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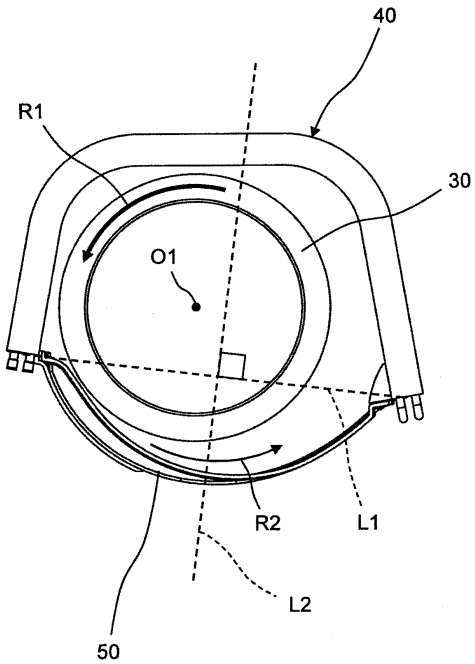
(54) **INDOOR UNIT FOR AIR CONDITIONER**

(57) An indoor unit for an air conditioner includes a turbo fan (30) disposed in a casing and configured to rotate in a predetermined rotation direction (arrow R1), a heat exchanger (40) disposed along a periphery of the turbo fan (30) in the casing; and a partition plate (50) connected to two ends of the heat exchanger (40) to surround the turbo fan (30) in conjunction with the heat exchanger (40). The turbo fan (30) has a center (O1) located upstream of a current of air (arrow R2) between the turbo fan (30) and the partition plate (50), with respect to a perpendicular bisector (L2) of a line (L1) connecting two ends of the partition plate (50). The indoor unit for an air conditioner thus reduces a pressure at a high-pressure spot that may occur at an end of the partition with which an opening of the heat exchanger (40) is covered, to thereby reduce unusual noise.

Fig.6



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Description

TECHNICAL FIELD

[0001] The present invention relates to an indoor unit for an air conditioner.

BACKGROUND ART

[0002] A conventional indoor unit for an air conditioner includes a heat exchanger having a U shape, a partition with which an opening of the heat exchanger is covered, and a turbo fan surrounded with the heat exchanger and the partition and configured to suck in and blow out air in two directions via the heat exchanger (see, for example, JP 2015-81692 A (Patent Literature 1).

[0003] In the indoor unit for an air conditioner, the partition has a protrusion extending toward the turbo fan, and the protrusion equalizes airflows directed to blow-out ports in the two directions.

CITATION LIST

PATENT LITERATURE

[0004] Patent Literature 1: JP 2015-81692 A

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005] In the conventional indoor unit for an air conditioner, the turbo fan has a center located on a center line of the heat exchanger and a center line of a casing main body, and each of the heat exchanger and the partition has a laterally symmetrical shape. Accordingly, the left airflow and the right airflow are different from each other although the turbo fan rotates in a single direction. Consequently, a high-pressure spot occurs at the partition, which makes unusual noise.

[0006] Hence, the present invention sets out to provide an indoor unit for an air conditioner, the indoor unit being capable of reducing a pressure at a high-pressure spot that occurs at an end of a partition with which an opening of a heat exchanger is covered, to thereby reduce unusual noise.

SOLUTIONS TO PROBLEM

[0007] An aspect of the present invention provides an indoor unit for an air conditioner, including:

a casing;
a centrifugal fan disposed in the casing and configured to rotate in a predetermined rotation direction;
a heat exchanger disposed along a periphery of the centrifugal fan in the casing; and
a partition connected to two ends of the heat exchanger to surround the centrifugal fan in conjunction with the heat exchanger,
wherein
the centrifugal fan has a center located upstream of a current of air flowing between the centrifugal fan and the partition, with respect to a perpendicular bisector of a line connecting two ends of the partition.

[0008] According to the configuration described above, the center of the centrifugal fan configured to rotate in the predetermined rotation direction is located upstream of the current of air between the centrifugal fan and the partition, with respect to the perpendicular bisector of the line connecting the two ends of the partition. Consequently, a clearance between an outer periphery of the centrifugal fan and the downstream-side end of the partition with which an opening of the heat exchanger is covered is larger than a clearance between the outer periphery of the centrifugal fan and the upstream-side end of the partition. This configuration therefore enables reduction in pressure near the downstream-side end of the partition that makes loud unusual noise. This configuration thus enables reduction in pressure at a high-pressure spot that occurs at the end of the partition with which the opening of the heat exchanger is covered, to thereby reduce unusual noise.

[0009] In the indoor unit for an air conditioner according to an embodiment,
the casing has a blow-out port at a position opposite to the partition with respect to the heat exchanger.

[0010] According to the embodiment described above, the casing has the blow-out port at the position opposite to the partition with respect to the heat exchanger. Therefore, air from the centrifugal fan is smoothly blown out through the blow-out port via the heat exchanger.

[0011] In the indoor unit for an air conditioner according to an embodiment,
the partition is bowed outward beyond the line connecting the two ends in plan view, and
the centrifugal fan partially overlaps a region surrounded with the partition and the line connecting the two ends of the partition.

[0012] According to the embodiment described above, the partition is bowed outward beyond the line connecting the two ends of the partition in plan view. In addition, the centrifugal fan partially overlaps the region surrounded with the partition and the line connecting the two ends of the partition. Therefore, the centrifugal fan rotates along the partition bowed outward, and the partition smoothly guides air from the centrifugal fan, which contributes to reduction in space for housing the components in the casing.

[0013] In the indoor unit for an air conditioner according to an embodiment,
the heat exchanger includes:

a first heat exchange part,
a second heat exchange part located at an upstream

side of the first heat exchange part with respect to the rotation direction of the centrifugal fan in plan view, and

a third heat exchange part located at a downstream side of the first heat exchange part with respect to the rotation direction of the centrifugal fan in plan view, and

the third heat exchange part is shorter in length than the second heat exchange part.

[0014] According the embodiment described above, the third heat exchange part located at the downstream side of the first heat exchange part with respect to the rotation direction of the centrifugal fan is shorter in length than the second heat exchange part located at the upstream side of the first heat exchange part with respect to the rotation direction of the centrifugal fan. Therefore, pipe connection parts may be connected to an end of the third heat exchange part. In other words, a space for connecting pipes is ensured in the casing. As compared with a case where the third heat exchange part is equal in length to the second heat exchange part, the clearance between the outer periphery of the centrifugal fan and the downstream-side end of the partition is made larger than the clearance between the outer periphery of the centrifugal fan and the upstream-side end of the partition.

ADVANTAGEOUS EFFECT OF INVENTION

[0015] As is clear from the foregoing description, according to the present invention, an indoor unit for an air conditioner is arranged such that a centrifugal fan configured to rotate in a predetermined rotation direction is disposed with a center thereof located upstream of a current of air between the centrifugal fan and a partition, with respect to a perpendicular bisector of a line connecting two ends of the partition, whereby it is possible to reduce a pressure at a high-pressure spot that may occur at an end of the partition with which an opening of a heat exchanger is covered, to thereby reduce unusual noise.

BRIEF DESCRIPTION OF DRAWINGS

[0016]

FIG. 1 is a perspective view of an indoor unit for an air conditioner according to a first embodiment of the present invention, the indoor unit being seen obliquely from below.

FIG. 2 is a perspective view of the indoor unit seen obliquely from above.

FIG. 3 is a bottom view of the indoor unit.

FIG. 4 is a sectional view taken along line IV-IV in FIG. 3.

FIG. 5 is a bottom view of the indoor unit from which a panel, a drain pan, and the like are detached.

FIG. 6 illustrates a center of a turbo fan in the indoor unit.

FIG. 7 illustrates the center of the turbo fan in the indoor unit.

FIG. 8 is a bottom view of the indoor unit which is illustrated in FIG. 5 and to which a flap is attached.

FIG. 9 is a bottom view of the indoor unit from which the flap is detached.

FIG. 10 illustrates a pressure distribution in the indoor unit of the indoor unit according to the first embodiment.

FIG. 11 illustrates the pressure distribution seen along line XI-XI in FIG. 10.

FIG. 12 is a bottom view of an indoor unit for an air conditioner according to a second embodiment of the present invention in a state in which a panel, a drain pan, and the like are detached from the indoor unit.

DESCRIPTION OF EMBODIMENTS

[0017] A specific description will be given of an indoor unit for an air conditioner according to the present invention, based on embodiments illustrated in the drawings.

[First Embodiment]

[0018] FIG. 1 is a perspective view of an indoor unit for an air conditioner according to a first embodiment of the present invention, the indoor unit being seen obliquely from below. This indoor unit is designed to be embedded in a ceiling.

