

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present disclosure relates to a heat pump apparatus using a flammable refrigerant.

Description of the Related Art

[0002] Japanese Patent Laid-Open No. 10-220824 discloses a heat pump apparatus using a flammable refrigerant as a working refrigerant in which safety in operating the apparatus in the event of refrigerant leakage is ensured. This heat pump apparatus includes a heat exchanger using the flammable refrigerant as the working refrigerant, and electrical components having a substantially airtight structure, the electrical components being provided above the heat exchanger.

[0003] Japanese Patent Laid-Open No. 2010-190454 discloses a heat pump apparatus in which heat dissipation fins of a heat sink are aligned with an air flowing direction for accommodating differences in the air flowing direction inside the heat pump apparatus to improve the heat dissipation efficiency of the heat sink. This heat pump apparatus includes a partition plate that separates a fan chamber and a machine chamber from each other, a rotating unit that supports an electrical component box, and the electrical component box that is disposed in an inclined manner so as to align the heat dissipation fins of the heat sink with an air blowing direction of a fan.

[0004] Japanese Patent Laid-Open No. 2015-215149 discloses a heat pump apparatus that can enhance the cooling performance for an electrical component box without degrading the performance of the heat pump apparatus. This heat pump apparatus includes a partition plate that separates a fan chamber and a machine chamber from each other, and an electrical component box that is disposed in such a manner that a heat sink is located directly above a fan.

[0005] The present disclosure provides a heat pump apparatus in which the support strength for an electrical component box is enhanced, thereby controlling temperature rises in electrical components to enhance the reliability of the electrical components while ensuring safety so as to prevent ignition even if a flammable refrigerant leaks.

SUMMARY OF THE INVENTION

[0006] A heat pump apparatus in the present disclosure includes: a refrigerant circuit including a compressor, and a heat exchanger configured to change heat between outdoor air and a refrigerant, the refrigerant circuit being filled with a flammable refrigerant; a fan configured to blow air to the heat exchanger; a pair of fan support posts supporting the fan; a control board config-

ured to control the compressor and the fan; an electrical component box storing the control board, the electrical component box having a sealed structure; and a heat sink installed in intimate contact with the control board, the heat sink being exposed to outside of the electrical component box, in which the electrical component box is supported by at least one of the fan support posts, the heat sink is disposed in front of the heat exchanger, and at least a part of the heat sink is located between the pair of fan support posts.

Advantageous Effects of Invention

[0007] In the heat pump apparatus in the present disclosure, it is possible to dispose the heat sink at a position where the amount of airflow is large and a high heat dissipation effect is obtained while firmly supporting the electrical component box close to the heavy heat sink. Thus, it is possible to enhance the support strength and the cooling performance for the electrical component box at the same time, and, even in the electrical component box having a sealed structure, it is possible to easily control the temperature rise in the control board inside the electrical component box. Thus, it is possible to provide the heat pump apparatus in which the support strength for the electrical component box is enhanced, thereby controlling temperature rises in electrical components to enhance the reliability of the electrical components while ensuring safety so as to prevent ignition even if the flammable refrigerant leaks.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

FIG. 1 is a front view of a heat pump apparatus in a first embodiment;

FIG. 2 is a front view showing an internal structure of the heat pump apparatus in the first embodiment; FIG. 3 is a sectional view of the heat pump apparatus in the first embodiment taken along line A-A' of FIG. 2;

FIG. 4 is a sectional view of the heat pump apparatus in the first embodiment taken along line B-B' of FIG. 2;

FIG. 5 is a refrigeration cycle circuit diagram of the heat pump apparatus in the first embodiment;

FIG. 6 is a perspective view showing a support structure for an electrical component box in the first embodiment viewed from front above;

FIG. 7 is an exploded perspective schematic view for describing an internal structure of the electrical component box in the first embodiment;

FIG. 8 is a perspective view of a support plate in the first embodiment;

FIG. 9 is a perspective view showing the support structure for the electrical component box in the first embodiment viewed from front below;

FIG. 10 is a perspective view of a support plate in a second embodiment; and

FIG. 11 is a perspective view showing a support structure for an electrical component box in the second embodiment viewed from front below.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Knowledge and the like Underlying Present Disclosure)

[0009] At the time when the inventors conceived of the present disclosure, heat pump apparatuses were required to use low-GWP (global warming potential) refrigerants. However, there is a problem in that low-GWP refrigerants are generally highly reactive and flammable. Thus, in the industry dealing with heat pump apparatuses, there have been proposed techniques to isolate the refrigerant from electrical components so as to prevent the refrigerant from igniting even if the refrigerant leaks from a refrigerant circuit.

[0010] An electrical component box having a sealed structure is known as such a technique to isolate the refrigerant from the electrical components. However, a challenge with the electrical component box having a sealed structure is heat dissipation of electrical components stored therein. Thus, in a conventional heat pump apparatus including an electrical component box having a sealed structure, there has been proposed a configuration in which a heat sink is disposed close to the top of a fan to control temperature rises in electrical components, thereby improving heat dissipation.

[0011] In order to dispose the heat sink close to the top of the fan, a partition plate may support the electrical component box. However, in the case of the electrical component box being supported by the partition plate, the partition plate serving as a support point is separated away from the heat sink, which is a heavy object, and the strength is thus not enough to stably support the heat sink above the fan. The inventors have found this problem and have come to constitute the subject matter of the present disclosure to solve the problem.

[0012] Thus, the present disclosure provides a heat pump apparatus in which the support strength for an electrical component box is enhanced, thereby controlling temperature rises in electrical components to enhance the reliability of the electrical components while ensuring safety so as to prevent ignition even if a flammable refrigerant leaks.

[0013] Hereinbelow, embodiments will be described in detail with reference to the drawings. Note that more details than necessary may be omitted. For example, detailed description of already well-known matters or repetitive description for substantially identical configurations may be omitted. This is to avoid making the following description unnecessarily redundant and facilitate the understanding of those skilled in the art.

[0014] Note that the accompanying drawings and the

following description are provided to enable those skilled in the art to fully understand the present disclosure and are not intended to limit the subject matter described in the claims.

(First Embodiment)

[0015] Hereinbelow, a first embodiment will be described with reference to FIGS. 1 to 9.

[1-1. Configuration]

[1-1-1. Entire Configuration]

[0016] FIG. 1 is a front view of a heat pump apparatus 1 viewed from the front of the heat pump apparatus 1. FIG. 2 is a front view showing an internal structure of the heat pump apparatus 1 viewed from the front side. FIG. 3 is a sectional view taken along line A-A' of FIG. 2, in other words, a bottom view of the heat pump apparatus 1 viewed from line A-A' of FIG. 2. FIG. 4 is a sectional view taken along line B-B' of FIG. 2, in other words, a side view of the heat pump apparatus 1 viewed from line B-B' of FIG. 2.

