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(54) **REFRIGERATION CYCLE DEVICE**
KÄLTEKREISLAUFVORRICHTUNG
DISPOSITIF À CYCLE DE RÉFRIGÉRATION

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(56) References cited:

EP-A1- 1 988 349	**EP-A2- 2 333 435**
CN-U- 201 652 623	**GB-A- 2 304 400**
JP-A- H1 194 291	**JP-A- H1 194 291**
JP-A- H07 248 133	**JP-A- 2004 184 047**
JP-A- 2004 184 047	**JP-U- S61 142 285**

Description

Technical Field

[0001] The present disclosure relates to a refrigeration cycle device using a combustible refrigerant.

Background Art

[0002] Currently, hydrofluorocarbon (HFC) refrigerants such as R410A are being used as refrigerant in refrigeration cycle devices. Unlike previous hydrochlorofluorocarbon (HCFC) refrigerants such as R22, R410A has an ozone depletion potential (ODP) of zero and does not damage the ozone layer, but R410A does have the property of a high global warming potential (GWP). For this reason, as part of stopping global warming, investigation is underway to shift from HFC refrigerants with a high GWP such as R410A to HFC refrigerants with a low GWP.

[0003] One candidate for an HFC refrigerant with a low GWP is R32 (CH_2F_2; difluoromethane). Other candidate refrigerants with similar characteristics include halogenated hydrocarbons having a carbon triple bond in their composition, such as HFO-1234yf ($CF_3CF=CH_2$; tetrafluoropropane) and HFO-1234ze (CF_3-CH=CHF). These are a type of HFC refrigerant similar to R32, but since the unsaturated hydrocarbons with a carbon double bond are called olefins, the O in olefin is often used to refer to these refrigerants as HFOs, to distinguish these refrigerants from HFC refrigerants that do not have a carbon double bond in their composition, such as R32.

[0004] Such low-GWP HFC refrigerants (including HFO refrigerants), although not as readily combustible as HC refrigerants such as R290 (C_3H_8; propane), do have a weakly combustible property, unlike the non-combustible R410A (hereinafter, refrigerants having a combustible property will be designated combustible refrigerants). For this reason, care is needed with respect to refrigerant leakage.

[0005] Regarding this problem, in Patent Literature 1, for example, if a combustible refrigerant leaks and the combustible refrigerant accumulates in an electrical component box inside a machine chamber of an outdoor unit, a blower housed in a blowing chamber is made to operate before a compressor housed in the machine chamber is made to operate. Consequently, the combustible refrigerant accumulated inside the electrical component box of the machine chamber is forcibly discharged externally.

Citation List

Patent Literature

[0006] Patent Literature 1: Unexamined Japanese Patent Application Kokai Publication No. H11-94291 showing a refrigeration cycle device according to the preamble of claim 1.

Summary of Invention

Technical Problem

[0007] In the refrigeration cycle device described in Patent Literature 1, the electrical component box is disposed in a top part inside the machine chamber. Also, a blow-through hole for discharging combustible refrigerant accumulated in the electrical component box is formed in a top part of a partition. Generally, the combustible refrigerant is denser than air and has a greater specific weight, and thus leaking combustible refrigerant accumulates not only in the electrical component box, but also in the bottom part of the machine chamber. However, with the refrigeration cycle device described in Patent Literature 1, it is physically difficult to cause combustible refrigerant with a greater specific weight than air accumulated in a location other than the electrical component box, such as the bottom part of the machine chamber, for example, to pass through the blow-through hole and be discharged externally. For this reason, there is a need to further raise safety.

[0008] The present invention has been devised in order to solve the above problem, and takes as an object to provide a highly safe refrigeration cycle device.

Solution to Problem

[0009] In order to achieve the above object, a refrigeration cycle device according to the present invention includes the features of claim 1.

Advantageous Effects of Invention

[0010] In the present invention, outside air introduced from an introduction hole passes through a blow-through hole formed in a bottom part of a partition, and is sent outside a casing by a blower. For this reason, even in the case in which, for example, combustible refrigerant having a greater specific weight than air leaks out from the refrigeration cycle circuit and accumulates at the floor of the first chamber, since a blow-through hole is formed in the bottom part of the partition, the combustible refrigerant is easily exhausted outside the casing together with the introduced outside air. Consequently, a highly safe refrigeration cycle device may be provided.

Brief Description of Drawings

[0011]

FIG. 1 is a schematic diagram of a refrigeration cycle device according to Embodiment 1 of the present disclosure.

FIG. 2 is a perspective view of an outdoor machine of a refrigeration cycle device.

FIG. 3 is a perspective view of an outdoor machine with part of the casing removed from the state of FIG.

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FIG. 4 is a cross-section along A-A in FIG. 2.

FIG. 5 is a perspective view of introduction holes formed in a side panel of the casing.

FIG. 6 is a perspective view of blow-through holes formed in a partition plate.

FIG. 7 is a diagram for explaining the action of a refrigeration cycle device.

FIG. 8 is a diagram for explaining the positional relationship between blow-through holes formed in the partition plate, and a bell mouth.

FIG. 9 is a diagram of an outdoor machine of a refrigeration cycle device according to Embodiment 2 of the present disclosure.

FIG. 10 is a perspective view of blow-through holes formed in a partition plate of a refrigeration cycle device according to Embodiment 3 of the present disclosure.

FIG. 11 is a front view of blow-through holes formed in a partition plate of a refrigeration cycle device according to Embodiment 4 of the present disclosure.

FIG. 12 is a perspective view of blow-through holes formed in a partition plate of a refrigeration cycle device according to Embodiment 5 of the present disclosure.

FIG. 13 is a perspective view of introduction holes formed in a casing of a refrigeration cycle device according to Embodiment 6 of the present disclosure.

Description of Embodiments

[0012] Embodiment 1 of the invention. Hereinafter, a refrigeration cycle device 10 according to Embodiment 1 will be described using FIGS. 1 to 8.

[0013] A refrigeration cycle device 10 according to Embodiment 1 of the present invention is an air conditioner that provides air conditioning for an air-conditioned room by circulating refrigerant through a refrigeration cycle circuit 100, for example. As illustrated in FIG. 1, the refrigeration cycle device 10 is a separated type that includes an indoor machine 20 and an outdoor machine 30. For refrigerant, Embodiment 1 uses the HFC refrigerant R32 (CH_2F_2; difluoromethane), which has a smaller global warming potential (GWP) and a comparatively smaller effect on global warming than the HFC refrigerant R410A widely being used in air conditioners today. This R32 is a combustible refrigerant. In addition, the refrigeration cycle device 10 includes, in addition to the indoor machine 20 and the outdoor machine 30, a controller that controls the refrigeration cycle circuit 100 and the like.

[0014] The indoor machine 20 is installed inside the air-conditioned room, and is equipped with an indoor heat exchanger 21 and a blower 22.

[0015] The indoor heat exchanger 21 cools or heats the air-conditioned room by exchanging heat between the refrigerant and the surrounding air. For example, during cooling operation, the indoor heat exchanger 21 functions as an evaporator, and causes inflowing refrigerant to evaporate. Consequently, the indoor heat exchanger 21 absorbs heat from the air surrounding the indoor heat exchanger 21, and cools the surrounding air. By supplying this cooled air to the room, the air-conditioned room is cooled as a result. Also, during heating operation, the indoor heat exchanger 21 functions as a condenser, and causes inflowing gas refrigerant to condense. Consequently, the indoor heat exchanger 21 emits heat into the air surrounding the indoor heat exchanger 21, and heats the surrounding air. By supplying this heated air to the room, the air-conditioned room is heated as a result.

[0016] The blower 22 is installed near the indoor heat exchanger 21, and includes a blowing fan 22a and a fan motor 22b that rotates the blowing fan 22a. By the rotation of the blowing fan 22a, the blower 22 generates airflow that passes through the indoor heat exchanger 21. Subsequently, heat-exchanged air is supplied to the air-conditioned room by the generated airflow. The type of blowing fan 22a of the blower 22 depends on the shape of the indoor machine 20. A cross-flow fan or turbofan may be used, for example.

[0017] The outdoor machine 30 is installed outdoors, and is equipped with a compressor 31, a four-way valve 32, an outdoor heat exchanger 33, an expansion valve 34, and a blower 35.

[0018] The compressor 31 is a device that compresses supplied refrigerant. As a result of being compressed by the compressor 31, refrigerant flowing in from a suction pipe 31a is changed into high temperature and high pressure gas refrigerant, Subsequently, the compressor 31 delivers the high temperature and high pressure refrigerant to the four-way valve 32 via a discharge pipe 31b. High temperature and high pressure gas refrigerant compressed by the compressor 31 continuously flows in the discharge pipe 31b. Meanwhile, low temperature and low pressure refrigerant flows in the suction pipe 31a. This low temperature and low pressure refrigerant is made up of gas refrigerant, or a two-phase refrigerant of gas refrigerant intermixed with a small quantity of liquid refrigerant. The compressor 31 is controlled by the controller.

[0019] The four-way valve 32 is provided downstream to the compressor 31. The four-way valve 32, by switching the circulation direction of refrigerant inside the refrigeration cycle circuit 100, switches to one of a heating operation cycle and a cooling operation cycle. The four-way valve 32 is controlled by the controller.

[0020] The outdoor heat exchanger 33 exchanges heat with air by evaporating or condensing inflowing refrigerant, thereby cooling or heating the air. For example, during cooling operation, the outdoor heat exchanger 33 functions as a condenser, and causes inflowing refrigerant to condense. Also, during heating operation, the outdoor heat exchanger 33 functions as an evaporator, and causes inflowing refrigerant to evaporate.

[0021] The expansion valve 34 is a pressure reducing device with a variable opening degree. The expansion valve 34 is made up of an electronically controlled expansion valve, for example. By causing inflowing refrigerant to expand, the expansion valve 34 reduces high pressure refrigerant to a low pressure. The expansion valve 34 then delivers the generated low pressure refrigerant.

[0022] The blower 35 is installed near the outdoor heat exchanger 33, and includes a blowing fan 35a and a fan motor 35b that rotates the blowing fan 35a. By the rotation of the blowing fan 35a, the blower 35 generates airflow that passes through the outdoor heat exchanger 33. Subsequently, heat-exchanged air is exhausted outdoors by the generated airflow. In Embodiment 1, a propeller fan that sucks air from the side or back is used for the blowing fan 35a of the blower 35. The blower 35 also includes two blowing fans 35a. However, the configuration is not limited thereto, and the blower 35 may also include a number of blowing fans 35a other than two. For example, the blower 35 may also include one blowing fan 35a.

[0023] The refrigeration cycle circuit 100 is configured to include the indoor heat exchanger 21, the compressor 31, the four-way valve 32, the outdoor heat exchanger 33, the expansion valve 34, flow channels joining these members (a flow channel carrying refrigerant and including a suction pipe 31a and a discharge pipe 31b, as well as connecting pipes 11a and 11b), and the like.

[0024] FIG. 2 is a perspective view of the outdoor machine 30 of the refrigeration cycle device 10. FIG. 3 is a perspective view of the outdoor machine 30 with part of the casing 40 removed from the state illustrated in FIG. 2. FIG. 4 is a cross-section along A-A in FIG. 2. Note that the XY plane in the drawings is a horizontal plane, while the direction of the Z axis in the drawings is a vertical direction. As illustrated in FIGS. 2 and 3, the outdoor machine 30 includes the above respective members (such as the compressor 31, the four-way valve 32, the outdoor heat exchanger 33, and the blower 35), as well as a casing 40 that houses these respective members.

[0025] As illustrated in FIG. 2, the casing 40 is a member that configures the outer contour of the outdoor machine 30. The casing 40 includes a top panel 41, a side panel 42, and front panels 43 and 44. The top panel 41, the side panel 42, and the front panels 43 and 44 are formed by sheet-metal working, for example. Note that the top panel 41, the side panel 42, and the front panels 43 and 44 are preferably made up of a material with excellent fire resistance. The top panel 41 configures the top face (the face on the +Z side) of the casing 40.

[0026] The side panel 42 is formed so that an XY cross-section thereof has an L-shape. The side panel 42 configures the side face (the face on the +X side) and part of the back face (the face on the +Y side) of the casing 40. Introduction holes 45 for introducing outside air are formed in the side panel 42.

[0027] As illustrated in FIG. 5, the introduction holes 45 are made up of multiple rectangular holes. Specifically, the cross-sectional shape of each introduction hole 45 is a rectangle with the longer direction in the Y axis direction. The length L1 in the shorter direction of the introduction holes 45 (the length in the Z axis direction) is predetermined on the basis of the quenching distance of the refrigerant. Herein, the quenching distance is the dimension of a gap through which a flame is unable to propagate (the flame is extinguished). At this gap or less, the flame becomes unable to propagate. In other words, the flame becomes unable to pass through. This quenching distance differs according to the type of refrigerant. In Embodiment 1, the HFC refrigerant R32 is used for the refrigerant. The quenching distance of R32 is 6 mm. Consequently, the introduction holes 45 are formed so that the length L1 in the shorter direction becomes 6 mm or less. Specifically, the length L1 in the shorter direction of the introduction holes 45 is set to 5.5 mm, for example. However, the configuration is not limited thereto, and the length L1 of the introduction holes 45 may be a dimension other than 5.5 mm insofar as the length is 6 mm or less.

[0028] In addition, the introduction holes 45 are plurally formed at equal intervals along the Z axis direction. The number of introduction holes 45 is 10, for example. However, the number of holes is not limited thereto, and may also be a number other than 10. However, if there are too few holes, the total cross-sectional area of the introduction holes 45 becomes too small, the blow-through resistance increases, and air circulates less smoothly. Consequently, it is desirable to form approximately 10 holes, enough to enable air to circulate smoothly. Note that the introduction holes 45 are formed at a position higher than the blow-through hole 51 formed in the partition plate 50 discussed later.