[0019] As illustrated in FIG. 1, the indoor unit for an air conditioner according to the first embodiment includes a casing main body 1, a panel 2 having a rectangular shape, the panel 2 being mounted to a lower side of the casing main body 1, and a grille 3 detachably mounted to the panel 2. The casing main body 1, the panel 2, and the grille 3 constitute a casing.

[0020] The panel 2 has, in its longitudinal end, a blow-out port 10 extending along a shorter edge of the panel 2. The panel 2 also has a flap 20 pivotably mounted thereto. In FIG. 1, the flap 20 closes the blow-out port 10.

[0021] The indoor unit also includes a drain socket 7 protruding from a sidewall of the casing main body 1. The drain socket 7 is connected to an external drain hose (not illustrated). The indoor unit also includes pipe connection parts 5 and 6 each protruding from the sidewall of the casing main body 1. Each of the pipe connection parts 5 and 6 is connected to an external refrigerant pipe (not illustrated).

[0022] As illustrated in FIG. 1, the indoor unit also includes an electrical component unit 8 and hanger fittings 101 to 103 each protruding sideward from the casing main body 1.

[0023] FIG. 2 is a perspective view of the indoor unit seen obliquely from above. In FIG. 2, the same constituent elements as those illustrated in FIG. 1 are denoted with the same reference signs.

[0024] FIG. 3 is a bottom view of the indoor unit. In

FIG. 3, the same constituent elements as those illustrated in FIG. 1 are denoted with the same reference signs.

[0025] As illustrated in FIG. 3, the casing main body 1 has in its center a suction port 1a. A filter 4 (see FIG. 4) is attached between the suction port 1a and the grille 3.

[0026] FIG. 4 is a sectional view taken along line IV-IV in FIG. 3. In FIG. 4, the same constituent elements as those illustrated in FIGS. 1 to 3 are denoted with the same reference signs.

[0027] As illustrated in FIG. 4, the casing main body 1 houses therein a turbo fan 30 to be driven by a motor 31. The casing main body 1 also houses therein a bell mouth 32 at a position between the suction port 1a and the turbo fan 30. The casing main body 1 also houses therein a heat exchanger 40 and a partition plate 50 at a position around the turbo fan 30. The casing main body 1 also houses therein a drain pan 60 at a position below the heat exchanger 40 and the partition plate 50.

[0028] The turbo fan 30 is an example of a centrifugal fan. The partition plate 50 is an example of a partition. The partition may be integrated with the casing.

[0029] An air flow path P is provided within the casing main body 1 for guiding air from the turbo fan 30 to the blow-out port 10 in the panel 2.

[0030] FIG. 5 is a bottom view of the indoor unit from which the panel 2, the drain pan 60, and the like are detached.

[0031] As illustrated in FIG. 5, the casing main body 1 includes a first wall 11 located near the blow-out port 10 (see FIG. 9), a second wall 12 opposite to the first wall 11, a third wall 13 connecting the first wall 11 and the second wall 12, and a fourth wall 14 connecting the first wall 11 and the second wall 12 and opposite to the third wall 13.

[0032] The heat exchanger 40 includes a first heat exchange part 41, a second heat exchange part 42 located at an upstream side of the first heat exchange part 41 with respect to a rotation direction (arrow R1) of the turbo fan 30 in plan view, and a third heat exchange part 43 located at a downstream side of the first heat exchange part 41 with respect to the rotation direction (arrow R1) of the turbo fan 30 in plan view.

[0033] The heat exchanger 40 has two ends connected to the partition plate 50 having an arcuate shape, so that the turbo fan 30 is surrounded with the heat exchanger 40 and the partition plate 50. The partition plate 50 is bowed outward.

[0034] The pipe connection parts 5 and 6 are connected to an end of the third heat exchange part 43 of the heat exchanger 40. The casing main body 1 also houses therein a drain pump 70 at a position between the partition plate 50 and the second wall 12 and near the third wall 13.

[0035] FIG. 6 illustrates a center O1 of the turbo fan 30 in the indoor unit. The center O1 of the turbo fan 30 is located upstream of a current of air (indicated by an arrow R2) between the turbo fan 30 and the partition plate 50, with respect to a perpendicular bisector L2 of a line L1 connecting the two ends of the partition plate 50. In other words, the center O1 of the turbo fan 30 is located on the left side of the perpendicular bisector L2 in FIG. 6.

[0036] The position of the center O1 of the turbo fan 30 is set as illustrated in FIG. 7. The heat exchanger 40 includes a heat exchange part 40a (a hatched region in FIG. 7) having a line symmetrical shape in plan view. The turbo fan 30 is disposed such that the center O1 of the turbo fan 30 is located upstream of the current of air (indicated by the arrow R2) between the turbo fan 30 and the partition plate 50, with respect to a symmetry axis L3 of the heat exchange part 40a having the line symmetrical shape. In other words, the turbo fan 30 is disposed such that the center O1 of the turbo fan 30 is located on the left side of the symmetry axis L3 in FIG. 7.

[0037] As to a positional relationship between the heat exchanger 40 and the casing main body 1, desirably, the heat exchanger 40 is disposed in the casing main body 1 such that the symmetry axis L3 of the heat exchange part 40a having the line symmetrical shape in the heat exchanger 40 is aligned with a longitudinal center line of the casing main body 1.

[0038] FIG. 8 illustrates the indoor unit which is illustrated in FIG. 5 and to which the flap 20 (diagonally shaded) is attached. FIG. 9 illustrates the indoor unit from which the flap 20 is detached. In FIGS. 8 and 9, the same constituent elements as those illustrated in FIGS. 1 to 7 are denoted with the same reference signs.

[0039] As illustrated in FIGS. 8 and 9, the heat exchanger 40 having a U shape in plan view includes the first heat exchange part 41 extending in parallel with the first wall 11 of the casing main body 1, the second heat exchange part 42 seamlessly elongated from a first end of the first heat exchange part 41, and the third heat exchange part 43 seamlessly elongated from a second end of the first heat exchange part 41.

[0040] A clearance between the second heat exchange part 42 and the third wall 13 is tapered from the first heat exchange part 41 toward a distal end, or tip, of the second heat exchange part 42. A clearance between the third heat exchange part 43 and the fourth wall 14 is tapered from the first heat exchange part 41 toward a distal end, or tip, of the third heat exchange part 43. In other words, a distance between the second heat exchange part 42 and the third heat exchange part 43 gradually increases toward the two ends of the heat exchanger 40.

[0041] As illustrated in FIG. 9, the blow-out port 10 includes a first blow-out port part 10a having a rectangular shape and extending along the first wall 11 (see FIG. 8) of the casing main body 1, and second blow-out port parts 10b respectively elongated from two ends of the first blow-out port part 10a toward the second wall 12 (see FIG. 8) of the casing main body 1.

[0042] As illustrated in FIG. 8, the flap 20 configured to control a direction of air to be blown out through the blow-out port 10 includes a flap main body 20a extending along the first wall 11 of the casing main body 1, and auxiliary flaps 20b respectively elongated from two ends

of the flap main body 20a toward the second wall 12 of the casing main body 1.

[0043] According to the indoor unit having the configuration described above, the center O1 of the turbo fan 30 (centrifugal fan) configured to rotate in the predetermined rotation direction (R1) is located upstream of the current of air (R2) between the turbo fan 30 and the partition plate 50, with respect to the perpendicular bisector L2 of the line L1 connecting the two ends of the partition plate 50 (partition). Consequently, a clearance between an outer periphery of the turbo fan 30 and the downstream-side end of the partition plate 50 with which the opening of the heat exchanger 40 is covered is larger than a clearance between the outer periphery of the turbo fan 30 and the upstream-side end of the partition plate 50. This configuration therefore enables reduction in pressure near the downstream-side end of the partition plate 50 that makes loud unusual noise. This configuration thus enables reduction in pressure at a high-pressure spot that may occur at the end of the partition plate 50 with which the opening of the heat exchanger 40 is covered, to thereby reduce unusual noise.

[0044] The inventors of the present invention performed a simulation on the condition that the center O1 of the turbo fan 30 is located upstream of the current of air (R2) between the turbo fan 30 and the partition plate 50, with respect to the perpendicular bisector L2 of the line L1 connecting the two ends of the partition plate 50. It was confirmed by this simulation that the indoor unit having the configuration described above reduces a pressure near the downstream-side end of the partition plate 50, and therefore reduces a pressure at a high-pressure spot that occurs at the end of the partition plate 50 with which the opening of the heat exchanger 40 is covered, to thereby reduce unusual noise.

[0045] FIG. 10 illustrates a pressure distribution obtained from the simulation performed on the indoor unit according to the first embodiment. FIG. 11 illustrates the pressure distribution seen along line XI-XI in FIG. 10. As illustrated in FIGS. 10 and 11, a pressure at a high-pressure spot is reduced, the high-pressure spot occurring near the downstream-side end of the partition plate 50 with which the opening of the heat exchanger 30 is covered.