[0017] As shown in FIG. 1, the heat pump apparatus 1 includes a housing 10 having a substantially rectangular parallelepiped shape, the housing 10 constituting the appearance of an outdoor unit. In the present embodiment, each part of the housing 10 is formed of a steel plate.

[0018] The housing 10 includes a bottom panel 14 constituting the bottom face of the housing 10, a pair of front and rear side panels 15 that cover the right side (one side in the left-right direction) of the housing 10 from front and rear, a front panel 16 that covers the left side (the other side in the left-right direction) of the front face of the housing 10, and a top plate 17 that covers the upper face of the housing 10.

[0019] The front panel 16 is provided with two opening portions 16a arranged in the up-down direction. Fans 21 are exposed through the respective opening portions 16a. Thus, the housing 10 tends to be higher upward than in a case in which one fan 21 is provided. Although not shown, when the heat pump apparatus 1 is in use, each of the opening portions 16a is covered from the outside with a lattice that allows air to pass through.

[0020] As shown in FIG. 2, an internal space of the housing 10 of the heat pump apparatus 1 is partitioned into left and right spaces by a partition plate 11 extending in the up-down direction. The partition plate 11 is a rectangular plate having a thickness in the left-right direction. The partition plate 11 is, on the rear side thereof, screwed with and held on an end plate of an air heat exchanger 20. In addition, the partition plate 11 is, on the lower face thereof, screwed with and held on the bottom panel 14. Note that, in the present embodiment, "screwing" refers to bolting or screw fastening. That is, "screwing" refers to fixation using an appropriate fixture such as a bolt or

screw with a thread in accordance with the size of a member or a component. The partition plate 11 forms a fan chamber 12 on the left side (the other side in the left-right direction) and a machine chamber 13 on the right side (one side in the left-right direction) inside the housing 10.

[0021] The air heat exchanger (heat exchanger) 20 is installed in the fan chamber 12. As shown in FIG. 3, the air heat exchanger 20 of the present embodiment is formed in a substantially L shape so as to be exposed to the rear face and the side face of the housing 10. The air heat exchanger 20 includes a rear portion 20a exposed to the rear face of the housing 10, and a side portion 20b exposed to the side face of the housing 10. For example, a finned tube heat exchanger is used as the air heat exchanger 20.

[0022] A fan support post 18 (refer to FIG. 2) extending in the up-down direction is installed in front of the rear portion 20a of the air heat exchanger 20. A pair of left and right fan support posts 18 are installed. The fan support posts 18 are screwed with and held on the bottom panel 14 of the housing 10. The upper and lower fans 21 are supported on the fan support posts 18.

[0023] Each of the fans 21 includes a motor 21a, and fan blades 21b fixed to a driving shaft of the motor 21a. For example, an axial fan including a propeller-shaped impeller is used as the fan 21. The fan 21 is disposed in such a manner that an axial flow is directed toward the opening portion 16a of the front panel 16 when the fan is driven. The motor 21a is held at the center between the pair of fan support posts 18. Specifically, the motor 21a is supported on the fan support posts 18 in such a manner that the center between the fan support posts 18 is aligned with the center of the motor 21a and the center of the fan blades 21b.

[0024] Thus, the air heat exchanger 20, the fan support posts 18, and the fans 21 are installed in the fan chamber 12 of the present embodiment.

[1-1-2. Configuration of Refrigerant Circuit]

[0025] FIG. 5 is a refrigeration cycle circuit diagram of the heat pump apparatus 1.

[0026] Various devices constituting a refrigerant circuit 29 such as a compressor 23, a water heat exchanger 24, and an expansion device 25, and a refrigerant pipe 26 that connects these devices to each other shown in FIG. 5 are housed inside the machine chamber 13.

[0027] As shown in FIG. 5, the compressor 23, a four-way valve 27, the water heat exchanger 24, the expansion device 25, and the air heat exchanger 20 are annularly connected through the predetermined refrigerant pipe 26 to constitute the refrigerant circuit 29.

[0028] For example, a plate heat exchanger is used as the water heat exchanger 24. A predetermined feed water pipe 22 is connected to the water heat exchanger 24, and heat exchange with a refrigerant circulating through the refrigerant circuit 29 is performed in the water heat exchanger 24.

[0029] The refrigerant compressed by the compressor 23 to have a high temperature and a high pressure is fed to the water heat exchanger 24 by flowing as indicated by solid arrows in FIG. 5, and exchanges heat with water flowing through the feed water pipe 22 in the water heat exchanger 24 and is thus cooled and condensed. The water becomes hot water by receiving heat of the refrigerant and is fed to, for example, a use side device (not shown).

[0030] The refrigerant discharged from the water heat exchanger 24 is decompressed by the expansion device 25 and evaporates, exchanges heat in the air heat exchanger 20, and is returned to the compressor 23 again as a gas refrigerant.

[0031] By switching the four-way valve 27, the refrigerant flows as indicated by dashed arrows in FIG. 5, and the refrigerant exchanges heat with outside air in the air heat exchanger 20, is decompressed by the expansion device 25, and is then fed to the water heat exchanger 24, thereby making it possible to cool water flowing through the feed water pipe 22. The cold water is fed to the use side device (not shown).

[0032] In the present embodiment, a flammable refrigerant is used as the refrigerant. R32 can be used as the flammable refrigerant. Instead of R32, the flammable refrigerant may be a mixed refrigerant containing 70% by weight or more of R32. Furthermore, instead of these refrigerants, the flammable refrigerant may be propane. Instead of propane, the flammable refrigerant may be a mixed refrigerant containing propane. R32 and propane are refrigerants having low GWP and low environmental load.

[0033] The refrigerant circuit 29 is provided with sensors that detect various physical quantities. A temperature sensor (not shown) that measures the temperature of the pipe surface is provided at each part of the refrigerant pipe 26. Pressure sensors PS1 and PS2 that measure the pressure of the refrigerant are provided on the intake side and the discharge side of the compressor 23. In addition, the feed water pipe 22 is provided with temperature sensors TS1 and TS2 that detect the water temperature on the upstream side and the downstream side of the water heat exchanger 24. Furthermore, a refrigerant sensor RS1 that detects leakage of the refrigerant from the air heat exchanger 20 is provided near the air heat exchanger 20.

[0034] The expansion device 25 is provided with an actuator for driving the expansion device 25, and the four-way valve 27 is provided with an actuator for driving the four-way valve 27.