[0029] Returning to FIG. 2, the front panel 43 is a plate-like member made of metal, and configures the front face (the face in the -Y direction) of the casing 40. Blow-out openings 46 for air blown out from the blower 35 are formed in the front panel 43. The blow-out openings 46 are formed in an approximately circular shape. Also, two blow-out openings 46 are formed, in correspondence with the installed number of blowing fans 35a of the blower 35. Fan guards 47 having a mesh part for ensuring safety while the blowing fans 35a are operating are attached to the blow-out openings 46.

[0030] Also, on the inner sides of each blow-out opening 46 of the front panel 43, a tubular bell mouth 48 is formed, as illustrated in FIG. 4. The bell mouth 48 is integrally formed with the front panel 43. The outer circumferential face of the bell mouth 48 is formed in a curved face. As a result of this bell mouth 48 being formed, the flow of air blown from the blowing fans 35a of the blower 35 is stabilized.

[0031] The front panel 44 is formed so that an XY cross-section thereof has an L-shape, and configures the front face (the face on the -Y side) and part of the side face (the face on the +X side) of the casing 40. Note that these panels discussed above (such as the top panel 41, the side panel 42, and the front panels 43 and 44) may be configured to be further disassembled, or several of these panels discussed above may be integrally formed.

[0032] Also, as illustrated in FIG. 3, the outdoor machine 30 includes a partition plate 50 (partition) that partitions the interior of the casing 40 into two spaces. The partition plate 50 is formed extending in the vertical direction (+Z direction) from the floor of the casing 40. By this partition plate 50, the interior of the casing 40 is demarcated into a machine chamber M (first chamber) housing members such as the compressor 31 and electronic components for controlling the refrigeration cycle circuit 100, and a blowing chamber F (second chamber) housing members such as the blower 35. The machine chamber M is formed on the +X side (the right side from a front view) of the casing 40, while the blowing chamber F is formed on the -X side (the left side from a front view) of the casing 40 interior. The partition plate 50 is for preventing the intrusion of rainwater due to rainy weather and the like into the machine chamber M via the blowing chamber F. On the bottom (the edge on the -Z side) of the partition plate 50, blow-through holes 51 connecting from the machine chamber M to the blowing chamber F are formed. The blow-through holes 51 are formed at a position lower than the introduction holes 45 of the casing 40.

[0033] As illustrated in FIG. 6, the blow-through holes 51 are made up of multiple rectangular holes. Specifically, the cross-sectional shape of each blow-through hole 51 is a rectangle with the longer direction in the Y axis direction. The length L2 in the shorter direction of the blow-through holes 51 (the length in the Z axis direction) is predetermined on the basis of the quenching distance of the refrigerant. In Embodiment 1, since the HFC refrigerant R32 is used for the refrigerant, the quenching distance of R32 is 6 mm. Consequently, the blow-through holes 51 are formed so that the length L2 in the shorter direction becomes 6 mm or less. Specifically, the length L2 in the shorter direction of the blow-through holes 51 is set to 5.5 mm, for example. However, the configuration is not limited thereto, and the length L2 of the blow-through holes 51 may be a dimension other than 5.5 mm insofar as the length is 6 mm or less.

[0034] In addition, the blow-through holes 51 are plurally formed at equal intervals along the Z axis direction. The number of blow-through holes 51 is 10, for example. However, the number of holes is not limited thereto, and may also be a number other than 10. However, if there are too few holes, the total cross-sectional area of the blow-through holes 51 becomes too small, the blow-through resistance increases, and air circulates less smoothly. Consequently, it is desirable to form approximately 10 holes, enough to enable air to circulate smoothly.

[0035] Also, as illustrated in FIG. 8, the blow-through holes 51 are formed to be covered by the bell mouth 48 and not exposed to the outside from the blow-out openings 46.

[0036] As illustrated in FIG. 3, the compressor 31 is disposed inside the machine chamber M. The compressor 31 is disposed on the floor of the machine chamber M via anti-vibration rubber or the like, for example. The compressor 31 is a scroll compressor that includes a fixed spiral, and a movable spiral that revolves around the fixed spiral. This revolving decreases the volume of the compression chamber, and compresses the refrigerant.

[0037] Note that the compressor 31 is not limited such a scroll compressor. The compressor 31 may also be a rotary compressor in which a circular piston eccentrically rotates the internal space of a cylindrical cylinder, thereby decreasing the volume of the compression chamber formed between the inner circumferential face of the cylinder and the outer circumferential face of the piston, and compressing the refrigerant. Additionally, a compressor of a type other than a scroll compressor and a rotary compressor is also acceptable.

[0038] Also, on the top side (+Z side) of the compressor 31 disposed on the floor of the machine chamber M, the four-way valve 32 and a refrigerant pipe group 36 are disposed. Herein, the refrigerant pipe group 36 is conducted to include members such as a refrigerant pipe connecting the connecting pipe 11a and the four-way valve 32, as well as the suction pipe 31a and discharge pipe 31b connected to the compressor 31, for example.

[0039] In the top part (the portion on the +Z side) of the machine chamber M, there is disposed an electronic component box 61 housing multiple electronic components constituting the controller (such as a smoothing capacitor, for example), and a circuit board on which these electronic components are mounted, and the like. The electronic component box 61 is formed at a position higher than the introduction holes 45 of the casing 40, in order to prevent the intrusion of rainwater and the like. Specifically, the electronic component box 61 is disposed so that the height of the bottom edge 61a (the edge on the -Z side) becomes the same height as the height of the top edge 45a of the introduction holes 45 (the top edge of the uppermost introduction hole 45 among the multiple introduction holes 45).

[0040] The electronic component box 61 is a case formed in an approximately cuboid shape. A ventilation hole 62 is formed on the wall face on the +X side of the electronic component box 61. Also, as illustrated in FIG. 7, a ventilation hole 63 is also formed on the wall face on the -X side of the electronic component box 61. The ventilation hole 62 is used as an air inlet for cooling the electronic components, while the ventilation hole 63 is used as an air outlet.

[0041] In addition, blow-through holes 52 are formed on the top part (the edge on the +Z side) of the partition plate 50. The blow-through holes 52 are formed facing opposite the ventilation hole 63 of the electronic component box 61. Air flowing out from the ventilation hole 63 of the electronic component box 61 passes through these blow-through holes 52. Similarly to the blow-through holes 51 formed on the bottom part, the blow-through holes 52 are made up of multiple rectangular holes. Specifically, the cross-sectional shape of each blow-through hole 52 is a rectangle with the longer direction in the Y axis direction. Also, similarly to the blow-through holes

51, the length in the shorter direction of the blow-through holes 52 is also predetermined on the basis of the quenching distance of the refrigerant. The blow-through holes 52 are plurally formed at equal intervals along the Z axis direction. The number of blow-through holes 52 is 10, for example. However, the number of holes is not limited thereto, and may also be a number other than 10.

[0042] Returning to FIG. 3, in the blowing chamber F, members such as the outdoor heat exchanger 33 and the blower 35 are disposed. The two blowing fans 35a of the blower 35 are disposed along the Z axis direction. A fan motor 35b is attached to the back face of each blowing fan 35a. The fan motors 35b are supported by a fan motor support plate 35c. The fan motor support plate 35c is provided extending in the vertical direction (+Z direction) from the floor of the casing 40. In addition, the outdoor heat exchanger 33 is disposed so as to cover the blower 35. Specifically, the outdoor heat exchanger 33 is formed so that an XY cross-section thereof has an L-shape, and is disposed so as to cover the back face (the face on the +Y side) and a side face (the side on the -X side) of the blower 35.

[0043] The controller is made up of an indoor machine control device of the indoor machine 20 and an outdoor machine control device of the outdoor machine 30, for example, and controls the operation of the refrigeration cycle device 10. The controller controls the rotation of the blowing fans 22a and 35a by applying a voltage according to the number of revolutions of the blowing fans 22a and 35a of the blowers 22 and 35, for example. The outdoor machine control device of the outdoor machine 30 is configured to include the electronic components housed in the electronic component box 61 discussed above.

[0044] The refrigerant flow channel of the indoor machine 20 and the refrigerant flow channel of the outdoor machine 30 are connected by the two connecting pipes 11a and 11b, as illustrated in FIG. 1. The connecting pipes 11a and 11b are connected to the respective flow channels of the indoor machine 20 and the outdoor machine 30 by flare nuts or the like, for example. Consequently, the refrigeration cycle circuit 100 is configured into a circuit that is sealed from the outside.

[0045] The refrigeration cycle device 10 configured as discussed above provides air conditioning for an air-conditioned room by conducting cooling operation, dehumidifying operation, heating operation, blowing operation, and the like. Blowing operation is operation that supplies air using the blower 22 only, without operating the refrigeration cycle of the refrigeration cycle device 10. Cooling operation, dehumidifying operation, and heating operation are operations that supply cool air and warm air using the blower 22 while also operating the refrigeration cycle. The operation of the refrigeration cycle is the same for cooling operation and dehumidifying operation. Hereinafter, operations of the refrigeration cycle will be described using FIG. 1. The solid arrows in FIG. 1 indicate the flow of refrigerant during cooling operation and dehumidifying operation. Also, the dashed arrows in FIG. 1 indicate the flow of refrigerant during heating operation.

[0046] In the case of cooling operation, the four-way valve 32 is switched to deliver refrigerant from the compressor 31 to the outdoor heat exchanger 33. Consequently, the refrigerant flows as indicated by the solid arrows in FIG. 1. In this case, the outdoor heat exchanger 33 functions as a condenser, while the indoor heat exchanger 21 functions as an evaporator.

[0047] First, when refrigerant flows into the compressor 31, the inflowing refrigerant is compressed by the compressor 31. As a result, the pressure and the specific enthalpy of the refrigerant rises, and the refrigerant changes to high temperature and high pressure gas refrigerant and is sent out from the compressor 31. The gas refrigerant sent out from the compressor 31 passes through the discharge pipe 31b and the four-way valve 32, and flows into the outdoor heat exchanger 33.

[0048] When the gas refrigerant flows into the outdoor heat exchanger 33, the refrigerant condenses due to the exchange of heat with external air (outside air) supplied by the blower 35. Consequently, the specific enthalpy of the refrigerant falls, while the pressure remains constant. As a result, the gas refrigerant changes to low temperature and high pressure liquid refrigerant. This liquid refrigerant is then sent out from the outdoor heat exchanger 33.

[0049] When the liquid refrigerant flows into the expansion valve 34, the liquid refrigerant expands due to the expansion valve 34. Subsequently, the liquid refrigerant is depressurized while the specific enthalpy remains constant, and the refrigerant changes to a low pressure state. At this point, the refrigerant becomes two-phase gas-liquid refrigerant in which gas refrigerant and liquid refrigerant are intermixed. This two-phase gas-liquid refrigerant is then sent out from the expansion valve 34.

[0050] The two-phase gas-liquid refrigerant sent out from the expansion valve 34 passes through the connecting pipe 11b, and flows into the refrigerant flow channel of the indoor machine 20. Subsequently, the refrigerant flows into the indoor heat exchanger 21 of the indoor machine 20.

[0051] When the two-phase gas-liquid refrigerant flows into the indoor heat exchanger 21, the refrigerant evaporates due to the exchange of heat with the indoor air of the air-conditioned room supplied by the blower 22. Consequently, the specific enthalpy of the refrigerant rises, while the pressure remains constant. As a result, the refrigerant changes to high temperature and low pressure gas refrigerant in a heated state. Additionally, the heat-exchanged air is supplied to the room, and thus the indoor air is cooled. As a result, the room temperature of the air-conditioned room falls.

[0052] The gas refrigerant in a heated state sent out from the indoor heat exchanger 21 passes through the connecting pipe 11a, and flows into the refrigerant flow channel of the outdoor machine 30. The refrigerant then flows into the compressor 31 again via the four-way valve

32 and the suction pipe 31a of the outdoor machine 30. Thereafter, the above refrigeration cycle is repeated. Note that the refrigeration cycle for dehumidifying operation is similar to the above refrigeration cycle for cooling operation.

[0053] Next, in the case of heating operation, the four-way valve 32 is switched to deliver refrigerant from the compressor 31 to the indoor heat exchanger 21. Consequently, the refrigerant flows as indicated by the dashed arrows in FIG. 1. In this case, the outdoor heat exchanger 33 functions as an evaporator, while the indoor heat exchanger 21 functions as a condenser.

[0054] The gas refrigerant sent out from the compressor 31 passes through the discharge pipe 31b and the four-way valve 32, and flows out from the outdoor heat exchanger 30. Subsequently, the refrigerant passes through the connecting pipe 11a and flows into the indoor heat exchanger 21.

[0055] When the gas refrigerant flows into the indoor heat exchanger 21, the refrigerant condenses due to the exchange of heat with the indoor air of the air-conditioned room supplied by the blower 22. Consequently, the specific enthalpy of the refrigerant falls, while the pressure remains constant. As a result, the gas refrigerant changes to low temperature and high pressure liquid refrigerant in a supercooled state. Additionally, the heat-exchanged air is supplied to the room, and thus the indoor air is warmed. As a result, the room temperature of the air-conditioned room rises.

[0056] The liquid refrigerant in a supercooled state sent out from the indoor heat exchanger 21 passes through the connecting pipe 11b, and flows into the refrigerant flow channel of the outdoor machine 30. Subsequently, the refrigerant flows into the expansion valve 34 of the outdoor machine 30.

[0057] When the liquid refrigerant flows into the expansion valve 34, the liquid refrigerant expands due to the expansion valve 34. Subsequently, the liquid refrigerant is depressurized while the specific enthalpy remains constant, and the refrigerant changes to a low temperature and low pressure state. At this point, the refrigerant becomes two-phase gas-liquid refrigerant in which gas refrigerant and liquid refrigerant are intermixed. This two-phase gas-liquid refrigerant is then sent out from the expansion valve 34. Subsequently, the refrigerant flows into the expansion valve 34 of the outdoor machine 30.

