



(11)

EP 4 538 605 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
16.04.2025 Bulletin 2025/16

(21) Application number: **23839553.7**

(22) Date of filing: **05.07.2023**

(51) International Patent Classification (IPC):
F24F 1/38 ^(2011.01) **F04D 29/66** ^(2006.01)
F24H 9/00 ^(2022.01) **F25B 13/00** ^(2006.01)
F25B 39/00 ^(2006.01) **F25B 41/40** ^(2021.01)
F28D 1/053 ^(2006.01)

(52) Cooperative Patent Classification (CPC):
F04D 29/38; F04D 29/66; F24F 1/38; F24F 1/46;
F24H 9/00; F25B 13/00; F25B 39/00; F25B 41/40;
F28D 1/053

(86) International application number:
PCT/JP2023/025004

(87) International publication number:
WO 2024/014381 (18.01.2024 Gazette 2024/03)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **15.07.2022 JP 2022113830**

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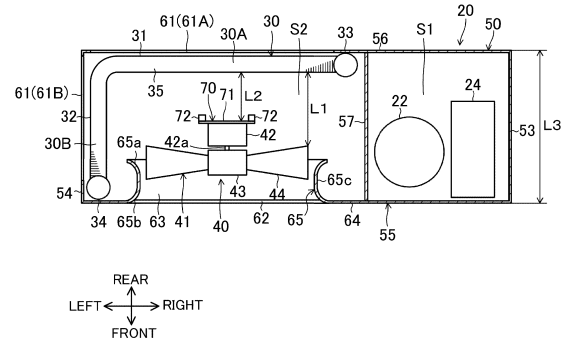
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(54) **HEAT SOURCE UNIT, AND REFRIGERATION DEVICE**

(57) A heat source unit (20) includes a heat exchanger (30) including a plurality of flat tubes (35) in each of which heat medium flow paths (C) are formed; including a plurality of fins (36) defining a plurality of air flow paths (37) where air flows between the flat tubes (35) adjacent to each other; and disposed in an air passage (S2). The heat source unit (20) also includes a fan (40) including an impeller (41) having a porous portion (46); and disposed in the air passage (S2).

FIG.2



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a heat source unit and a refrigeration apparatus.

BACKGROUND ART

[0002] A heat source unit applied to a refrigeration apparatus has been known. The heat source unit of Patent Document 1 includes a heat exchanger and a fan for conveying air. The heat exchanger includes a plurality of flat tubes and a plurality of fins. The plurality of fins define a plurality of air flow paths where air flows between the flat tubes adjacent to each other. When the air conveyed by the fan passes through the heat exchanger, the heat exchanger exchanges heat between the air and the heat media flowing through the flat tubes.

CITATION LIST

PATENT DOCUMENT

[0003] Patent Document 1: Japanese Unexamined Patent Publication No. 2016-205743

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0004] The heat source unit disclosed in Patent Document 1 generates noise when the fan is operating.

[0005] An object of the present disclosure is to reduce the noise of the heat source unit.

SOLUTION TO THE PROBLEM

[0006] A first aspect is directed to a heat source unit including:

a casing (50) in which an air passage (S2) formed; a heat exchanger (30) including a plurality of flat tubes (35) in each of which heat medium flow paths (C) are formed; including a plurality of fins (36) defining a plurality of air flow paths (37) where air flows between the flat tubes (35) adjacent to each other; and disposed in the air passage (S2); and a fan (40) including an impeller (41) having a porous portion (46); and disposed in the air passage (S2).

[0007] In the first aspect, the impeller (41) of the fan (40) has the porous portion (46). The porous portion (46) can reduce oscillation components of pressure near the surface of the impeller (41), and thus vortex flow can be less generated on the surface of the impeller (41). Thus, the noise emitted when the fan (40) is operating can be reduced.

[0008] A second aspect is an embodiment of the first aspect. In the second aspect, the heat exchanger (30) is disposed upstream of the impeller (41) in an air flow of the air passage (S2).

[0009] The impeller (41) including the porous portion (46) has a function of reducing generation of the vortex flow, and thus the air flowing into the impeller (41) is preferably less disturbed for the impeller (41) to adequately perform that function. The heat exchanger (30) of the second aspect includes the plurality of flat tubes (35), and thus the air passing through the heat exchanger (30) is less likely to be disturbed in comparison with a configuration including circular heat transfer tubes. The heat exchanger (30) is disposed upstream of the impeller (41), whereby the air flowing into the impeller (41) can be less disturbed. Thus, the impeller (41) can adequately perform a function of reducing the vortex flow, and thus the noise can be effectively reduced.

[0010] A third aspect is an embodiment of the second aspect. In the third aspect, the heat exchanger (30) is a single-surface-type heat exchanger including only one air through surface (31).

[0011] In the third aspect, the heat exchanger (30) is a single-surface-type heat exchanger, and thus the direction of air passing through the impeller (41) can be less uneven. As a result, the impeller (41) can adequately perform a function of reducing the vortex flow, and thus the noise can be effectively reduced.

[0012] A fourth aspect is an embodiment of any one of the first to third aspects. In the fourth aspect, a distance L1 between the impeller (41) and the heat exchanger (30) is 125 mm or more.

[0013] If the distance L1 between the impeller (41) and the heat exchanger (30) is too short, the distribution of the speed of air passing through the impeller (41) becomes uneven, and the noise is more likely to be generated. In the third aspect, the distance L1 between the impeller (41) and the heat exchanger (30) is 125 mm or more, whereby the distribution of the speed of air can be less uneven. As a result, the impeller (41) can adequately perform a function of reducing the vortex flow, and thus the noise can be effectively reduced.

[0014] A fifth aspect is an embodiment of any one of the first to fourth aspects. In the fifth aspect, the heat source unit includes

a motor (42) configured to drive the impeller (41); and a support structure (70) configured to support the motor (42), wherein the support structure (70) is disposed downstream of the impeller (41) in an air flow of the air passage (S2).

[0015] In the fifth aspect, the support structure (70) is disposed downstream of the impeller (41), whereby the support structure (70) can reduce the turbulence of air passing through the impeller (41). Thus, the impeller (41) can adequately perform a function of reducing the vortex flow, and thus the noise can be effectively reduced.

[0016] A sixth aspect is an embodiment of any one of the first to fifth aspects. In the sixth aspect,

the casing (50) includes a blow-out panel (55) where a blow-out port (62) of the air passage (S2) is formed, the heat source unit includes a motor (42) configured to drive the impeller (41) and includes a support structure (70) configured to support the motor (42), and the support structure (70) includes a plurality of fixing members (72) each configured to couple the blow-out panel (55) and the motor (42).

[0017] In the sixth aspect, the motor (42) is supported by the blow-out panel (55) via the fixing members (72). This configuration allows the support structure (70) to be less likely to disturb the air flow in comparison with the configuration in which, for example, the motor (42) is supported by a support base. Thus, the air flowing through the impeller (41) can be less disturbed. As a result, the impeller (41) can adequately perform a function of reducing the vortex flow, and thus the noise can be effectively reduced.

[0018] A seventh aspect is an embodiment of the sixth aspect. In the seventh aspect, the blow-out panel (55) includes a bell mouth (65) forming the blow-out port (62), and the plurality of fixing members (72) are each configured to couple the bell mouth (65) and the motor (42).

[0019] In the seventh aspect, the motor (42) is supported by the bell mouth (65) of the blow-out panel (55) via the fixing members (72).

[0020] An eighth aspect is directed to a refrigeration apparatus including the heat source unit (20) of any one of the first to seventh aspects and performing a refrigeration cycle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 is a piping system diagram of a hot water supply apparatus according to the embodiment.

FIG. 2 is a plan view showing a schematic internal structure of a heat source unit.

FIG. 3 is a front view showing the schematic internal structure of the heat source unit.

FIG. 4 is a schematic perspective view showing a first heat exchange portion of a heat source heat exchanger.

FIG. 5 is a sectional side view of part of a fin.

FIG. 6 is a cross-sectional view taken along line VI-VI of FIG. 3.

FIG. 7 is a plan view showing a schematic internal structure of a heat source unit of the first variation.

FIG. 8 is a plan view showing a schematic internal structure of a heat source unit of the second variation.

FIG. 9 is a plan view showing a schematic internal

structure of a heat source unit of the third variation. FIG. 10 is a perspective view of a support structure of the third variation.

FIG. 11 is a plan view showing a schematic internal structure of a heat source unit of the fourth variation.

FIG. 12 is a front view of a support structure of the fourth variation.

FIG. 13 is a plan view showing a schematic internal structure of a heat source unit of the fifth variation.

FIG. 14 is a perspective view of a support structure of the fifth variation.

FIG. 15 is a plan view showing a schematic internal structure of a heat source unit of the sixth variation.

FIG. 16 is a sectional side view of part of a fin of the seventh variation.

FIG. 17 is a front view showing a schematic internal structure of a heat source unit of the eighth variation.

FIG. 18 is a block diagram of main devices of a hot water supply apparatus of the eighth variation.

FIG. 19 is a plan view showing a schematic internal structure of a heat source unit of the ninth variation.

DESCRIPTION OF EMBODIMENTS

[0022] Embodiments of the present disclosure will be described in detail below with reference to the drawings. The present disclosure is not limited to the embodiments shown below, and various changes can be made within the scope without departing from the technical concept of the present disclosure. Each of the drawings is intended to illustrate the present disclosure conceptually, and dimensions, ratios, or numbers may be exaggerated or simplified as necessary for the sake of ease of understanding.

<<Embodiments>>

(1) General Configuration

[0023] A refrigeration apparatus of the present disclosure is a hot water supply apparatus (10) that generates hot water. The hot water supply apparatus (10) generates hot water. The hot water supply apparatus (10) supplies the generated hot water to destinations such as a faucet, a bath, and a shower. As shown in FIG. 1, the hot water supply apparatus (10) includes a heat source unit (20) and a hot water supply unit (11). The heat source unit (20) is an outdoor unit. The hot water supply unit (11) is a utilization unit including a tank (13). The hot water supply apparatus (10) includes a refrigerant circuit (21) provided in the heat source unit (20) and includes a hot water supply circuit (12) in which a heat medium such as water circulates. The hot water supply circuit (12) and the refrigerant circuit (21) are connected to each other via the refrigerant water heat exchanger (24).

(1-1) Outline of Heat Source Unit

[0024] The heat source unit (20) is installed outdoors. As shown in FIG. 1, the heat source unit (20) includes a refrigerant circuit (21) filled with a refrigerant. The refrigerant circuit (21), where a refrigerant circulates, performs a vapor compression refrigeration cycle.

[0025] The refrigerant circuit (21) includes a compressor (22), a heat source heat exchanger (30), an expansion valve (23), a refrigerant water heat exchanger (24), and a four-way switching valve (25). The compressor (22) compresses a refrigerant. The heat source heat exchanger (30) is an air heat exchanger that exchanges heat between an air and a refrigerant as a heat medium. The expansion valve (23) decompresses a refrigerant. The refrigerant water heat exchanger (24) includes a first flow path (24a) connected with the refrigerant circuit (21) and a second flow path (24b) connected with the hot water supply circuit (12). The refrigerant water heat exchanger (24) exchanges heat between the refrigerant flowing through the first flow path (24a) and the water flowing through the hot water supply circuit (12).

[0026] The four-way switching valve (25) has a first port (P1), a second port (P2), a third port (P3), and a fourth port (P4). The first port (P1) communicates with the discharge side of the compressor (22). The second port (P2) communicates with the gas end of the heat source heat exchanger (30). The third port (P3) communicates with the gas end of the first flow path (24a) of the refrigerant water heat exchanger (24). The fourth port (P4) communicates with the suction side of the compressor (22). The four-way switching valve (25) switches between a first state indicated by solid lines in FIG. 1 and a second state indicated by broken lines in FIG. 1. The four-way switching valve (25) in the first state makes the first port (P1) and the third port (P3) communicate with each other, and the second port (P2) and the fourth port (P4) communicate with each other. In this state, the refrigerant circuit (21) performs a first refrigeration cycle in which the refrigerant water heat exchanger (24) functions as a radiator and the heat source heat exchanger (30) functions as an evaporator. The four-way switching valve (25) in the second state makes the first port (P1) and the second port (P2) communicate with each other, and the third port (P3) and the fourth port (P4) communicate with each other. In this state, the refrigerant circuit (21) performs a second refrigeration cycle in which the heat source heat exchanger (30) functions as a radiator and the refrigerant water heat exchanger (24) functions as an evaporator.

[0027] The heat source unit (20) includes a fan (40) and a pump (26). The fan (40) conveys air passing through the heat source heat exchanger (30). The pump (26) is a circulation pump for transporting water in the hot water supply circuit (12). The pump (26) may be provided in the hot water supply unit (11).

(1-2) Hot Water Supply Unit

[0028] The hot water supply unit (11) includes a tank (13) connected to the hot water supply circuit (12). The tank (13) is a hollow container. The tank (13) stores hot water heated by the refrigerant water heat exchanger (24). The water at the bottom of the tank (13) is conveyed to the refrigerant water heat exchanger (24) by the pump (26). Hot water generated in the tank (13) is supplied to a destination via a supply path (14). The tank (13) is supplied with water from a water source such as a water pipe.

(2) Operation

[0029] When the hot water supply apparatus (10) is in a normal operation, the compressor (22) and the fan (40) are operated; the four-way switching valve (25) is switched to the first state; and the expansion valve (23) is adjusted to a predetermined opening degree. The refrigerant circuit (21) performs the first refrigeration cycle.

[0030] Specifically, the refrigerant compressed in the compressor (22) flows through the first flow path (24a) of the refrigerant water heat exchanger (24). In the refrigerant water heat exchanger (24), the refrigerant in the first flow path (24a) dissipates heat to the liquid in the second flow path (24b). The refrigerant that has dissipated heat in the first flow path (24a) is decompressed by the expansion valve (23), and then flows through the heat source heat exchanger (30). In the heat source heat exchanger (30), the refrigerant absorbs heat from the outdoor air and evaporates. The evaporated refrigerant is sucked into the compressor (22) and compressed again.

[0031] The water heated in the second flow path (24b) is stored as hot water in the tank (13). The hot water in the tank (13) is supplied to a destination as appropriate.