[0035] FIG. 6 is a perspective view showing a support structure for the electrical component box 30 viewed from front above.

[0036] An upper part of the partition plate 11 has a cut-away portion 11a. In the present embodiment, the cut-away portion 11a has a cut-away shape recessed downward in a rectangular shape. The electrical component box 30 having a sealed structure is disposed in the cut-

away portion 11a. That is, the electrical component box 30 is supported in such a manner that an electrical component storage case 32 of the electrical component box 30 is fitted in the cut-away portion 11a. The electrical component box 30 is disposed at an upper part of the housing 10 across the machine chamber 13 and the fan chamber 12. The electrical component box 30 is connected across the upper face of the air heat exchanger 20 as shown in FIG. 6.

[0037] In the fan chamber 12, the electrical component box 30 is attached to upper ends of the fan support posts 18 that support the fan 21 (refer to FIG. 4). In the present embodiment, the electrical component box 30 is attached to the upper ends of the fan support posts 18 via a support plate 19. Thus, the electrical component box 30 of the present embodiment is supported by the partition plate 11 and the fan support posts 18. In this case, a space S (refer to FIG. 4) that allows air to pass through is formed between an upper end of the electrical component box 30 disposed at an upper part of the fan chamber 12 and an upper part of the machine chamber 13 and the top plate 17.

[1-1-3. Configuration of Electrical Component Box]

[0038] FIG. 7 is an exploded perspective schematic view for describing an internal structure of the electrical component box 30.

[0039] The electrical component box 30 includes the box-shaped electrical component storage case 32 whose top is open, and a resin lid 33 (refer to FIG. 6) that closes the electrical component storage case 32.

[0040] The electrical component storage case 32 is formed of a highly thermally conductive material, for example, a metal material. In the present embodiment, the electrical component storage case 32 is made of sheet metal. The electrical component storage case 32 is formed in an airtight box shape by bending the sheet metal into a box shape and welding joints at four corners of the bent box. The electrical component storage case 32 has an opening portion 31 open upward. The electrical component storage case 32 has, at the bottom thereof, a bottom opening portion 35 (refer to FIG. 7) open in a rectangular shape. A heat sink 34 projects downward through the bottom opening portion 35.

[0041] As shown in FIG. 6, the resin lid 33 is formed in a rectangular flat plate shape. The resin lid 33 is attached to the electrical component storage case 32 via an annular rubber gasket (not shown) so as to close the opening portion 31. Specifically, the resin lid 33 is appropriately screwed with the entire circumference of a flange 32F (refer to FIG. 7) of the electrical component storage case 32. Accordingly, the opening portion 31 of the electrical component storage case 32 is sealed by the resin lid 33 and the annular rubber gasket. The annular rubber gasket is formed of, for example, foam rubber, chloroprene rubber, EPDM, NBR, or H-NBR. In the present embodiment, the annular rubber gasket is an O-ring

made of a foam rubber string that has a circular cross section and is formed in an annular shape. The annular rubber gasket may be a flat-shaped rubber gasket.

[0042] A control board 40 that controls the compressor 23 and the fan 21, and the heat sink 34 exposed to the outside through the bottom opening portion 35 of the electrical component storage case 32 are disposed inside the electrical component storage case 32.

[0043] Wires through which a large current may flow such as a power supply wire for supplying power to the control board 40 inside the electrical component storage case 32 and a compressor connecting wire that connects the control board 40 to the compressor 23 are drawn to the outside of the electrical component box 30 from the inside thereof through a cable gland (sealing means). In the present embodiment, a current up to a reference current I (described further below) flows through the power supply wire of the control board 40 and the compressor connecting wire.

[1-1-4. Detailed Configuration of Control Board]

[0044] The control board 40 is a board that controls each part of the heat pump apparatus 1 such as the fan 21, the compressor 23, the expansion device 25, and the four-way valve 27. The control board 40 is connected to each of the sensors attached to each part of the refrigerant circuit 29 and the feed water pipe 22, and receives output signals originated from the sensors. Specifically, the control board 40 receives output signals from the pressure sensors PS1 and PS2 (refer to FIG. 5), the temperature sensors TS1 and TS2 (refer to FIG. 5), and the refrigerant sensor RS1 (refer to FIG. 5).

[0045] In the present embodiment, a value of current supplied to the control board 40 is set up to the reference current I. In the present embodiment, the reference current I is 15 A.

[0046] An electrical component such as a capacitor 42 is provided on the upper face of the control board 40. An inverter element (not shown) is provided on the lower face of the control board 40. The capacitor 42 projects upward from the upper face of the control board 40. The control board 40 is used to control the fan 21, the compressor 23, the expansion device 25, and the four-way valve 27. A large current may flow through the inverter element.

[1-1-5. Configurations of Electrical Component Box and Control Board]

[0047] The control board 40 is disposed closing the bottom opening portion 35 of the electrical component box 30 from the inside of the electrical component storage case 32. The control board 40 is screwed with and attached to the electrical component storage case 32 via a resin case 41. The resin case 41 is located between the control board 40 and the electrical component storage case 32. In other words, the resin case 41 fixes the

control board 40 at a position where the control board 40 is not in contact with the electrical component storage case 32.

[0048] Specifically, the resin case 41 is a saucer-shaped member that is long in the left-right direction. The control board 40 is fixed to the upper face of the resin case 41. The resin case 41 and the control board 40 are screwed together at their four corners. The resin case 41 has a heat dissipation opening portion 43. The heat dissipation opening portion 43 is a substantially rectangular opening penetrating the resin case 41 in the up-down direction. The heat dissipation opening portion 43 is formed corresponding to an installation area of the inverter element of the control board 40. That is, the heat dissipation opening portion 43 is formed at a position where the inverter element of the control board 40 can be visually recognized from outside below through the heat dissipation opening portion 43.

[0049] The heat sink 34 including a plurality of heat dissipation fins 34a is attached to the lower face of the resin case 41. The heat sink 34 is disposed covering the heat dissipation opening portion 43 from below. The heat sink 34 is oriented with the heat dissipation fins 34a projecting downward from the heat dissipation opening portion 43. The heat sink 34 is disposed with the heat dissipation fins 34a extending in the front-rear direction. The heat sink 34 is positioned with the four corners screwed from the upper face of the resin case 41. In addition, the heat sink 34 is screwed from the upper face of the control board 40 with a lubricant such as grease interposed therebetween. Accordingly, the heat sink 34, the resin case 41, and the control board 40 are integrated together. At this time, the heat sink 34 is in intimate contact with the inverter element on the lower face of the control board 40 through the heat dissipation opening portion 43. Accordingly, the heat sink 34 is configured to receive and transfer heat dissipation of the inverter element. The heat sink 34 dissipates heat of the inverter element.