[0058] When the two-phase gas-liquid refrigerant flows into the outdoor heat exchanger 33, the two-phase gas-liquid refrigerant condenses due to the exchange of heat with external air (outside air) supplied by the blower 35. Consequently, the specific enthalpy of the refrigerant rises, while the pressure remains constant. As a result, the two-phase gas-liquid refrigerant changes to high temperature and low pressure gas refrigerant in a heated state. This gas refrigerant is then sent out from the outdoor heat exchanger 33.

[0059] The gas refrigerant in a heated state sent out from the outdoor heat exchanger 33 flows into the compressor 31 again via the four-way valve 32 and the suction pipe 31a. Thereafter, the above refrigeration cycle is repeated.

[0060] In the refrigeration cycle device 10 configured as discussed above, if an instruction to start operation such as cooling operation or heating operation is transmitted from a user to the controller of the refrigeration cycle device 10, before operating the refrigeration cycle, the controller first causes the blowing fans 35a of the blower 35 of the outdoor machine 30 to rotate for a predetermined time. The time to rotate the blowing fans 35a is stored in advance in memory of the controller. In Embodiment 1, the set time to rotate the blowing fans 35a is one minute.

[0061] Since the blowing fans 35a are propeller fans, when the blowing fans 35a rotate, air is suctioned from the back face and lateral sides of the blowing fans 35a. Due to the suction of the blowing fans 35a, outside air of the outdoor machine 30 is introduced inside the machine chamber M from the introduction holes 45 of the casing 40, as indicated by the arrow W1 in FIG. 7.

[0062] Part of the air introduced into the machine chamber M moves upward (+Z direction) inside the machine chamber M, and flows into the electronic component box 61 from the ventilation hole 62, as indicated by the arrow W2. Air flowing into the electronic component box 61 passes through the interior of the electronic component box 61, as indicated by the arrow W3. At this point, if current is flowing and producing heat in the electronic components and circuit board housed in the electronic component box 61, the airflow passing through the interior of the electronic component box 61 functions as cooling air that cools the circuit board that is producing heat. Air passing through the interior of the electronic component box 61 flows out from the ventilation hole 63. Subsequently, the air flowing out from the ventilation hole 63 flows into the blowing chamber F via the blow-through holes 52 of the partition plate 50, as indicated by the arrow W4.

[0063] At this point, depending on the location of refrigerant leakage from the refrigeration cycle circuit 100, combustible refrigerant may in some cases accumulate in the electronic component box 61. In this case, the accumulated combustible refrigerant is exhausted from the ventilation hole 63 together with the air flowing into the electronic component box 61, and subsequently flows into the blowing chamber F via the blow-through holes 52 of the partition plate 50. In other words, the airflow passing through the blow-through holes 52 functions as an airflow for exhausting combustible refrigerant. Subsequently, the air flowing into the blowing chamber F is blown out from the blow-out openings 46 by the blowing fans 35a, as indicated by the arrows W8 and W9. The exhausted combustible refrigerant dissipates outdoors and the refrigerant concentration goes outside the combustible range, and for this reason safety may be assured.

[0064] Additionally, part of the air introduced into the machine chamber M also moves downward (-Z direction) inside the machine chamber M, as indicated by the arrow W5. If part of the air moves downward inside the machine chamber M, the air moves vertically down the length of the interior of the machine chamber M. Subsequently, the air passes through the vicinity of the compressor 31 and the like, as indicated by the arrow W6. Air passing through the vicinity of the compressor 31 and the like flows into the blowing chamber F via the blow-through holes 51 of the partition plate 50, as indicated by the arrow W7.

[0065] At this point, if combustible refrigerant is leaking from the refrigeration cycle circuit 100 (for example, the compressor 31 or the connecting pipes 11a and 11b connected to the compressor 31), the combustible refrigerant, being denser than air, accumulates at the floor of the machine chamber M. In this case, the accumulated combustible refrigerant converges with the air indicated by the arrows W5 and W6 moving downward inside the machine chamber M. Subsequently, the combustible refrigerant accumulated at the floor flows together with the air into the blowing chamber F via the blow-through holes 51 of the partition plate 50, as indicated by the arrow W7. In other words, the airflow passing through the blow-through holes 51 functions as an airflow for exhausting combustible refrigerant. Subsequently, the air flowing into the blowing chamber F is blown out from the blow-out openings 46 by the blowing fans 35a, as indicated by the arrows W8 and W9. The exhausted combustible refrigerant dissipates outdoors and the refrigerant concentration goes outside the combustible range, and for this reason safety may be assured.

[0066] Note that the one minute set as the time to rotate the blowing fans 35a before operating the refrigeration cycle is in Embodiment 1 a conceivable time enabling combustible refrigerant accumulated in the machine chamber M or the electronic component box 61 to be completely exhausted. However, since this set time depends on factors such as the volume and shape of the machine chamber M and the electronic component box 61, the set time must be modified appropriately according to the configuration and model of the outdoor machine 30.

[0067] After rotating the blowing fans 35a of the blower 35 for a predetermined time while in a state of not operating the refrigeration cycle, the controller of the refrigeration cycle device 10 switches the four-way valve 32 of the outdoor machine 30 according to the instructed operating mode (such as heating operation, cooling operation, or dehumidifying operation, for example). Subsequently, the refrigerant compressing operation of the compressor 31 is initiated by causing the revolving spiral of the compressor 31 to revolve. Consequently, refrigerant is circulated through the refrigeration cycle circuit 100. As a result, the instructed operating mode is initiated.

[0068] Note that even after the instructed operating mode is initiated, the suction of the blowing fans 35a continues to cause outside air of the outdoor machine 30 to be introduced into the machine chamber M from the introduction holes 45 of the casing 40. Part of the air introduced into the machine chamber M moves upward inside the machine chamber M and flows into the electronic component box 61, thereby cooling the electronic components and circuit board housed in the electronic component box 61. Also, air introduced into the machine chamber M moves downward inside the machine chamber M and passes through the vicinity of the compressor 31 and the like, thereby moderating temperature rises in the operating compressor 31. Consequently, the operating performance of the compressor 31 is increased.

[0069] As described above, in the refrigeration cycle device 10 according to Embodiment 1, blow-through holes 51 are formed in the bottom part of the partition plate 50. For this reason, air introduced from the introduction holes 45 formed on the side panel 42 of the casing 40 passes through these blow-through holes 51, and is sent outside of the casing 40 by the blower 35. Consequently, even in a case in which refrigerant leaks out from the refrigeration cycle circuit 100 inside the machine chamber M and accumulates at the floor of the machine chamber M, combustible refrigerant is exhausted outside the casing 40 together with the introduced outside air.

[0070] For example, in a case in which, as with a refrigeration cycle device 10 of the related art, the blow-through holes 51 are not formed in the bottom part of the partition plate 50 and only the blow-through holes 52 are formed in the top part of the partition plate 50, if refrigerant leaks out from the refrigeration cycle circuit 100 inside the machine chamber M, the combustible refrigerant, being denser than air, accumulates at the floor of the machine chamber M. Since the refrigerant accumulated at the floor must move upward (the direction opposing gravity) to pass through the blow-through holes 52 in the upper part by suction based on the rotation of the blowing fans 35a of the blower 35, exhausting all accumulated refrigerant from the machine chamber M is difficult. Also, in the case in which the electronic component box 61 is disposed in the upper part of the machine chamber M, the electronic components housed in the electronic component box 61 may potentially become an ignition source if powered on. For this reason, there is a risk that refrigerant moving upward may pass through near such a potential ignition source.

[0071] In contrast, in the refrigeration cycle device 10 according to Embodiment 1, since the blow-through holes 51 are formed in the bottom part of the partition plate 50, refrigerant accumulated at the floor of the machine chamber M becomes easily exhausted outside the casing 40 by the outside air introduced from the introduction holes 45 formed in the side panel 42 of the casing 40. Consequently, the safety of the refrigeration cycle device 10 may be increased.

[0072] Also, in the refrigeration cycle device 10 according to Embodiment 1, since the blow-through holes 51 are formed in the bottom part of the partition plate 50, even if the refrigeration cycle device 10 is stopped, refrigerant may be exhausted from the blow-out openings 46 of the blowing chamber F on the basis of natural convection. Specifically, combustible refrigerant accumulated at the floor of the machine chamber M passes through the blow-through holes 51 formed in the bottom part over time by natural convection. It is then naturally exhausted from the blow-out openings 46 of the blowing chamber F. Consequently, in Embodiment 1, leaked combustible refrigerant becomes less likely to accumulate at the floor of the machine chamber M even while the refrigeration cycle device 10 is stopped, and the safety of the refrigeration cycle device 10 may be further increased.

[0073] Also, in Embodiment 1, the introduction holes 45 for introducing outside air are formed at a position higher than the blow-through holes 51. For this reason, outside air introduced from the introduction holes 45 flows vertically down the length of the interior of the machine chamber M from a high position to a low position, following gravity. Consequently, combustible refrigerant accumulated at the floor of the machine chamber M may be more smoothly exhausted outside the casing 40.

[0074] Also, in Embodiment 1, the introduction holes 45 are formed at a position lower than the electronic component box 61. For this reason, rainwater intruding from the introduction holes 45 is less likely to intrude into the electronic component box 61. As a result, failures of the electronic components housed in the electronic component box 61 may be prevented.

[0075] Also, in Embodiment 1, before starting operation of the refrigeration cycle, the blowing fans 35a of the blower 35 are rotated for a predetermined time. For this reason, even in a case in which combustible refrigerant has accumulated at the floor of the machine chamber M (around the compressor 31), the combustible refrigerant may be exhausted outside the casing 40 before starting operation of the refrigeration cycle. Consequently, combustible refrigerant may be removed from around the compressor 31 before the electrical components and electronic components included in the compressor 31 are powered on, and the safety of the refrigeration cycle device 10 may be increased.

[0076] Also, in Embodiment 1, part of the air introduced into the machine chamber M moves upward (+Z direction) inside the machine chamber M, and flows into the electronic component box 61. For this reason, the electronic components and circuit board inside the electronic component box 61 may be cooled.

[0077] Also, in Embodiment 1, part of the air introduced into the machine chamber M moves downward (-Z direction) inside the machine chamber M, and passes through the vicinity of the compressor 31 and the like. For this reason, in the case in which the refrigeration cycle is operating, temperature rises in the operating compressor 31 may be moderated. Consequently, decreases in the operating performance of the compressor 31 may be moderated.

[0078] In Embodiment 1, part of the air introduced into the machine chamber M moves upward (+Z direction) inside the machine chamber M, and passes through the electronic component box 61. Similarly, part of the air introduced into the machine chamber M moves downward (-Z direction) inside the machine chamber M, and passes through the vicinity of the compressor 31 and the like. Consequently, cooling of the electronic components and circuit board inside the electronic component box 61 and moderation of temperature rises in the compressor 31 may be conducted at the same time.

[0079] Also, in Embodiment 1, the blow-through holes 51 formed in the bottom part of the partition plate 50 are covered by the bell mouth 48 so as to not be exposed from the blow-out openings 46 of the casing 40. Consequently, the intrusion of rainwater due to rainy weather and the like into the machine chamber M may be prevented. As a result, the electronic components in the electronic component box 61 as well as the compressor 31 disposed in the machine chamber M may be protected, and failures thereof may be prevented.

[0080] Also, in Embodiment 1, the length L2 in the shorter direction of the blow-through holes 51 of the partition plate 50 is predetermined on the basis of the quenching distance of the refrigerant. For this reason, even in the remote chance that combustible refrigerant accumulated inside the machine chamber M does ignite, the refrigerant flame is unable to pass through the blow-through holes 51, and thus the refrigerant flame does not leak outside the machine chamber M, nor does the refrigerant flame leak outside the casing 40. Also, after the combustible refrigerant acting as the source of the ignition fully burns out, the flame is naturally extinguished. Consequently, the safety of users of the refrigeration cycle device 10 may be ensured, and the safety of the refrigeration cycle device 10 may be increased.

[0081] Similarly, the length L1 in the shorter direction of the introduction holes 45 in the side panel 42 of the casing 40 is also predetermined on the basis of the quenching distance of the refrigerant. For this reason, even in the remote chance that combustible refrigerant accumulated inside the machine chamber M does ignite, the refrigerant flame is unable to pass through the introduction holes 45, and thus the refrigerant flame does not leak outside the casing 40. Consequently, the safety of users of the refrigeration cycle device 10 may be ensured, and the safety of the refrigeration cycle device 10 may be increased.

[0082] The foregoing thus describes Embodiment 1 of the present invention, but the present disclosure is not limited to the above Embodiment 1.

[0083] For example, in the refrigeration cycle device 10 according to the above Embodiment 1, the HFC refrigerant R32 (CH_2F_2; difluoromethane) is used as the refrigerant. However, the refrigerant is not limited thereto. For example, the refrigerant may an HFC refrigerant similar to R32, the weakly combustible refrigerant HFO1234yf ($CF_3CF=CH_2$; tetrafluoropropane), or HFO1234ze ($CF_3CF=CHF$). The refrigerant may also be a strongly combustible refrigerant such as R290 (propane). Also, the refrigerant may also be a mixed refrigerant of the above. Even if the refrigerant is strongly combustible, the refrigeration cycle device 10 according to the above Embodiment 1 is able to effectively exhibit safety. Note that in the present disclosure, combustible refrigerants include all refrigerants having a possibility of combustion, from weakly combustible refrigerants to strongly combustible refrigerants.

Embodiment 2.