(3) Details of Heat Source Unit

[0032] The heat source unit (20) will be described in detail with reference to the drawings. In the following description, "upper", "lower", "right", "left", "front", and "rear" are based on the directions indicated by the arrows in FIG. 2 or 3.

(3-1) Casing

[0033] As shown in FIGS. 2 and 3, the heat source unit (20) includes a hollow casing (50). The casing (50) is formed in a rectangular parallelepiped shape having six surfaces. The casing (50) has a bottom plate (51) on the lower side, an upper plate (52) on the upper side, a first side plate (53) on the right side, a second side plate (54) on the left side, a front surface panel (55) on the front side, and a rear surface panel (56) on the rear side. The front surface panel (55) is an example of a blow-out panel of the present disclosure.

[0034] A partition plate (57) is provided in the casing

(50). The partition plate (57) partitions the internal space of the casing (50) into a machine chamber (S1) and an air passage (S2). The machine chamber (S1) is formed to the right side of the partition plate (57). The machine chamber (S1) houses main devices such as the compressor (22) and the refrigerant water heat exchanger (24). The air passage (S2) houses the fan (40) and the heat source heat exchanger (30).

[0035] The casing (50) has an intake port (61) and a blow-out port (62). In the casing (50), an air passage (S2) is formed from the intake port (61) to the blow-out port (62). The intake port (61) includes a first intake port (61A) and a second intake port (61B). The first intake port (61A) is formed in a left portion of the rear surface panel (56). The second intake port (61B) is formed in the second side plate (54). The blow-out port (62) is formed in a left portion of the front surface panel (55). The blow-out port (62) is a circular opening.

[0036] The front surface panel (55) includes a front panel (64) and a bell mouth (65) continuous with the front panel (64). The bell mouth (65) is provided around an impeller (41). The bell mouth (65) is formed in a cylindrical shape in which a blow-out flow path (63) is formed. The blow-out port (62) is formed at the downstream end of the blow-out flow path (63). The bell mouth (65) changes the diameter of the blow-out flow path (63) to adjust the flow of air. The bell mouth (65) of this example includes a diameter-reducing portion (65a) located on the upstream side, a diameter-increasing portion (65b) located on the downstream side, and a constant-diameter portion (65c) located between the diameter-reducing portion (65a) and the diameter-increasing portion (65b). The diameter-reducing portion (65a) gradually reduces the diameter of the blow-out flow path (63) toward the downstream side. The diameter-increasing portion (65b) gradually increases the diameter of the blow-out flow path (63) toward the upstream side. The inside diameter of the constant-diameter portion (65c) is axially constant from end to end.

(3-2) Heat Source Heat Exchanger

[0037] The heat source heat exchanger (30) is an example of a heat exchanger of the present disclosure. The heat source heat exchanger (30) is disposed in the air passage (S2). The heat source heat exchanger (30) is disposed upstream of the fan (40) in the air passage (S2). The outer shape of the heat source heat exchanger (30) is an L shape in plan view. The heat source heat exchanger (30) is a two-surface-type heat exchanger consisting of a first heat exchange portion (30A) including a first air through surface (31) and a second heat exchange portion (30B) including a second air through surface (32). The first heat exchange portion (30A) is a main heat exchange portion located behind the fan (40). The second heat exchange portion (30B) is an auxiliary heat exchange portion located beside the fan (40). The first air through surface (31) is formed along the rear surface

panel (56) or the first intake port (61A). The second air through surface (32) is formed along the second side plate (54) or the second intake port (61B). The area of the second air through surface (32) is smaller than the area of the first air through surface (31).

[0038] The heat source heat exchanger (30) shown in FIGS. 2 to 5 includes a first header collecting pipe (33), a second header collecting pipe (34), a plurality of flat tubes (35), and a plurality of fins (36).

[0039] The first header collecting pipe (33) is located at one of side ends of the heat source heat exchanger (30), and the second header collecting pipe (34) is located at the other one of the side ends of the heat source heat exchanger (30). Specifically, the first header collecting pipe (33) is located at the right end of the first heat exchange portion (30A), and the second header collecting pipe (34) is located at the front end of the second heat exchange portion (30B). The first header collecting pipe (33) and the second header collecting pipe (34) are each formed in a cylindrical shape, and an internal flow path is formed in each of them.

[0040] The plurality of flat tubes (35) extend from the first header collecting pipe (33) to the second header collecting pipe (34). The flat tube (35) of this example is formed in an L shape in plan view. The plurality of flat tubes (35) are made of a material having high thermal conductivity such as copper or aluminum.

[0041] As shown in FIGS. 4 and 5, the plurality of flat tubes (35) are arranged in the direction orthogonal to the air flow. The plurality of flat tubes (35) of this example are arranged in the top-bottom direction. The width direction of the plurality of flat tubes (35) corresponds to the air flow direction. A wide first surface (35a) is formed at one of ends of each of the flat tubes (35) in the thickness direction (the top-bottom direction), and a wide second surface (35b) is formed at the other one of the ends of each of the flat tubes (35) in the thickness direction. The first surface (35a) of one of the flat tubes (35) adjacent to each other and the second surface (35b) of the other one of the flat tubes (35) adjacent to each other face each other.

[0042] The cross section of the flat tube (35) that is perpendicular to its axial direction is formed in an elliptical shape, an oval shape, or a substantially rectangular shape extending in the air flow direction. A plurality of refrigerant flow paths (C) are formed in the flat tube (35) and arranged in the air flow direction. In other words, the flat tube (35) is configured as a multi-path flat tube. Accordingly, the flat tube (35) has a larger area of the refrigerant flow path, and the heat source heat exchanger (30) exchanges heat more efficiently.

[0043] The plurality of fins (36) are arranged in the axial direction of the flat tube (35). The plurality of fins (36) are made of a material having high thermal conductivity such as copper or aluminum. The plurality of fins (36) are each formed in a plate shape, and its thickness direction corresponds to the arrangement direction of the plurality of fins (36). The plurality of fins (36) define a plurality of air flow paths (37) where air flows between the flat tubes (35)

adjacent to each other.

[0044] The fin (36) is formed in a rectangular shape extending in the arrangement direction of the flat tubes (35). The fin (36) includes a plurality of notches (36a) formed on one of sides of the fin (36) in the width direction (the air flow direction). The plurality of notches (36a) are arranged in the longitudinal direction of the fin (36). Specifically, the plurality of notches (36a) are formed at equal intervals in the top-bottom direction. The notches (36a) of this example are formed on the upstream side of the fin (36).

[0045] The fin (36) includes a continuous portion (36b) extending in the longitudinal direction (the top-bottom direction) of the fin (36) and includes a plurality of intermediate portions (36c) extending from the continuous portion (36b) in the width direction of the fin (36). In this example, the plurality of intermediate portions (36c) are formed on the upstream side of the fin (36), and the continuous portion (36b) is formed on the downstream side of the fin (36). The notch (36a) is formed between the intermediate portions (36c) adjacent to each other. The flat tube (35) is inserted into the notch (36a) one by one. The air flow path (37) is formed between the flat tubes (35) adjacent to each other and between the intermediate portions (36c) adjacent to each other.

(3-3) Fan

[0046] As shown in FIGS. 2 and 3, the fan (40) is disposed in the air passage (S2). The fan (40) is disposed downstream of the heat source heat exchanger (30) in the air passage (S2). The fan (40) of this embodiment is a propeller fan. The fan (40) includes an impeller (41) and a motor (42) for driving the impeller (41). The motor (42) of the fan (40) is located upstream of the impeller (41) in the air flow of the air passage (S2). The impeller (41) constitutes a propeller fan. The impeller (41) includes a hub (43) and a plurality of blades (44).

[0047] The hub (43) is coupled to the motor (42) via a shaft (42a). The outer shape of the hub (43) is a cylindrical shape. The axis of the hub (43) or the rotation axis of the motor (42) extends in the front-rear direction.

[0048] The plurality of blades (44) are fixed to the outer peripheral surface of the hub (43). The number of blades in this example is three but not limited thereto, and may be two or may be four or more. The width of the blade (44) in the rotational direction gradually increases in the direction from the hub (43) to the radially outer side.

(3-4) Support Mechanism

[0049] As shown in FIGS. 2 and 3, the heat source unit (20) includes a support structure (70) that supports the motor (42). The support structure (70) of this example includes a supporting portion (71) to which the motor (42) is fixed, and two fixing members (72) which are fixed to the supporting portion (71). The supporting portion (71) is formed in a rectangular plate shape in front view. The

motor (42) is fixed to the front surface of the supporting portion (71). The fixing members (72) are fixed to both side ends of the supporting portion (71). The fixing member (72) is a support extending in the top-bottom direction. The lower end of each fixing member (72) is fixed to the bottom plate (51) of the casing (50). The upper end of each fixing member (72) is fixed to the upper plate (52) of the casing (50).

10 (3-5) Porous Portion

[0050] As shown in FIG. 6, each of the blades (44) includes a solid portion (45) and a porous portion (46). The solid portion (45) is a main part of the impeller (41) and is made of a hard resin material.

[0051] The porous portion (46) is formed in a part of the impeller (41) except the solid portion (45). The porous portion (46) is made of a porous material. The porous portion (46) has a plurality of fine pores communicating with each other. In other words, the porous portion (46) has a continuous-bubble structure. The material of the porous portion (46) is, for example, polypropylene (PP), polyphenylene ether (PPE), or the like.

[0052] The porous portion (46) of this example is formed in a part of the blade (44) that is closer to the hub (43) (or closer to the root of the blade). The porous portion (46) is formed from the negative pressure surface (44a) to the positive pressure surface (44b) of the blade (44). Here, the negative pressure surface (44a) is the rear surface of the blade (44), and the positive pressure surface (44b) is the front surface of the blade (44).

[0053] When the fan (40) is operating, the porous portion (46) reduces oscillation components of pressure near the surface of the blade (44). As a result, vortex flow is less generated on the surface of the blade (44), and thus air turbulence is less produced. In this manner, the porous portion (46) has a function of reducing the vortex flow of air. Thus, it is possible to reduce an increase in the noise produced by generation of the vortex flow of air when the fan (40) is operating.

(3-6) Distance between Heat Source Heat Exchanger and Fan

[0054] As shown in FIG. 2, the distance between the heat source heat exchanger (30) and the impeller (41) is defined as L1. More precisely, the shortest distance between the first heat exchange portion (30A) of the heat source heat exchanger (30) and the impeller (41) is defined as L1. In this embodiment, the distance L1 is set to 125 mm or more.

[0055] If the distance between the heat source heat exchanger (30) and the impeller (41) is too short, the distribution of the speed of air passing through the impeller (41) is likely to be uneven. Accordingly, the fan (40) tends to emit louder noise. In particular, when the air flowing through the impeller (41) is disturbed, the porous portion (46) cannot adequately perform a function of

reducing the turbulence.

[0056] In contrast, if the distance L1 is 125 mm or more, the distribution of the speed of air passing through the impeller (41) can be uniform. Accordingly, the porous portion (46) can adequately perform a function of reducing the turbulence, and thus the noise can be effectively reduced.

[0057] The distance L1 is $0.25 \times L3$ or less in one preferred embodiment. Here, L3 refers to the length of the casing (50) in the shorter direction (the front-rear direction). If the distance L1 is $0.25 \times L3$ or less, the heat source unit (20) can be downsized. In addition, if the distance L1 is longer, the impeller (41) is located closer to the surface (the front surface panel (55)) of the casing (50), and thus the operation noise of the fan (40) more easily reach the outside of the casing (50). In contrast, if the distance L1 is $0.25 \times L3$ or less, the operating noise of the fan (40) less easily reach the outside of the casing (50), and thus the noise can be reduced.

[0058] As shown in FIG. 2, the distance between the heat source heat exchanger (30) and the support structure (70) of the motor (42) is defined as L2. More precisely, the shortest distance between the heat source heat exchanger (30) and the support structure (70) is defined as L2. In this embodiment, the distance L2 is set to 45 mm or more. The support structure (70) is located between the impeller (41) and the heat source heat exchanger (30).

[0059] If the distance between the heat source heat exchanger (30) and the support structure (70) is too short, the distribution of the speed of air passing through the impeller (41) is likely to be uneven. Accordingly, the fan (40) tends to emit louder noise. In particular, when the air flowing through the impeller (41) is disturbed, the porous portion (46) cannot adequately perform a function of reducing the turbulence.

[0060] In contrast, if the distance L2 is 45 mm or more, the distribution of the speed of air passing through the impeller (41) can be uniform. Accordingly, the porous portion (46) can adequately perform a function of reducing the turbulence, and thus the noise can be effectively reduced. The distance L2 is $0.45 \times L3$ or less in one preferred embodiment.

(4) Advantages of Embodiment

[0061] (4-1)

The heat source unit (20) of this embodiment includes the heat source heat exchanger (30) including the plurality of flat tubes (35) in each of which the heat medium flow paths (C) are formed; including the plurality of fins (36) defining the plurality of air flow paths (37) where air flows between the flat tubes (35) adjacent to each other; and disposed in an air passage (S2). The heat source unit (20) of this embodiment also includes the fan (40) including the impeller (41) having the porous portion (46); and disposed in the air passage (S2).

[0062] The porous portion (46) can reduce oscillation

components of pressure near the surface of the blade (44). As a result, vortex flow is less generated on the surface of the blade (44), and thus air turbulence is less produced. Therefore, it is possible to reduce an increase in the noise produced by generation of the vortex flow of air when the fan (40) is operating.

[0063] The flat tube (35) is a multi-path flat tube including the plurality of flow paths (C), and thus the heat source heat exchanger (30) exchanges heat more efficiently. Thus, the volume of air produced by the fan (40) can be reduced, and thus the noise emitted when the fan (40) is operating can be reduced. In addition, the air passing through the fan (40) can be less disturbed, and thus the porous portion (46) can adequately perform a function of reducing the turbulence.

[0064] (4-2)

The heat source heat exchanger (30) of this embodiment is disposed upstream of the impeller (41) in the air flow of the air passage (S2).