[0046] In addition, the panel 2 has the blow-out port 10 at the position opposite to the partition plate 50 with respect to the heat exchanger 40. Therefore, air from the turbo fan 30 is smoothly blown out through the blow-out port 10 via the heat exchanger 40.

[0047] As illustrated in FIG. 6, the partition plate 50 is bowed outward beyond the line L1 connecting the two ends of the partition plate 50 (partition) in plan view. In addition, the turbo fan 30 partially overlaps the region surrounded with the partition plate 50 and the line L1 connecting the two ends of the partition plate 50 (partition). Therefore, the turbo fan 30 rotates along the partition plate 50 bowed outward, and the partition plate 50 smoothly guides air from the turbo fan 30. Also, reduction in space for housing the components in the casing main body 1 is achievable.

[0048] The third heat exchange part 43 elongated from the first heat exchange part 41 of the heat exchanger 40 at the downstream side in the rotation direction of the turbo fan 30 is shorter in length than the second heat exchange part 42 elongated from the first heat exchange part 41 at the upstream side in the rotation direction of the turbo fan 30. Therefore, the pipe connection parts 5 and 6 are connected to the end of the third heat exchange part 43. In other words, a space for connecting pipes is ensured in the casing main body 1. As compared with a case where the third heat exchange part 43 is equal in length to the second heat exchange part 42, the clearance between the outer periphery of the turbo fan 30 and the downstream-side end of the partition plate 50 is made larger than the clearance between the outer periphery of the turbo fan 30 and the upstream-side end of the partition plate 50.

[0049] In the first embodiment, the turbo fan 30 is a centrifugal fan. Alternatively, the turbo fan 30 may by any centrifugal fan such as a sirocco fan.

[Second Embodiment]

[0050] FIG. 12 is a bottom view of an indoor unit for an air conditioner according to a second embodiment of the present invention in a state in which a panel, a drain pan, and the like are detached from the indoor unit. The indoor unit for an air conditioner according to the second embodiment is identical in configuration to the indoor unit for an air conditioner according to the first embodiment except for a heat exchanger, and is therefore described with also reference to FIGS. 1 to 9.

[0051] As illustrated in FIG. 12, the indoor unit for an air conditioner according to the second embodiment includes a heat exchanger 140 having a U shape in plan view. The heat exchanger 140 includes a first heat exchange part 141 extending in parallel with a first wall 11 of a casing main body 1, a second heat exchange part 142 elongated from a first end of the first heat exchange part 141, and a third heat exchange part 143 elongated from a second end of the first heat exchange part 141. The second heat exchange part 142 extends in parallel with a second wall 12. The third heat exchange part 143 extends in parallel with a third wall 13.

[0052] The indoor unit for an air conditioner according to the second embodiment produces effects similar to those of the indoor unit for an air conditioner according to the first embodiment.

[0053] Preferably, the second heat exchange part 142 and the third heat exchange part 143, which are respectively elongated from the two ends of the first heat exchange part 141, extend in parallel with each other irrespective of the shape of the casing main body.

[Third Embodiment]

[0054] An indoor unit for an air conditioner according to a third embodiment of the present invention is identical in configuration to the indoor unit for an air conditioner according to the first embodiment except for a blow-out port, and is therefore described with also reference to FIGS. 1 to 5.

[0055] The indoor unit for an air conditioner according to the first embodiment has one blow-out port 10 through which air is blown out in one direction. On the other hand, the indoor unit for an air conditioner according to the third embodiment has blow-out ports through which air is blown out in three directions.

[0056] Specifically, the indoor unit has a blow-out port 10 extending along a shorter edge of a panel 2, and also has a second blow-out port and a third blow-out port respectively extending along two opposite longer edges of the panel 2.

[0057] The indoor unit for an air conditioner according to the third embodiment produces effects similar to those of the indoor unit for an air conditioner according to the first embodiment.

[0058] In the first to third embodiments, the casing of the indoor unit is constituted of the casing main body 1, the panel 2, and the grille 3; however, the shape of the casing is not limited thereto.

[0059] Also in the first to third embodiments, the heat exchanger 40 of the indoor unit has a U shape; however, the shape of the heat exchanger is not limited thereto. Examples of the shape of the heat exchanger may include a circular arc shape, a V shape, and the like.

[0060] Also in the first to third embodiments, the indoor unit is designed to be embedded in a ceiling; however, the indoor unit is not limited thereto. Alternatively, the present invention is also applicable to, for example, an indoor unit designed to be suspended from a ceiling.

[0061] Also in the first to third embodiments, the heat exchanger 40 of the indoor unit includes the first heat exchange part 41, the second heat exchange part 42 seamlessly elongated from the first end of the first heat exchange part 41, and the third heat exchange part 43 seamlessly elongated from the second end of the first heat exchange part 41. Alternatively, the present invention is also applicable to an indoor unit including a heat exchanger 40 divided into different pieces of a first heat exchange part, a second heat exchange part, and a third heat exchange part.

[0062] The foregoing description concerns specific embodiments of the present invention; however, the present invention is not limited to the first to third embodiments, and various modifications and variations may be made within the scope of the present invention. For example, an appropriate combination of the configurations described in the first to third embodiments may be regarded as an embodiment of the present invention.

REFERENCE SIGNS LIST

[0063]

1	casing main body
1a	suction port
2	panel
3	grille
4	filter
5, 6	pipe connection part
7	drain socket
8	electrical component unit
10	blow-out port
11	first wall
12	second wall
13	third wall
14	fourth wall
20	flap
30	turbo fan (centrifugal fan)
31	motor
32	bell mouth
40, 140	heat exchanger
41, 141	first heat exchange part
42, 142	second heat exchange part
43, 143	third heat exchange part
50	partition plate (partition)
60	drain pan
70	drain pump

Claims

1. An indoor unit for an air conditioner, comprising:

a casing (1, 2, 3);
a centrifugal fan (30) disposed in the casing (1, 2, 3) and configured to rotate in a predetermined rotation direction;
a heat exchanger (40) disposed along a periphery of the centrifugal fan (30) in the casing (1, 2, 3); and
a partition (50) connected to two ends of the heat exchanger (40, 140) to surround the centrifugal fan (30) in conjunction with the heat exchanger (40, 140),
wherein
the centrifugal fan (30) has a center located upstream of a current of air between the centrifugal fan (30) and the partition (50), with respect to a perpendicular bisector of a line connecting two ends of the partition (50).

2. The indoor unit for an air conditioner according to claim 1, wherein
the casing (1, 2, 3) has a blow-out port (10) at a position opposite to the partition (50) with respect to the heat exchanger (40, 140).

3. The indoor unit for an air conditioner according to claim 1 or 2, wherein
the partition (50) is bowed outward beyond the line connecting the two ends of the partition in plan view, and
the centrifugal fan (30) partially overlaps a region surrounded with the partition (50) and the line connecting the two ends of the partition (50).

4. The indoor unit for an air conditioner according to any one of claims 1 to 3, wherein the heat exchanger (40, 140) includes:

a first heat exchange part (41, 141),
a second heat exchange part (42, 142) located at an upstream side of the first heat exchange part (41, 141) with respect to the rotation direction of the centrifugal fan (30) in plan view, and
a third heat exchange part (43, 143) located at a downstream side of the first heat exchange part (41, 141) with respect to the rotation direction of the centrifugal fan (30) in plan view, and
the third heat exchange part (43, 143) is shorter in length than the second heat exchange part (42, 142).