[0084] Also, in the above Embodiment 1, the introduction holes 45 for introducing outside air are formed so that the height of the top edge 45a becomes the same height as the height of the bottom edge 61a of the electronic component box 61, as illustrated in FIG. 7. However, the configuration is not limited thereto. For example, as illustrated in FIG. 9, the introduction holes 45 may also be formed at a position higher than the blow-through holes 51 formed in the partition plate 50, and formed at a position lower than the electronic component box 61. However, with higher positions of the introduction holes 45, the outside air introduced from the introduction holes 45 more easily flows vertically down the length of the interior of the machine chamber M from a high position to a low position, following gravity. Consequently, in order to smoothly exhaust combustible refrigerant, the introduction holes 45 are preferably formed at as high a position as possible. Furthermore, in order to prevent the intrusion of rainwater into the electronic component box 61, the introduction holes 45 are preferably formed at a position lower than the electronic component box 61. Specifically, it is most preferable for the height of the top edge 45a of the introduction holes 45 to be the same height as the height of the bottom edge 61a of the electronic component box 61, so that the introduction holes 45 are positioned directly below the electronic component box 61, as illustrated in FIG. 7.

[0085] Also, in the above Embodiment 1, the blow-through holes 51 connecting from the machine chamber M to the blowing chamber F are formed in the bottom part of the partition plate 50, as illustrated in FIG. 7. Specifically, the blow-through holes 51 are formed near the bottom edge of the partition plate 50. In the present disclosure, the bottom part of the partition plate 50 indicates the side below the middle position of the partition plate 50 in the Z axis direction. Consequently, if the blow-through holes 51 are positioned below the middle position of the partition plate 50, the blow-through holes 51 may also be formed at a position other than the position illustrated in FIG. 7. However, from the perspective of the ease of exhaustion for dense combustible refrigerant, the position where the blow-through holes 51 are formed is preferably as low a position as possible. However, if the position where the blow-through holes 51 are formed is at the bottommost edge of the partition plate 50, water accumulated in the blowing chamber F due to rainy weather or the like becomes more likely to flow backward into the machine chamber M. For this reason, it is most preferable for the bottom edge of the blow-through holes 51 to be at a position several centimeters (for example, 1 cm to 3 cm) higher than the floor of the machine chamber M and blowing chamber F.

Embodiment 3.

[0086] In the above Embodiment 1, the blow-through holes 51 of the partition plate 50 are formed so that a YZ cross-section thereof becomes a rectangular shape, as illustrated in FIG. 6. However, the configuration is not limited thereto, and insofar as the shortest dimension of the blow-through holes 51 is predetermined on the basis of the quenching distance, the blow-through holes 51 may also be formed with a cross-section in a shape other than a rectangle. For example, as illustrated in FIG. 10, the blow-through holes 51 may also be formed so that a YZ cross-section thereof becomes a circular hole shape. In this case, the diameter D1 of the circular hole shape becomes 6 mm or less, on the basis of the quenching distance of the R32 being used as the refrigerant.

Embodiment 4.

[0087] As illustrated in FIG. 11, the blow-through holes 51 may also be formed so that a YZ cross-section thereof becomes an elliptical shape. In this case, the minor dimension L3 of the elliptical shape becomes 6 mm or less, on the basis of the quenching distance of the R32 being used as the refrigerant. Additionally, the cross-section of the blow-through holes 51 may be an oval shape, or a shape other than the above (rectangular shape, circular shape, elliptical shape, oval shape).

[0088] Note that the cross-sectional shape of the blow-through holes 51 is specifically described as not being limited to a rectangular shape as indicated in the above Embodiment 1, the cross-sectional shape of the introduction holes 45 formed in the side panel 42 of the casing 40 is also similar. In the above Embodiment 1, the introduction holes 45 are formed so that a YZ cross-section thereof becomes a rectangular shape, as illustrated in FIG. 5. However, the configuration is not limited thereto, and insofar as the shortest dimension of the blow-through holes 51 is predetermined on the basis of the quenching distance, the introduction holes 45 may also be formed with a cross-section in a shape other than a rectangle. For example, the introduction holes 45 may also be formed so that a YZ cross-section thereof becomes a circular hole shape. In this case, the diameter of the circular hole shape becomes 6 mm or less, on the basis of the quenching distance of the R32 used in the embodiments.

[0089] Additionally, the introduction holes 45 may also be formed so that a YZ cross-section thereof becomes an elliptical shape. In this case, the minor dimension of the elliptical shape becomes 6 mm or less, on the basis of the quenching distance of the R32 used in the embodiments. Additionally, the cross-section of the blow-through holes 51 may be an oval shape, or a shape other than the above (rectangular shape, circular shape, elliptical shape, oval shape).

[0090] Note that since the quenching distance differs depending on the type of refrigerant, it is necessary to modify the dimensions of the introduction holes 45 and the blow-through holes 51 and 52 as appropriate, according to the refrigerant used in the refrigeration cycle device 10.

Embodiment 5.

[0091] As illustrated in FIG. 12, on the blow-through holes 51 formed in the partition plate 50, screens 71 formed to cover the openings on the -X side (the openings on the side of the blowing chamber F) may also be provided. The screens 71 cover the front side (-X side), top side (+Z side), and lateral sides (+Y side and -Y side) of the blow-through holes 51, for example. As a result of these screens 71 being formed, the openings of the blow-through holes 51 are substantially formed to face downward (-Z direction). The screens 71 may be integrally formed with the partition plate 50, or separately formed and later attached to the partition plate 50. By forming these screens 71, rainwater due to rainy weather flows downward along the screens 71, thereby preventing the intrusion of rainwater from the blowing chamber F into the machine chamber M. As a result, the electronic components in the electronic component box 61 as well as the compressor 31 disposed in the machine chamber M may be protected, and failures thereof may be prevented.

Embodiment 6.

[0092] Similarly, as illustrated in FIG. 13, on the introduction holes 45 formed in the side panel 42 of the casing 40, screens 72 formed to cover the openings on the +X side (the openings on the side of the casing 40) may also be provided. The screens 72 cover the front side (+X side), top side (+Z side), and lateral sides (+Y side and -Y side) of the introduction holes 45, for example. As a result of these screens 72 being formed, the openings of the introduction holes 45 are substantially formed to face downward (-Z direction). The screens 72 may be integrally formed with the side panel 42, or separately formed and later attached to the side panel 42. By forming these screens 72, rainwater due to rainy weather flows downward along the screens 72, thereby preventing the intrusion of rainwater from the outer side of the casing 40. As a result, the electronic components in the electronic component box 61 as well as the compressor 31 disposed in the machine chamber M may be protected, and failures thereof may be prevented.

[0093] In addition, although Embodiments 1 to 6 describe an example of using the refrigeration cycle device 10 in an air conditioner, the refrigeration cycle device 10 is also applicable to other equipment, such as the heat source machine of a water heater.

[0094] Various embodiments and alterations of the present disclosure are possible without departing from the scope of the invention as defined by the appending claims.

Industrial Applicability

[0095] A refrigeration cycle device of the present disclosure is suitable for providing air conditioning.

Reference Signs List

[0096]

10	refrigeration cycle device
11a, 11b	connecting pipe
20	indoor machine
21	indoor heat exchanger
22	blower
22a	blowing fan
22b	fan motor
23	outdoor heat exchanger
30	outdoor machine
31	compressor
31a	suction pipe
31b	discharge pipe
32	four-way valve
33	outdoor heat exchanger
34	expansion valve
35	blower
35a	blowing fan
35b	fan motor
35c	fan motor support plate
36	refrigerant pipe group
40	casing
41	top panel
42	side panel
43, 44	front panel
45	introduction hole
45a	top edge
46	blow-out opening
47	fan guard
48	bell mouth
50	partition plate (partition)
51, 52	blow-through hole
53	blower
61	electronic component box (electronic component housing)
61a	bottom edge
62	ventilation hole (first ventilation hole)
63	ventilation hole (second ventilation hole)
71	screen (second screen)
72	screen (first screen)
100	refrigeration cycle circuit
M	machine chamber (first chamber)
F	blowing chamber (second chamber)

Claims

1. A refrigeration cycle device (10) comprising:

   a casing (40) that configures an outer contour of an outdoor machine (30), has a first chamber (M) and a second chamber (F) formed therewithin, and has formed an introduction hole (45) for introducing outside air into the first chamber (M);
   a partition (50) that partitions the interior of the casing (40) so as to demarcate the first chamber (M) and the second chamber (F);
   a refrigeration cycle circuit (100), of which at least a portion is disposed in the first chamber (M), and through which a combustible refrigerant circulates;
   a blower (35) disposed in the second chamber (F) that sends out the outside air introduced from the introduction hole (45) through a blow-through hole (51) and outside the casing (40) from a blow-out opening (46) formed in the second chamber (F); and
   a controller that includes a plurality of electronic components used to control the refrigeration cycle circuit (100) and the blower (35), and an electronic component housing (61) that houses the electronic components;
   wherein the electronic component housing (61) is disposed in a top part inside the first chamber (M), and
   the introduction hole (45) is formed at a position lower than the electronic component housing (61);
   a height of a top edge (45a) of the introduction hole (45) is the same height as a height of a bottom edge (61a) of the electronic component housing (61);
   characterized in that
   the partition has formed in a bottom part thereof the blow-through hole (51) connecting from the first chamber (M) to the second chamber (F);
   wherein a tubular bell mouth (48) is attached on an inner side of the blow-out opening (46), and the blow-through hole (51) is covered by the bell mouth (48) so as to not be exposed from the blow-out opening (46).

2. The refrigeration cycle device (10) according to Claim 1, **characterized in that** the introduction hole (45) is formed at a position higher than a position where the blow-through hole (51) is formed.

3. The refrigeration cycle device (10) according to Claim 1 or 2, **characterized in that**
   the controller is arranged for, before starting operation of the refrigeration cycle circuit (100), controlling a blowing fan (35a) of the blower (35) to rotate for a predetermined time.

4. The refrigeration cycle device (10) according to any one of Claims 1 to 3, **characterized in that**
   in the electronic component housing (61), a first ventilation hole (62) for internally introducing air and a second ventilation hole (63) for exhausting the introduced air are formed.

5. The refrigeration cycle device (10) according to any one of Claims 1 to 4, **characterized in that**
   the introduction hole (45) is formed on the basis of a quenching distance of the refrigerant.

6. The refrigeration cycle device (10) according to Claim 5, **characterized in that** the introduction hole (45) comprises a plurality of holes with a cross-section formed in a rectangular shape, and formed so that a short edge of the rectangular shape is a dimension less than or equal to a quenching distance of the refrigerant.

7. The refrigeration cycle device (10) according to Claim 5 or 6, **characterized in that**
   on the introduction hole (45), a first screen (72) formed so as to cover an opening is provided to prevent intrusion of rainwater from outside into the first chamber (M).

8. The refrigeration cycle device (10) according to any one of Claims 1 to 7, **characterized in that**
   the blow-through hole (51) is formed on the basis of a quenching distance of the refrigerant.

9. The refrigeration cycle device (10) according to Claim 8, **characterized in that** the blow-through hole (51) comprises a plurality of holes with a cross-section in a rectangular shape, and formed so that a short edge of the rectangular shape is a dimension less than or equal to a quenching distance of the refrigerant.

10. The refrigeration cycle device (10) according to Claim 8 or 9, **characterized in that**
    on the blow-through hole (51), a second screen (71) formed so as to cover an opening is provided to prevent intrusion of rainwater from the second chamber (F) into the first chamber (M).

Patentansprüche

1. Kältekreislaufeinrichtung (10), aufweisend:

   ein Gehäuse (40), das eine Außenkontur einer Außeneinheit (30) bildet, eine erste Kammer (M) und eine zweite Kammer (F) aufweist, die darin ausgebildet sind, und das mit einem Einfüh-

rungsloch (45) zum Einführen von Außenluft in die erste Kammer (M) ausgebildet ist;
eine Trennwand (50), die das Innere des Gehäuses (40) abteilt, um die erste Kammer (M) und die zweite Kammer (F) abzugrenzen;
einen Kältekreislauf (100), von dem zumindest ein Teil in der ersten Kammer (M) angeordnet ist und durch den ein brennbares Kältemittel zirkuliert;
ein Gebläse (35), das in der zweiten Kammer (F) angeordnet ist, das die aus dem Einführungsloch (45) eingeführte Außenluft durch ein Durchblasloch (51) und aus dem Gehäuse (40) durch eine in der zweiten Kammer (F) ausgebildete Ausblasöffnung (46) ausbläst; und
ein Steuereinheit, die eine Vielzahl von elektronischen Komponenten, die zur Steuerung des Kältekreislaufs (100) und des Gebläses (35) eingesetzt werden, und ein elektronische-Komponenten-Gehäuse (61), in dem die elektronischen Komponenten untergebracht sind, aufweist;
wobei das elektronische-Komponenten-Gehäuse (61) in einem oberen Teil innerhalb der ersten Kammer (M) angeordnet ist, und
das Einführungsloch (45) an einer Position ausgebildet ist, die niedriger ist als das elektronische-Komponenten-Gehäuse (61);
eine Höhe einer oberen Kante (45a) des Einführungslochs (45) die gleiche Höhe wie eine Höhe einer unteren Kante (61a) des elektronische-Komponenten-Gehäuses (61) aufweist;
dadurch gekennzeichnet, dass
die Trennwand in einem unteren Teil mit dem Durchblasloch (51) ausgebildet ist, das die erste Kammer (M) mit der zweiten Kammer (F) verbindet;
wobei eine röhrenförmige Glockenmündung (48) an einer Innenseite der Ausblasöffnung (46) angebracht ist und das Durchblasloch (51) durch die Glockenmündung (48) abgedeckt ist, um von der Ausblasöffnung (46) nicht freigelegt zu sein.