[0050] The integrated resin case 41 is positioned with respect to the electrical component storage case 32 in such a manner that the heat sink 34 is exposed to the outside of the electrical component storage case 32 through the bottom opening portion 35. That is, the resin case 41 is positioned in such a manner that the heat dissipation opening portion 43 overlaps the heat sink 34 and the bottom opening portion 35 in the up-down direction (in bottom view). At this time, the resin case 41 is in contact with the electrical component storage case 32, and the heat sink 34 is separated from the electrical component storage case 32. That is, the heat sink 34 is supported in such a manner that the heat sink 34 is not in direct contact with the electrical component storage case 32 made of metal.

[1-1-6. Configuration of Support Plate]

[0051] FIG. 8 is a perspective view of the support plate 19 in the first embodiment.

[0052] The electrical component box 30 is attached to the fan support posts 18 via the support plate 19. The electrical component box 30 of the present embodiment is attached to the fan support posts 18 by screwing the electrical component box 30 with the support plate 19.

[0053] The support plate 19 has a bent plate shape. The support plate 19 of the present embodiment includes a plate-like rear portion 19a having a thickness in the front-rear direction. The rear portion 19a has a left-right width larger than the distance between the left and right fan support posts 18. The rear portion 19a has an opening portion 19a1. The opening portion 19a1 has a hole shape penetrating the rear portion 19a in the thickness direction.

[0054] A support post fixing portion 19c is formed under the rear portion 19a. The support post fixing portion 19c is screwed with an upper end portion of the fan support post 18. In the present embodiment, a pair of left and right support post fixing portions 19c are formed. A gate-like surrounding shape formed by the pair of left and right support post fixing portions 19c and the rear portion 19a forms an opening portion (opening) 19a2 open downward. In other words, the opening portion 19a2 has an opening shape formed by cutting away the support plate 19 upward. The left and right support post fixing portions 19c are fixed to the upper end portions of the left and right fan support posts 18, respectively. Accordingly, the support plate 19 is fixed across the left and right fan support posts 18.

[0055] Specifically, the left support post fixing portion 19c includes a downward extending portion 19d extending downward from a left outer end portion of the rear portion 19a, and the right support post fixing portion 19c includes a downward extending portion 19d extending downward from a right outer end portion of the rear portion 19a. At a lower end of each of the downward extending portions 19d, a forward extending portion 19e having a shape bent forward is formed. At a front end of the forward extending portion 19e, a front fixing portion 19f having a shape bent downward is formed. At an outer side in the left-right direction of the front fixing portion 19f, a side fixing portion 19g is formed. The side fixing portion 19g has a shape formed by bending an outer end in the left-right direction of the rear portion 19a forward.

[0056] At an upper side of the rear portion 19a, a rearward extending portion 19h having a shape bent rearward from the rear portion 19a is formed. At a rear end of the rearward extending portion 19h, a rear end fixing portion 19i having a shape bent upward is formed. In the present embodiment, a pair of left and right rear end fixing portions 19i are formed. At a front end of the rearward extending portion 19h, a box fixing portion 19j screwable in the up-down direction is formed.

[0057] At the bottom of the rear portion 19a, a support portion 19b projecting forward from the rear portion 19a is formed. The support portion 19b of the present embodiment has a lanced shape relating to the opening portion 19a2. The support portion 19b extends forward corresponding to the front-rear width of the electrical com-

ponent box 30. The support portion 19b has an avoidance opening portion 19b1 for avoiding the heat sink 34. The avoidance opening portion 19b1 has a cut-away shape formed by cutting away the support portion 19b in the left-right direction. The presence of the avoidance opening portion 19b1 enables the support portion 19b to support (be in contact with) the electrical component box 30 at a position close to the center of gravity of the heat sink 34.

[0058] At a front end of the support portion 19b, a front portion 19k having a shape bent forward is formed. At an upper end of the front portion 19k, a front end extending portion 19m having a shape bent forward is formed. At a front end of the front end extending portion 19m, a front end fixing portion 19n having a shape bent upward is formed. At a rear end of the front end extending portion 19m, a box fixing portion 19p screwable in the up-down direction is formed.

[1-1-7. Support Configuration for Electrical Component Box]

[0059] FIG. 9 is a perspective view showing the support structure for the electrical component box 30 in the first embodiment viewed from front below.

[0060] The electrical component box 30 is supported on the fan support posts 18 via the support plate 19. The support plate 19 is screwed with the upper end portions of the fan support posts 18. The fan support posts 18 of the present embodiment are made of a highly thermally conductive material. The fan support posts 18 have a prism shape in appearance. The support post fixing portions 19c of the support plate 19 are placed on the upper end portions of the fan support posts 18 covering the front face and the outer side face of each of the fan support posts 18.

[0061] That is, the front fixing portion 19f of the support plate 19 is placed on the front face of the fan support post 18. The side fixing portion 19g of the support plate 19 is placed on the outer side face of the fan support post 18. The upper end of the fan support post 18 abuts against the forward extending portion 19e of the support plate 19. In this state, the front fixing portion 19f is screwed with the front face of the fan support post 18 from the front side. In addition, the side fixing portion 19g is screwed with the side face of the fan support post 18 from the outside in the left-right direction. Accordingly, the support plate 19 is fixed to the upper end portions of the fan support posts 18.

[0062] The rearward extending portion 19h of the support plate 19 is placed above the air heat exchanger 20. At this time, the rear end fixing portions 19i of the rearward extending portion 19h are located on the rear side of the air heat exchanger 20. The top plate 17 is screwed with the rear end fixing portions 19i. Thus, the support plate 19 is screwed with the top plate 17 at the back portion of the air heat exchanger 20.

[0063] Furthermore, in the present embodiment, the

front end extending portion 19m of the support plate 19 is placed on an upper portion of the front panel 16. At this time, the front end fixing portion 19n of the front end extending portion 19m is screwed with the front panel 16.

[0064] Thus, the support plate 19 is firmly fixed across the front and rear of the housing 10.

[0065] When the support plate 19 is fixed above the fan 21, the rear portion 19a of the support plate 19 is placed along the front face of the rear portion 20a of the air heat exchanger 20. At this time, since the support plate 19 has the opening portions 19a1 and 19a2, air that has exchanged heat can flow into the housing 10 through the opening portions 19a1 and 19a2.