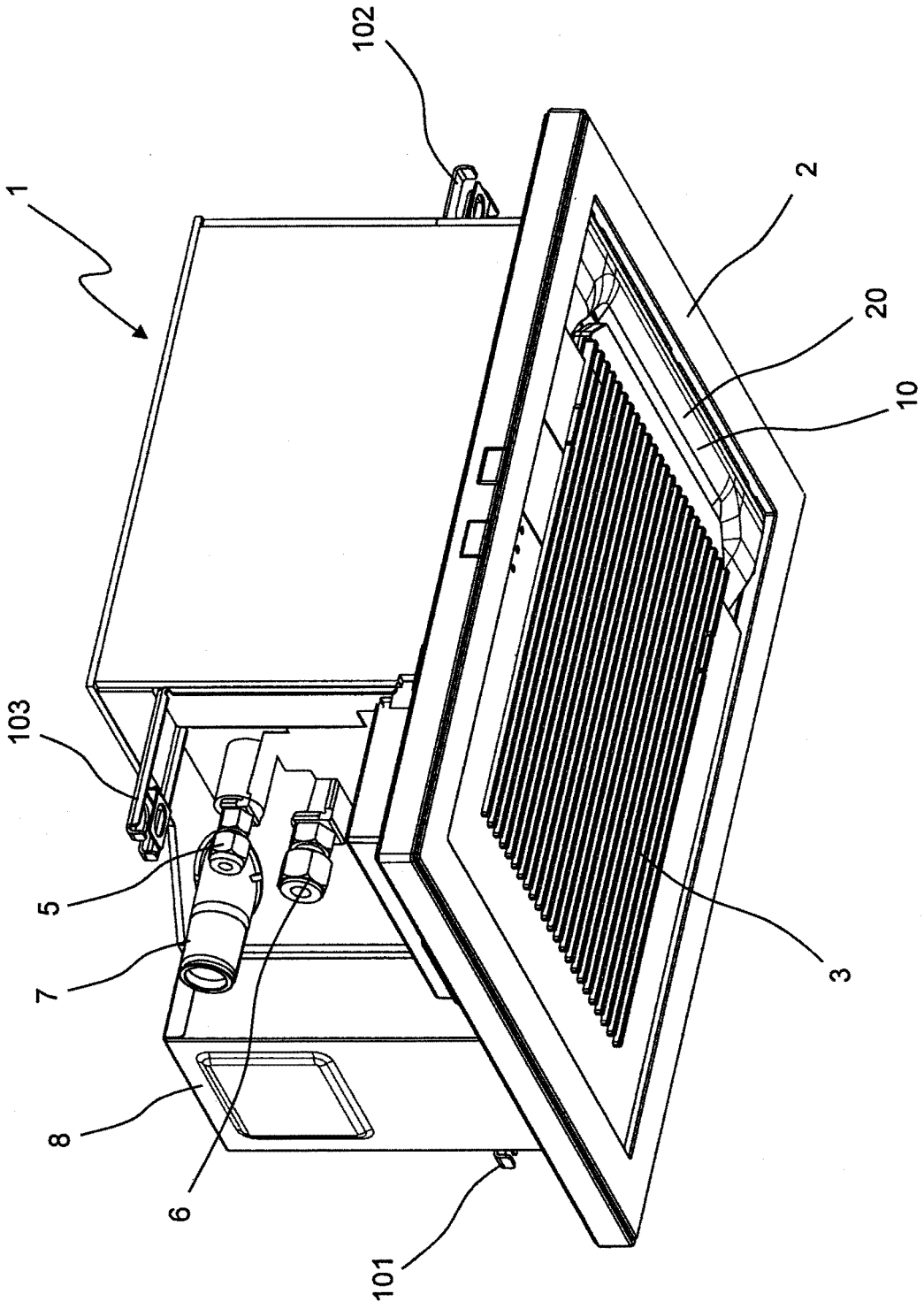


Fig.1

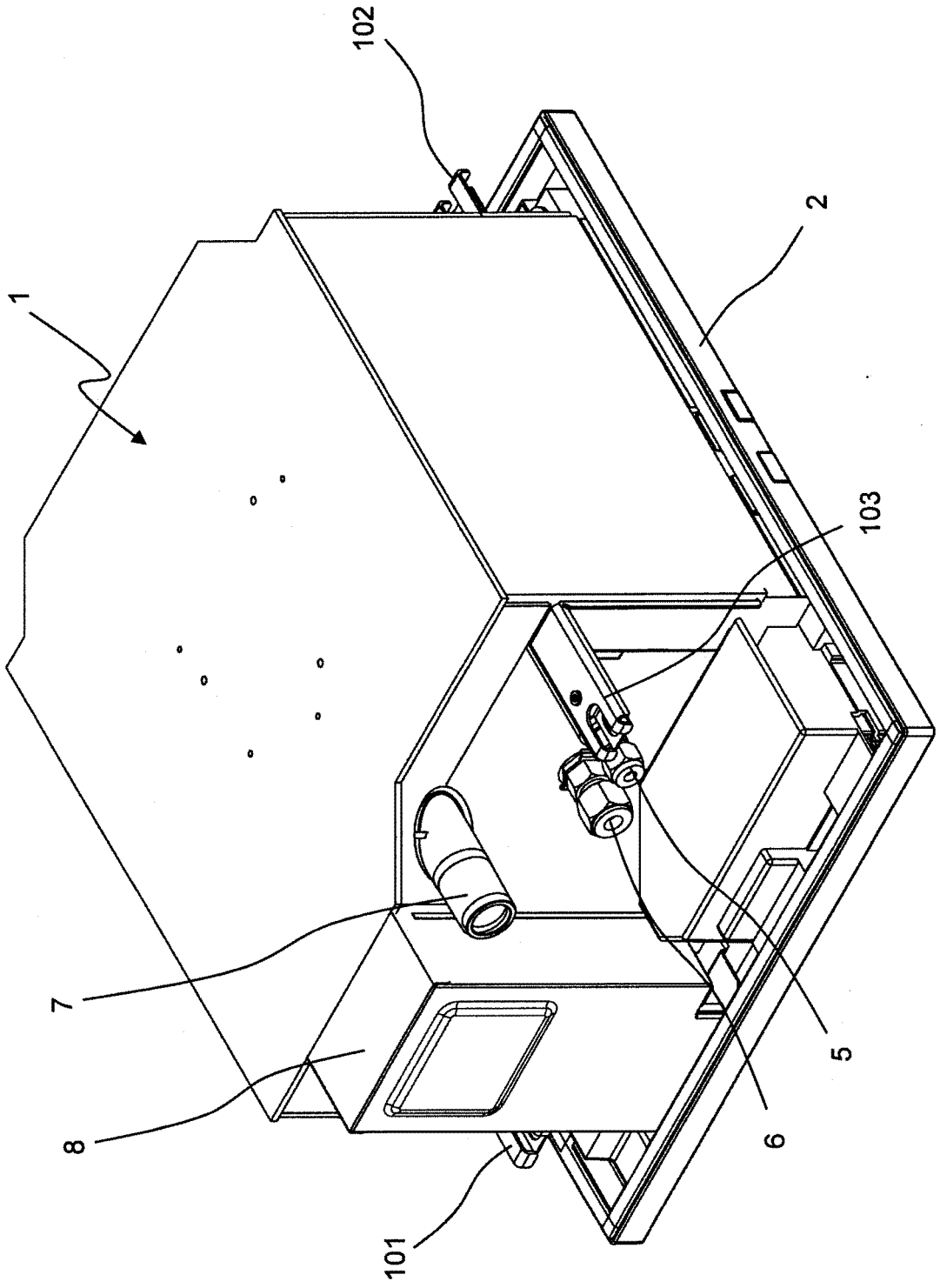
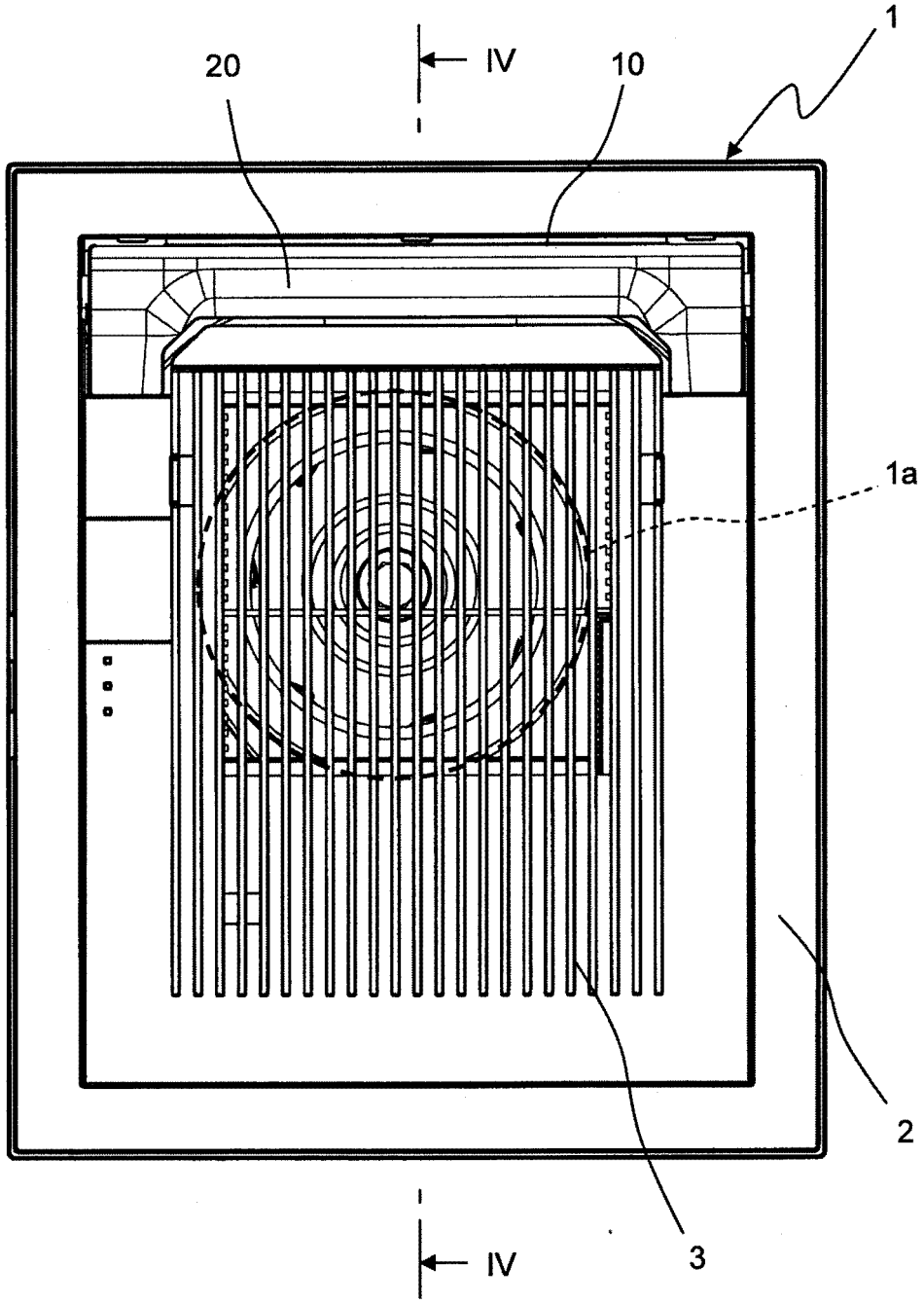