2. Kältekreislaufeinrichtung (10) gemäß Anspruch 1, **dadurch gekennzeichnet, dass**
das Einführungsloch (45) an einer Position ausgebildet ist, die höher ist als eine Position, an der das Durchblasloch (51) ausgebildet ist.

3. Kältekreislaufeinrichtung (10) gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**
die Steuereinheit eingerichtet ist, vor Starten des Betriebs des Kühlkreislaufs (100), einen Gebläselüfter (35a) des Gebläses (35) zu steuern, um sich für eine vorherbestimmte Zeit zu drehen.

4. Kältekreislaufeinrichtung (10) nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass**:
in dem elektronische-Komponenten-Gehäuse (61) ein erstes Belüftungsloch (62) zum Einführen von Luft nach Innen und ein zweites Belüftungsloch (63) zum Abführen der eingeführten Luft ausgebildet sind.

5. Kältekreislaufeinrichtung (10) nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass**:
das Einführungsloch (45) auf Grundlage einer Quench-Distanz des Kältemittels ausgebildet ist.

6. Kältekreislaufeinrichtung (10) gemäß Anspruch 5, **dadurch gekennzeichnet, dass**
das Einführungsloch (45) eine Vielzahl von Löchern mit einem in einer Rechteckform ausgebildeten Querschnitt aufweist und so geformt ist, dass eine kurze Kante der Reckteckform eine Abmessung hat, die kleiner als oder gleich einer Quench-Distanz des Kältemittels ist.

7. Kältekreislaufeinrichtung (10) gemäß Anspruch 5 oder 6, **dadurch gekennzeichnet, dass**
an dem Einführungsloch (45) eine erste Abschirmung (72) vorgesehen ist, die ausgebildet ist, um eine Öffnung abzudecken, um das Eindringen von Regenwasser von außen in die erste Kammer (M) zu verhindern.

8. Kältekreislaufeinrichtung (10) nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, dass**:
das Durchblasloch (51) auf Grundlage einer Quench-Distanz des Kältemittels ausgebildet ist.

9. Kältekreislaufeinrichtung (10) gemäß Anspruch 8, **dadurch gekennzeichnet, dass**
das Durchblasloch (51) eine Vielzahl von Löchern mit einem Querschnitt in einer Rechteckform umfasst und so geformt ist, dass eine kurze Kante der Rechteckform eine Abmessung hat, die kleiner als oder gleich einer Quench-Distanz des Kältemittels ist.

10. Kältekreislaufeinrichtung (10) gemäß Anspruch 8 oder 9, **dadurch gekennzeichnet, dass**
an dem Durchblasloch (51) eine zweite Abschirmung (71) vorgesehen ist, die ausgebildet ist, um eine Öffnung abzudecken, um das Eindringen von Regenwasser von der zweiten Kammer (F) in die erste Kammer (M) zu verhindern.

Revendications

1. Dispositif de cycle de réfrigération (10) comprenant :

un logement (40) qui configure un contour extérieur d'une machine extérieure (30), présente

une première chambre (M) et une seconde chambre (F) formées à l'intérieur de celui-ci, et dans lequel est formé un trou d'introduction (45) pour introduire l'air extérieur dans la première chambre (M) ;
une cloison (50) qui partage l'intérieur du logement (40) afin de délimiter la première chambre (M) et la seconde chambre (F) ;
un circuit de cycle de réfrigération (100), dont une partie au moins est disposée dans la première chambre (M), et à travers lequel circule un fluide réfrigérant combustible ;
un ventilateur (35) disposé dans la seconde chambre (F) qui envoie l'air extérieur introduit par le trou d'introduction (45) à travers un trou de soufflage (51) et à l'extérieur du logement (40) à partir d'une ouverture de soufflage (46) formée dans la seconde chambre (F) ; et
un contrôleur qui comprend une pluralité de composants électroniques utilisés pour contrôler le circuit de cycle de réfrigération (100) et le ventilateur (35), et un logement de composants électroniques (61) qui abrite les composants électroniques ;
dans lequel le logement de composants électroniques (61) est disposé dans une partie supérieure à l'intérieur de la première chambre (M), et le trou d'introduction (45) est formé au niveau d'une position plus basse que le logement de composants électroniques (61) ;
la hauteur d'un bord supérieur (45a) du trou d'introduction (45) est de hauteur identique à celle d'un bord inférieur (61a) du logement de composants électroniques (61) ;
caractérisé en ce que
dans une partie inférieure de la cloison est formé le trou de soufflage (51) connectant la première chambre (M) et la seconde chambre (F) ;
dans lequel un évasement tubulaire (48) est attaché sur un côté intérieur de l'ouverture de soufflage (46), et le trou de soufflage (51) est couvert par l'évasement (48) afin de ne pas être exposé à partir de l'ouverture de soufflage (46).

2. Dispositif de cycle de réfrigération (10) selon la revendication 1, **caractérisé en ce que**
le trou d'introduction (45) est formé en une position plus haute que la position où est formé le trou de soufflage (51).

3. Dispositif de cycle de réfrigération (10) selon la revendication 1 ou 2, **caractérisé en ce que**
le contrôleur est agencé afin de commander, avant une opération de démarrage du circuit de cycle de réfrigération (100), une ventilation (35a) du ventilateur (35) pour tourner pendant un temps prédéterminé.

4. Dispositif de cycle de réfrigération (10) selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que**
dans le logement de composants électroniques (61), sont formés un premier trou de ventilation (62) destiné à introduire l'air intérieurement et un second trou de ventilation (63) destiné à évacuer l'air introduit.

5. Dispositif de cycle de réfrigération (10) selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que**
le trou d'introduction (45) est formé sur la base d'une distance d'extinction du fluide réfrigérant.

6. Dispositif de cycle de réfrigération (10) selon la revendication 5, **caractérisé en ce que**
le trou d'introduction (45) comprend une pluralité de trous qui présentent une section transversale de forme rectangulaire, et qui sont formés de telle sorte qu'un bord court de la forme rectangulaire soit d'une dimension inférieure ou égale à la distance d'extinction du fluide réfrigérant.

7. Dispositif de cycle de réfrigération (10) selon la revendication 5 ou 6, **caractérisé en ce que**
sur le trou d'introduction (45), un premier écran (72) formé afin de couvrir une ouverture est prévu pour empêcher l'intrusion d'eau de pluie en provenance de l'extérieur dans la première chambre (M).

8. Dispositif de cycle de réfrigération (10) selon l'une quelconque des revendications 1 à 7, **caractérisé en ce que**
le trou de soufflage (51) est formé sur la base de la distance d'extinction du fluide réfrigérant.

9. Dispositif de cycle de réfrigération (10) selon la revendication 8, **caractérisé en ce que**
le trou de soufflage (51) comprend une pluralité de trous qui présentent une section transversale de forme rectangulaire, et qui sont formés de telle sorte qu'un bord court de la forme rectangulaire, soit d'une dimension inférieure ou égale à la distance d'extinction du fluide réfrigérant.

10. Dispositif de cycle de réfrigération (10) selon la revendication 8 ou 9, **caractérisé en ce que**
sur le trou de soufflage (51), un second écran (71) formé afin de couvrir une ouverture est prévu pour empêcher l'intrusion d'eau de pluie en provenance de la seconde chambre (F) dans la première chambre (M).

