blow-out side S2 of the second end portion side 71b are positioned at an identical position. That is, a shape of the edge on the blow-out side S2 of the tongue portion 71 does not change in the longitudinal directions.
[0048] A dimension of a gap between the second end portion 71b and the impeller 30 is equal to the dimension of the gap between the central portion 71c and the impeller 30. Specifically, a shortest distance from the edge on the blow-out side S2 of the second end portion 71b to the virtual circumscribed circle of the impeller 30 is equal to the shortest distance from the edge on the blow-out side S2 of the central portion 71c to the virtual circumscribed circle of the impeller 30.
[0049] When a length dimension in the directions of the axis on the second end portion 71b is defined as M', and the outer diameter of the impeller 30 is defined as D, M' / D satisfies Formula (1)'.

$$\text{Formula (1)': } 0.10 \leq M' / D \leq 1.35$$

[0050] A range of M' / D is preferably from 0.25 to 1.25, and more preferably from 0.40 to 1.15.
[0051] An angle, when viewed in one of the directions of the axis, formed by the first straight line L1 extending from the axis O to the edge on the suction side S1 of the central portion 71c and the second straight line L2 extending from the axis O to the edge on the blow-out side S2 of the central portion 71c is defined as θa. An angle, when viewed in the one of the directions of the axis, formed by a fifth straight line L5 extending from the axis O to the edge on the suction side S1 of the second end portion 71b and a sixth straight line L6 extending from the axis O to the edge on the blow-out side S2 of the second end portion 71b is defined as θb'. The angle θa is greater than the angle θb'. Specifically, θb' / θa satisfies Formula (2)'.

$$\text{Formula (2)': } 0.39 \leq \theta b' / \theta a \leq 0.98 \text{ (2)}$$

[0052] A range of θb' / θa is preferably from 0.42 to 0.95, and more preferably from 0.47 to 0.90.

(3) Heat Exchanger and Filter

[0053] The heat exchanger 20 is a fin-and-tube type heat exchanger having a truncated wedge shape in a vertical cross-sectional view. The shape of the heat exchanger 20 is not limited. The heat exchanger 20 may have, for example, an inverted V shape. The heat exchanger 20 allows heat to be exchanged between air flowing from a side on which the suction port 10a is present to a side on which the impeller 30 is present and a refrigerant flowing through a tube. The heat exchanger 20 includes a plurality of aluminum heat transfer fins and a plurality of tubes passing through a plurality of holes formed in the heat transfer fins. The tubes, which are copper heat transfer tubes, each have an outer diameter of 5 mm or 4 mm.
[0054] An air flow upstream side of the impeller 30 is covered with the filter 40. Specifically, the heat exchanger 20 positioned above and in front of the impeller 30 is covered with the filter 40. The filter 40 collects dust contained in air flowing from the suction port 10a to the heat exchanger 20.

(4) Feature

[0055] (4-1)
Both end portions in the directions of the axis of the cross-flow fan are more affected by lateral suction than a central portion. As a result, separation of a flow of air occurs on side surfaces. Therefore, air is rarely sucked at both the end portions of the cross-flow fan, allowing a circulation vortex of air inside the fan to increase in size. As a result, a wind speed decreases, allowing surging to occur. At this time, a circulation vortex at each of both the end portions inside the cross-flow fan becomes larger in size than a circulation vortex at the central portion, as illustrated by a broken-line arc in Fig. 4.
[0056] In the cross-flow fan, regarding a width dimension of the tongue portion 71, which represents a length from the edge on the suction side S1 to the edge on the blow-out side S2 of the tongue portion 71, the width dimension on the first end portion 71a of the tongue portion 71 is smaller than the width dimension on the central portion 71c of the tongue portion 71. As a result, on each of the first end portion 71a and the second end portion 71b, a circulation vortex inside the cross-flow fan becomes smaller in size, similar to a circular arc illustrated by an solid line in Fig. 4. As a result, it is possible to increase static pressure in a blow-out air flow path, making it possible to increase a wind speed. As a result, it is possible to suppress

occurrence of surging.

[0057] (4-2)

The edge on the blow-out side S2 of the central portion 71c and the edge on the blow-out side S2 of the first end portion 71a are positioned at an identical position, when viewed in one of the directions of the axis.

[0058] Note herein that, when viewed in one of the directions of the axis, a position of the edge on the blow-out side S2 does not change between the central portion 71c and the first end portion 71a. Therefore, since a distance between the tongue portion 71 and the impeller 30 is kept constant over a whole length of the tongue portion 71, preventing air blowing efficiency from being lowered.

[0059] (4-3)

The first end portion 71a represents an end portion on which a wind speed decreases when the width dimension of the tongue portion 71 is constant on the central portion 71c, the first end portion 71a, and the second end portion 71b.

[0060] Therefore, it is possible to increase a blow-out speed on the end portion where a wind speed is originally low.

[0061] (4-4)

Each of the width dimension on the first end portion 71a and the width dimension on the second end portion 71b is smaller than the width dimension on the central portion 71c.

[0062] Note herein that, since each of the width dimension on the first end portion 71a and the width dimension on the second end portion 71b is smaller than the width dimension on the central portion 71c, it is possible to increase a blow-out speed, compared with a case where a width dimension on only one end is reduced.

[0063] (4-5)

The dimension of the gap between the central portion 71c and the impeller 30 is equal to the dimension of the gap between the first end portion 71a and the impeller 30.

[0064] Note herein that the distance between the tongue portion 71 and the impeller 30 is kept constant over the whole length of the tongue portion 71. Therefore, there is no reduction in air blowing efficiency.

[0065] (4-6)

When the length dimension in the directions of the axis on the first end portion 71a is defined as M, and the outer diameter of the impeller 30 is defined as D, Formula (1) is satisfied.

$$\text{Formula (1): } 0.10 \leq M / D \leq 1.35$$

[0066] As illustrated in Figs. 5 and 6, when M / D ranges from 0.10 to 1.35, occurrence of surging is suppressed.

[0067] (4-7)

When an angle, when viewed in one of the directions of the axis, formed by the first straight line L1 extending from the axis O to the edge on the suction side S1 of the central portion 71c and the second straight line L2 extending from the axis O to the edge on the blow-out side S2 of the central portion 71c is defined as θa, and an angle, when viewed in the one of the directions of the axis, formed by the third straight line L3 extending from the axis O to the edge on the suction side S1 of the first end portion 71a and the fourth straight line L4 extending from the axis O to the edge on the blow-out side S2 of the first end portion 71a is defined as θb, Formula (2) is satisfied.

$$\text{Formula (2): } 0.39 \leq \theta b / \theta a \leq 0.98$$

[0068] As illustrated in Fig. 7, when θb / θa ranges from 0.39 to 0.98, occurrence of surging is suppressed.

[0069] (4-8)

The air conditioning unit 100 includes the blowing device 101 described above. As a result, the air conditioning unit 100 makes it possible to suppress occurrence of surging.

[0070] (4-9)

The diameter of the fan of the impeller 30 is equal to or greater than 126 mm.

[0071] According to this configuration, since the cross-flow fan having a large diameter of the fan of the impeller 30 is used, it is possible to reduce noise and power consumption during air conditioning operation.