Fig.2

Fig.3



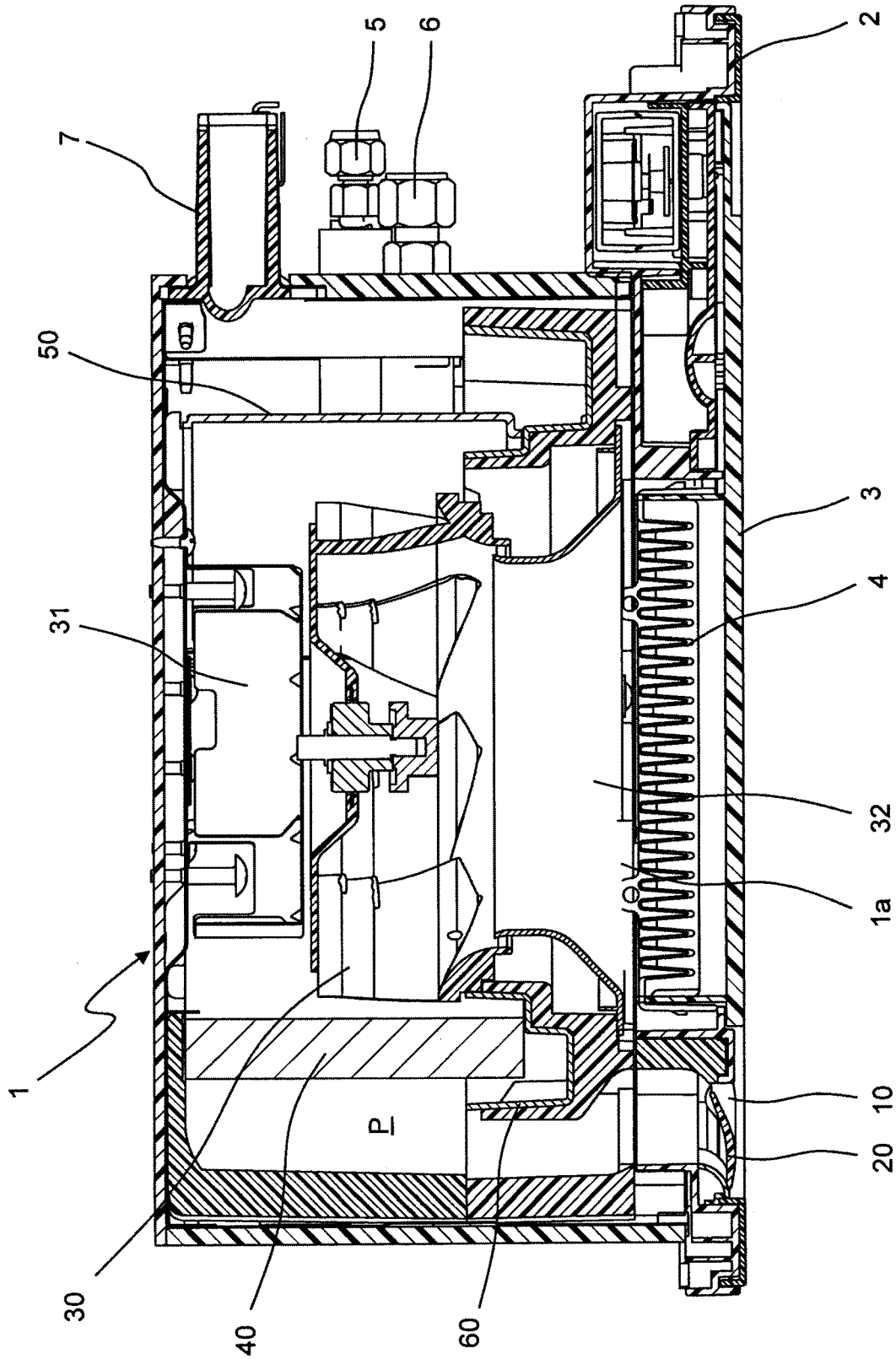


Fig.4

Fig.5

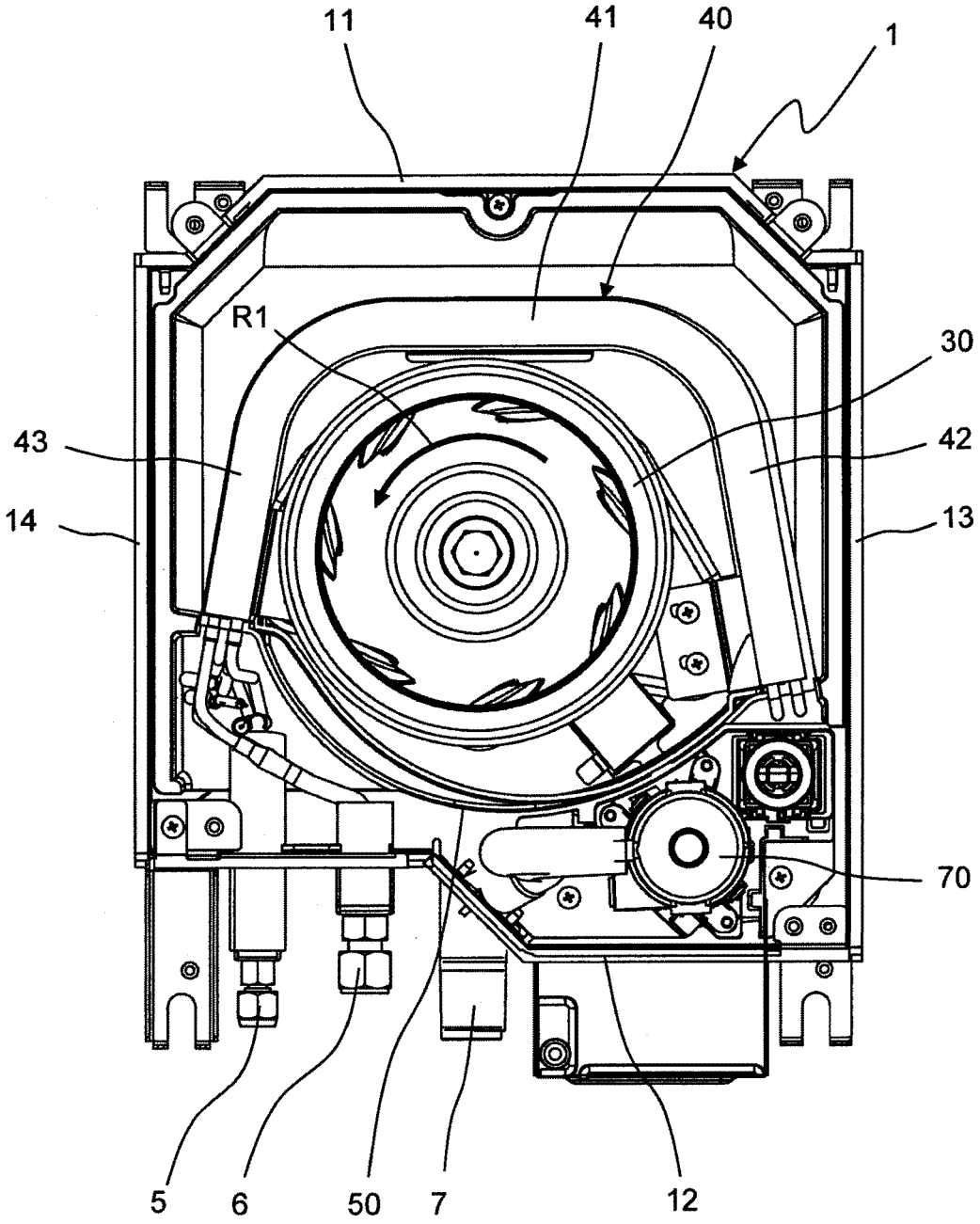