FIG.1

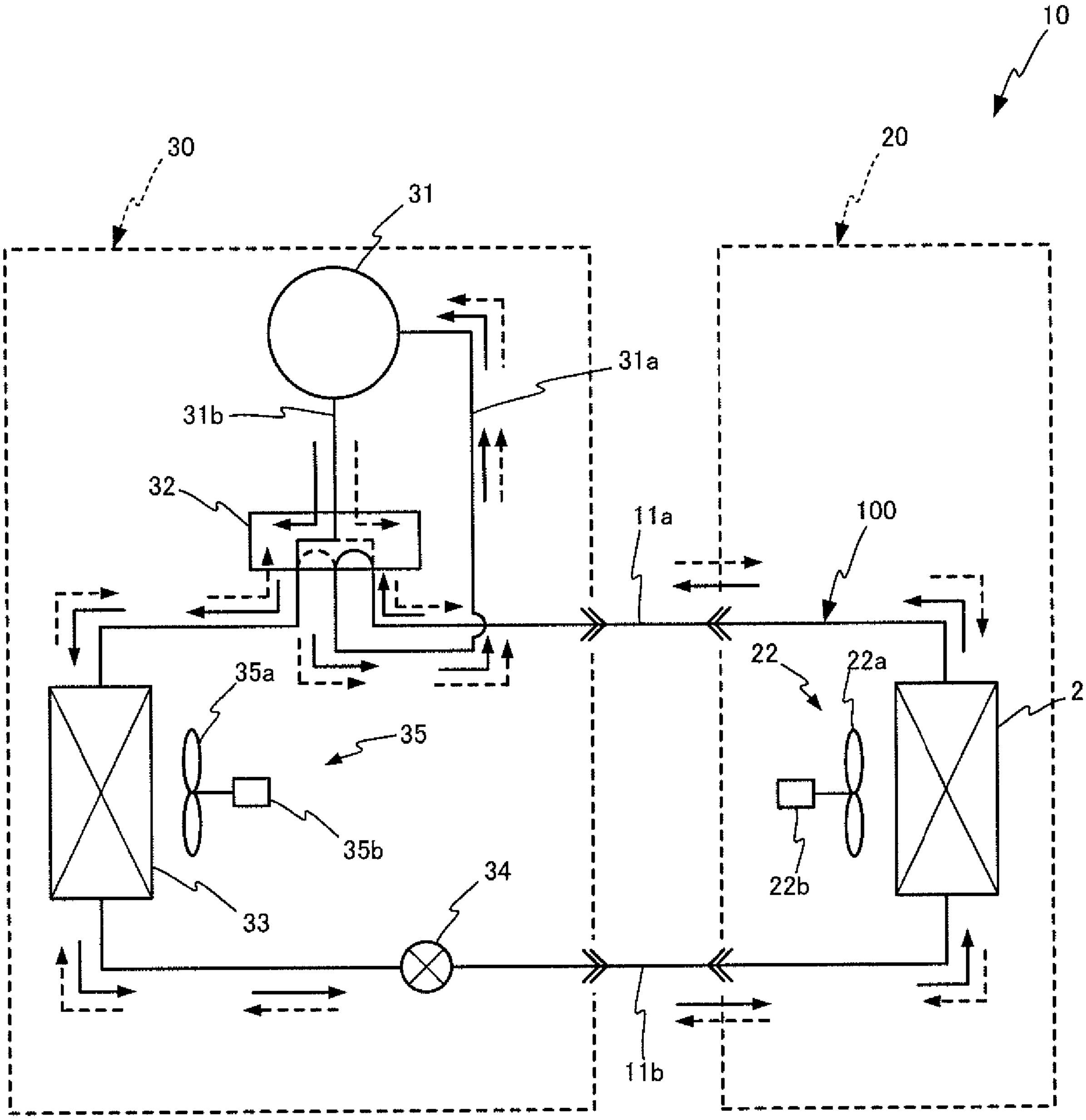


FIG.2

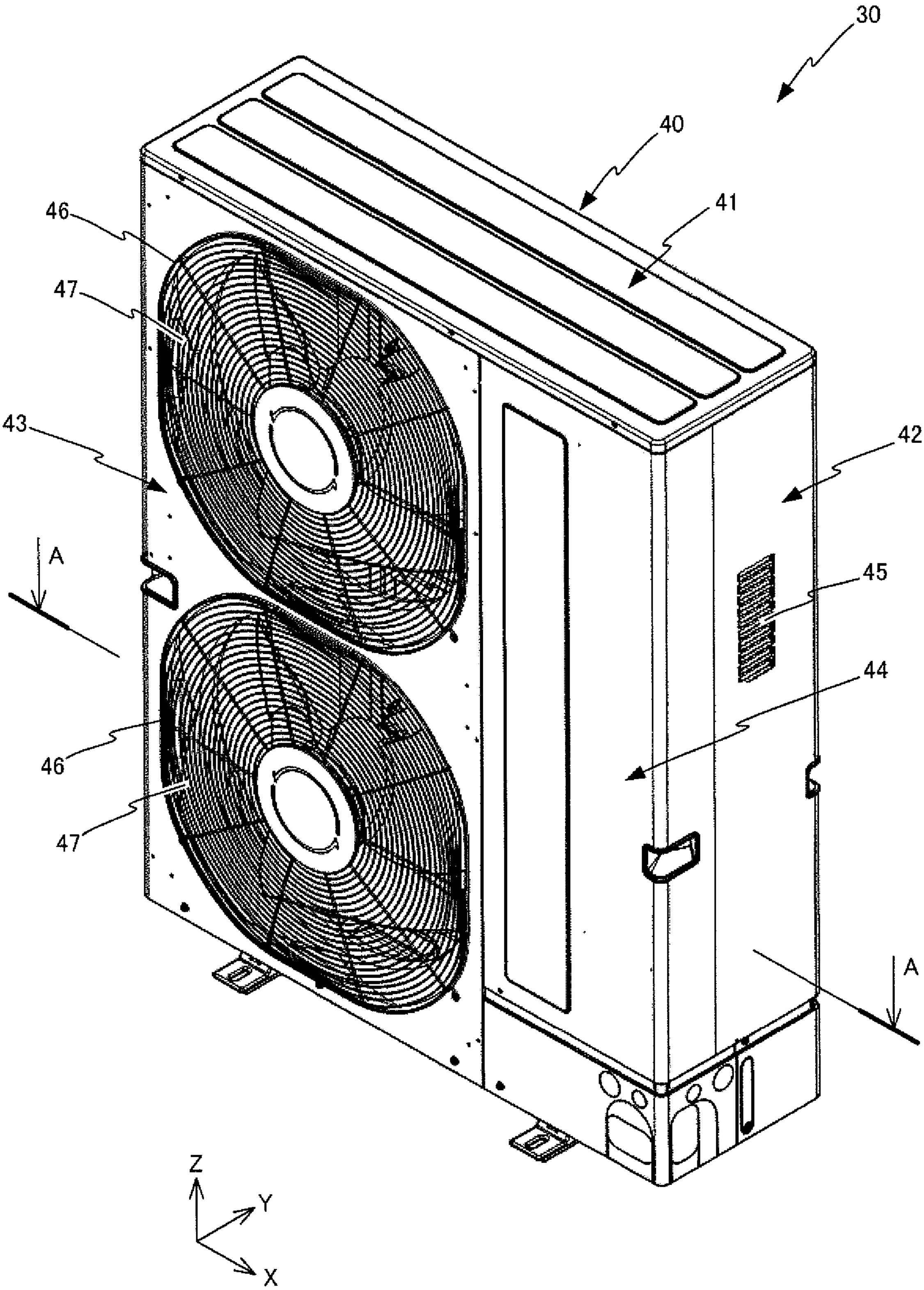


FIG.3

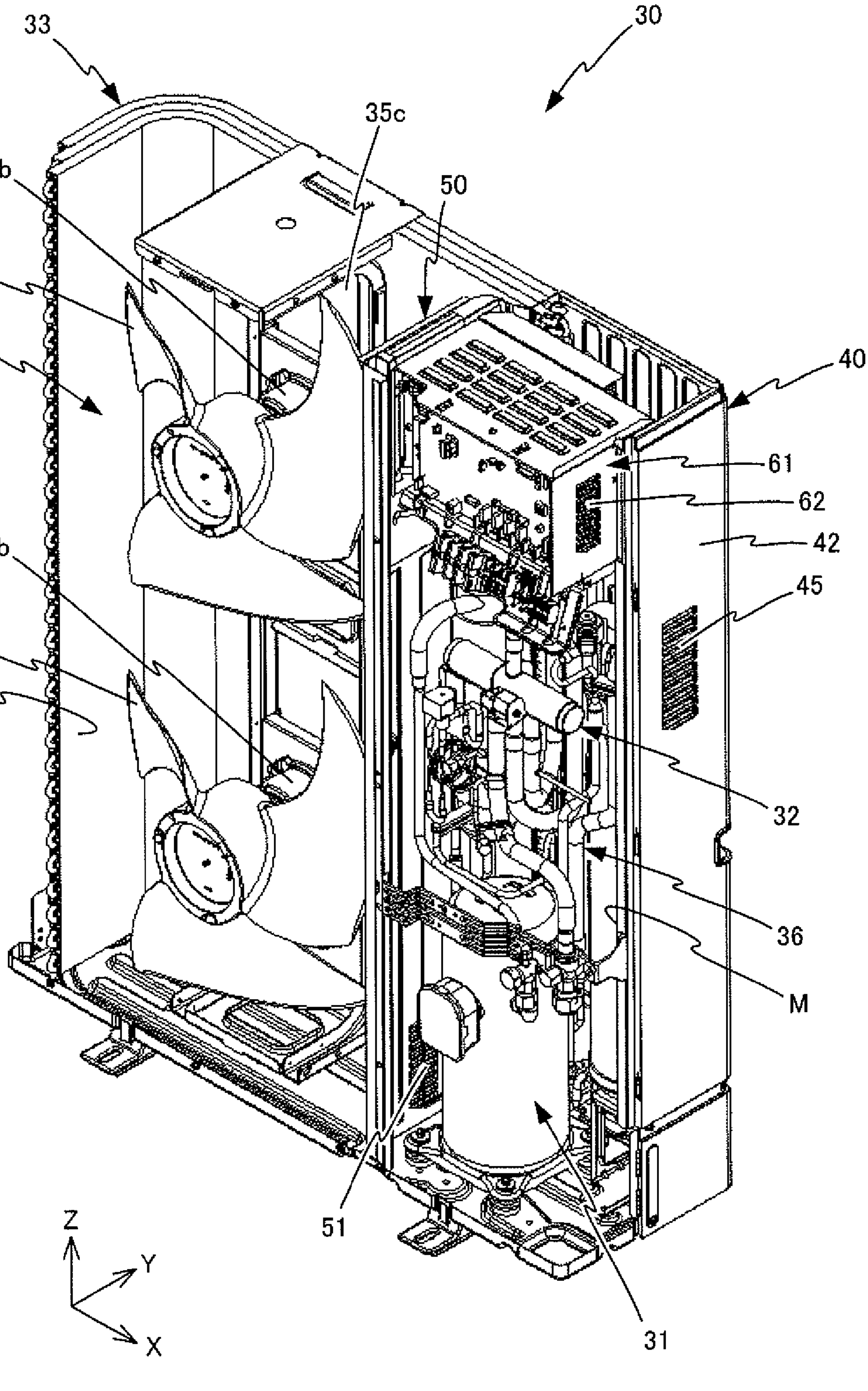


FIG.4

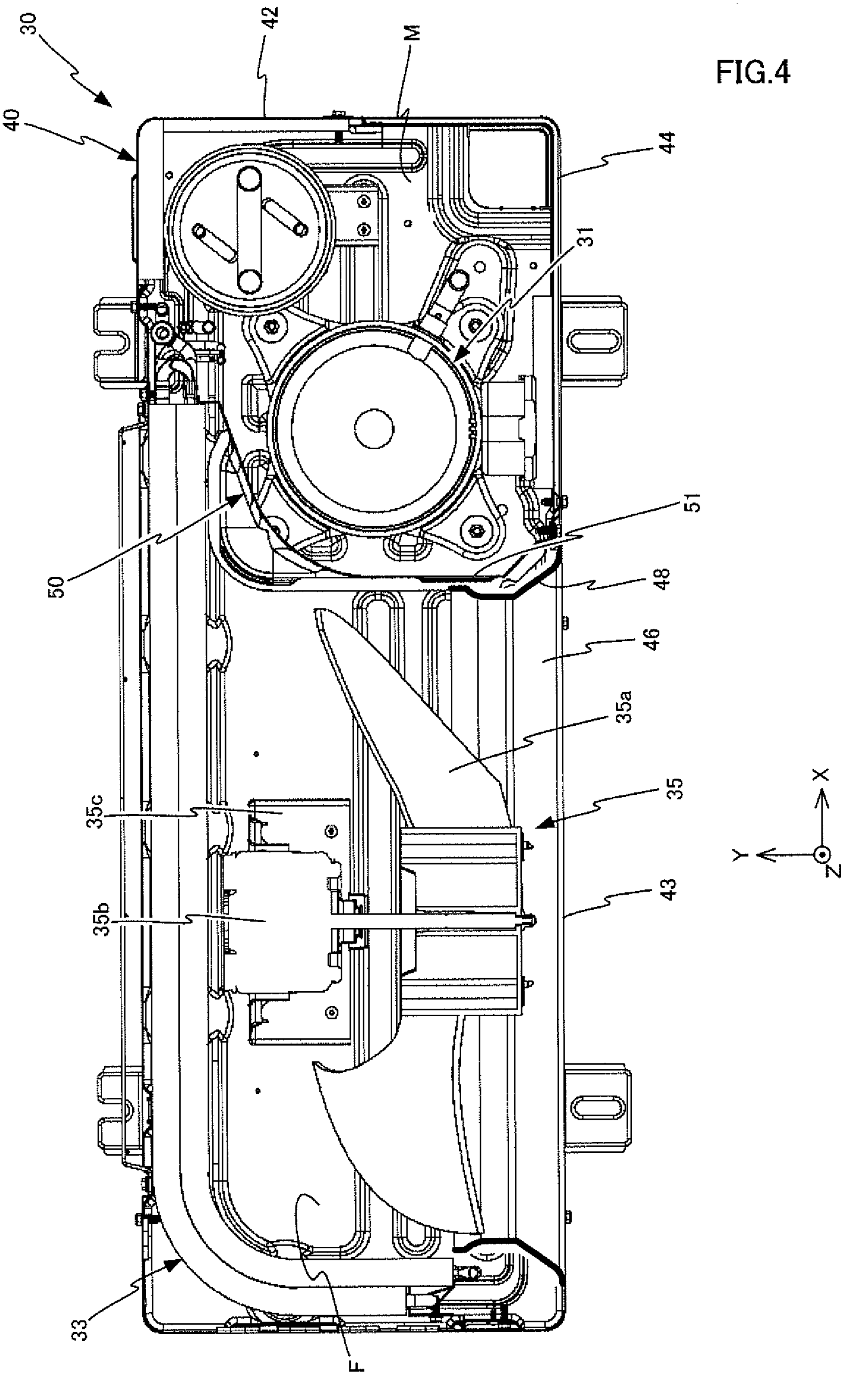


FIG.5