[0065] The heat source heat exchanger (30) includes the plurality of flat tubes (35), and thus the air passing through the heat source heat exchanger (30) is less likely to be disturbed in comparison with a configuration including typical perfect circular heat transfer tubes. Thus, the air flowing into the fan (40) can be less disturbed. If the air flowing into the fan (40) is disturbed, the porous portion (46) of the impeller (41) fails to perform a function of reducing the turbulence, and the noise is increased. In contrast, in this embodiment, the air flowing into the fan (40) is less likely to be disturbed due to the heat source heat exchanger (30) including the flat tubes (35), and thus the porous portion (46) can adequately perform a function of reducing the turbulence. Therefore, the noise can be effectively reduced.

[0066] (4-3)

In this embodiment, the distance L1 between the impeller (41) and the heat source heat exchanger (30) is 125 mm or more.

[0067] If the distance L1 between the impeller (41) and the heat source heat exchanger (30) is 125 mm or more, the distribution of the speed of air passing through the impeller (41) can be uniform. Accordingly, the porous portion (46) can adequately perform a function of reducing the turbulence, and thus the noise can be effectively reduced.

(5) Variations

[0068] The above embodiment may be modified as follows. In the following description, the differences from the above embodiment will be described in principle.

(5-1) First Variation

[0069] As shown in FIG. 7, the heat source heat exchanger (30) of the first variation is a single-surface-type heat exchanger including only one air through surface (the first air through surface (31)). The heat source heat

exchanger (30) includes the first heat exchange portion (30A), but does not include the second heat exchange portion (30B) of the embodiment. The casing (50) is provided with the first intake port (61A), but is not provided with the second intake port (61B) of the embodiment. The first heat exchange portion (30A) is located upstream of the fan (40) in the air flow in the axial direction. In other words, the first heat exchange portion (30A) is disposed between the first intake port (61A) and the fan (40). The first intake port (61A), the fan (40), and the first heat exchange portion (30A) overlap each other in the axial direction (the front-rear direction) of the fan (40). The plurality of flat tubes (35) extend in the direction orthogonal to the axial direction of the fan (40).

[0070] In the first variation, the air flowing into the air passage (S2) from the first intake port (61A) flows straight through the first heat exchange portion (30A) and the fan (40) in sequence. Thus, the air passing through the fan (40) can be less disturbed, and thus the porous portion (46) can adequately perform a function of reducing the turbulence. Therefore, the noise can be effectively reduced.

(5-2) Second Variation

[0071] As shown in FIG. 8, the support structure (70) of the second variation is disposed downstream of the impeller (41) in the air flow of the air passage (S2). Accordingly, the air flowing into the impeller (41) is not disturbed by the support structure (70). In addition, the motor (42) is disposed downstream of the impeller (41) in the air flow of the air passage (S2). Accordingly, the air flowing into the impeller (41) is not disturbed by the support structure (70). Thus, in the second variation, the air passing through the fan (40) can be less disturbed due to the support structure (70) and the motor (42), and thus the porous portion (46) can adequately perform a function of reducing the turbulence. Therefore, the noise can be effectively reduced.

(5-3) Third Variation

[0072] As shown in FIGS. 9 and 10, the support structure (70) of the third variation is different in configuration from the support structure (70) of the above embodiment. The fixing member (72) of the support structure (70) extends from the supporting portion (71) in order to connect the motor (42) and the front surface panel (55). In this embodiment, the support structure (70) is disposed upstream of the impeller (41) in the air flow of the air passage (S2).

[0073] As shown in FIG. 10, the supporting portion (71) is a circular plate having a central mounting hole (71a). The front surface of the supporting portion (71) is fixed to the rear surface of the motor (42). The plurality of fixing members (72) extend radially outward from the peripheral portion of the supporting portion (71). The fixing member (72) extends from the rear to the front of the

fan (40), and the end of the fixing member (72) is fixed to the front surface panel (55).

[0074] The fixing member (72) consists of a pair of elongated wire members adjacent to and substantially parallel to each other. The cross section of the wire member that is orthogonal to the extending direction is a circular shape. The circular shape includes an elliptical shape. The fixing member (72) consists of the elongated wire members of which the cross section is a circular shape, thereby less disturbing the air flow of the air passage (S2). The number of wire members of the fixing member (72) is not limited to two, and may be one.

[0075] The plurality of fixing members (72) extend radially outward from the supporting portion (71). The support structure (70) includes four fixing members (72) arranged at intervals of 90° in the circumferential direction. The number of fixing members (72) is not limited thereto, and may be three or may be five or more. The angle between the fixing members (72) adjacent to each other is not limited to 90°.

[0076] Each fixing member (72) includes a tilted portion (72a), an elongated portion (72b), a leg portion (72c) and a leg fixing portion (72d). The tilted portion (72a) extends upstream while extending radially outward from the supporting portion (71). The elongated portion (72b) extends from the radially outer end of the tilted portion (72a) and extends in the direction substantially orthogonal to the direction in which the shaft extends. The leg portion (72c) extends from the radially outer end of the elongated portion (72b) and extends downstream in the direction in which the shaft extends. The leg fixing portion (72d) extends from the downstream end of the leg portion (72c) and extends radially outward along the front panel (64). The leg fixing portion (72d) is located on the rear surface of the front panel (64) and is fixed to the outer periphery of the blow-out port (62).

[0077] The four fixing members (72) are coupled to each other in the circumferential direction by a plurality of annular ribs (73a, 73b, 73c, 73d) having different diameters. The annular ribs (73a, 73b, 73c, 73d) each consist of a member thinner than the wire member of the fixing member (72). The annular ribs (73a, 73b, 73c, 73d) are disposed concentrically with respect to the shaft (42a). The first annular rib (73a), the second annular rib (73b), and the third annular rib (73c) are fixed to the front side of the elongated portion (72b). The fourth annular rib (73d) is located at the downstream ends of the leg portions (72c) and is inscribed on and fixed to the four leg portions (72c).

[0078] The support structure (70) supporting the motor (42) is configured as described above, whereby the support structure (70) does not intervene the air flow, and the porous portion (46) of the impeller (41) can adequately perform a function of reducing the noise.

(5-4) Fourth Variation

[0079] As shown in FIG. 11, in the heat source unit (20)

of the fourth variation, the motor (42) is located downstream of the impeller (41) in the air flow of the air passage (S2). The shaft (42a) of the motor (42) extends rearward and is coupled to the front surface of the hub (43). The motor (42) is supported by the support structure (70) and is disposed in the blow-out flow path (63).

[0080] As shown in FIG. 12, the support structure (70) includes the supporting portion (71) for fixing the motor (42) and includes the plurality of fixing members (72) extending from the supporting portion (71) and coupling the motor (42) with the front surface panel (55). The outer shape of the support structure (70) is a circular shape in plan view, and its diameter is larger than that of the bell mouth (65). The support structure (70) is laid across the blow-out port (62) and fixed to the front surface of the front panel (64).

[0081] The supporting portion (71) is a circular plate shape of which the center is present on the extension line of the shaft (42a). The supporting portion (71) includes the central mounting hole (71a) and has the rear surface fixed to the front surface of the motor (42). The plurality of fixing members (72) extend radially outward from the peripheral portion of the supporting portion (71). The fixing member (72) extends radially outward from the peripheral portion of the supporting portion (71), and the end of the fixing member (72) is fixed to the front surface panel (55).

[0082] The fixing member (72) consists of a pair of elongated wire members adjacent to and substantially parallel to each other. The cross section of the wire member that is orthogonal to the extending direction is a circular shape. The circular shape includes an elliptical shape. The fixing member (72) consists of the elongated wire members of which the cross section is a circular shape, thereby less disturbing the air flow of the air passage (S2). The number of wire members of the fixing member (72) is not limited to two, and may be one.

[0083] The plurality of fixing members (72) extend radially outward from the supporting portion (71). The support structure (70) includes four fixing members (72) arranged at intervals of 90° in the circumferential direction. The number of fixing members (72) is not limited thereto, and may be three or may be five or more. The angle between the fixing members (72) adjacent to each other is not limited to 90°. Each fixing member (72) extends in the direction substantially orthogonal to the direction in which the shaft extends. The end of the fixing member (72) is located on the peripheral portion of the blow-out port (62) and is fixed to the front surface of the front panel (64).

[0084] The four fixing members (72) are coupled to each other in the circumferential direction by a plurality of annular ribs (73a, 73b, 73c, 73d) having different diameters. The annular ribs (73a, 73b, 73c, 73d) each consist of a member thinner than the wire member of the fixing member (72). The annular ribs (73a, 73b, 73c, 73d) are disposed concentrically with respect to the shaft (42a). The annular ribs (73a, 73b, 73c, 73d) are fixed

to the front sides of the four fixing members (72).

[0085] In the fourth variation, the fixing member (72) and the motor (42) both configured as described above can less disturb the air flow than if they are located upstream of the impeller (41). Thus, the porous portion (46) can more adequately perform a function of reducing the noise.

(5-5) Fifth Variation

[0086] As shown in FIG. 13, the support structure (70) of the fifth variation is disposed downstream of the impeller (41) in the air flow of the air passage (S2).

[0087] As shown in FIG. 14, the support structure (70) of this embodiment includes the supporting portion (71) for fixing the motor (42) and includes the plurality of fixing members (72) extending from the supporting portion (71) and coupling the motor (42) with the front surface panel (55).

[0088] The supporting portion (71) is a cylindrical shape of which the axis center is present on the extension line of the shaft. The front side of the supporting portion (71) includes a circular closed surface having a central mounting hole (71a), and the rear side of the supporting portion (71) includes an opening. The front portion of the motor (42) is fixed to the inside of the cylinder of the supporting portion (71) through the rear opening of the supporting portion (71).

[0089] The plurality of fixing members (72) are a substantially plate shape. Each fixing member (72) is twisted and extends radially outward from the outer peripheral surface of the supporting portion (71). The radially outer ends of the plurality of fixing members (72) are coupled to a frame member (74).

[0090] The frame member (74) is a cylindrical shape. The frame member (74) is provided to surround the outer periphery of the plurality of fixing members (72). The diameter of the frame member (74) is smaller than that of the bell mouth (65). A flange (75) extends radially outward from the downstream end of the frame member (74). The flange (75) is located on the periphery of the blow-out port (62) and is fixed to the front surface of the front panel (64). The supporting portion (71), the fixing members (72), and the frame member (74) are located inside the bell mouth (65).

[0091] In this embodiment, the support structure (70) includes thirteen fixing members (72). The thirteen fixing members (72) are disposed at equal intervals in the circumferential direction. The number of the fixing members (72) is a prime number of 5 or more in one preferred embodiment, and is 5, 7, or 11, for example. If the number of the fixing members (72) is a prime number of 5 or more, the disturbance in the air flow can be dispersed. Accordingly, the fixing member (72) allows the porous portion (46) to more adequately perform a function of reducing the noise.

[0092] The cross section of the fixing member (72) that is orthogonal to its extending direction is a blade shape.

The fixing member (72) gradually decreases in thickness from its rear end (72e) toward its front end (72f) along its chord (72g).

[0093] In this embodiment, the fixing member (72) configured as described above can less disturb the air flow. Thus, the porous portion (46) can more adequately perform a function of reducing the noise.

(5-6) Sixth Variation

[0094] As shown in FIG. 15, the support structure (70) of the sixth variation is fixed to the inner peripheral surface of the bell mouth (65). The support structure (70) is disposed upstream of the impeller (41) in the air flow of the air passage (S2).

[0095] The length from the front end portion to the rear end portion of the bell mouth (65) is longer than those of the fan (40) and the support structure (70) in the direction in which the shaft extends. The bell mouth (65) covers the outer peripheries of the impeller (41), the motor (42), and the support structure (70).

[0096] The support structure (70) includes the supporting portion (71) for fixing the motor (42) and includes the plurality of fixing members (72) extending from the supporting portion (71) and coupling the motor (42) with the bell mouth (65).

[0097] The supporting portion (71) is a cylindrical shape of which the axis center is present on the extension line of the shaft. The rear side of the supporting portion (71) includes a circular closed surface, and the front side of the supporting portion (71) includes an opening. The rear portion of the motor (42) is fixed to the inside of the cylinder of the supporting portion (71) through the front opening of the supporting portion (71).

[0098] The plurality of fixing members (72) are a substantially plate shape. Each fixing member (72) is twisted and extends radially outward from the outer peripheral surface of the supporting portion (71). The radially outer ends of the plurality of fixing members (72) are coupled to a frame member (74). The outer peripheral surface of the frame member (74) is fixed to the inner peripheral surface of the bell mouth (65).

[0099] In the sixth variation, the fixing member (72) configured as described above can less disturb the air flow. Thus, the porous portion (46) can adequately perform a function of reducing the turbulence.

(5-7) Seventh Variation

[0100] The seventh variation shown in FIG. 16 is different in configuration from the heat source heat exchanger (30) of the above embodiment. Similarly to the embodiment, the heat source heat exchanger (30) includes the plurality of flat tubes (35). The plurality of flat tubes (35) are arranged in the direction orthogonal to the air flow. The plurality of flat tubes (35) of this example are arranged in the top-bottom direction. The width direction of the plurality of flat tubes (35) corresponds to the air flow

direction. A wide first surface (35a) is formed at one of ends of each of the flat tubes (35) in the thickness direction (the top-bottom direction), and a wide second surface (35b) is formed at the other one of the ends of each of the flat tubes (35) in the thickness direction. The first surface (35a) of one of the flat tubes (35) adjacent to each other and the second surface (35b) of the other one of the flat tubes (35) adjacent to each other face each other.

[0101] The cross section of the flat tube (35) that is perpendicular to its axial direction is formed in an elliptical shape, an oval shape, or a substantially rectangular shape extending in the air flow direction. A plurality of refrigerant flow paths (C) are formed in the flat tube (35) and arranged in the air flow direction. In other words, the flat tube (35) is configured as a multi-path flat tube. Accordingly, the flat tube (35) has a larger area of the refrigerant flow path, and the heat source heat exchanger (30) exchanges heat more efficiently.

[0102] The plurality of fins (36) of the heat source heat exchanger (30) of the seventh variation include a plurality of windward fins (80A) located windward of the flat tubes (35) and include a plurality of leeward fins (80B) located leeward of the flat tubes (35). The windward fin (80A) and the leeward fin (80B) are arranged in the axial direction of the flat tube.