[0072] (4-10)

The air conditioning unit 100 satisfies Formula (3).

$$\text{(the diameter of the fan of the impeller / the height dimension of the air conditioning unit)} \geq (126 / 300) \qquad \text{Formula (3):}$$

[0073] According to this configuration, since the cross-flow fan having a large diameter of the fan of the impeller 30 with respect to an indoor unit main body is used, it is possible to reduce noise and power consumption during air conditioning operation.

(5) Modification Examples

(5-1) Modification Example A

[0074] In the embodiment described above, the width dimension on the first end portion 71a is identical to the width dimension on the second end portion 71b. However, each of the width dimension on the first end portion 71a and the width dimension on the second end portion 71b is not limited to the width dimension in the embodiment described above. The width dimension on the first end portion 71a and the width dimension on the second end portion 71b may be different from each other. For example, the width dimension on the first end portion 71a may be smaller than the width dimension on the second end portion 71b.
[0075] In this case, it is possible to make a wind speed higher on the first end portion 71a, where a wind speed is originally low, than a wind speed on the second end portion 71b.

(5-2) Modification Example B

[0076] In the embodiment described above, the length dimension M2 in the directions of the axis on the second end portion 71b is identical to the length dimension M in the directions of the axis on the first end portion 71a. However, the length dimension M2 in the directions of the axis on the second end portion 71b may be different from the length dimension M in the directions of the axis on the first end portion 71a. For example, the length dimension M2 in the directions of the axis on the second end portion 71b may be smaller than the length dimension M in the directions of the axis on the first end portion 71a.
[0077] In this case, it is possible to make a wind speed higher on the first end portion 71a, where a wind speed is originally low, than a wind speed on the second end portion 71b.

(5-3) Modification Example C

[0078] In the embodiment described above and Modification Example A, each of both the width dimension on the first end portion 71a and the width dimension on the second end portion 71b is smaller than the width dimension on the central portion 71c. However, each of the width dimension on the first end portion 71a and the width dimension on the second end portion 71b is not limited to the width dimension in the embodiment described above. For example, only the width dimension on the first end portion 71a may be smaller than the width dimension on the central portion 71c.
[0079] In this case, it is possible to make a wind speed higher on the first end portion 71a, where a wind speed is originally low.

(5-4) Modification Example D

[0080] In the embodiment described above, the width dimension on the first end portion 71a is constant in the directions of the axis. However, the present disclosure is not limited to the embodiment described above. As illustrated in Fig. 10, on the first end portion 71a, a width dimension of the tongue portion 71 may decrease in a stepwise manner as a distance from a portion closer to the central portion 71c increases.
[0081] In this case, continuity in the directions of the axis of a circulation vortex generated inside the impeller 30 is rarely lost, easily achieving a stable air flow.
[0082] In the case of Modification Example D, regarding Formula (2), the third straight line L3 represents a straight line extending from the axis O to the edge on the suction side S1 at a center of the first end portion 71a.

(5-5) Modification Example E

[0083] As illustrated in Fig. 11, on the first end portion 71a, the width dimension of the tongue portion 71 may decrease in a slope shape, as a distance from a portion closer to the central portion 71c increases.
[0084] In this case, since continuity in the directions of the axis of a circulation vortex generated inside the impeller 30 is not lost, the air flow stabilizes.
[0085] In the case of Modification Example E, regarding Formula (2), the third straight line L3 represents a straight line extending from the axis O to the edge on the suction side S1 at the center of the first end portion 71a.

(5-6) Modification Example F

[0086] As illustrated in Fig. 11, the first end portion 71a and the second end portion 71b may have different shapes.

EXAMPLE 1

[0087] Blowing devices in which diameters of fans of impellers are 115 mm, 126 mm, 135 mm, and 149 mm were prepared. In each of the blowing devices, for an angle θa, when viewed in one of the directions of the axis, formed by a first straight line extending from the axis to an edge on a suction side of a central portion and a second straight line extending from the axis to an edge on a blow-out side of the central portion, and an angle θb, as viewed in the one of the directions of the axis, formed by a third straight line extending from the axis to an edge on the suction side of a first end portion and a fourth straight line extending from the axis to an edge on the blow-out side of the first end portion were set to be θb / θa = 0.85. In each of the blowing devices, only a width dimension of a tongue portion was variously changed on both the first end portion and a second end portion, and an amount of increase in static pressure was measured. The width dimension of the tongue portion is set constant on the first end portion and the second end portion. Fig. 5 illustrates results.

[0088] Furthermore, blowing devices in which values of θb / θa were 0.98, 0.85, 0.68, and 0.39 were prepared. Diameters of fans of impellers were each set to 135 mm. In each of the blowing devices, only a width dimension of a tongue portion was variously changed on both the first end portion and the second end portion, and an amount of increase in static pressure was measured. Fig. 6 illustrates results.

[0089] In Figs. 5 and 6, a horizontal axis represents M / D, and a vertical axis represents an amount of increase in static pressure. As results of tests, an amount of increase in static pressure increased when M / D ranged from 0.10 to 1.35. This means that occurrence of surging was suppressed.

EXAMPLE 2

[0090] A blowing device in which a diameter of a fan of an impeller was 135 mm was prepared. It was set that M / D = 0.30. Amounts of increase in static pressure were measured by variously changing θb / θa. Amounts of increase in static pressure were measured when θb / θa was changed on both the first end portion and the second end portion, and when θb / θa was changed only on the first end portion. When θb / θa was changed on both the first end portion and the second end portion, a value of θb / θa on the first end portion was set to be identical to a value of θb / θa on the second end portion. Fig. 7 illustrates results.

[0091] In Fig. 7, the horizontal axis represents θb / θa, and the vertical axis represents an amount of increase in static pressure. As results of tests, when θb / θa was changed on both the first end portion and the second end portion, an amount of increase in static pressure increased when θb / θa ranged from 0.39 to 0.98. This means that occurrence of surging was suppressed.

EXAMPLE 3

[0092] Blowing devices in which diameters of fans of impellers were 115 mm, 126 mm, 135 mm, and 149 mm were prepared. In each of the blowing devices, it was set that θb / θa = 0.85. In each of the blowing devices, only a width dimension of a tongue portion was variously changed on a first end portion, and an amount of increase in static pressure was measured. A width dimension on a second end portion of the tongue portion was set to be identical to a width dimension on a central portion of the tongue portion.

[0093] Furthermore, for one of the blowing devices, in which the diameter of the fan of the impeller was 135 mm, a width dimension of a tongue portion was changed on a second end portion, where a wind speed was originally high, and an amount of increase in static pressure was measured. In this example, a width dimension on the first end portion of the tongue portion was set to be identical to a width dimension on the central portion of the tongue portion.

[0094] Fig. 9 illustrates results.

[0095] In Fig. 9, the horizontal axis represents M / D, and the vertical axis represents an amount of increase in static pressure. As results of tests, an amount of increase in static pressure increased when M / D ranged from 0.10 to 1.35. This means that occurrence of surging was suppressed even when only the width dimension on the first end portion of the tongue portion was changed.

[0096] While the embodiment of the present disclosure has been described above, it will be understood that various modifications in form and detail may be made therein without departing from the spirit and scope of the present disclosure as set forth in the appended claims.