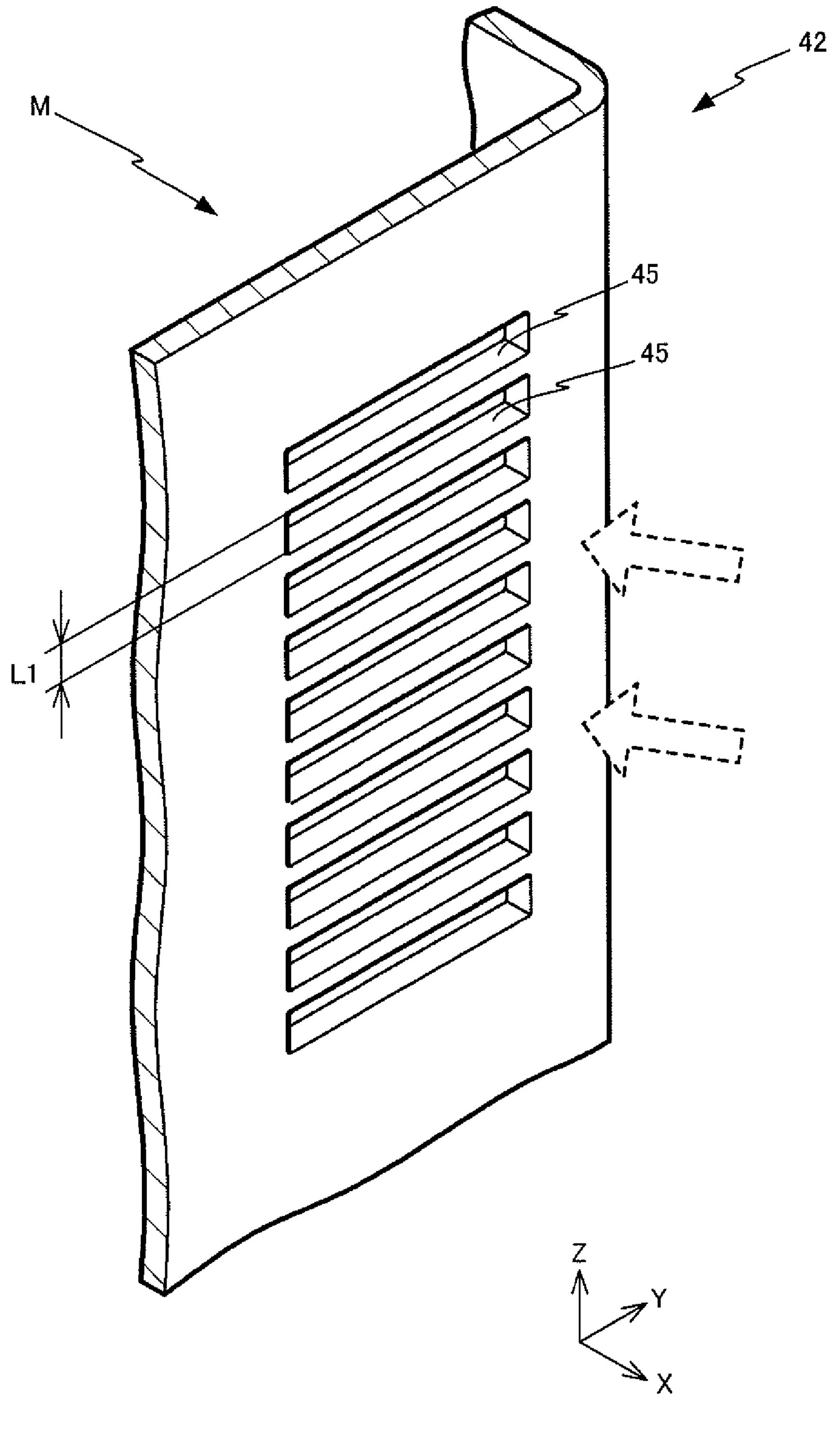


FIG.6

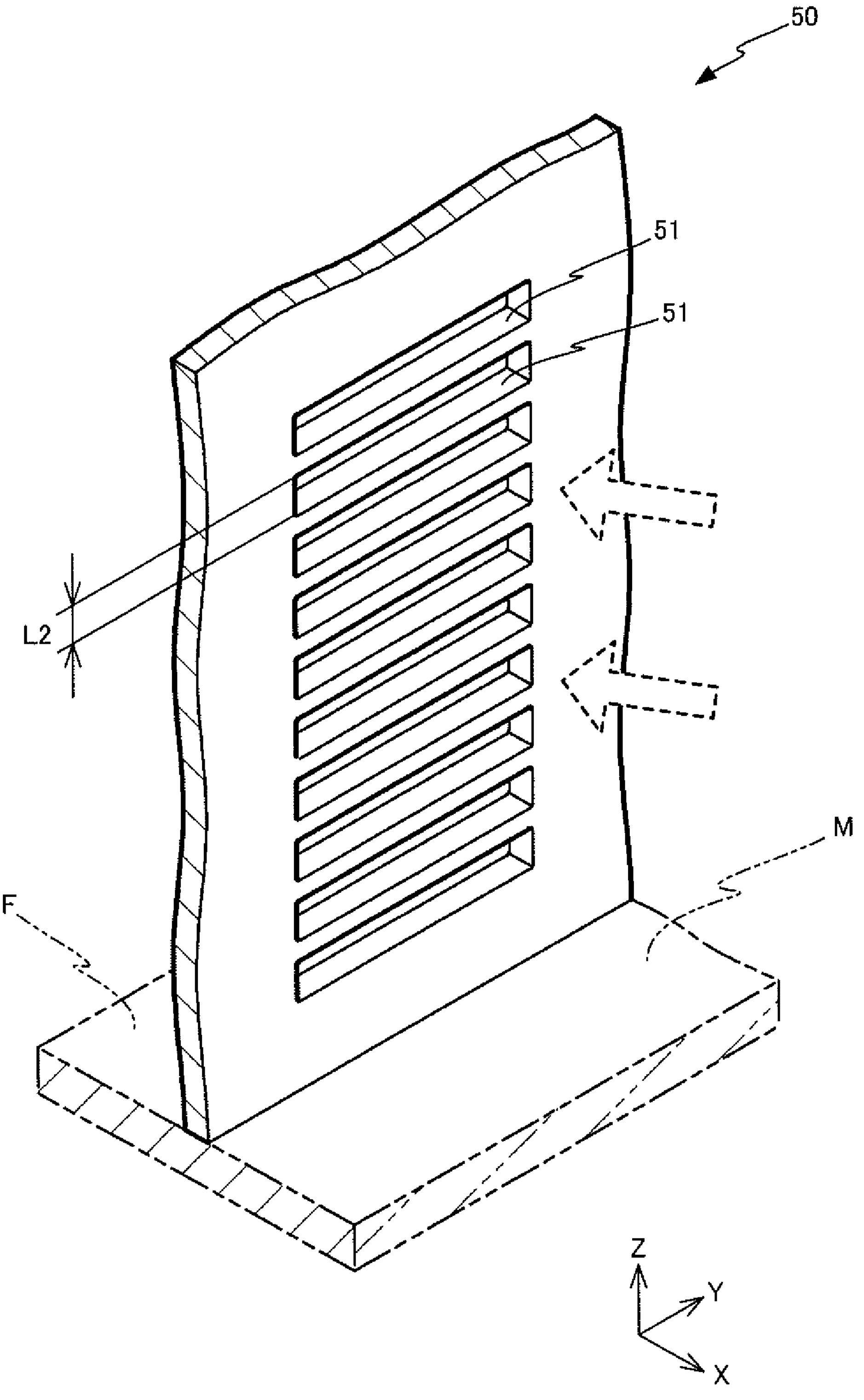


FIG.7

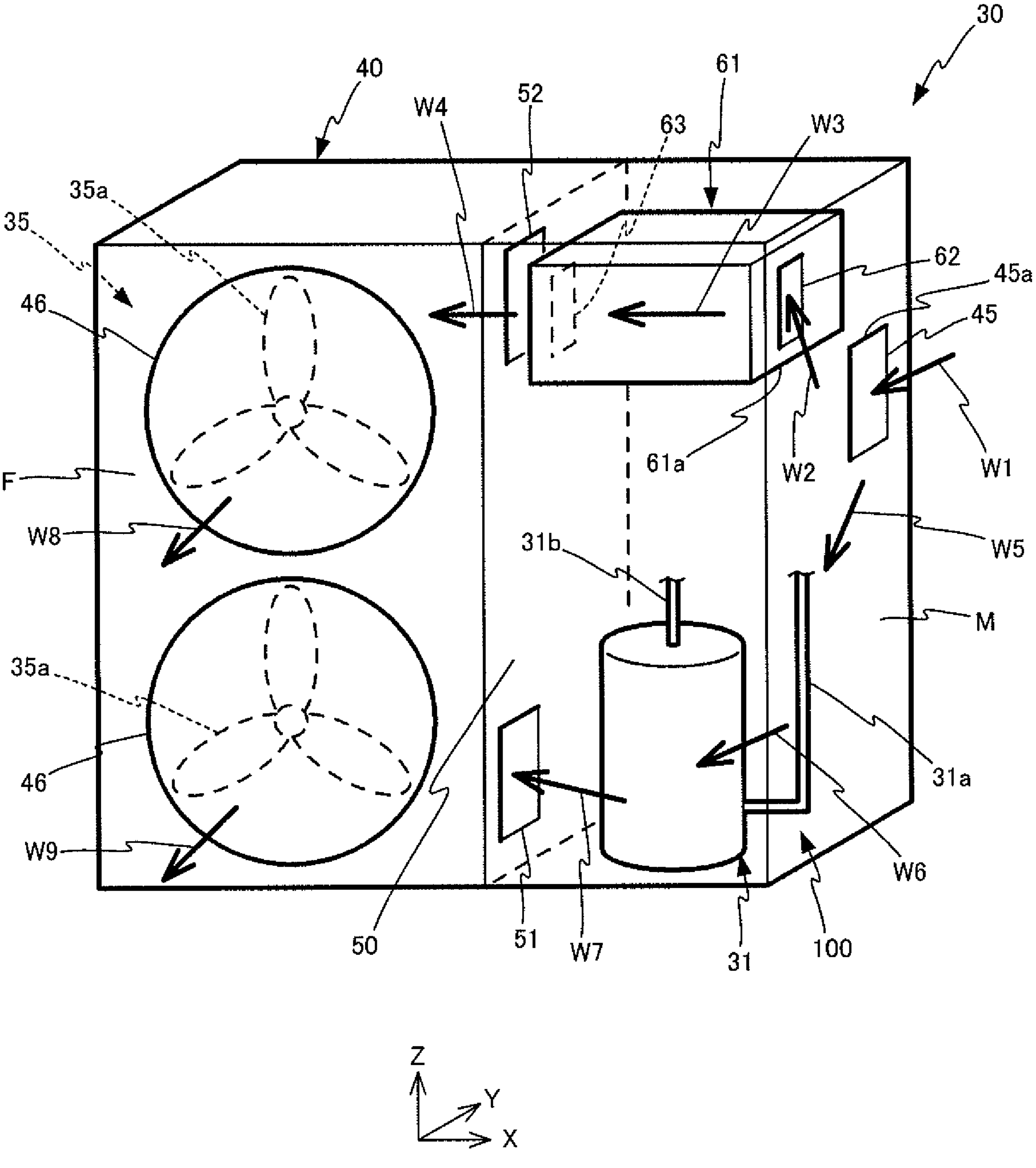

30
40
61
52
W4
63
W3
35a
35
62
45a
45
46
W2
W1
61a
F
W8
31b
W5
M
35a
46
31a
W9
W6
50
51
W7
31
100
Z
Y
X