[0066] The electrical component box 30 is disposed in the cut-away portion 11a of the partition plate 11. The electrical component box 30 is disposed across the fan chamber 12 and the machine chamber 13. At this time, the electrical component box 30 is supported on the support plate 19 in the fan chamber 12. That is, the electrical component box 30 is housed in the recessed shape defined by the rear portion 19a, the support portion 19b, and the front portion 19k of the support plate 19. The electrical component box 30 is positioned in the front-rear direction by the rear portion 19a and the front portion 19k. The electrical component box 30 is in contact with and supported by the support portion 19b. At this time, the flange 32F of the electrical component box 30 is screwed with the box fixing portions 19j and 19p. In the present embodiment, the electrical component box 30 is screwed with the fan support posts 18 by screwing the electrical component box 30 with the box fixing portions 19j and 19p of the support plate 19. The electrical component box 30 is supported with its front face, bottom face, and rear face surrounded by the support plate 19, which facilitates more firm support of the electrical component box 30.

[0067] The electrical component box 30 is provided with the heat sink 34 projecting downward, and the support plate 19 enables the fan support posts 18 to support the electrical component box 30 at a predetermined distance, specifically, an insulation distance or more from the heat sink 34.

[0068] In the present embodiment, the heat sink 34 is inserted into the avoidance opening portion 19b1 of the support portion 19b and projects downward from the support portion 19b. At this time, the heat sink 34 is disposed in such a manner that at least a part of the heat sink 34 is located at the center between the left and right fan support posts 18 and above the upper fan 21. In addition, the heat sink 34 is exposed to the front face of the air heat exchanger 20, and the heat dissipation fins 34a are arranged extending in an axial flow direction B (refer to FIG. 4) of the fan 21. That is, the heat sink 34 is disposed in such a manner that air from the fan 21 flows between the heat dissipation fins 34a of the heat sink 34. At this time, the heat dissipation fins 34a face the opening portion 19a2 of the support plate 19. That is, in front view, the heat dissipation fins 34a overlap the opening portion

19a2 of the support plate 19.

[0069] Although, in the present embodiment, the entire electrical component storage case 32 is made of a metal material, only a part located in the fan chamber 12 may be made of a metal material.

[1-2. Operation]

[0070] Hereinbelow, the operation of the heat pump apparatus 1 configured as described above will be described.

[0071] In the heat pump apparatus 1, during operation, power is supplied from an external power source through the power supply wire connected to the control board 40, and the operations of components relating to the compressor 23, the fan 21, the expansion device 25, the four-way valve 27, and the refrigerant circuit 29 are controlled by the control board 40 inside the electrical component box 30.

[0072] Elements on the control board 40 generate heat due to a current passed through the control board 40. The generated heat is transmitted to air inside the electrical component box 30 and also transmitted to the heat sink 34 connected in intimate contact with the inverter element on the lower face of the control board 40.

[0073] The electrical component box 30 has a sealed structure having no ventilation hole so as to prevent the entry of the flammable refrigerant. Thus, the temperature of air inside the electrical component box 30 rises, but heat is dissipated by air passing around the electrical component storage case 32 and the resin lid 33. In addition, the inverter element generates a lot of heat due to a large current flowing therethrough. However, the inverter element is located on the lower face of the control board 40 and directly in intimate contact with the heat sink 34, which facilitates heat dissipation from the inverter element through the heat sink 34.

[0074] When the fan 21 is driven, outside air is drawn through an inlet port, exchanges heat with the refrigerant through the air heat exchanger 20, is drawn by the fan blades 21b of the fan 21, and is blown out to a blow-off port 16b of the front panel 16. Thus, when the fan 21 is driven, the outside air flowing through the air heat exchanger 20 passes between the heat dissipation fins 34a of the heat sink 34 located on the bottom of the electrical component box 30. Accordingly, heat of the heat dissipation fins 34a is taken away by the outside air and dissipated to the blow-off port 16b.

[0075] In the present embodiment, at least a part of the heat sink 34 is located between the left and right fan support posts 18 in front view, and the center of the fan 21 is aligned with the center between the left and right fan support posts 18. Outside air drawn in by the fan 21 flows toward the center of the fan 21 and thus flows parallel to the heat dissipation fins 34a of the heat sink 34 between the heat dissipation fins 34a. Thus, the heat dissipation of the heat sink 34 is improved, and the temperature rise in the inverter element on the control board

40 can be controlled even in the electrical component box 30 having a sealed structure.

[0076] Although the heat sink 34 is a heavy element component in the electrical component box 30, the electrical component box 30 can be supported at the position close to the center of gravity by supporting the heat sink 34 in such a manner that the heat sink 34 is located at the center between the left and right fan support posts 18. Thus, in the present embodiment, the electrical component box 30 can be stably disposed at the upper part of the housing 10.

[1-3. Effects]

[0077] As described above, in the present embodiment, the heat pump apparatus 1 includes the refrigerant circuit 29, the fan 21, the pair of fan support posts 18, the control board 40, the electrical component box 30, and the heat sink 34. The refrigerant circuit 29 includes the compressor 23, and the air heat exchanger 20. The air heat exchanger 20 changes heat between outdoor air and the refrigerant. The refrigerant circuit 29 is filled with a flammable refrigerant. The fan 21 blows air to the air heat exchanger 20. The pair of fan support posts 18 support the fan 21. The control board 40 controls the compressor 23 and the fan 21. The electrical component box 30 stores the control board 40 and has a sealed structure. The heat sink 34 is installed in intimate contact with the control board 40 and exposed to the outside of the electrical component box 30. In the heat pump apparatus 1, the electrical component box 30 is supported by at least one of the fan support posts 18. The heat sink 34 is disposed in front of the air heat exchanger 20. At least a part of the heat sink 34 is located between the pair of fan support posts 18.

[0078] This configuration makes it possible to dispose the heat sink 34 at a position where the amount of airflow is large and a high heat dissipation effect is obtained while firmly supporting the electrical component box 30 close to the heavy heat sink 34. Thus, it is possible to enhance the support strength and the cooling performance for the electrical component box 30 at the same time. Thus, even in the electrical component box 30 having a sealed structure, it is possible to easily control the temperature rise in the control board 40 inside the electrical component box 30. Thus, it is possible to provide the heat pump apparatus 1 in which the support strength for the electrical component box 30 is enhanced, thereby controlling temperature rises in electrical components to enhance the reliability of the electrical components while ensuring safety so as to prevent ignition even if the flammable refrigerant leaks.

[0079] As in the present embodiment, the fan support post 18 supporting the electrical component box 30 may be disposed at a predetermined distance from the heat sink 34.