Fig.6

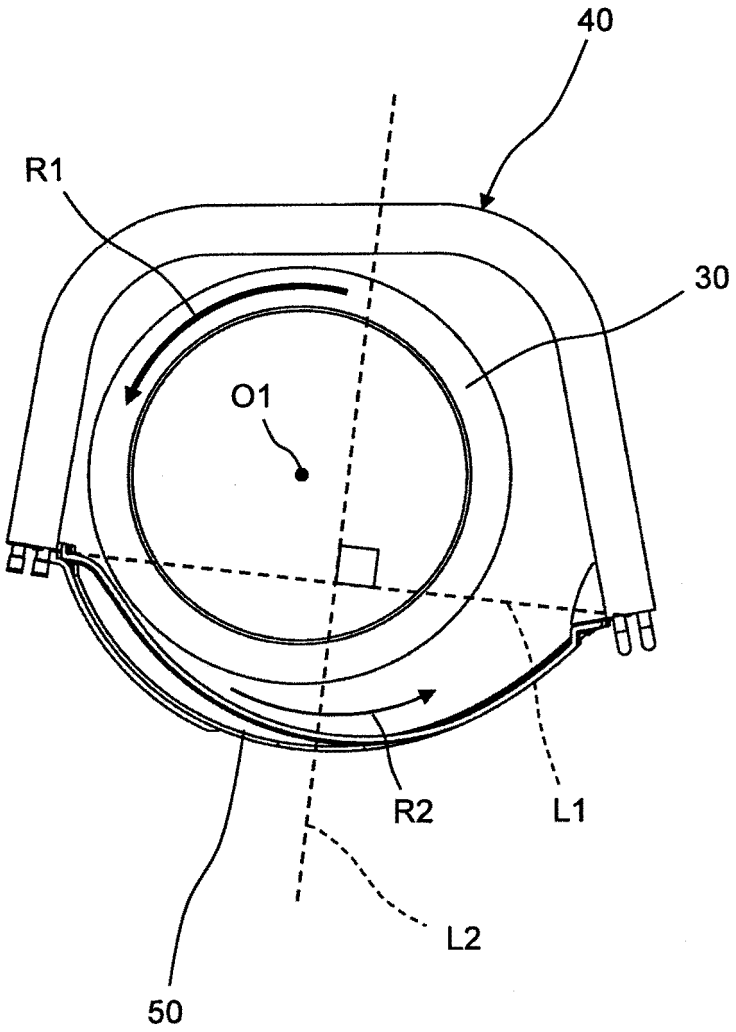


Fig.7

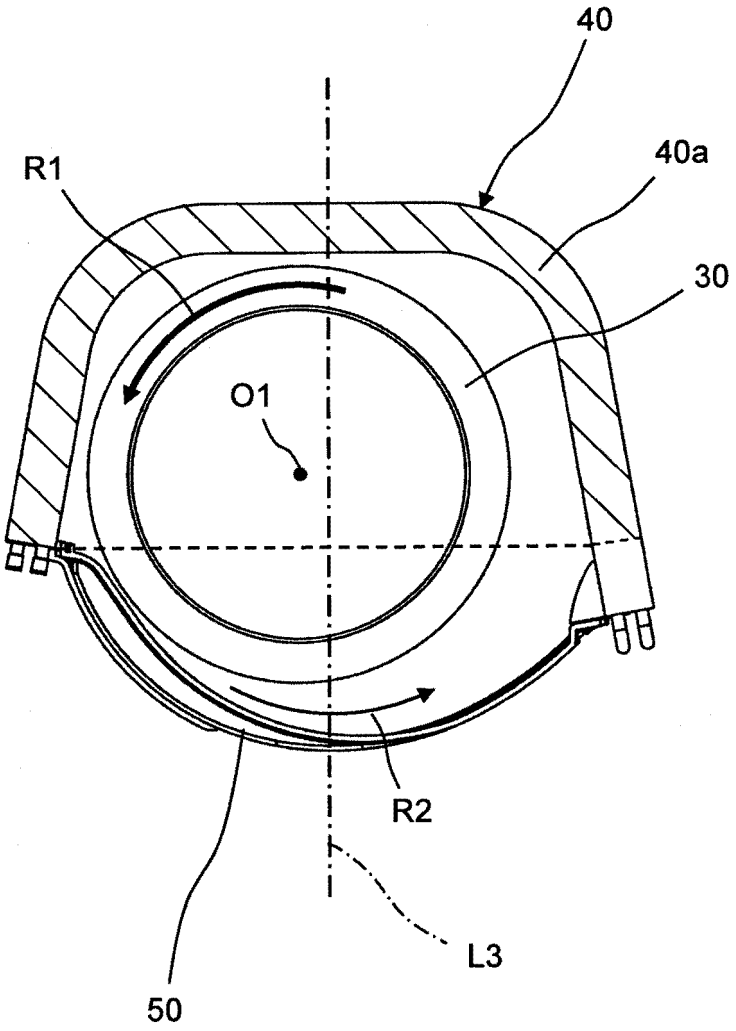


Fig.8