[0103] The windward fins (80A) and the leeward fins (80B) are each formed in a plate shape, and their thicknesses directions correspond to the arrangement direction the fins (36). The plurality of fins (36) define a plurality of air flow paths (37) where air flows between the flat tubes (35) adjacent to each other. Specifically, the windward fins (80A) define a plurality of windward air flow paths (81A) each between the flat tubes (35) adjacent to each other. The leeward fins (80B) define a plurality of leeward air flow paths (81B) each between the flat tubes (35) adjacent to each other.

[0104] The fin (36) is formed in a rectangular shape extending in the arrangement direction of the flat tubes (35). The fin (36) includes a plurality of notches formed on one of sides of the fin (36) in the width direction (the air flow direction). Specifically, the windward fin (80A) includes a plurality of windward notches (82A), and the leeward fin (80B) includes a plurality of leeward notches (82B). The windward notches (82A) are formed on the long side of the windward fin (80A) that is located on the downstream side. The leeward notches (82B) are formed on the long side of the leeward fin (80B) that is located on the upstream side. The windward notches (82A) and the leeward notches (82B) are arranged in the longitudinal direction of the fin (36). The plurality of windward notches (82A) are formed at equal intervals in the top-bottom direction. The plurality of leeward notches (82B) are formed at equal intervals in the top-bottom direction. The windward notch (82A) and the leeward notch (82B) face each other in the width direction of the flat tube (35).

[0105] The fin (36) includes a continuous portion (36b) extending in the longitudinal direction (the top-bottom

direction) of the fin (36) and includes a plurality of intermediate portions (36c) extending from the continuous portion (36b) in the width direction of the fin (36). In the windward fin (80A), the plurality of intermediate portions (36c) are formed on the downstream side of the windward fin (80A), and the continuous portion (36b) is formed on the upstream side of the windward fin (80A). In the leeward fin (80B), the plurality of intermediate portions (36c) are formed on the upstream side of the leeward fin (80B), and the continuous portion (36b) is formed on the downstream side of the leeward fin (80B).

[0106] In the windward fin (80A), the windward notch (82A) is formed between the intermediate portions (36c) adjacent to each other. In the leeward fin (80B), the leeward notch (82B) is formed between the intermediate portions (36c) adjacent to each other. The windward portion of the flat tube (35) is inserted into the windward notch (82A) one by one. The leeward portion of the flat tube (35) is inserted into the leeward notch (82B) one by one.

[0107] The intermediate portions (36c) and the continuous portion (36b) of each fin (36) include a plurality of tabs (83) and a plurality of raised portions (84).

[0108] The tab (83) is a cut and raised portion formed by cutting and raising the fin (36) in the thickness direction. The tab (83) is formed by cutting the fin (36) in a U-shape as viewed in the thickness direction of the fin (36) and inclining the inside part of the cut portion with respect to the fin (36). The tab (83) extends in the axial direction of the flat tube (35). The distal end of the tab (83) is in contact with the adjacent one of the fins (36), whereby the distance between the pair of fins (36) adjacent to each other can be maintained.

[0109] The raised portion (84) is raised in the thickness direction of the fin (36). The raised portion (84) is formed in a U-shape when viewed in the thickness direction of the fin (36). The raised portion (84) functions as a rib that increases the heat transfer area of the fin (36) and that reinforces the fin (36). The raised portion (84) includes a portion extending in the width direction of the flat tube (35) and includes a portion extending in the arrangement direction of the flat tubes (35).

[0110] In the seventh variation as well, the flat tube (35) is a multi-path flat tube including the plurality of flow paths (C), and thus the heat source heat exchanger (30) exchanges heat more efficiently. Thus, the volume of air produced by the fan (40) can be reduced, and thus the noise emitted when the fan (40) is operating can be reduced. In addition, the air passing through the fan (40) can be less disturbed, and thus the porous portion (46) can adequately perform a function of reducing the turbulence.

(5-8) Eighth Variation

[0111] The hot water supply apparatus (10) of the eighth variation includes a refrigerant leakage sensor (90). The refrigerant leakage sensor (90) detects leakage

of refrigerant from the refrigerant circuit (21).

[0112] Propane (R290) is used as a refrigerant of the refrigerant circuit (21). The density of the refrigerant in the refrigerant circuit (R) is higher than that of air. The refrigerant in the refrigerant circuit (21) is a natural refrigerant. The natural refrigerant has an ozone depletion potential of zero; has a low global warming potential; and has a small impact on the environment. The refrigerant may be carbon dioxide (CO₂), ammonia (R717), methane (R50), ethane (R170), butane (R600), or isobutane (R600a). The refrigerant may be difluoromethane (R32), 2,3,3,3-tetrafluoropropene (HFO-1234yf), 1,3,3,3-tetrafluoropropene (HFO-1234ze). The refrigerant may be a single component refrigerant or may be a refrigerant mixture mixed with another refrigerant. The mixed refrigerant may be a refrigerant composed of two types of substances: 2,3,3,3-tetrafluoropropene (HFO-1234yf) and difluoromethane (R32). The mixed refrigerant may be a refrigerant (R454C) composed of two types of substances: 78.5 wt% of 2,3,3,3-tetrafluoropropene (HFO-1234yf) and 21.5 wt% of difluoromethane (R32). These refrigerants may be used in the above embodiment and the other variations.

[0113] As shown in FIG. 17, the refrigerant leakage sensor (90) is provided in the heat source unit (20). The refrigerant leakage sensor (90) is disposed in the casing (50). The refrigerant leakage sensor (90) is disposed in the machine chamber (S1). The refrigerant leakage sensor (90) is disposed in a lower portion of the machine chamber (S1). In other words, the refrigerant leakage sensor (90) is located at a position lower than 1/2 of the entire height of the machine chamber (S1). The refrigerant leakage sensor (90) is disposed, for example, near the compressor (22).

[0114] As shown in FIG. 18, the hot water supply apparatus (10) includes a control unit (91). The control unit (91) controls the hot water supply apparatus (10). Specifically, the control unit (91) controls the compressor (22), the fan (40), the four-way switching valve (25), and the expansion valve (23). The control unit (91) receives the first signal emitted from the refrigerant leakage sensor (90). The control unit (91) includes a microprocessor, an electric circuit, and an electronic circuit. The microprocessor includes a central processing unit (CPU), a memory, a communication interface, an analog input/output, and a contact input/output interface. The memory stores various programs to be executed by the CPU and stores data to be used by the programs.

[0115] If the refrigerant leakage sensor (90) detects leakage of the refrigerant, the refrigerant leakage sensor (90) outputs a first signal to the control unit (91). If the control unit (91) receives the first signal, the control unit (91) stops the compressor (22). Accordingly, leakage of the refrigerant in the refrigerant circuit (21) can be reduced. What "the refrigerant leakage sensor (90) detects leakage of the refrigerant" means herein is that the concentration of the refrigerant detected by the refrigerant leakage sensor (90) has reached a reference value or

higher.

[0116] If the refrigerant leakage sensor (90) detects leakage of the refrigerant, the control unit (91) may operate the fan (40) or may increase the volume of air produced by the fan (40). Accordingly, the leaked refrigerant can be diffused, and the concentration of the refrigerant can be reduced.

[0117] If the refrigerant leakage sensor (90) detects leakage of the refrigerant, the control unit (91) may close the expansion valve (23) completely or may close another valve (a shut-off valve) connected to the refrigerant circuit (21).

[0118] If the refrigerant leakage sensor (90) detects leakage of the refrigerant, the notification unit may notify somebody of the leakage of the refrigerant. The notification unit may be a display unit for showing that the refrigerant has leaked, or may be a sound generation unit for alerting by sound that the refrigerant has leaked.

[0119] The refrigerant leakage sensor (90) may be disposed in an upper portion of the machine chamber (S1). The refrigerant leakage sensor (90) may be disposed in the air passage (S2) in which the fan (40) is disposed.

(5-9) Ninth Variation

[0120] As shown in FIG. 19, the heat source unit (20) of the ninth variation includes the bell mouth (65) of which the position is different from that of the above embodiment. In the ninth variation, the bell mouth (65) is disposed in the casing (50). The front panel (64) of the ninth variation includes a flat plate portion (64a) extending along the front surface panel (55) and includes a recessed portion (64b) recessed rearward from the flat plate portion (64a). The bell mouth (65) extends toward the front from the inner edge of the recessed portion (64b). The bell mouth (65) is located rearward of the front end of the bottom plate (51) of the casing. The bell mouth (65) extends from the inner edge of the recessed portion (64b) toward the flat plate portion (64a).

[0121] The blow-out flow path (63) is formed in the bell mouth (65). The blow-out port (62) is formed at the upstream end of the blow-out flow path (63). The bell mouth (65) changes the diameter of the blow-out flow path (63) to adjust the flow of air. The bell mouth (65) includes a diameter-reducing portion (65a) located on the upstream side, a diameter-increasing portion (65b) located on the downstream side, and a constant-diameter portion (65c) located between the diameter-reducing portion (65a) and the diameter-increasing portion (65b). The diameter-reducing portion (65a) gradually reduces the diameter of the blow-out flow path (63) toward the downstream side. The diameter-increasing portion (65b) gradually increases the diameter of the blow-out flow path (63) toward the upstream side. The inside diameter of the constant-diameter portion (65c) is axially constant from end to end. The bell mouth (65) can adjust the flow of air, and thus the noise can be further reduced.

(6) Other Embodiments

[0122] The refrigeration apparatus may not be the hot water supply apparatus (10), and may be any other apparatus that performs a refrigeration cycle. Examples of the other apparatus include an air conditioner that adjusts the temperature of air; a humidity control apparatus that adjusts the humidity of air; a cooling apparatus that cools air in a refrigerator, a container, or the like; and a hot-water-supply and air-heating apparatus that performs both hot water supply and air heating.

[0123] The heat source heat exchanger (30) may be disposed downstream of the impeller (41) in the air flow of the air passage (S2).

[0124] The heat source heat exchanger (30) may be of a three-surface-type heat exchanger or may be a four-surface-type heat exchanger.

[0125] The flat tube (35) may include only one flow path (C).

[0126] The fin (36) may be a corrugated fin.

[0127] The fan (40) may be a sirocco fan, a turbo fan, an oblique flow fan, or a cross-flow fan. The impeller (41) of these fans includes the porous portion (46).

[0128] While the embodiment and variations thereof have been described above, it will be understood that various changes in form and details may be made without departing from the spirit and scope of the claims. The elements according to the embodiment, the variations thereof, and the other embodiments may be combined and replaced with each other.

[0129] The ordinal numbers such as "first," "second," "third," . . . , described above are used to distinguish the terms to which these expressions are given, and do not limit the number and order of the terms.

INDUSTRIAL APPLICABILITY

[0130] As described above, the present disclosure is useful for a heat source unit and a refrigeration apparatus.

DESCRIPTION OF REFERENCE CHARACTERS

[0131]

10	Hot Water Supply Apparatus (Refrigeration Apparatus)
20	Heat Source Unit
35	Flat Tube
36	Fin
37	Air Flow Path
40	Fan
41	Impeller
42	Motor
46	Porous Portion
50	Casing
55	Front Surface Panel (Blow-Out Panel)
62	Blow-Out Port

65 Bell Mouth
 70 Support Mechanism
 72 Fixing Member
 C Flow Path
 S2 Air Passage

the support structure (70) includes a plurality of fixing members (72) each configured to couple the blow-out panel (55) and the motor (42).

Claims

1. A heat source unit comprising:

a casing (50) in which an air passage (S2) formed;
 a heat exchanger (30) including a plurality of flat tubes (35) in each of which heat medium flow paths (C) are formed; including a plurality of fins (36) defining a plurality of air flow paths (37) where air flows between the flat tubes (35) adjacent to each other; and disposed in the air passage (S2); and
 a fan (40) including an impeller (41) having a porous portion (46); and disposed in the air passage (S2).

5 7. The heat source unit of claim 6, wherein

the blow-out panel (55) includes a bell mouth (65) forming the blow-out port (62), and the plurality of fixing members (72) are each configured to couple the bell mouth (65) and the motor (42).

8. A refrigeration apparatus comprising the heat source unit (20) of any one of claims 1 to 7 and performing a refrigeration cycle.

2. The heat source unit of claim 1, wherein

the heat exchanger (30) is disposed upstream of the impeller (41) in an air flow of the air passage (S2).

3. The heat source unit of claim 2, wherein

the heat exchanger (30) is a single-surface-type heat exchanger including only one air through surface (31).

4. The heat source unit of any one of claims 1 to 3, wherein

a distance L1 between the impeller (41) and the heat exchanger (30) is 125 mm or more.

5. The heat source unit of any one of claims 1 to 4, comprising:

a motor (42) configured to drive the impeller (41); and
 a support structure (70) configured to support the motor (42), wherein
 the support structure (70) is disposed downstream of the impeller (41) in an air flow of the air passage (S2).