[0080] This configuration makes it possible to dispose the fan support post 18 supporting the electrical compo-

nent box 30 at the insulation distance from the heat sink 34, the heat sink 34 being in intimate contact with the control board 40 through with a high-voltage large current flows. Thus, the fan support post 18 can support the electrical component box 30 with no large current passing through the fan support post 18 from the heat sink 34. Therefore, the fan support post 18 can hold the electrical component box 30 and the heat sink 34 above the fan 21 while maintaining safety, and it is possible to improve the cooling performance for the electrical components and improve the reliability of the electrical components.

[0081] As in the present embodiment, the support plate 19 may be fixed to the fan support post 18 supporting the electrical component box 30, and the electrical component box 30 may be fixed to the support plate 19.

[0082] According to this configuration, the support plate 19 can increase the flexibility in supporting the electrical component box 30 and make it easy to keep the insulation distance between the fan support post 18 and the heat sink 34. Thus, it is possible to hold the heat sink 34 above the fan 21 while maintaining safety, thereby improving the cooling performance and improving the reliability.

[0083] As in the present embodiment, the support plate 19 may have the opening portion 19a2 corresponding to the position between the pair of fan support posts 18, and the heat sink 34 may be fixed facing the opening portion 19a2 between the pair of fan support posts 18.

[0084] This configuration can make air flow between the heat dissipation fins 34a of the heat sink 34 less likely to be obstructed. Thus, it is possible to more firmly support the electrical component box 30 while improving the heat dissipation of the heat sink 34 and possible to improve the reliability of the electrical components.

[0085] As in the present embodiment, the heat sink 34 may be attached to the control board 40 and the electrical component storage case 32 of the electrical component box 30 via the resin case 41.

[0086] This configuration makes it possible to attach the heat sink 34 to the electrical component box 30 in such a manner that the heat sink 34 is not in direct contact with the electrical component storage case 32 of the electrical component box 30. Thus, even when the heat sink 34 is in intimate contact with the control board 40, it is possible to support the heat sink 34 on the electrical component storage case 32 of the electrical component box 30 while insulating the electrical component storage case 32 of the electrical component box 30 from the heat sink 34 and the control board 40 using the resin case 41. Thus, it is possible to enhance the reliability of the electrical components while ensuring safety.

[0087] As in the present embodiment, the heat pump apparatus 1 may include the partition plate 11 separating the machine chamber 13 and the fan chamber 12 from each other, and the partition plate 11 and the fan support post 18 may support the electrical component box 30.

[0088] According to this configuration, since the fan support post 18 and the partition plate 11 support the

heat sink 34 attached to the electrical component box 30 above the fan 21, the electrical component box 30 can be more firmly supported. Thus, it is possible to enhance the reliability of the electrical components while ensuring safety by enhancing the support strength for the electrical component box 30.

[0089] As in the present embodiment, the support plate 19 may be connected to the front face of the heat pump apparatus 1. In the present embodiment, the support plate 19 is connected to the front panel 16.

[0090] According to this configuration, since the support plate 19 is connected to the front face of the heat pump apparatus 1, the support plate 19 can be easily supported across the front and rear together with the fan support post 18. Thus, the electrical component box 30 can be more firmly supported.

[0091] As in the present embodiment, the flammable refrigerant may be R32 or a mixed refrigerant containing 70% by weight or more of R32, or propane or a mixed refrigerant containing propane.

[0092] According to this configuration, since R32 and propane are refrigerants having low GWP, it is possible to reduce the environmental load.

(Second Embodiment)

[0093] Hereinbelow, a second embodiment will be described with reference to FIGS. 10 and 11.

[2-1. Configuration]

[2-1-1. Entire Configuration]

[0094] FIG. 10 is a perspective view of a support plate 219 in the second embodiment. FIG. 11 is a perspective view showing a support structure for an electrical component box 230 in the second embodiment viewed from front below.

[0095] A heat pump apparatus 1 in the second embodiment includes the support plate 219 and the electrical component box 230, instead of the support plate 19 and the electrical component box 30 in the first embodiment. The second embodiment differs from the heat pump apparatus 1 of the first embodiment in that the electrical component box 230 is supported on the fan support post 18 via the support plate 219.

[2-1-2. Configuration of Support Plate]

[0096] The support plate 219 of the second embodiment has a shape in which the front portion 19k, the front end extending portion 19m, the front end fixing portion 19n, and the box fixing portion 19p of the first embodiment is omitted, and has a simple structure.

[0097] Specifically, the support plate 219 of the second embodiment includes a rear portion 219a, an opening portion 219a1, a rearward extending portion 219h, rear end fixing portions 219i, and a box fixing portion 219j

corresponding to the rear portion 19a, the opening portion 19a1, the rearward extending portion 19h, the rear end fixing portions 19i, and the box fixing portion 19j of the support plate 19 of the first embodiment.

[0098] At the bottom of the rear portion 219a, a support portion 219b projecting forward from the rear portion 219a is formed. The support portion 219b of the present embodiment has a lanced shape relating to the opening portion 219a1. The support portion 219b projects forward at a length that prevents the support portion 219b from coming into contact with the heat sink 34.

[0099] A support post fixing portion 219c is formed under the rear portion 219a. The support post fixing portion 219c is screwed with the upper end portion of the fan support post 18. In the present embodiment, a pair of left and right support post fixing portions 219c are formed. Each of the support post fixing portions 219c includes a downward extending portion 219d, a front fixing portion 219f, and a side fixing portion 219g corresponding to the downward extending portion 19d, the front fixing portion 19f, and the side fixing portion 19g of the first embodiment.

[0100] The support plate 219 also includes a forward extending portion 219e corresponding to the forward extending portions 19e of the first embodiment. The forward extending portion 219e of the second embodiment differs from the forward extending portions 19e of the first embodiment in that the forward extending portion 219e is not separated into left and right parts and has a single plate shape extending in the left-right direction.

[0101] A surrounding shape formed by the pair of left and right support post fixing portions 219c, the rear portion 219a, and the forward extending portion 219e forms an opening portion 219a2 in the support plate 219, the opening portion 219a2 having a hole shape penetrating the support plate 219 in the up-down direction. The opening portion 219a2 can face the heat sink 34 in an installed state.

[2-1-3. Configuration of Electrical Component Box]

[0102] The electrical component box 230 in the second embodiment includes an electrical component storage case 232 instead of the electrical component storage case 32 in the first embodiment. The electrical component storage case 232 of the second embodiment differs from the electrical component storage case 32 in the first embodiment in that a front end fixing portion 232a is formed at the front edge of the opening portion 31. The front end fixing portion 232a is formed in a shape corresponding to the front end fixing portion 19n of the support plate 19 in the first embodiment.

[2-1-4. Support Configuration for Electrical Component Box]

[0103] The electrical component box 230 is supported on the fan support posts 18 via the support plate 219.