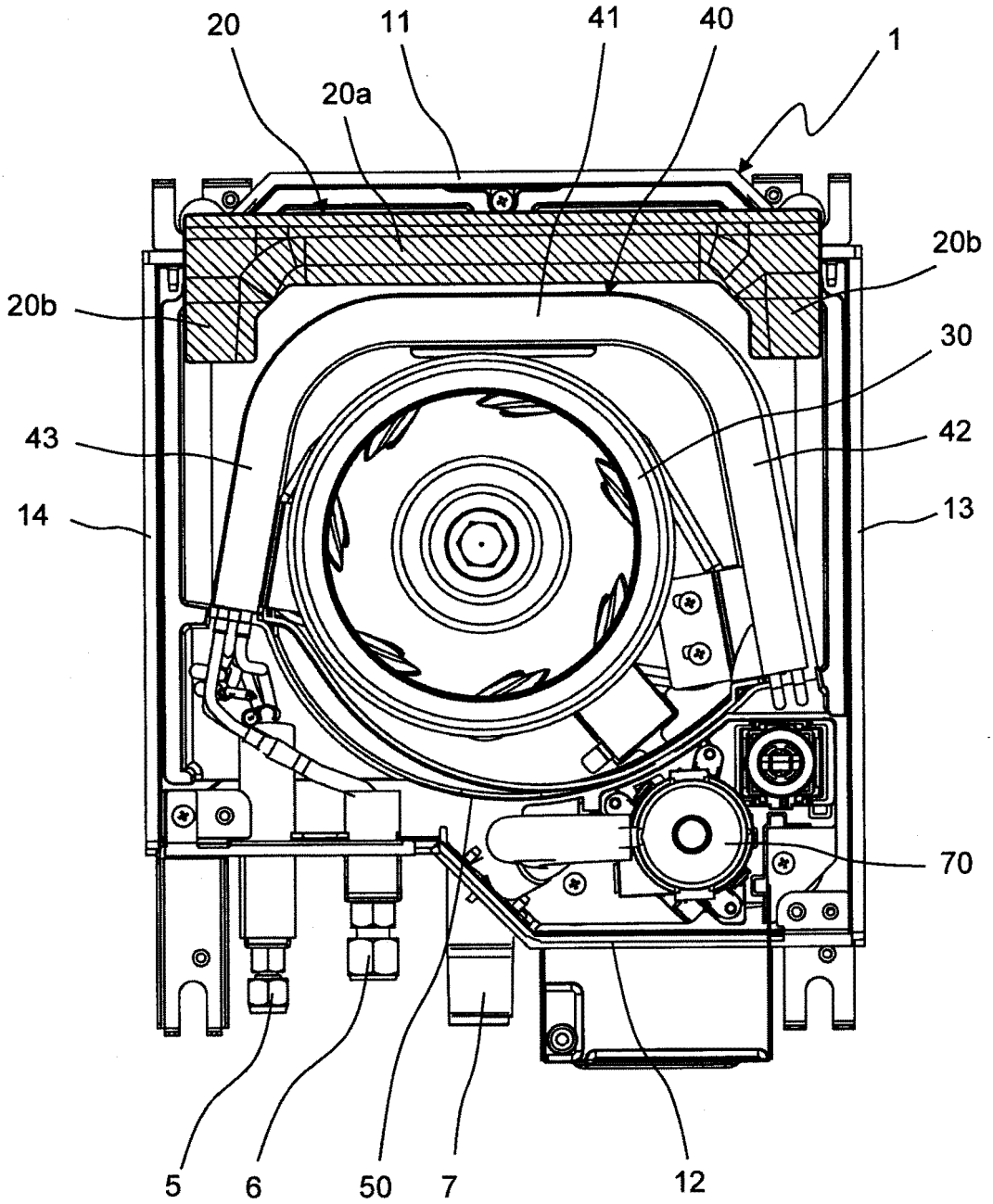


Fig.9

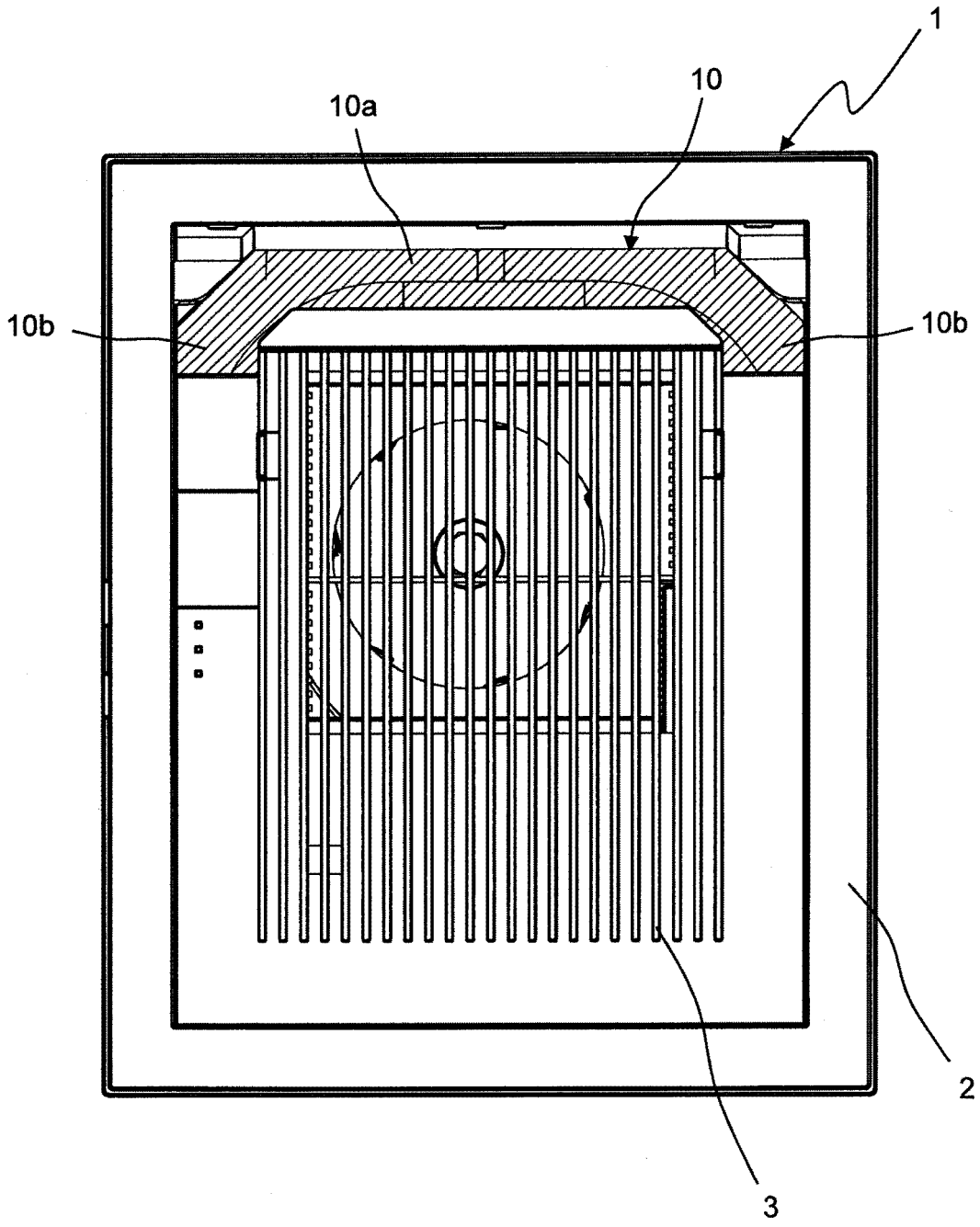
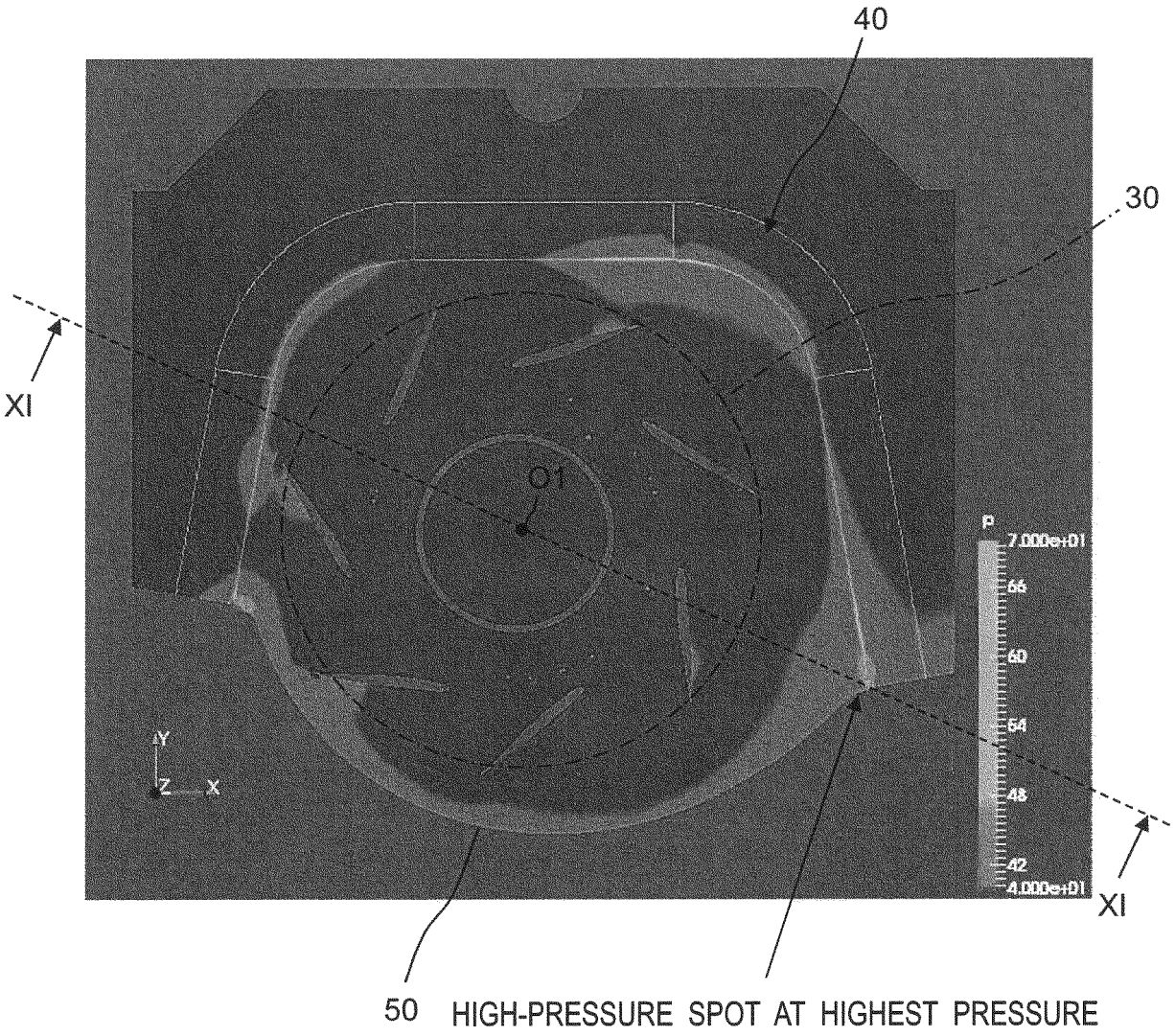