6. The heat source unit of any one of claims 1 to 5, wherein

the casing (50) includes a blow-out panel (55) where a blow-out port (62) of the air passage (S2) is formed,
 the heat source unit includes a motor (42) configured to drive the impeller (41) and includes a support structure (70) configured to support the motor (42), and

FIG. 2

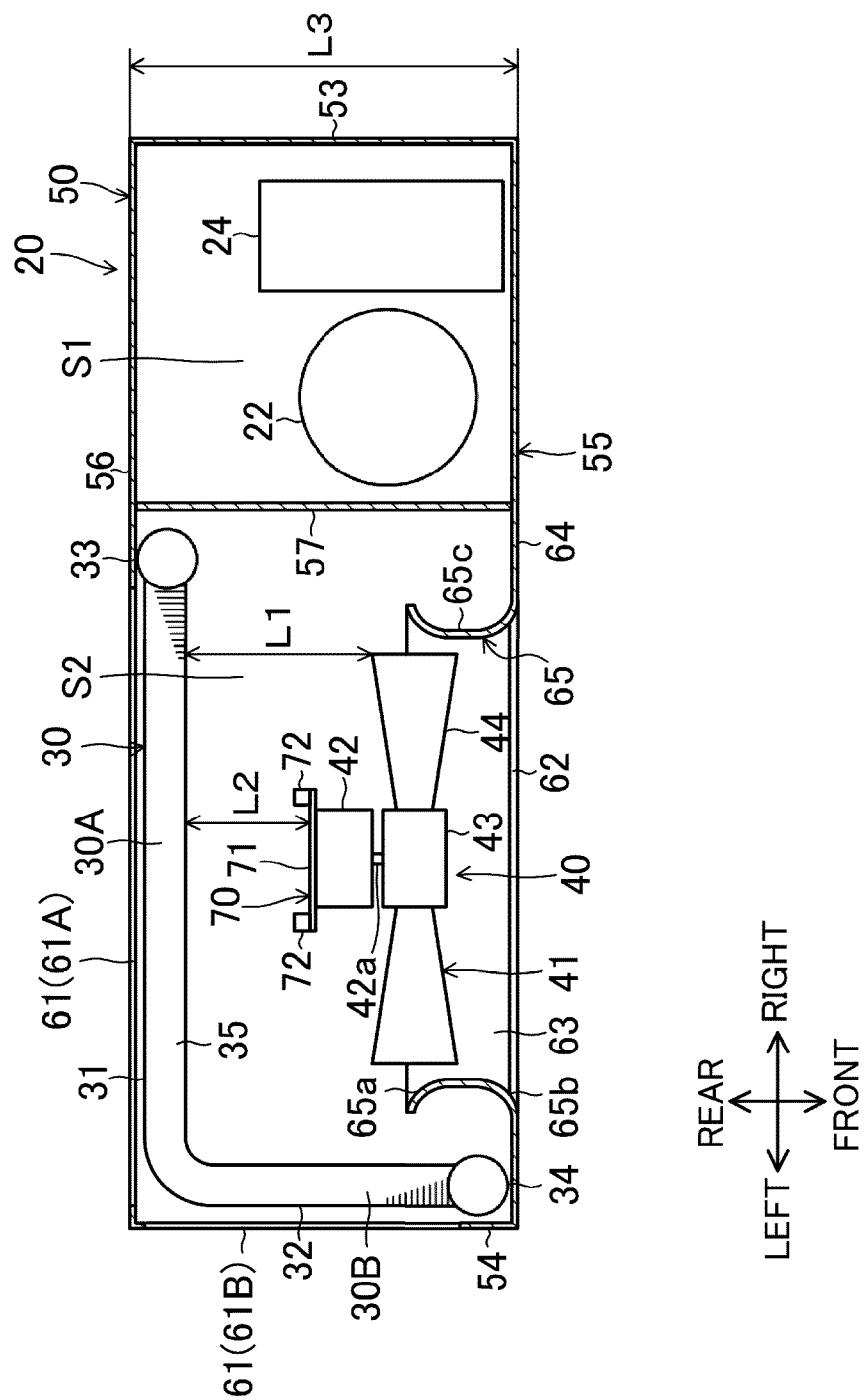


FIG.3

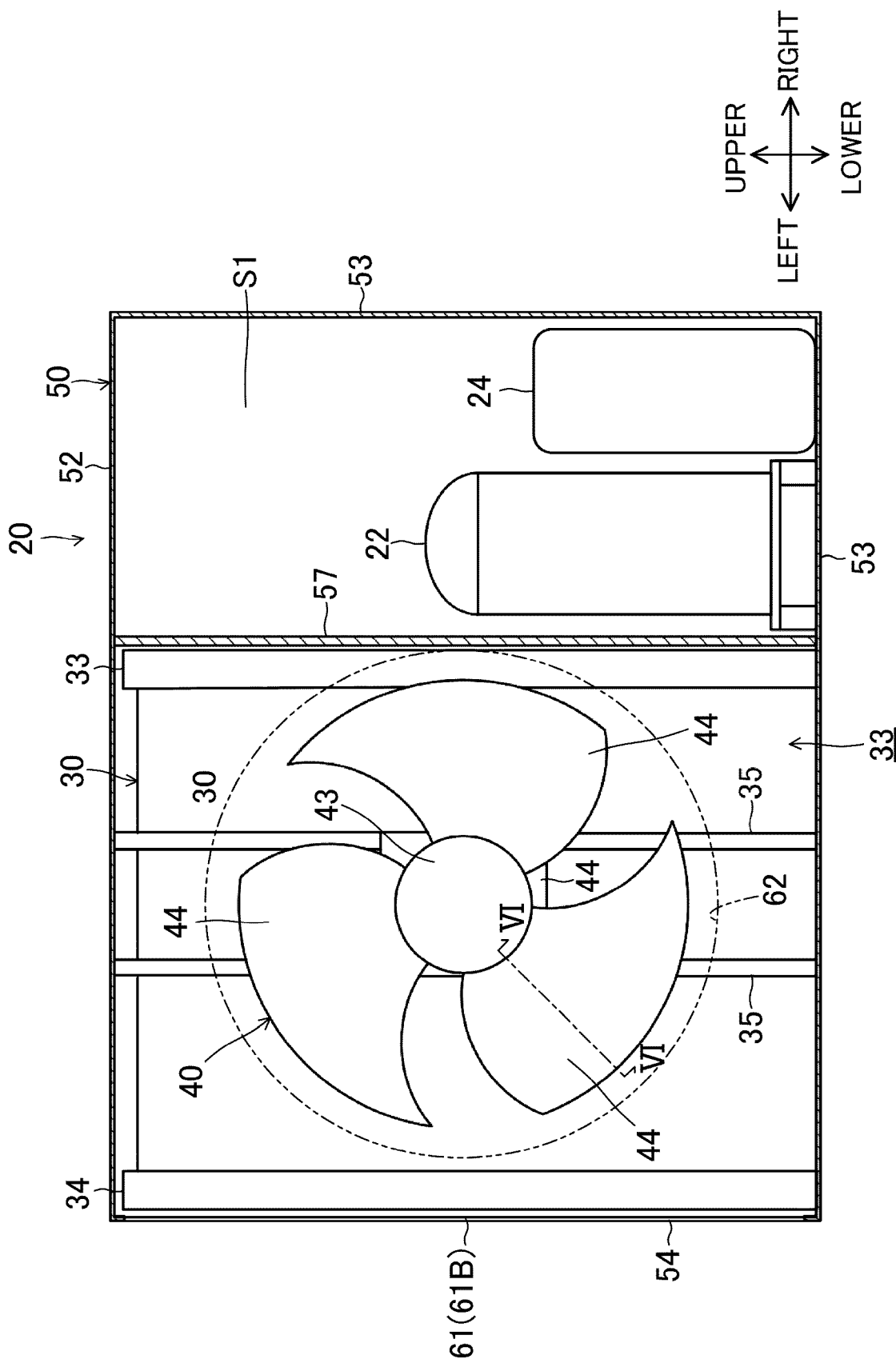


FIG.4

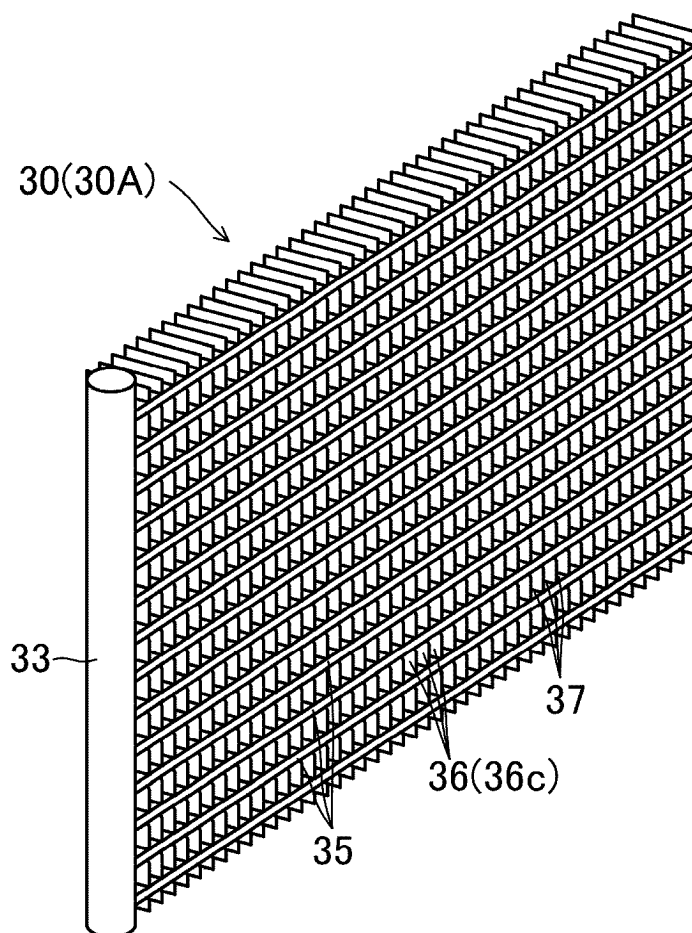


FIG.5

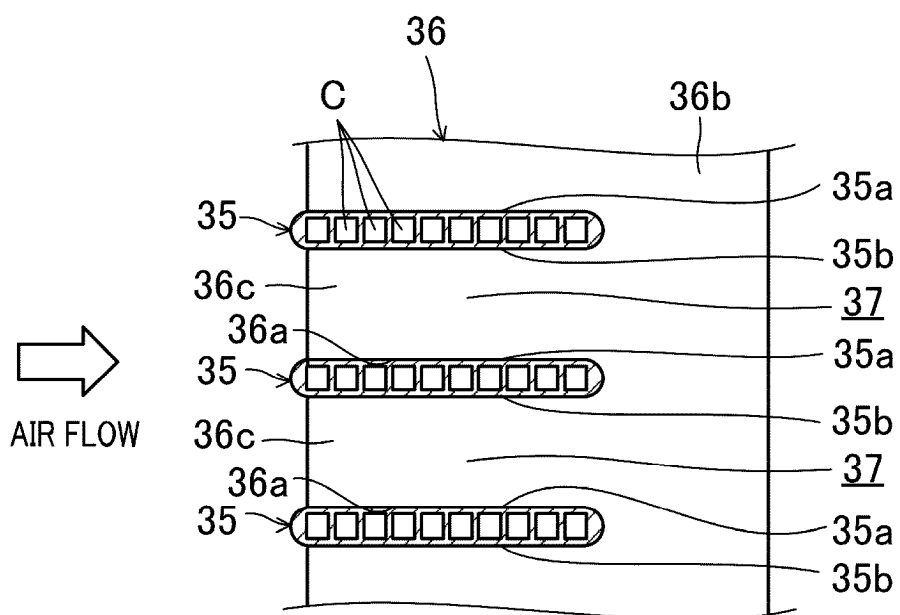


FIG.6

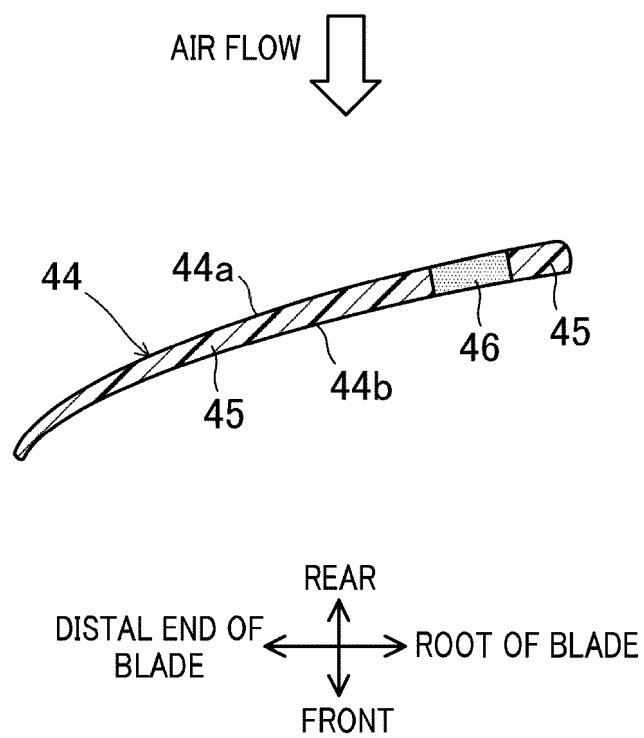


FIG.8

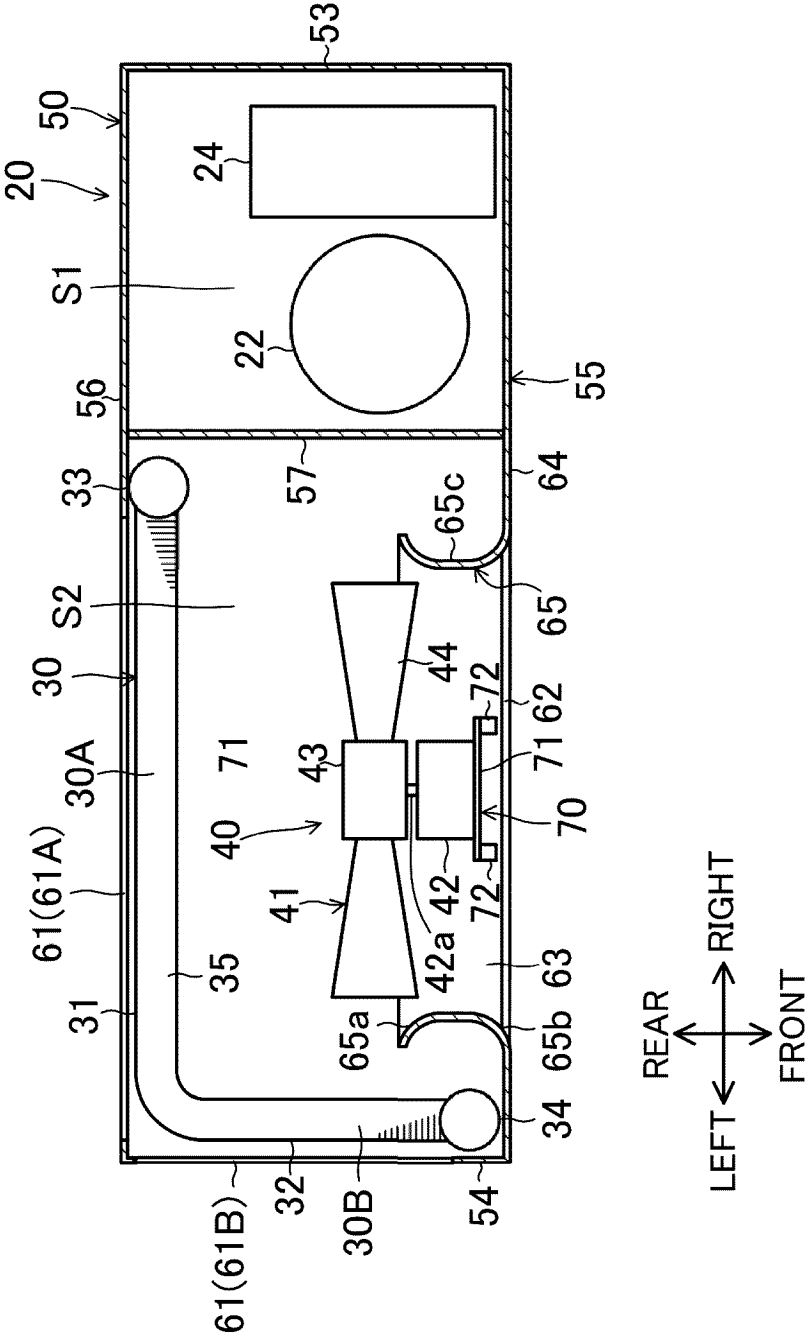


FIG. 9