REFERENCE SIGNS LIST

[0097]

10	Casing
10a	Suction port

10b	Blow-out port
10c	Blow-out air flow path
17	Stabilizer
18	Rear guider
20	Heat exchanger
30	Impeller
30a	Virtual circle (virtual circumscribed circle) coupling outer ends of fan blades
31	Fan blade
71	Tongue portion of stabilizer
71a	First end portion
71b	Second end portion
71c	Central portion
73	Support portion of stabilizer
100	Air conditioning unit
101	Blowing device
O	Axis of fan
L1	First straight line
L2	Second straight line
L3	Third straight line
L4	Fourth straight line
S1	Suction side
S2	Blow-out side

CITATION LIST

PATENT LITERATURE

[0098] PTL 1: Japanese Unexamined Patent Application Publication No. 2016-50720

Claims

1. A blowing device (101) comprising:

    an impeller (30); and
    a casing (10) including a tongue portion (71) extending in directions of an axis of the impeller and partitioning a suction side (S1) and a blow-out side (S2) from each other,
    wherein
    the tongue portion has a first end portion (71a) and a second end portion (71b) positioned at both ends in the directions of the axis, and a central portion (71c) positioned between the first end portion and the second end portion, and,
    regarding a width dimension of the tongue portion, the width dimension representing a length from an edge on the suction side to an edge on the blow-out side of the tongue portion, the width dimension on the first end portion of the tongue portion is smaller than the width dimension on the central portion of the tongue portion.

2. The blowing device according to claim 1, wherein the edge on the blow-out side of the central portion and the edge on the blow-out side of the first end portion are positioned at an identical position, when viewed in one of the directions of the axis.

3. The blowing device according to claim 1 or 2, wherein the first end portion represents an end portion on which a wind speed decreases when the width dimension of the tongue portion is constant on the central portion, the first end portion, and the second end portion.

4. The blowing device according to any one of claims 1 to 3, wherein each of the width dimension on the first end portion and the width dimension on the second end portion is smaller than the width dimension on the central portion.

5. The blowing device according to any one of claims 1 to 4, wherein the width dimension on the first end portion is smaller than the width dimension on the second end portion.

6. The blowing device according to any one of claims 1 to 5, wherein, on the first end portion, the width dimension of the tongue portion decreases in a stepwise manner as a distance from a portion closer to the central portion increases.

7. The blowing device according to any one of claims 1 to 6, wherein a dimension of a gap between the central portion and the impeller is equal to a dimension of a gap between the first end portion and the impeller.

8. The blowing device according to any one of claims 1 to 7, wherein, when a length dimension in the directions of the axis on the first end portion is defined as M, and an outer diameter of the impeller is defined as D, Formula (1) is satisfied.

$$\text{Formula (1): } 0.10 \leq M / D \leq 1.35$$

9. The blowing device according to any one of claims 1 to 8, wherein, when an angle, when viewed in one of the directions of the axis, formed by a first straight line (L1) extending from an axis (O) to the edge on the suction side of the central portion and a second straight line (L2) extending from the axis to the edge on the blow-out side of the central portion is defined as θa, and an angle, when viewed in the one of the directions of the axis, formed by a third straight line (L3) extending from the axis to the edge on the suction side of the first end portion and a fourth straight line (L4) extending from the axis to the edge on the blow-out side of the first end portion is defined as θb, Formula (2) is satisfied.

$$\text{Formula (2): } 0.39 \leq \theta b / \theta a \leq 0.98$$

10. The blowing device according to any one of claims 1 to 9, wherein, when a length dimension in the directions of the axis on the first end portion is defined as M, an outer diameter of the impeller is defined as D, an angle, when viewed in one of the directions of the axis, formed by a first straight line extending from the axis to the edge on the suction side of the central portion and a second straight line extending from the axis to the edge on the blow-out side of the central portion is defined as θa, and an angle, when viewed in the one of the directions of the axis, an angle formed by a third straight line extending from the axis to the edge on the suction side of the first end portion and a fourth straight line extending from the axis to the edge on the blow-out side of the first end portion is defined as θb, Formula (1) and Formula (2) are satisfied.

$$\text{Formula (1): } 0.10 \leq M / D \leq 1.35$$

$$\text{Formula (2): } 0.39 \leq \theta b / \theta a \leq 0.98$$

11. An air conditioning unit (100) comprising the blowing device according to any one of claims 1 to 10.

12. An air conditioning unit comprising the blowing device according to any one of claims 1 to 10, wherein a diameter of a fan of the impeller is equal to or greater than 126 mm.

13. An air conditioning unit comprising the blowing device according to any one of claims 1 to 10, wherein Formula (3) is satisfied.

(a diameter of a fan of the impeller / a height dimension of the air conditioning unit) ≥ (126 / 300) Formula (3):