Fig.10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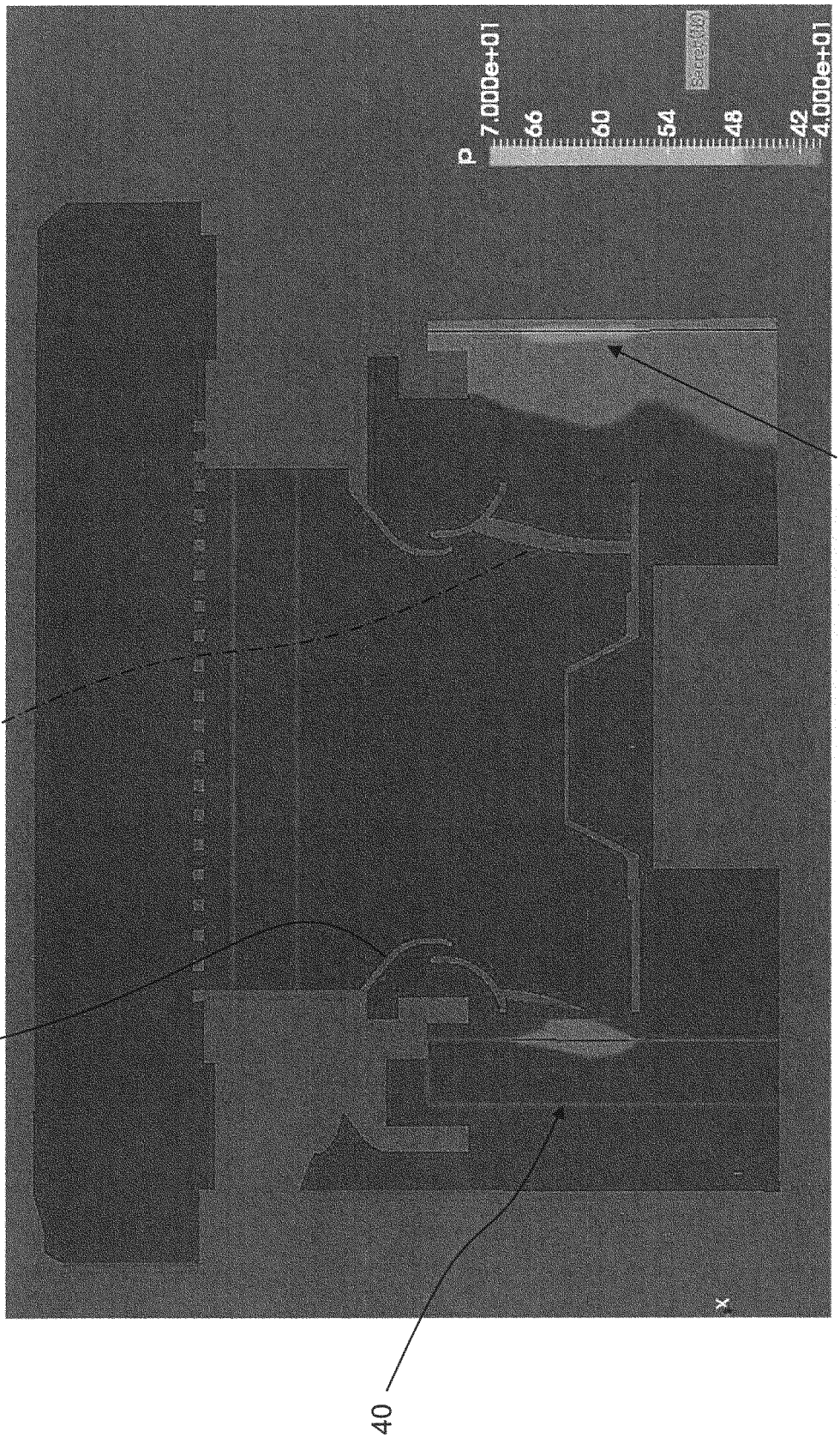
HIGH-PRESSURE SPOT AT HIGHEST PRESSURE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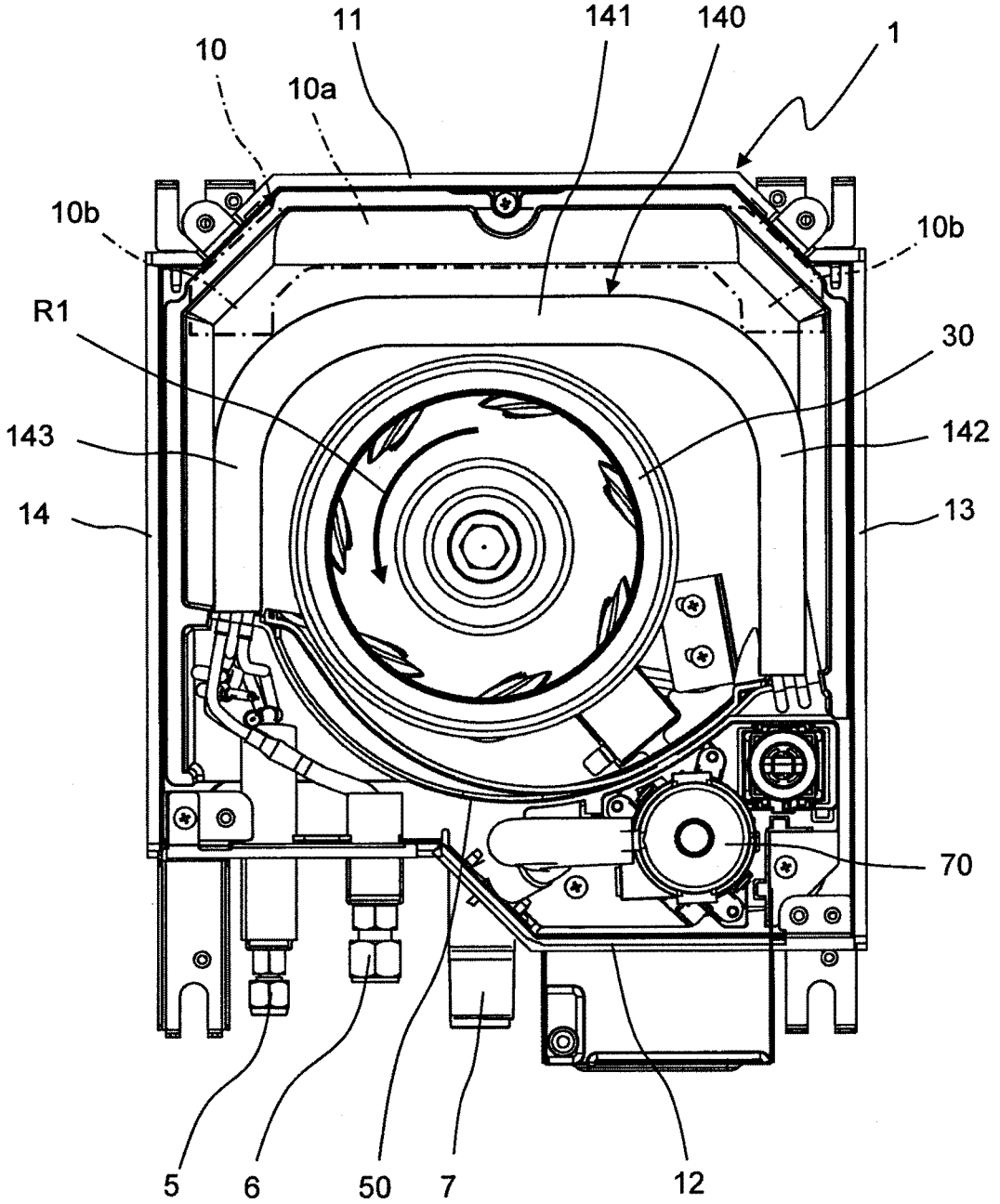
32
40
x

Fig.11

Fig.12



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/014253

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F24F13/20(2006.01)i, F24F1/00(2011.01)i, F24F13/24(2006.01)i, F24F13/30(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl. F24F13/20, F24F1/00, F24F13/24, F24F13/30

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	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

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 Y	JP 60-159528 A (SANYO ELECTRIC CO., LTD.) 21 August 1985, specification, page 2, upper left column, line 11 to page 3, lower left column, line 18, fig. 1-4 (Family: none)	1-3 4
Y	JP 2000-46360 A (HITACHI, LTD.) 18 February 2000, paragraph [0042], fig. 8 & US 2002/0023455 A1, paragraph [0058], fig. 8 & EP 985889 A2 & ES 2224557 T & CN 1244647 A	4
A	JP 9-133374 A (MITSUBISHI ELECTRIC CORP.) 20 May 1997, paragraphs [0012]-[0034], fig. 1-11 (Family: none)	1-4

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 May 2018 (28.05.2018)	05 June 2018 (05.06.2018)

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

Form PCT/ISA/210 (second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2015081692 A **[0002] [0004]**