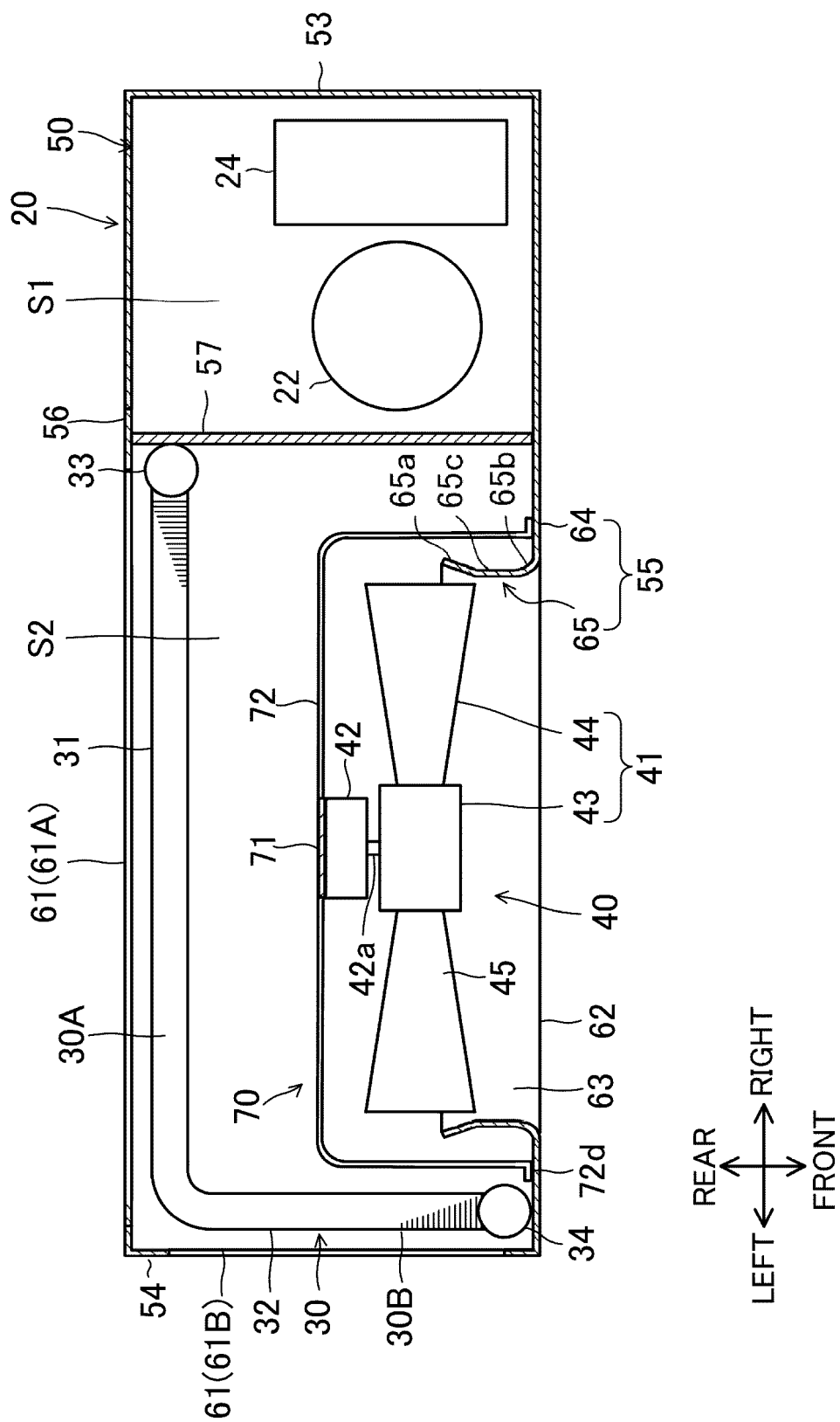


FIG.10

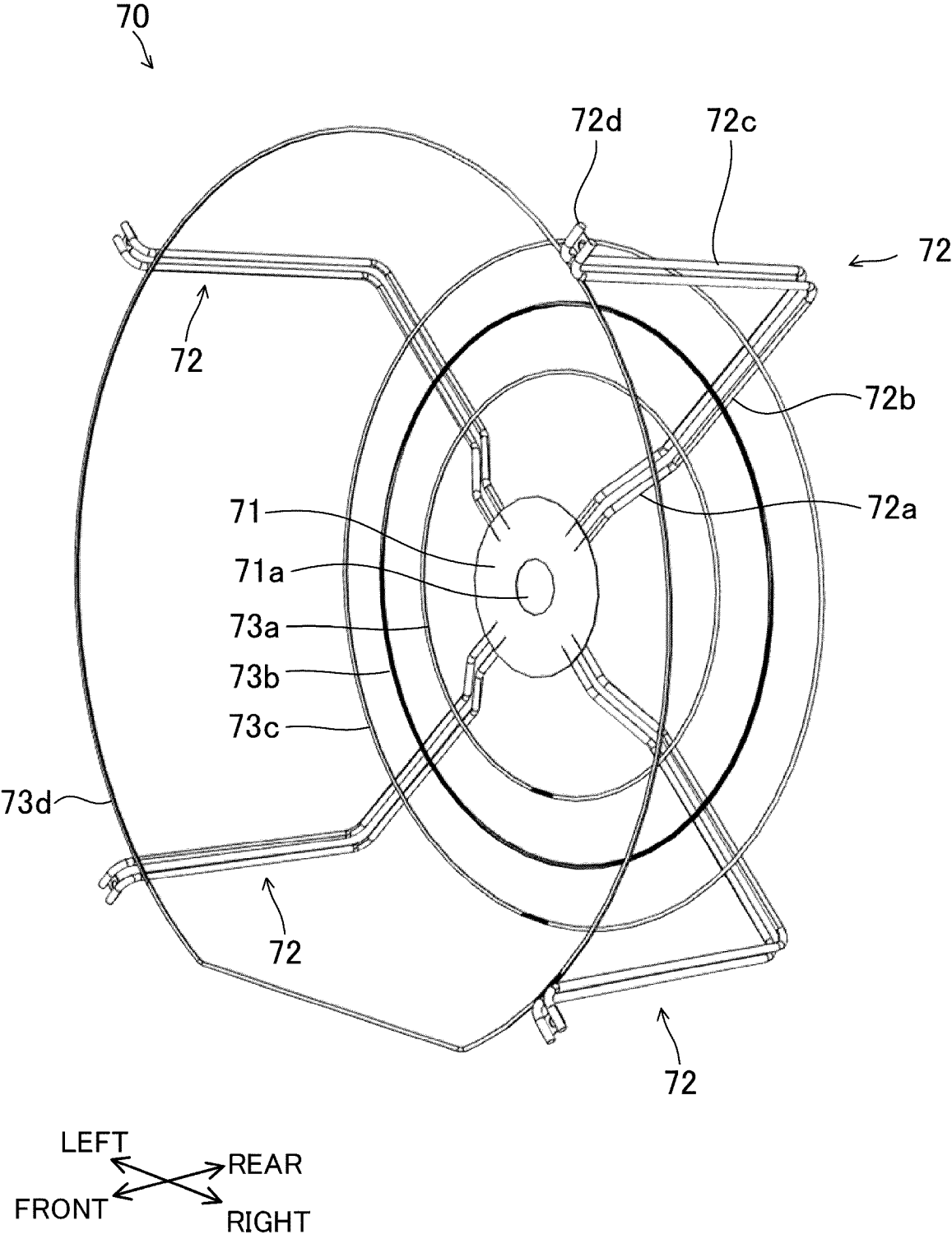


FIG. 11

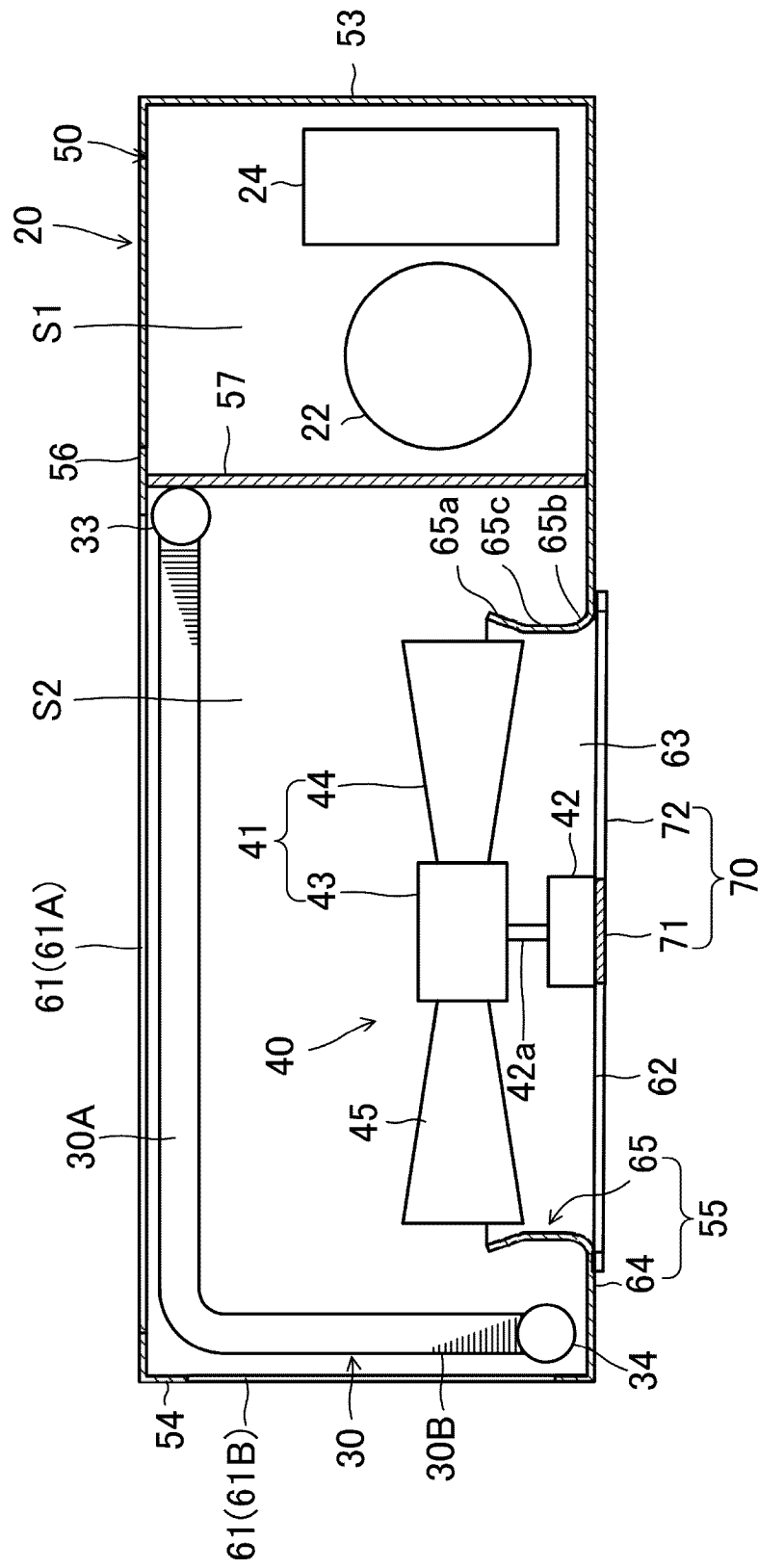


FIG.12

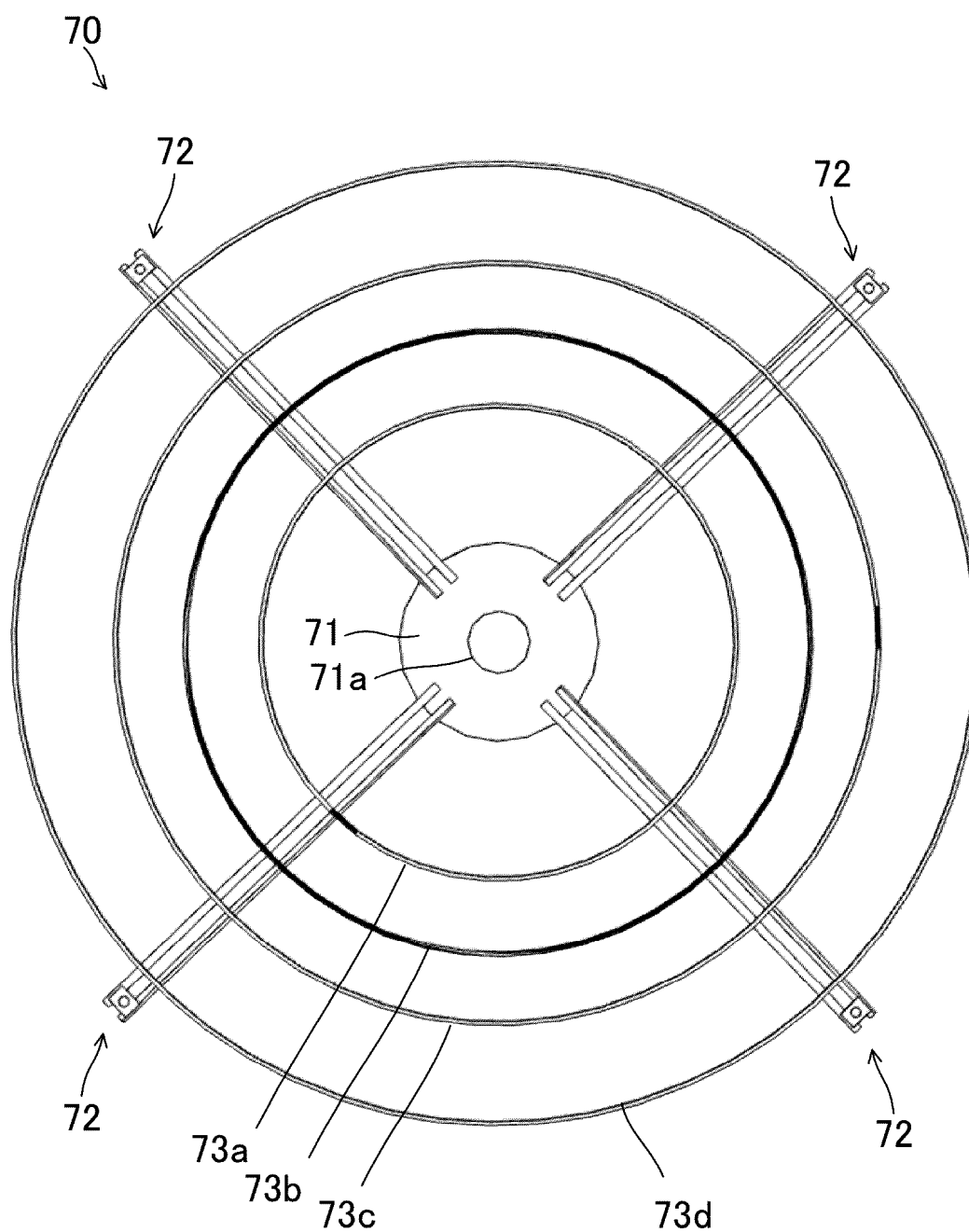


FIG. 13

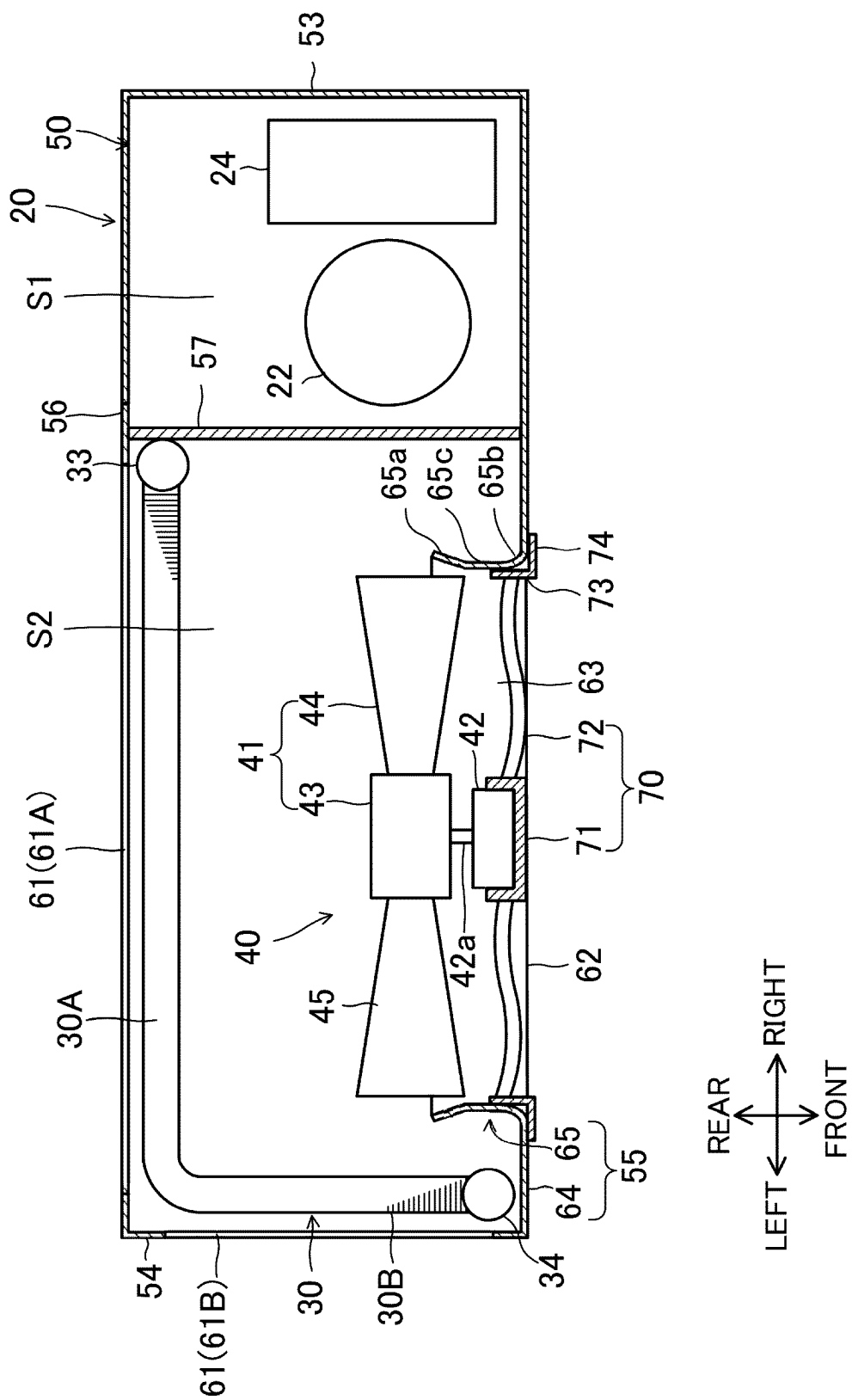


FIG.14

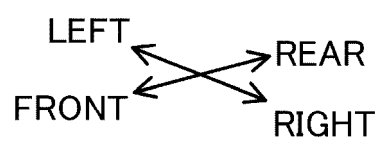
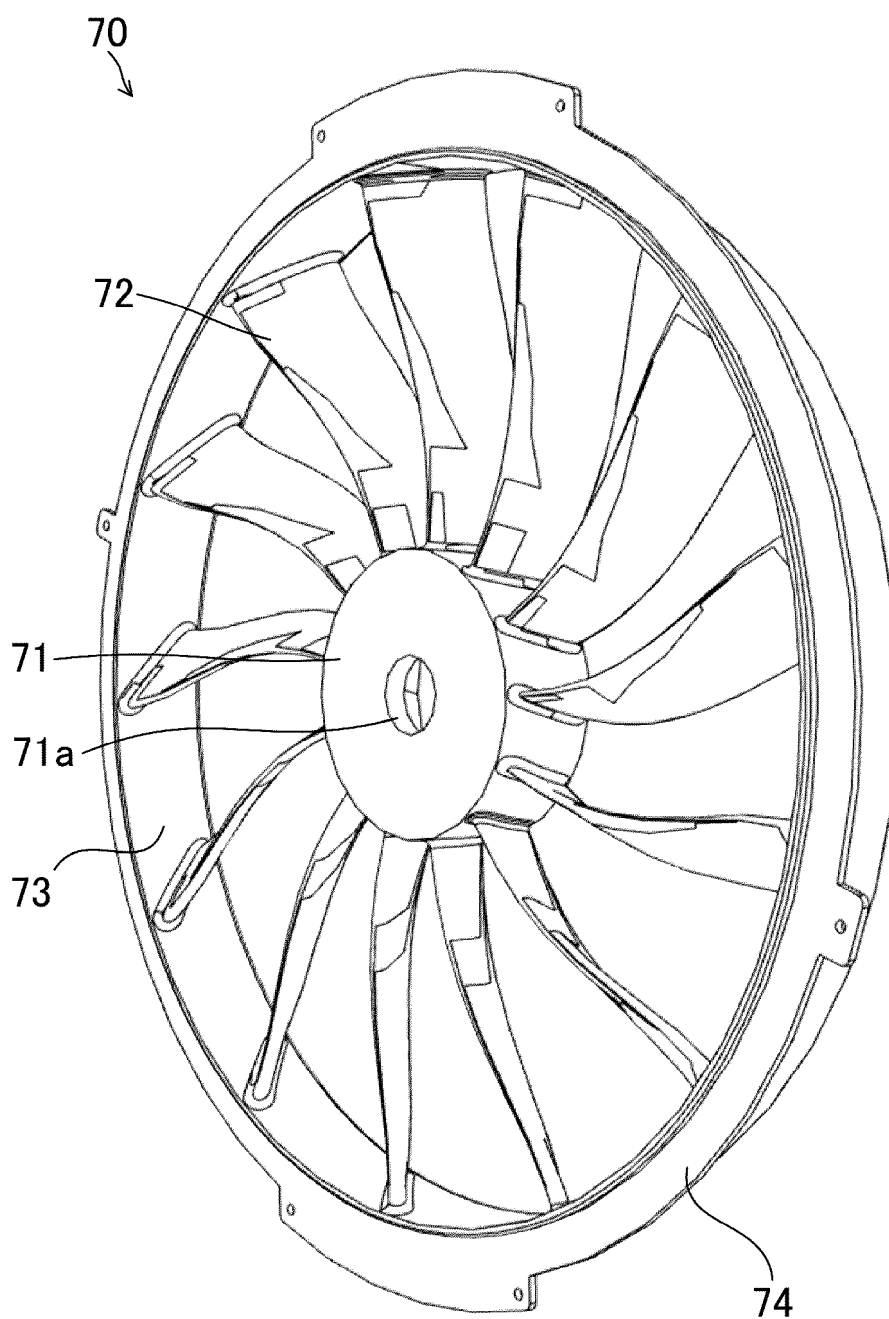