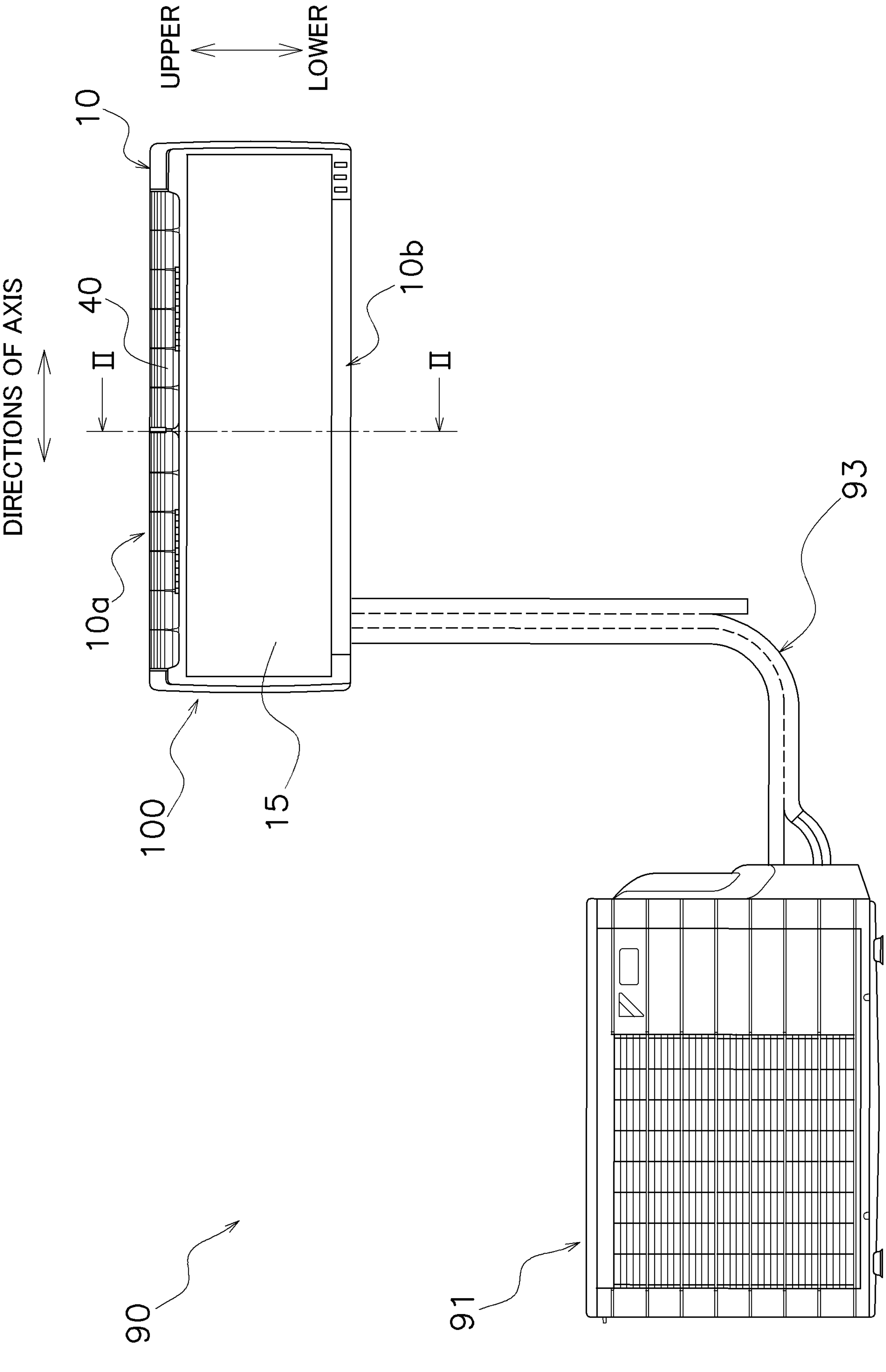
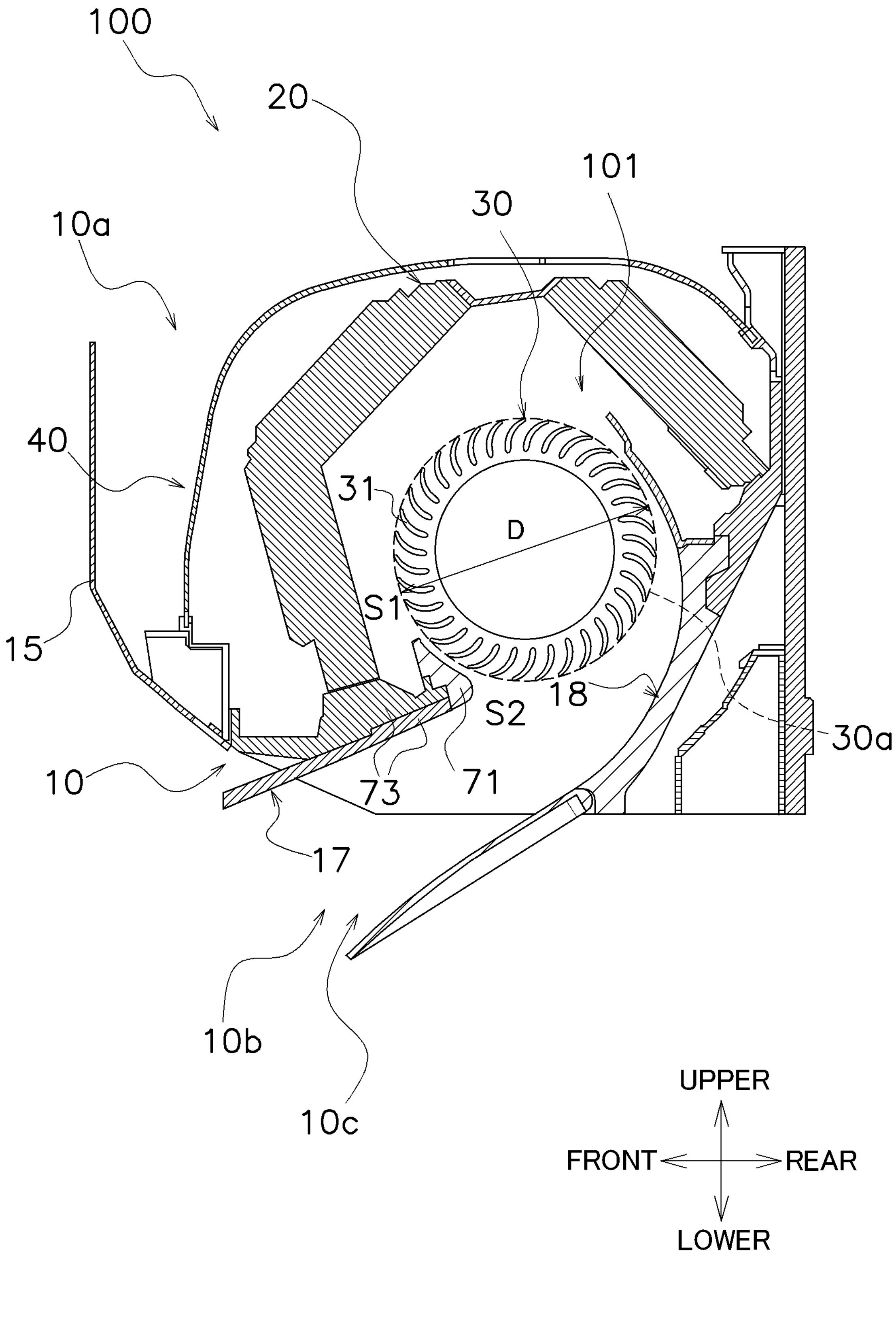