FIG.8

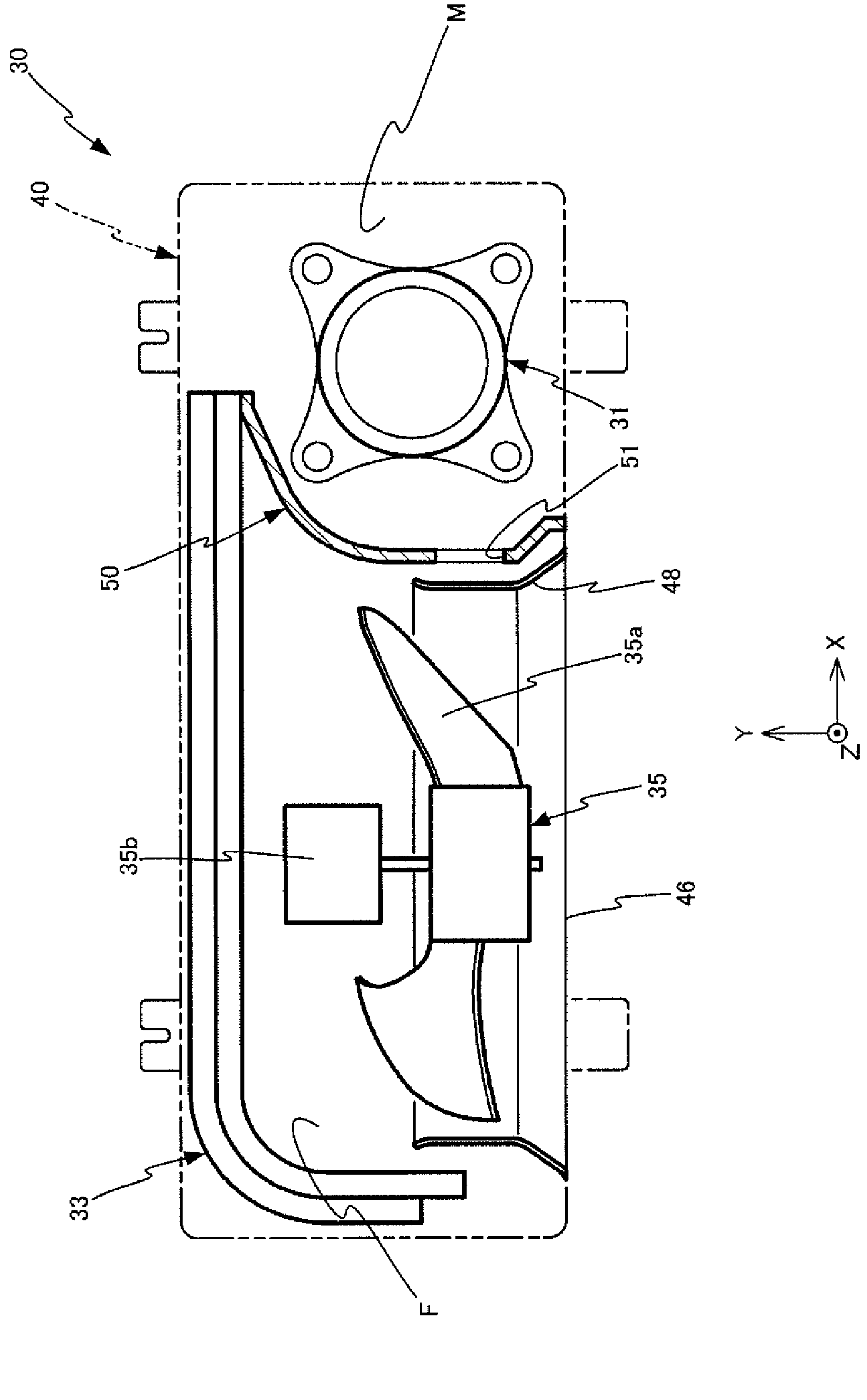


FIG.9

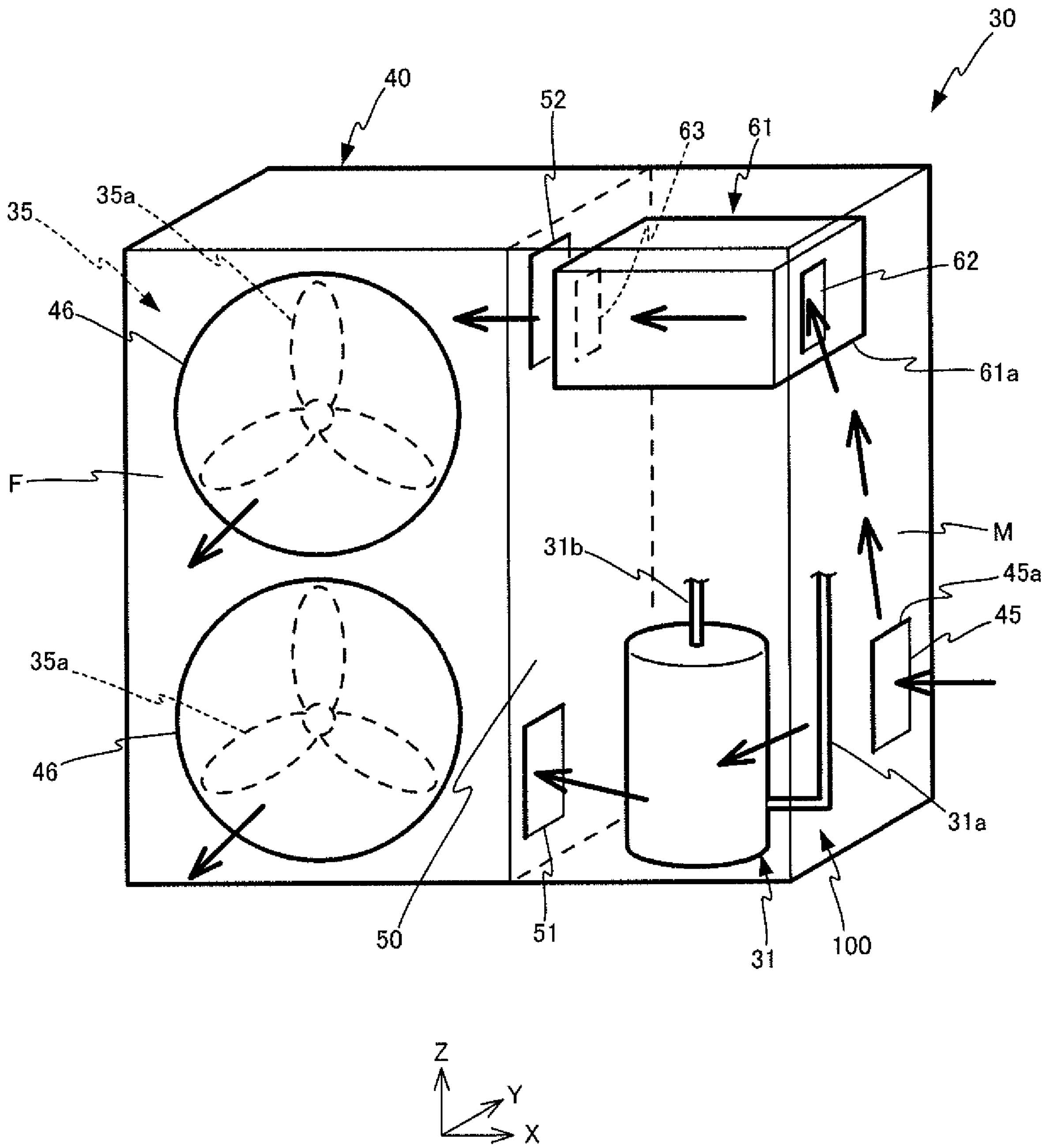

30
40
52
63
61
35a
35
62
46
61a
F
M
31b
45a
45
35a
46
31a
50
51
31
100
Z
Y
X

FIG.10

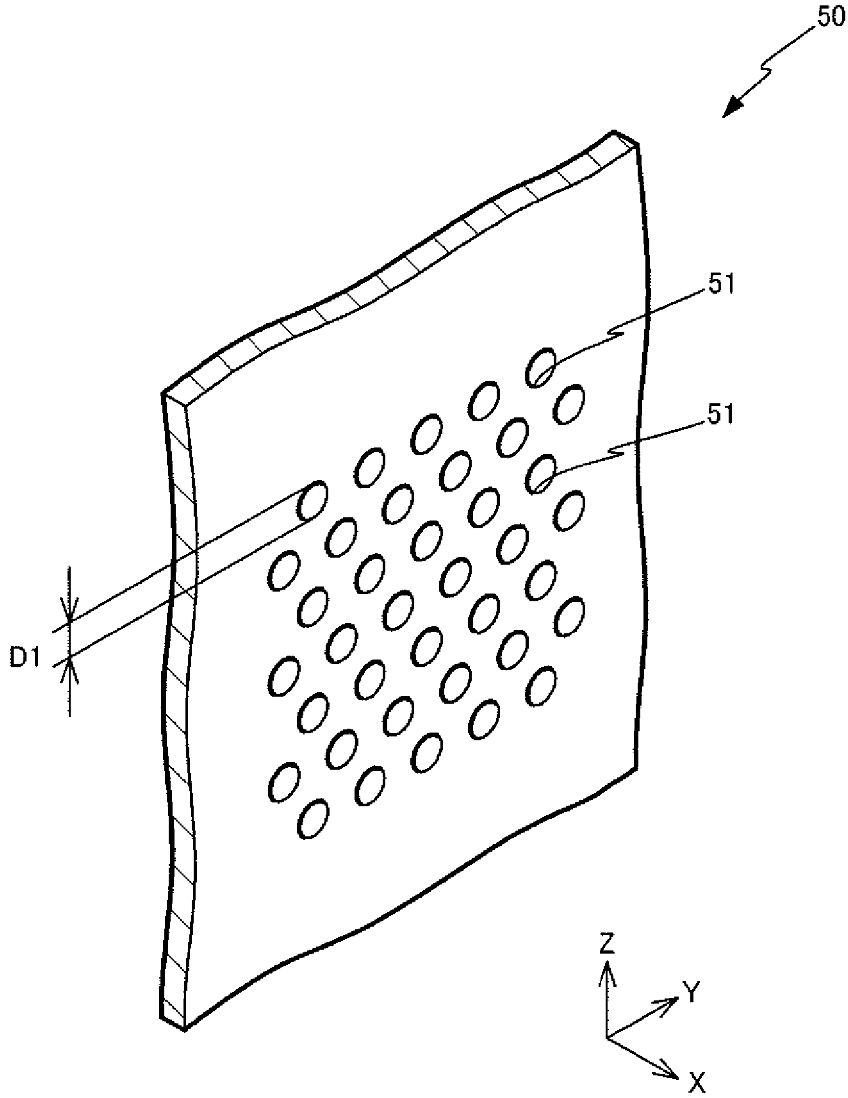


FIG.11

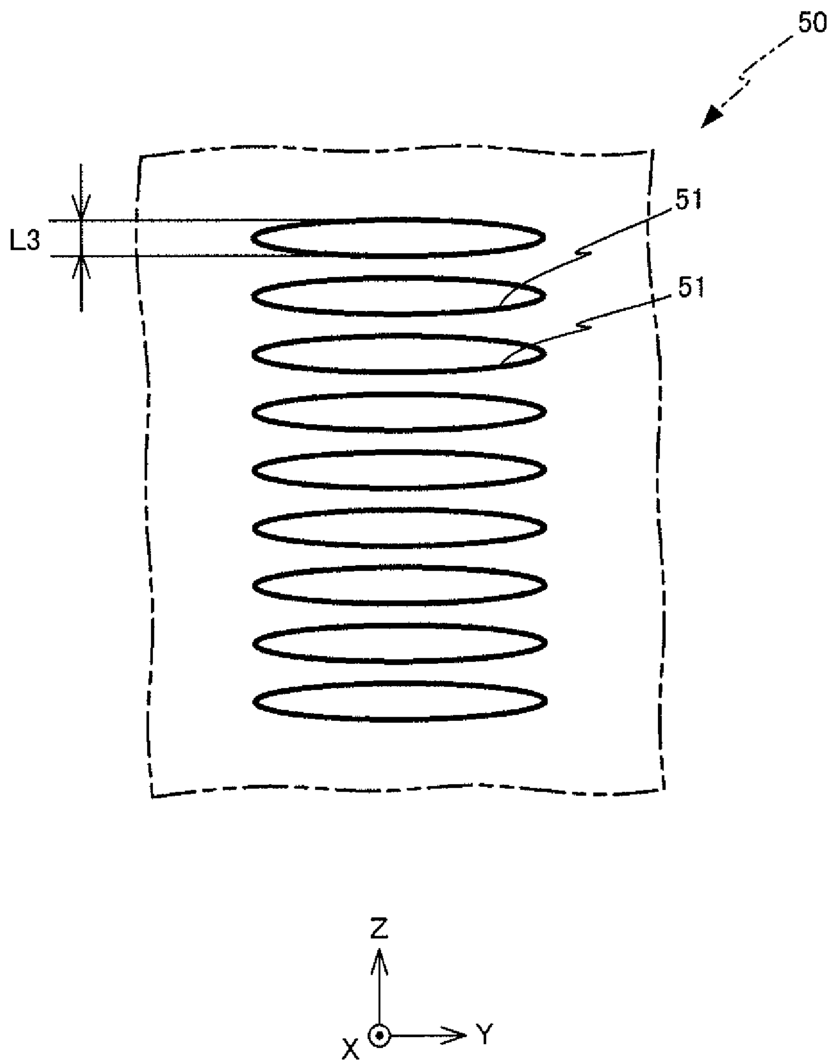


FIG.12

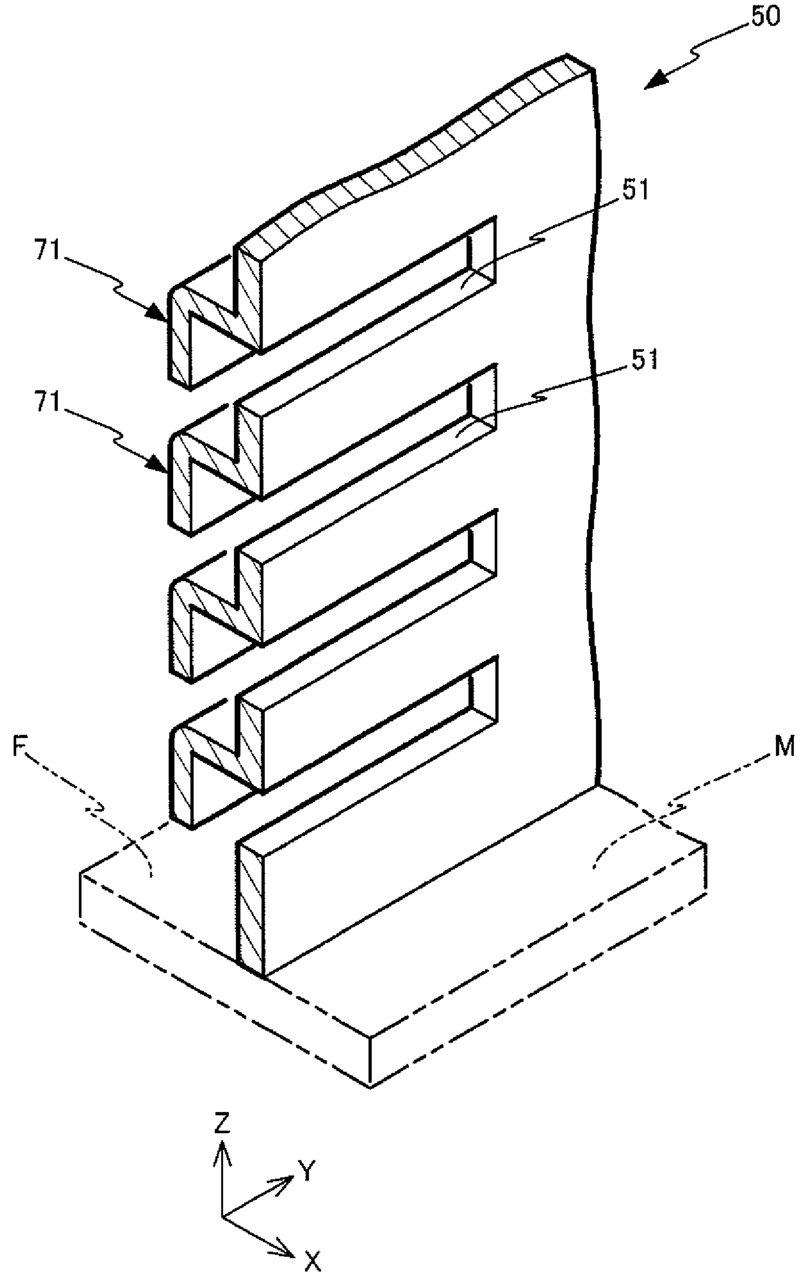
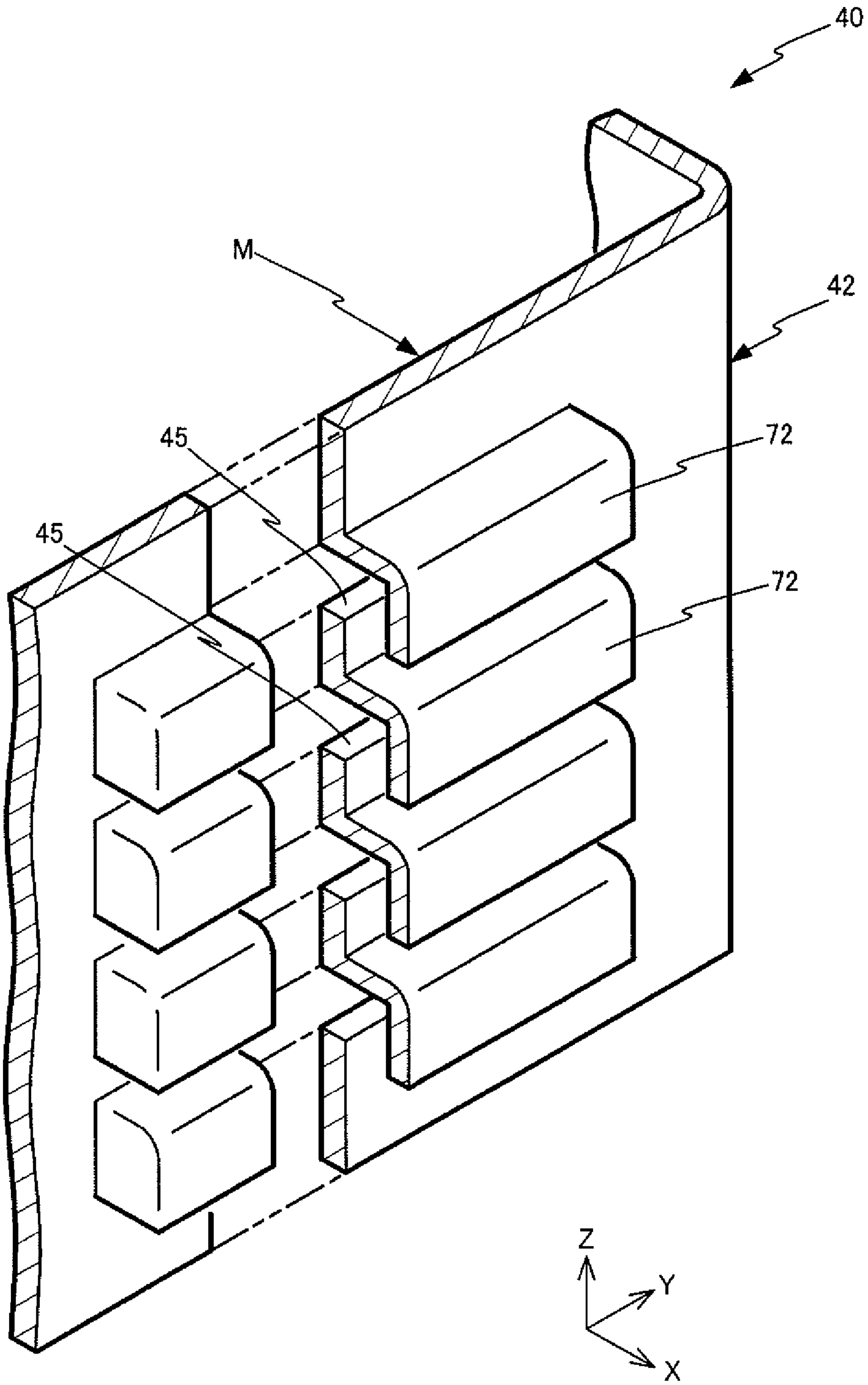


FIG.13



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H1194291 A **[0006]**