FIG.15

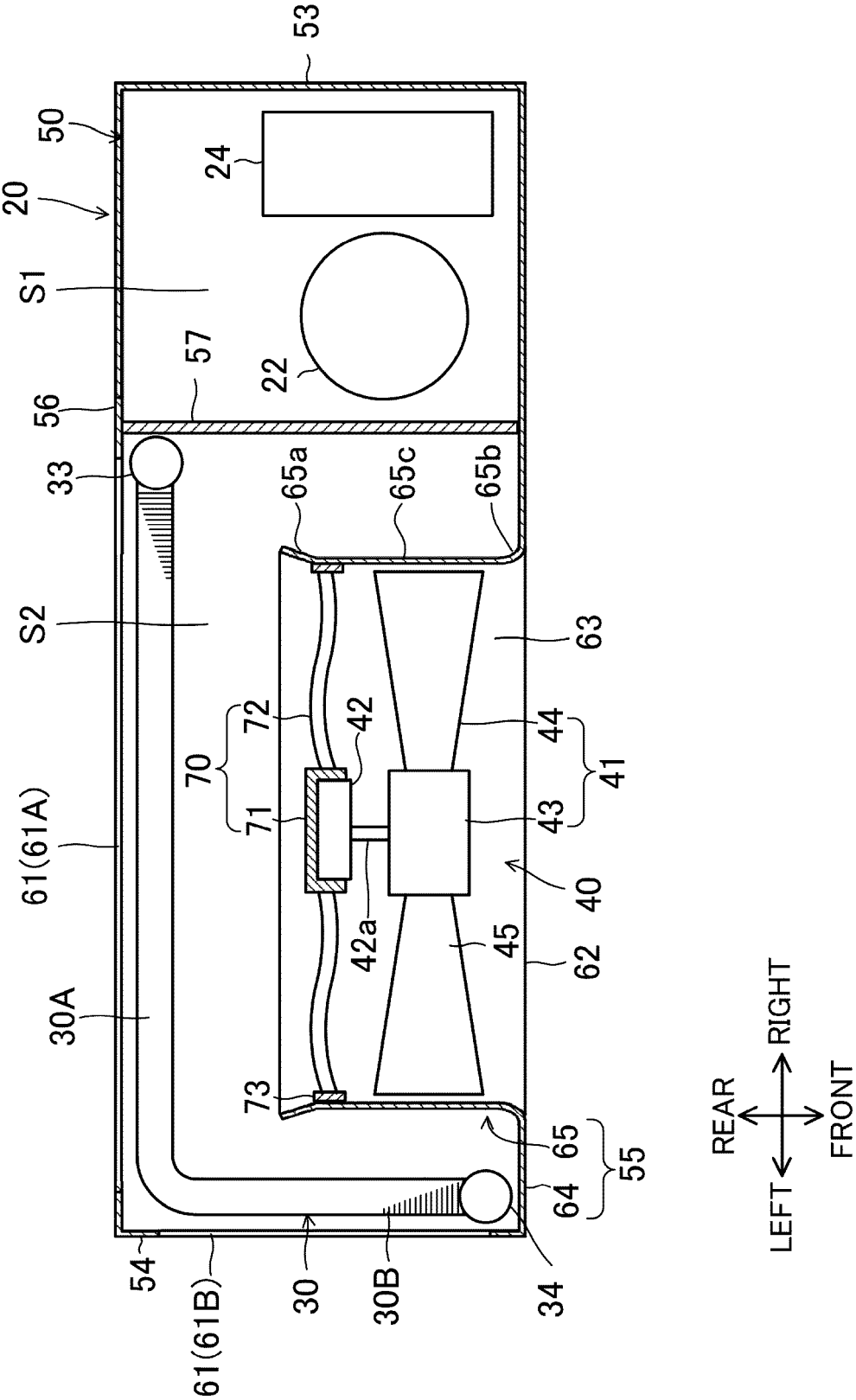


FIG.16

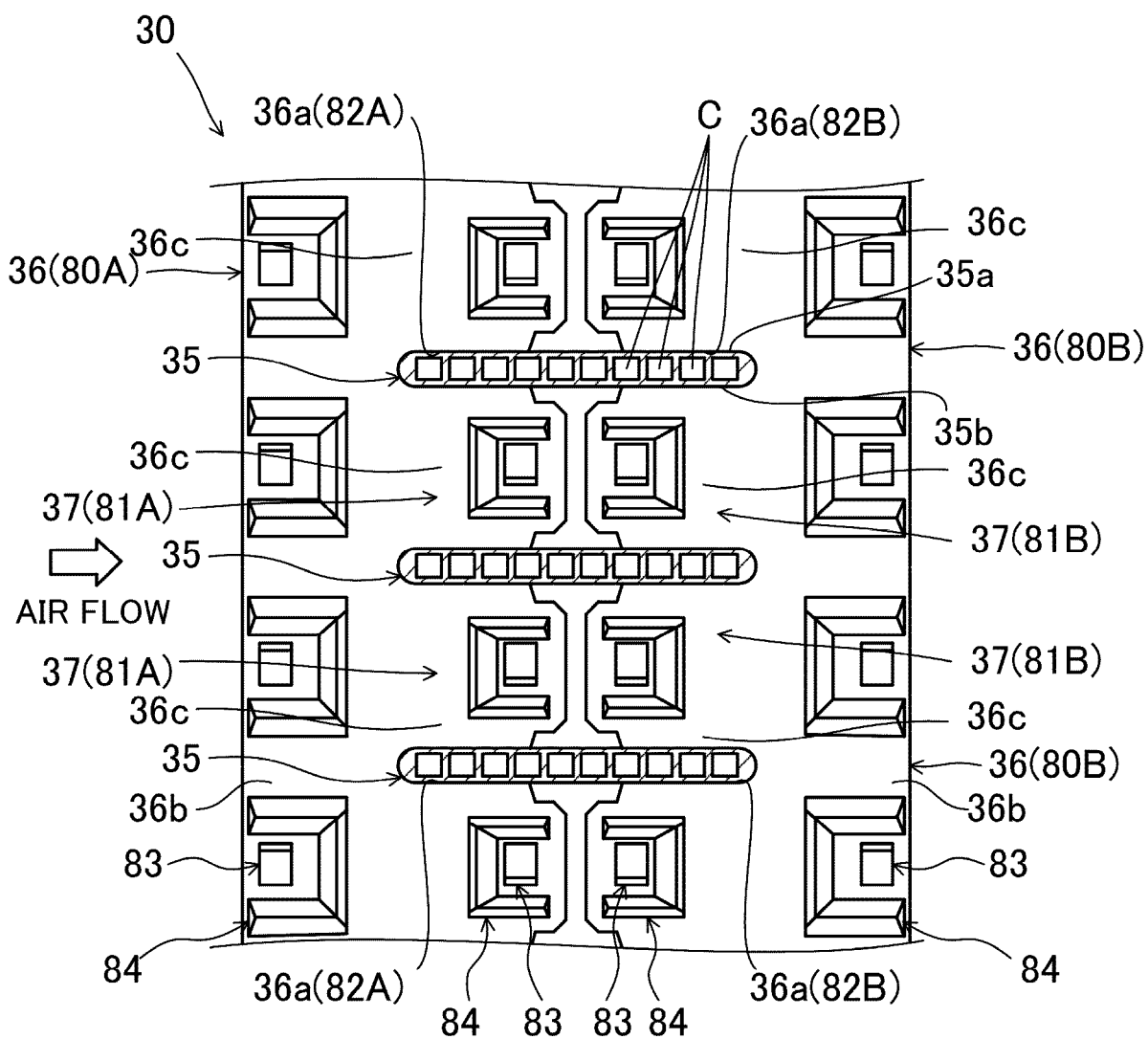


FIG.17

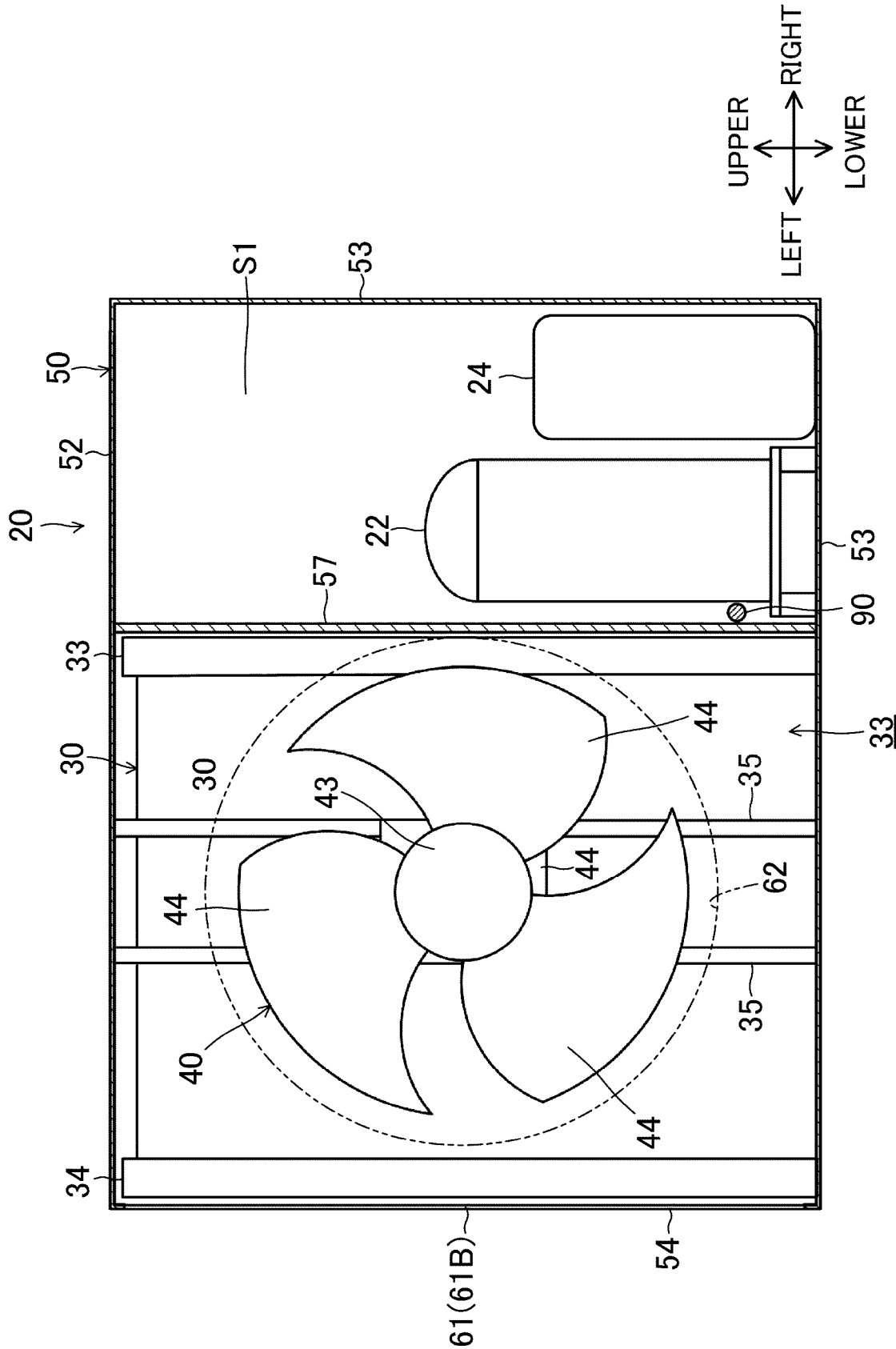


FIG.18

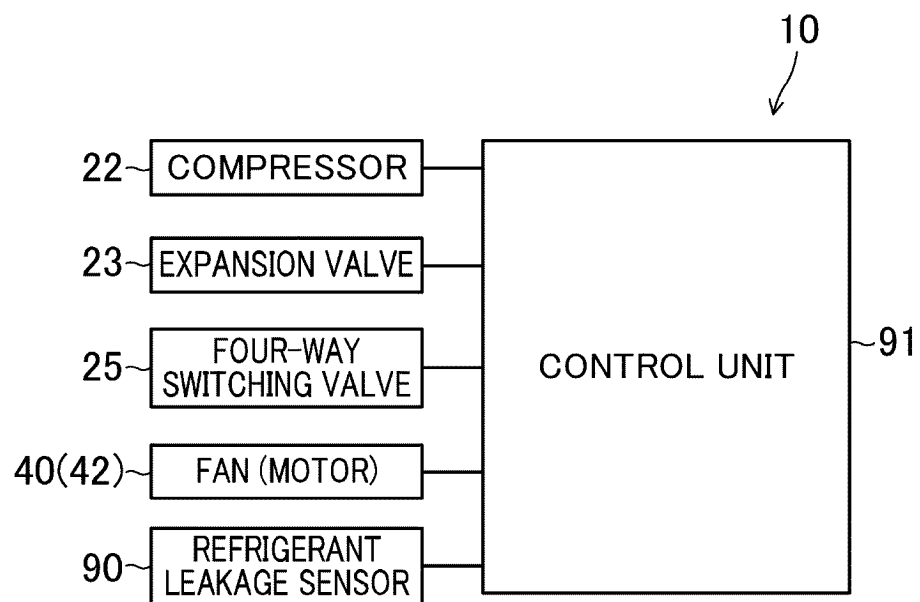
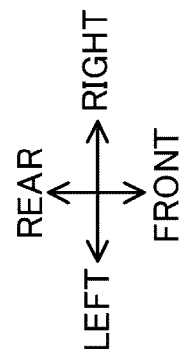
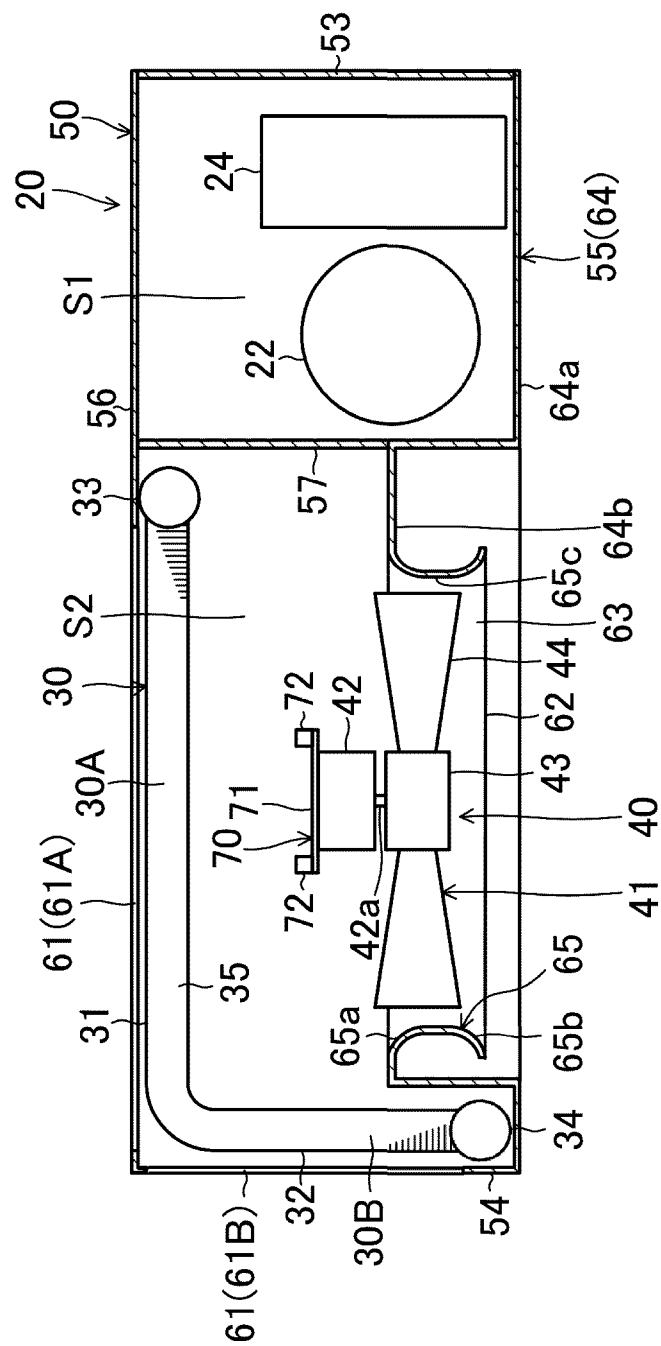


FIG. 19



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/025004

A. CLASSIFICATION OF SUBJECT MATTER

F24F 1/38(2011.01)i; **F04D 29/66**(2006.01)i; **F24H 9/00**(2022.01)i; **F25B 13/00**(2006.01)i; **F25B 39/00**(2006.01)i;
F25B 41/40(2021.01)i; **F28D 1/053**(2006.01)i

FI: F24F1/38; F24H9/00 A; F28D1/053 A; F25B39/00 D; F25B41/40 A; F24H9/00 N; F04D29/66 M; F25B13/00 R

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F1/00-13/32; F24H9/00; F25B1/00-49/04

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 1971-2023
 Registered utility model specifications of Japan 1996-2023
 Published registered utility model applications of Japan 1994-2023

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.
Y	JP 2003-74499 A (HITACHI LTD) 12 March 2003 (2003-03-12) paragraphs [0023], [0048]-[0050], fig. 9-11	1-8
Y	JP 2016-176646 A (JOHNSON CONTROLS HITACHI AIR CONDITIONING TECH (HONGKONG) LTD) 06 October 2016 (2016-10-06) paragraph [0015], fig. 2	1-8
Y	JP 2021-012018 A (DAIKIN IND LTD) 04 February 2021 (2021-02-04) fig. 3	1-8
Y	JP 2006-322379 A (MATSUSHITA ELECTRIC IND CO LTD) 30 November 2006 (2006-11-30) paragraph [0042], fig. 6	4-8
Y	JP 6-257783 A (MATSUSHITA ELECTRIC IND CO LTD) 16 September 1994 (1994-09-16) fig. 6	5-8
Y	JP 10-292925 A (DAIKIN IND LTD) 04 November 1998 (1998-11-04) fig. 3	5-8

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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“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

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

“&” document member of the same patent family

Date of the actual completion of the international search

19 September 2023

Date of mailing of the international search report

26 September 2023

Name and mailing address of the ISA/JP

**Japan Patent Office (ISA/JP)
 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915
 Japan**

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2023/025004

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2003-74499 A	12 March 2003	(Family: none)	
JP 2016-176646 A	06 October 2016	(Family: none)	
JP 2021-012018 A	04 February 2021	US 2022/0120481 A1 fig. 3 EP 3992548 A1 CN 114127488 A	
JP 2006-322379 A	30 November 2006	(Family: none)	
JP 6-257783 A	16 September 1994	(Family: none)	
JP 10-292925 A	04 November 1998	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2016205743 A [0003]