UPPER
LOWER
DIRECTIONS OF AXIS
II
II
10
40
10b
10a
100
15
93
90
91

FIG. 1



100
20
101
30
10a
40
31
D
S1
15
18
S2
30a
10
73
71
17
10b
10c
UPPER
FRONT
REAR
LOWER

FIG. 2

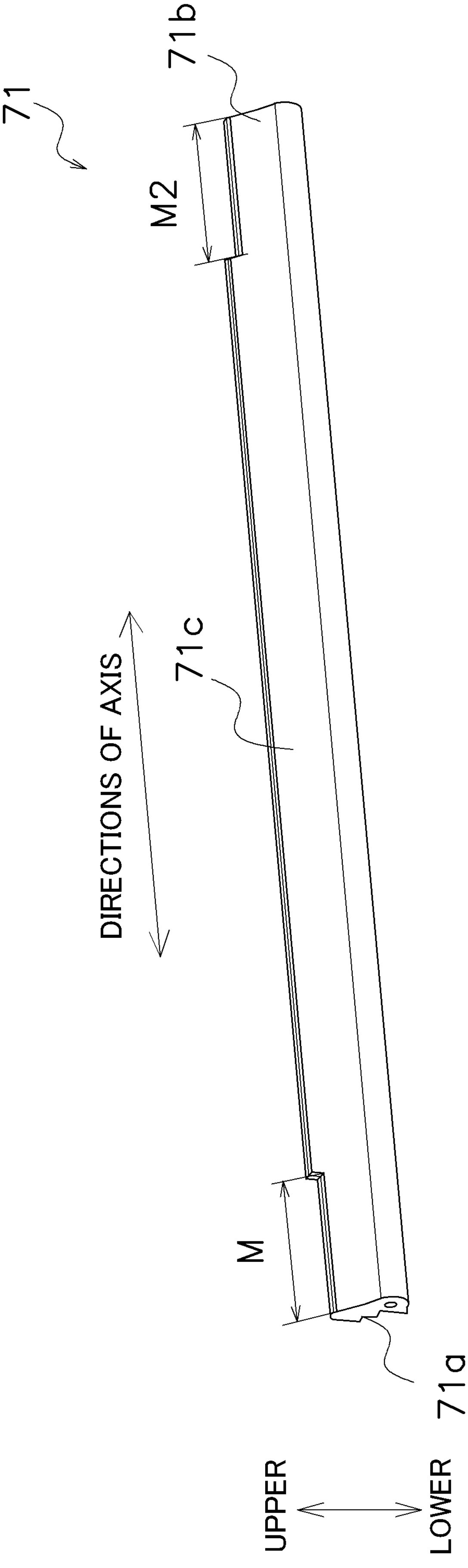


FIG. 3

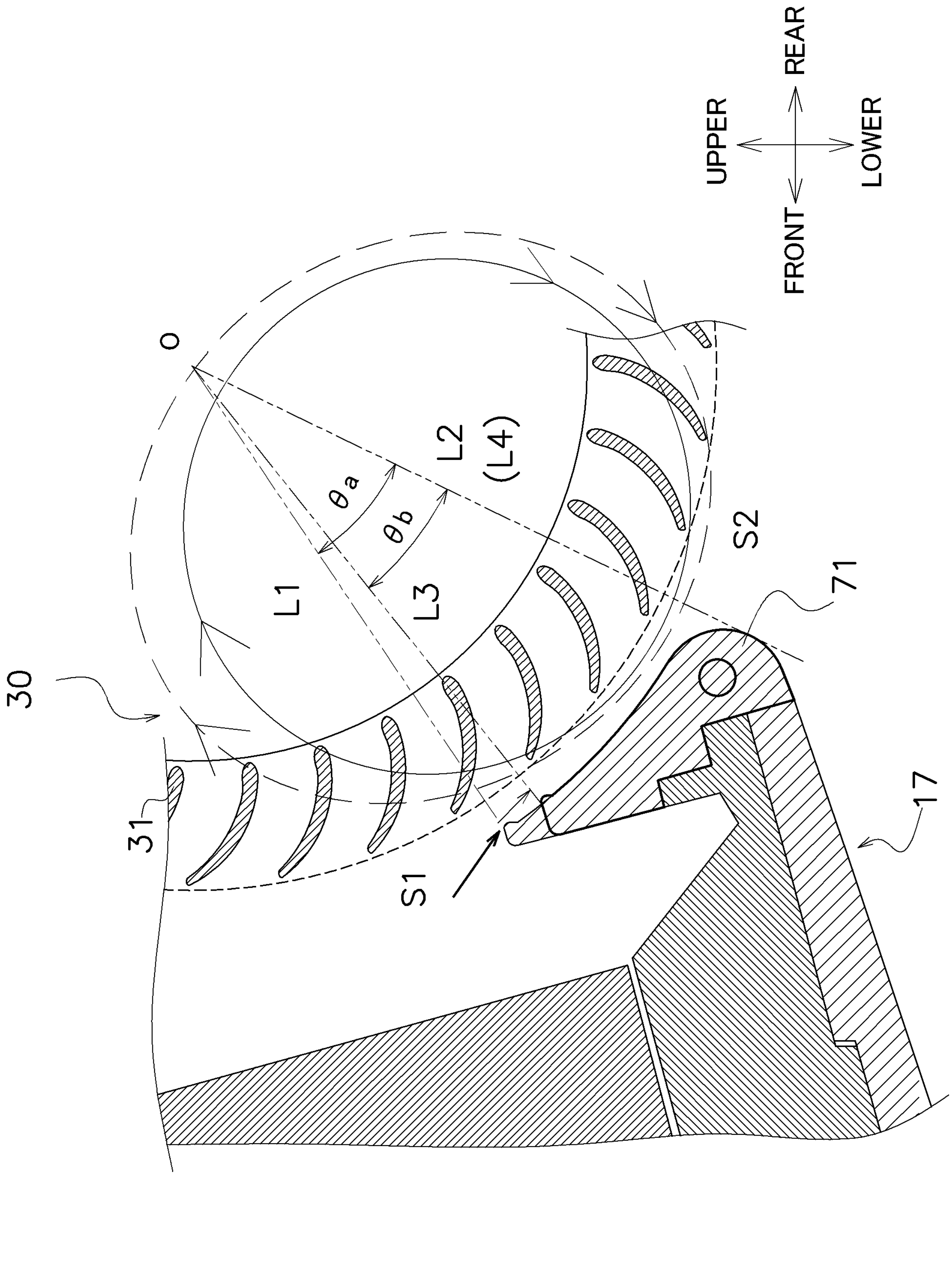


FIG. 4

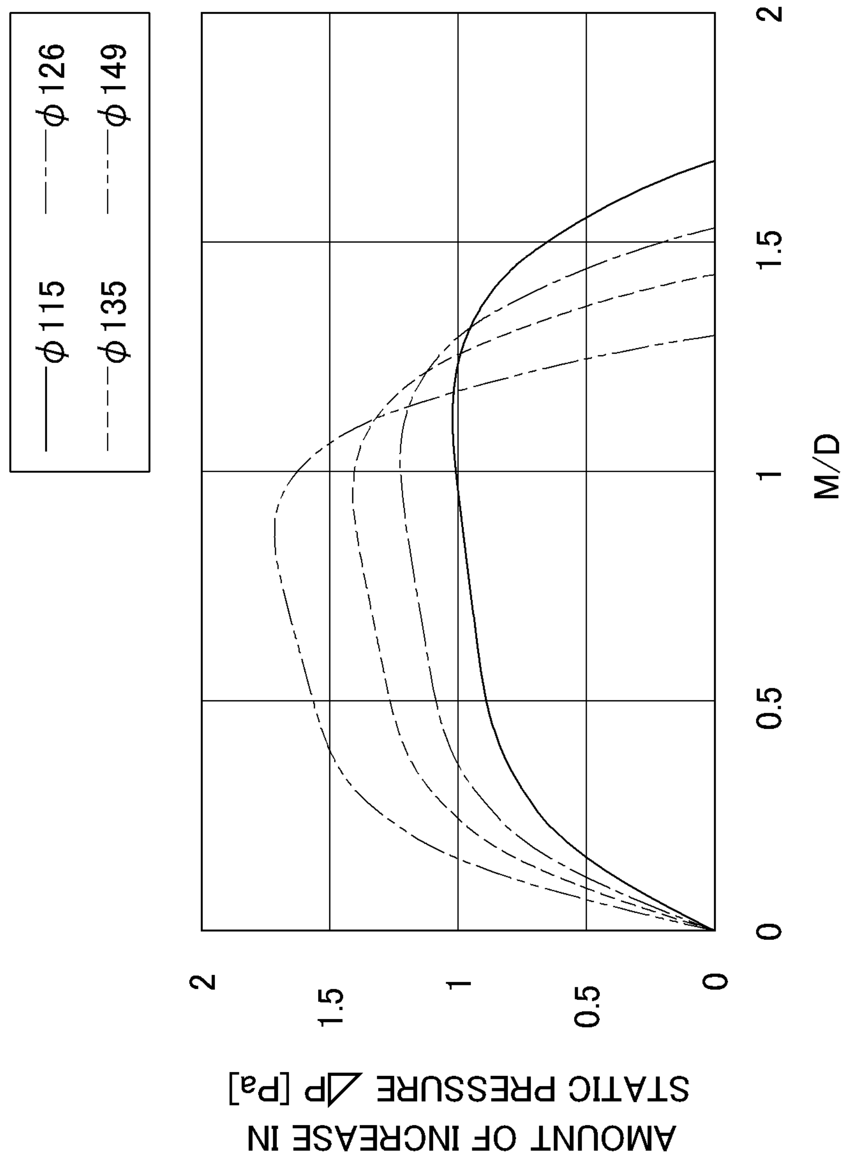

φ115
φ126
φ135
φ149
AMOUNT OF INCREASE IN
STATIC PRESSURE ⊿P [Pa]
M/D