The support plate 219 is screwed with the upper end portions of the fan support posts 18. Also in the present embodiment, the support post fixing portions 219c of the support plate 219 are placed covering the front face and the outer side face of each of the fan support posts 18 and screwed therewith.

[0104] In the support plate 219, the top plate 17 is screwed with the rear end fixing portions 219i of the rearward extending portion 219h.

[0105] Thus, the support plate 219 is fixed to the upper end portions of the fan support posts 18.

[0106] The electrical component box 230 extending from the partition plate 11 is disposed on the support plate 219. The electrical component box 230 is in contact with and supported by the support portion 219b. At this time, a flange 32F of the electrical component box 230 is screwed with the box fixing portion 219j. In addition, the front end fixing portion 232a of the electrical component box 230 is screwed with the front panel 16.

[0107] Thus, the electrical component box 230 is screwed with the fan support posts 18 and the front panel 16 and firmly fixed across the front and rear of the housing 10.

[2-2. Effects and the like]

[0108] As described above, also in the present embodiment, the electrical component box 230 is supported by at least one of the fan support posts 18. In addition, the heat sink 34 is disposed in front of the air heat exchanger 20. Furthermore, at least a part of the heat sink 34 is located between the pair of fan support posts 18.

[0109] Thus, also in the second embodiment, it is possible to provide the heat pump apparatus 1 in which the support strength for the electrical component box 230 is enhanced, thereby controlling temperature rises in electrical components to enhance the reliability of the electrical components while ensuring safety so as to prevent ignition even if the flammable refrigerant leaks.

[0110] In addition, also in the present embodiment, the support plate 219 enables the fan support post 18 to support the electrical component box 230 at the insulation distance from the heat sink 34.

[0111] Accordingly, even when the heat sink 34 is in intimate contact with the control board 40 through which a large current flows as described above, the configuration keeping the insulation distance can be easily achieved. Thus, it is possible to hold the heat sink 34 above the fan 21 while maintaining safety, thereby improving the cooling performance and improving the reliability of the electrical components, using the support plate 219 having a simple structure.

(Other Embodiments)

[0112] As described above, the embodiments have been described as examples of the technique disclosed in the present application. However, the technique in the

present disclosure is not limited thereto and also applicable to embodiments with changes, replacements, additions, omissions, and the like. In addition, each constituent element described above in the embodiments may be partially changed to constitute a new embodiment.

[0113] Thus, hereinbelow, other embodiments will be described as examples.

[0114] Although, in the first and second embodiments described above, the control board 40 is attached to the electrical component storage case 32, 232 via the resin case 41, this is an example. The control board 40 may be attached to the electrical component storage case 32, 232 by, for example, screwing via not the resin case 41 but an insulatable member such as a seal member.

[0115] Although, in the first and second embodiments described above, the fan support posts 18 are screwed with the bottom panel 14 of the housing 10, the fan support posts 18 do not need to extend in the up-down direction from the bottom panel 14 and may extend in the lateral direction from the housing 10 or the partition plate 11.

[0116] Although, in the first and second embodiments, the electrical component box 30, 230 is disposed across the machine chamber 13 and the fan chamber 12 through the cut-away portion 11a provided in the partition plate 11, the partition plate 11 may have a height equal to the height of the bottom face of the electrical component box 30, 230 without providing the cut-away portion 11a in the partition plate 11. In this case, the machine chamber 13 and the fan chamber 12 can be separated from each other above the partition plate 11 by providing multiple additional members above the partition plate 11.

[0117] Although, in the first and second embodiments, the support plate 19, 219 is desirably fixed to both of the fan support posts 18 in view of strength, the support plate 19, 219 may be fixed to only one of the fan support posts 18.

[0118] Although, in the first and second embodiments described above, the support plate 19, 219 is a single plate, different support plates may be fixed one-to-one to the left and right fan support posts 18, and the electrical component box 30, 230 may be fixed to the fan support posts 18 via the two support plates.

[0119] Since the embodiments described above are intended to exemplify the technique in the present disclosure, various changes, replacements, additions, omissions, and the like can be made within the scope of the claims or a scope equivalent thereto.

(Supplement)

[0120] The above description of the embodiments discloses the following techniques.

[0121] (Technique 1) A heat pump apparatus including: a refrigerant circuit including a compressor, and a heat exchanger configured to change heat between outdoor air and a refrigerant, the refrigerant circuit being filled with a flammable refrigerant; a fan configured to

blow air to the heat exchanger; a pair of fan support posts supporting the fan; a control board configured to control the compressor and the fan; an electrical component box storing the control board, the electrical component box having a sealed structure; and a heat sink installed in intimate contact with the control board, the heat sink being exposed to outside of the electrical component box, in which the electrical component box is supported by at least one of the fan support posts, the heat sink is disposed in front of the heat exchanger, and at least a part of the heat sink is located between the pair of fan support posts.

[0122] This configuration makes it possible to dispose the heat sink at a position where the amount of airflow is large and a high heat dissipation effect is obtained while firmly supporting the electrical component box close to the heavy heat sink. Thus, it is possible to enhance the support strength and the cooling performance for the electrical component box at the same time, and, even in the electrical component box having a sealed structure, it is possible to easily control the temperature rise in the control board inside the electrical component box. Thus, it is possible to provide the heat pump apparatus in which the support strength for the electrical component box is enhanced, thereby controlling temperature rises in electrical components to enhance the reliability of the electrical components while ensuring safety so as to prevent ignition even if the flammable refrigerant leaks.

[0123] (Technique 2) The heat pump apparatus according to technique 1, in which the fan support post supporting the electrical component box is disposed at a predetermined distance from the heat sink.

[0124] This configuration makes it possible to dispose the fan support post supporting the electrical component box at the insulation distance from the heat sink, the heat sink being in intimate contact with the control board through with a high-voltage large current flows. Thus, the fan support post can support the electrical component box with no large current passing through the fan support post from the heat sink. Therefore, the fan support post can hold the electrical component box and the heat sink above the fan while maintaining safety, and it is possible to improve the cooling performance for the electrical components and improve the reliability of the electrical components.

[0125] (Technique 3) The heat pump apparatus according to technique 1 or 2, in which a support plate is fixed to the fan support post supporting the electrical component box, and the electrical component box is fixed to the support plate.

[0126] According to this configuration, the support plate can increase the flexibility in supporting the electrical component box and make it easy to keep the insulation distance between the fan support post and the heat sink. Thus, it is possible to hold the heat sink above the fan while maintaining safety, thereby improving the cooling performance and improving the reliability.

[0127] (Technique 4) The heat pump apparatus ac-

cording to technique 3, in which the support plate has an opening corresponding to a position between the pair of fan support posts, and the heat sink is fixed facing the opening between the pair of fan support posts.