0
0.5
1
1.5
2

FIG. 5

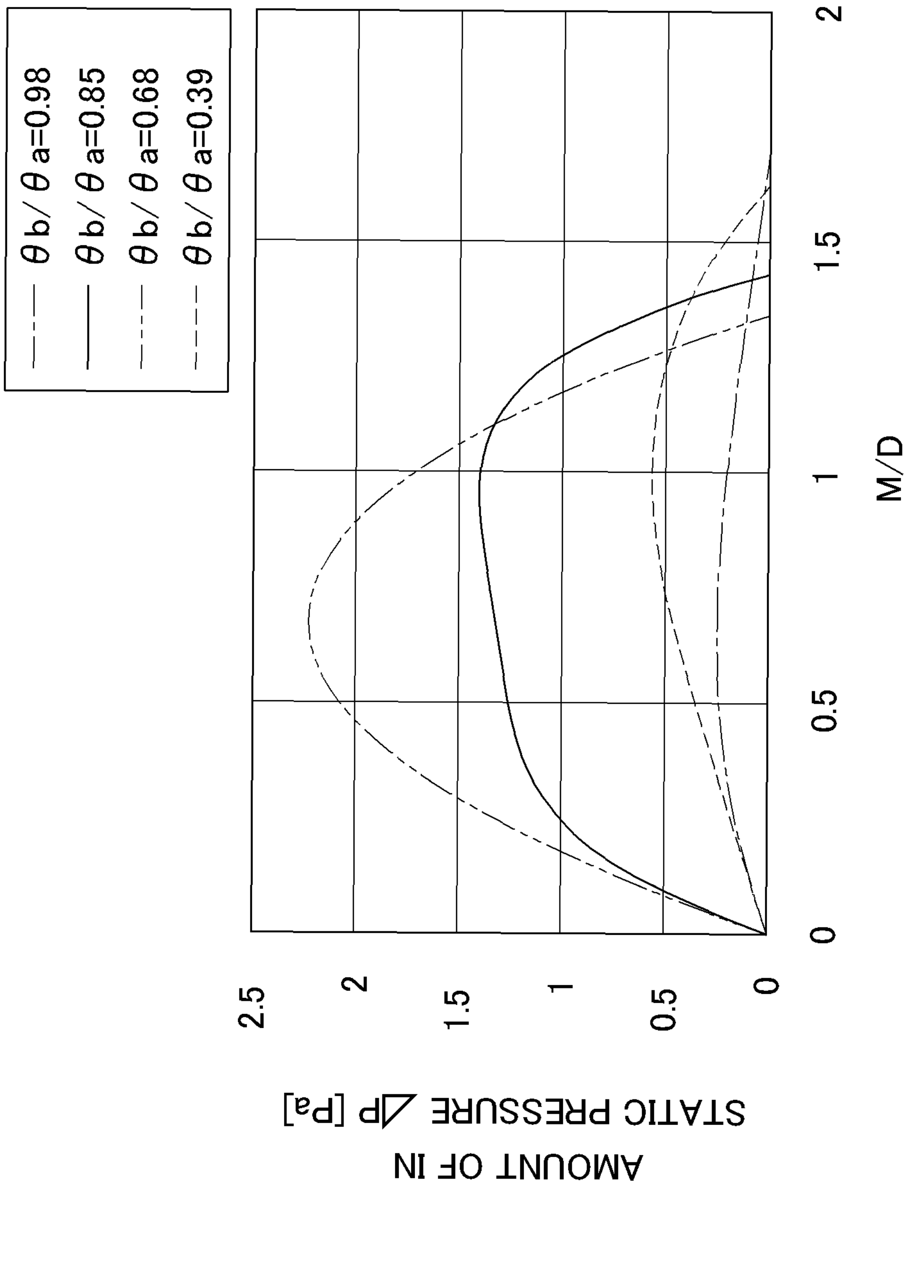

θb/θa=0.98
θb/θa=0.85
θb/θa=0.68
θb/θa=0.39
AMOUNT OF IN STATIC PRESSURE ∠P [Pa]
0
0.5
1
1.5
2
2.5
M/D
0
0.5
1
1.5
2

FIG. 6

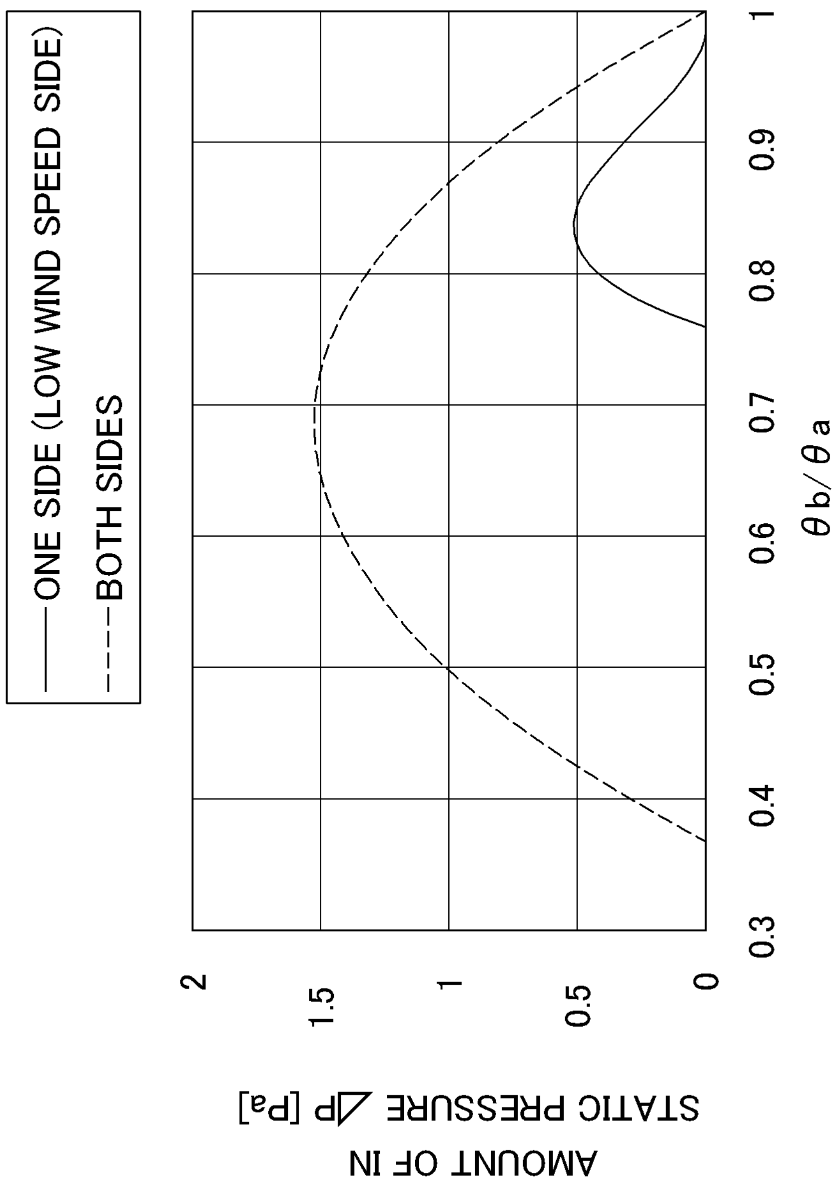

ONE SIDE (LOW WIND SPEED SIDE)
BOTH SIDES
θb/θa
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.5
1
1.5
2
AMOUNT OF IN
STATIC PRESSURE ΔP [Pa]

FIG. 7

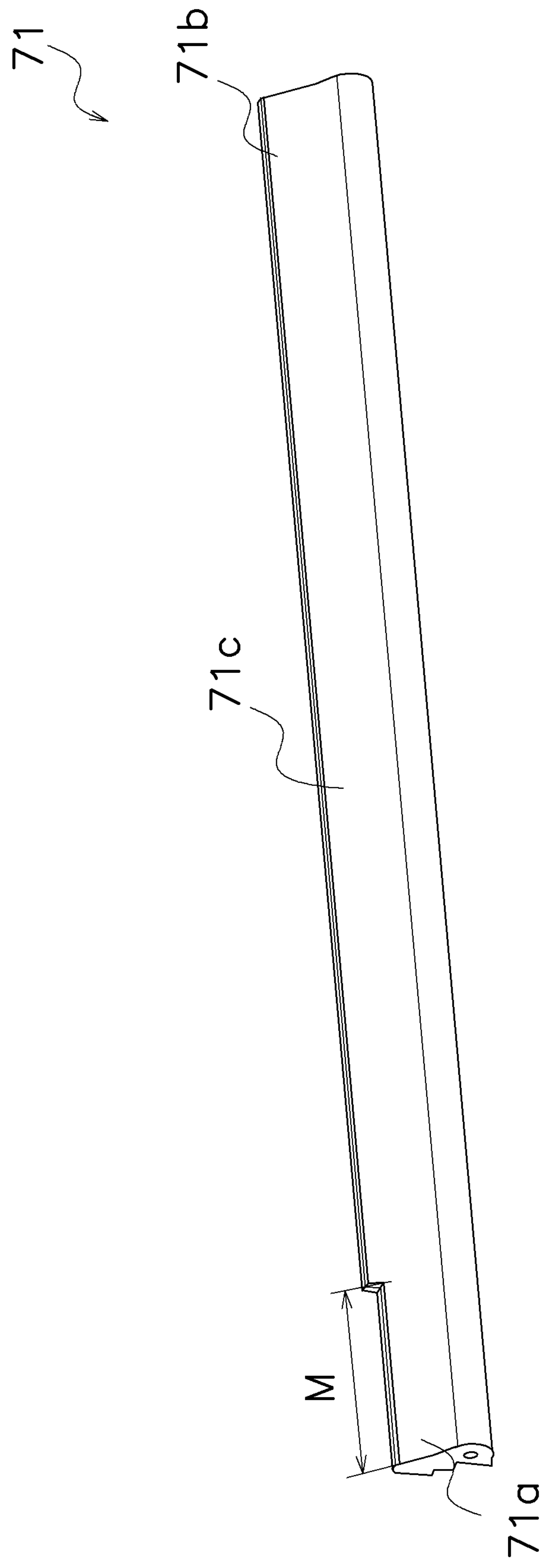


FIG. 8

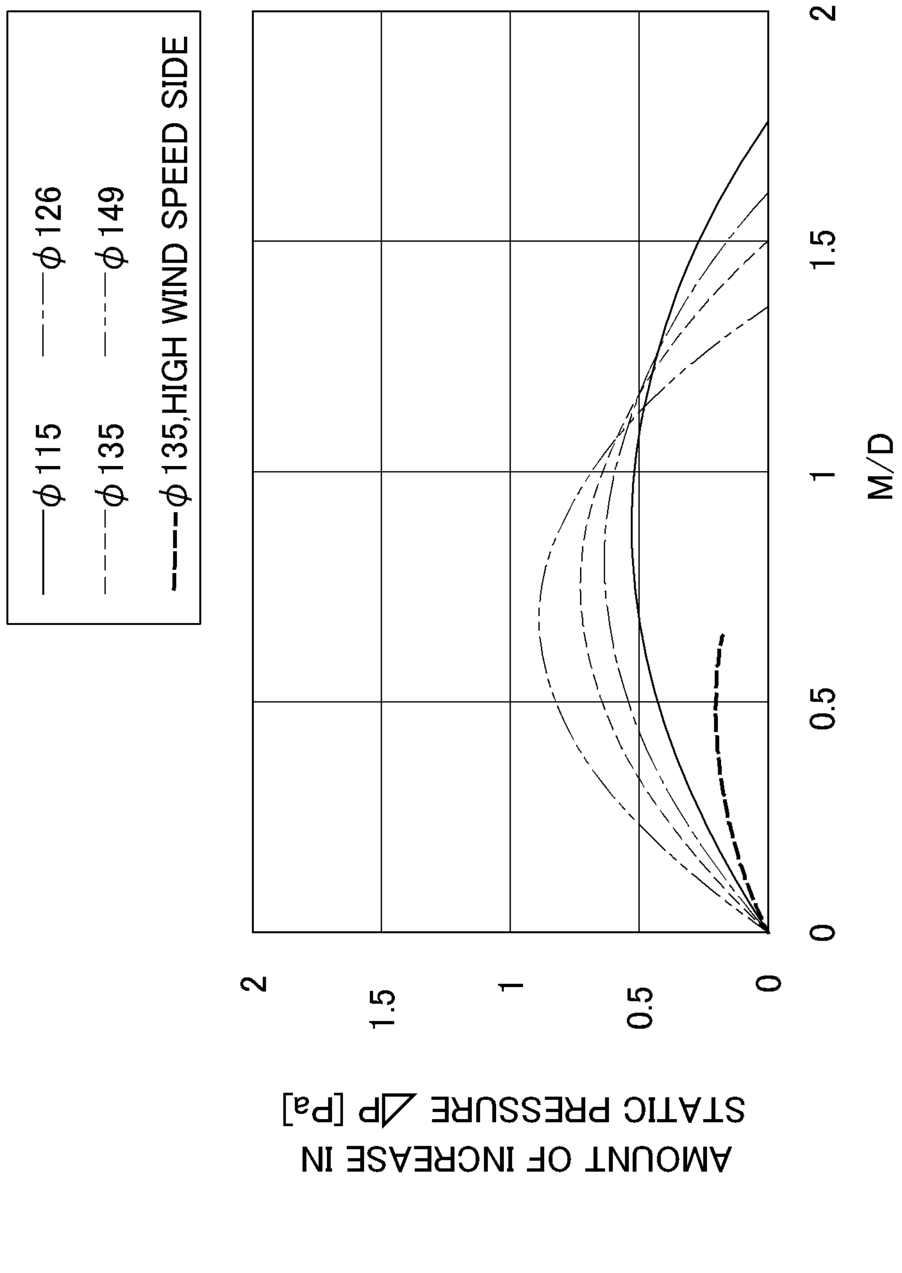

φ115
φ126
φ135
φ149
φ135,HIGH WIND SPEED SIDE
AMOUNT OF INCREASE IN STATIC PRESSURE ⊿P [Pa]
M/D
0
0.5
1
1.5
2

FIG. 9

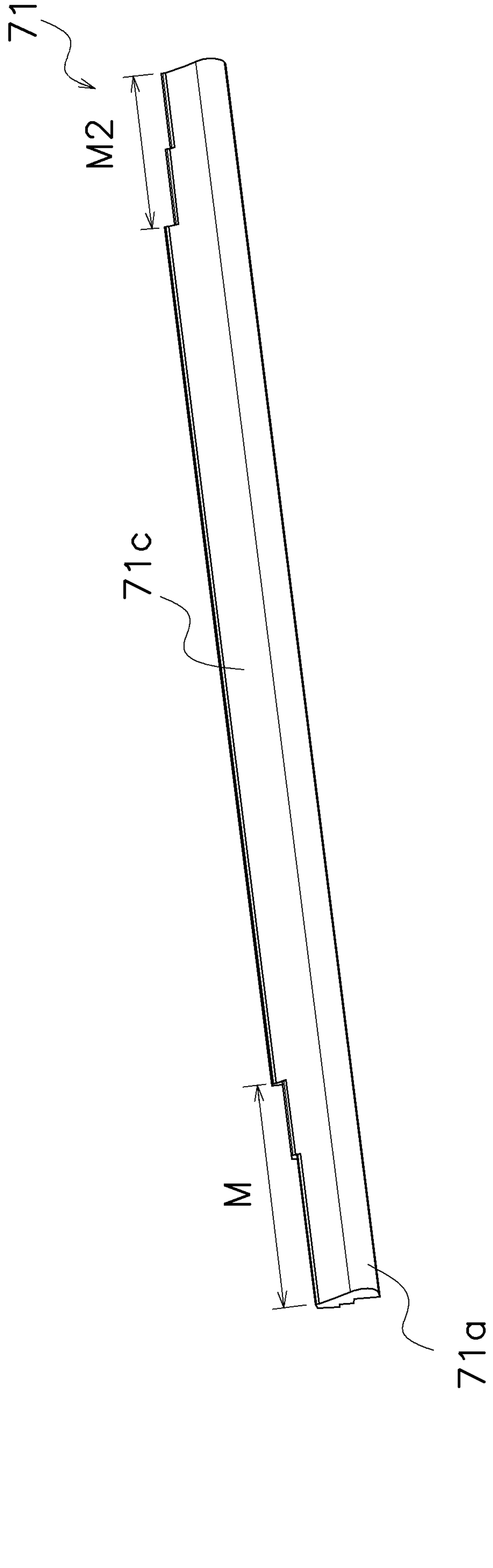


FIG. 10

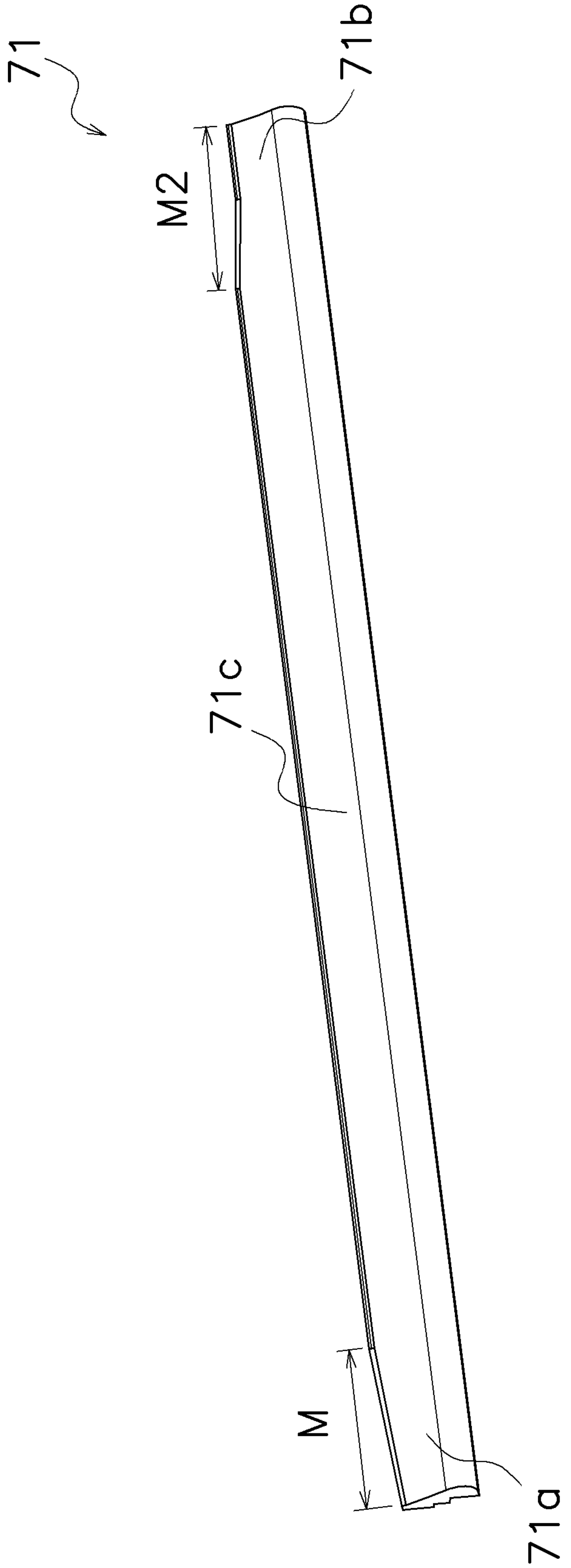


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2024/034557

A. CLASSIFICATION OF SUBJECT MATTER

F04D 29/44(2006.01)i; ***F04D 29/66***(2006.01)i; ***F24F 1/0025***(2019.01)i; ***F24F 13/24***(2006.01)i
FI: F04D29/44 V; F04D29/66 H; F24F13/24; F24F1/0025

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; F24F1/0025; F24F13/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2024
Registered utility model specifications of Japan 1996-2024
Published registered utility model applications of Japan 1994-2024

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	KR 10-2005-0108537 A (LG ELECTRONICS INC.) 17 November 2005 (2005-11-17) p. 4, lines 1-31, fig. 6, 7	1-13
A	JP 2002-195595 A (DAIKIN INDUSTRIES, LTD.) 10 July 2002 (2002-07-10) paragraphs [0051], [0052], fig. 3, 9	1-13
A	CN 209910140 U (NINGBO AUX ELECTRIC CO., LTD.) 07 January 2020 (2020-01-07) paragraphs [0038]-[0044], fig. 1-4	1-13
A	JP 58-38606 B1 (YAMAMOTO, Teruo) 24 August 1983 (1983-08-24) p. 1, left column, line 37 to right column, line 22, fig. 1-3	1-13

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 November 2024	**26 November 2024**

Name and mailing address of the ISA/JP	Authorized officer
Japan Patent Office (ISA/JP) **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2024/034557

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
KR 10-2005-0108537 A	17 November 2005	(Family: none)	
JP 2002-195595 A	10 July 2002	(Family: none)	
CN 209910140 U	07 January 2020	(Family: none)	
JP 58-38606 B1	24 August 1983	(Family: none)	

Form PCT/ISA/210 (patent family annex) (July 2022)

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- JP 2016050720 A **[0002] [0098]**