[0128] This configuration can make air flow between the heat dissipation fins of the heat sink less likely to be obstructed. Thus, it is possible to more firmly support the electrical component box while improving the heat dissipation of the heat sink and possible to improve the reliability of the electrical components.

[0129] (Technique 5) The heat pump apparatus according to any one of techniques 1 to 4, in which the heat sink is attached to the control board and the electrical component box via a resin case.

[0130] This configuration makes it possible to attach the heat sink to the electrical component box in such a manner that the heat sink is not in direct contact with the electrical component box. Thus, even when the heat sink is in intimate contact with the control board, it is possible to support the heat sink on the electrical component box while insulating the electrical component box from the heat sink and the control board using the resin case. Thus, it is possible to enhance the reliability of the electrical components while ensuring safety.

[0131] (Technique 6) The heat pump apparatus according to any one of techniques 1 to 5, further including a partition plate separating a machine chamber and a fan chamber from each other, in which the partition plate and the fan support post support the electrical component box.

[0132] According to this configuration, since the fan support post and the partition plate support the heat sink attached to the electrical component box above the fan, the electrical component box can be more firmly supported. Thus, it is possible to enhance the reliability of the electrical components while ensuring safety by enhancing the support strength for the electrical component box.

[0133] (Technique 7) The heat pump apparatus according to technique 3 or 4, in which the support plate is connected to a front face of the heat pump apparatus.

[0134] According to this configuration, since the support plate is connected to the front face of the heat pump apparatus, the support plate can be easily supported across the front and rear together with the fan support post. Thus, the electrical component box can be more firmly supported.

[0135] (Technique 8) The heat pump apparatus according to any one of techniques 1 to 7, in which the flammable refrigerant is R32 or a mixed refrigerant containing 70% by weight or more of R32, or propane or a mixed refrigerant containing propane.

[0136] According to this configuration, since R32 and propane are refrigerants having low GWP, it is possible to reduce the environmental load.

Industrial Applicability

[0137] The present disclosure is applicable to a heat

pump apparatus using a flammable refrigerant. Specifically, the present disclosure is applicable to, for example, a heat pump hot water heater, a heat pump water heater, or a heat pump apparatus.

5

Reference Signs List

[0138]

10	1	heat pump apparatus
	10	housing
	11	partition plate
	11a	cut-away portion
	12	fan chamber
15	13	machine chamber
	14	bottom panel
	15	side panel
	16	front panel
	16a	opening portion
20	16b	blow-off port
	17	top plate
	18	fan support post
	19	support plate
	19a	rear portion
25	19a1	opening portion
	19a2	opening portion (opening)
	19b	support portion
	19b1	avoidance opening portion
	19c	support post fixing portion
30	19d	downward extending portion
	19e	forward extending portion
	19f	front fixing portion
	19g	side fixing portion
	19h	rearward extending portion
35	19i	rear end fixing portion
	19j	box fixing portion
	19k	front portion
	19m	front end extending portion
	19n	front end fixing portion
40	19p	box fixing portion
	20	air heat exchanger (heat exchanger)
	20a	rear portion
	20b	side portion
	21	fan
45	21a	motor
	21b	fan blade
	22	feed water pipe
	23	compressor
	24	water heat exchanger
50	25	expansion device
	26	refrigerant pipe
	27	four-way valve
	29	refrigerant circuit
	30	electrical component box
55	31	opening portion
	32	electrical component storage case
	32F	flange
	33	resin lid

34	heat sink
34a	heat dissipation fin
35	bottom opening portion
40	control board
41	resin case
42	capacitor (electrical component)
43	heat dissipation opening portion
219	support plate
219a	rear portion
219a1	opening portion
219a2	opening portion (opening)
219b	support portion
219c	support post fixing portion
219e	forward extending portion
219f	front fixing portion
219h	rearward extending portion
219i	rear end fixing portion
219j	box fixing portion
230	electrical component box
232	electrical component storage case
232a	front end fixing portion
B	axial flow direction
I	reference current
PS1	pressure sensor (sensor)
PS2	pressure sensor (sensor)
RS1	refrigerant sensor (sensor)
S	space
TS1	temperature sensor (sensor)
TS2	temperature sensor (sensor)

Claims

1. A heat pump apparatus (1) comprising:

a refrigerant circuit (29) including a compressor (23), and a heat exchanger (20) configured to change heat between outdoor air and a refrigerant, the refrigerant circuit (29) being filled with a flammable refrigerant;
a fan (21) configured to blow air to the heat exchanger (20);
a pair of fan support posts (18) supporting the fan;
a control board (40) configured to control the compressor (23) and the fan (21);
an electrical component box (30, 230) storing the control board (40), the electrical component box (30, 230) having a sealed structure; and
a heat sink (34) installed in intimate contact with the control board (40), the heat sink (34) being exposed to outside of the electrical component box (30, 230), **characterized in that** the electrical component box (30, 230) is supported by at least one of the fan support posts (18),
the heat sink (34) is disposed in front of the heat exchanger (20), and

at least a part of the heat sink (34) is located between the pair of fan support posts (18).

2. The heat pump apparatus (1) according to claim 1, wherein the fan support post (18) supporting the electrical component box (30, 230) is disposed at a predetermined distance from the heat sink (34).

3. The heat pump apparatus (1) according to claim 2, wherein

a support plate (19, 219) is fixed to the fan support post (18) supporting the electrical component box (30, 230), and the electrical component box (30, 230) is fixed to the support plate (19, 219).

4. The heat pump apparatus (1) according to claim 3, wherein

the support plate (19, 219) has an opening (19a2, 219a2) corresponding to a position between the pair of fan support posts (18), and the heat sink (34) is fixed facing the opening (19a2, 219a2) between the pair of fan support posts (18).

5. The heat pump apparatus (1) according to any one of claims 1 to 4, wherein the heat sink (34) is attached to the control board (40) and the electrical component box (30, 230) via a resin case (41).

6. The heat pump apparatus (1) according to any one of claims 1 to 4, further comprising a partition plate (11) separating a machine chamber (13) and a fan chamber (12) from each other, wherein the partition plate (11) and the fan support post (18) support the electrical component box (30, 230).

7. The heat pump apparatus (1) according to claim 3 or 4, wherein the support plate (19, 219) is connected to a front face of the heat pump apparatus (1).

8. The heat pump apparatus (1) according to any one of claims 1 to 4, wherein the flammable refrigerant is R32 or a mixed refrigerant containing 70% by weight or more of R32, or propane or a mixed refrigerant containing propane.

FIG. 1

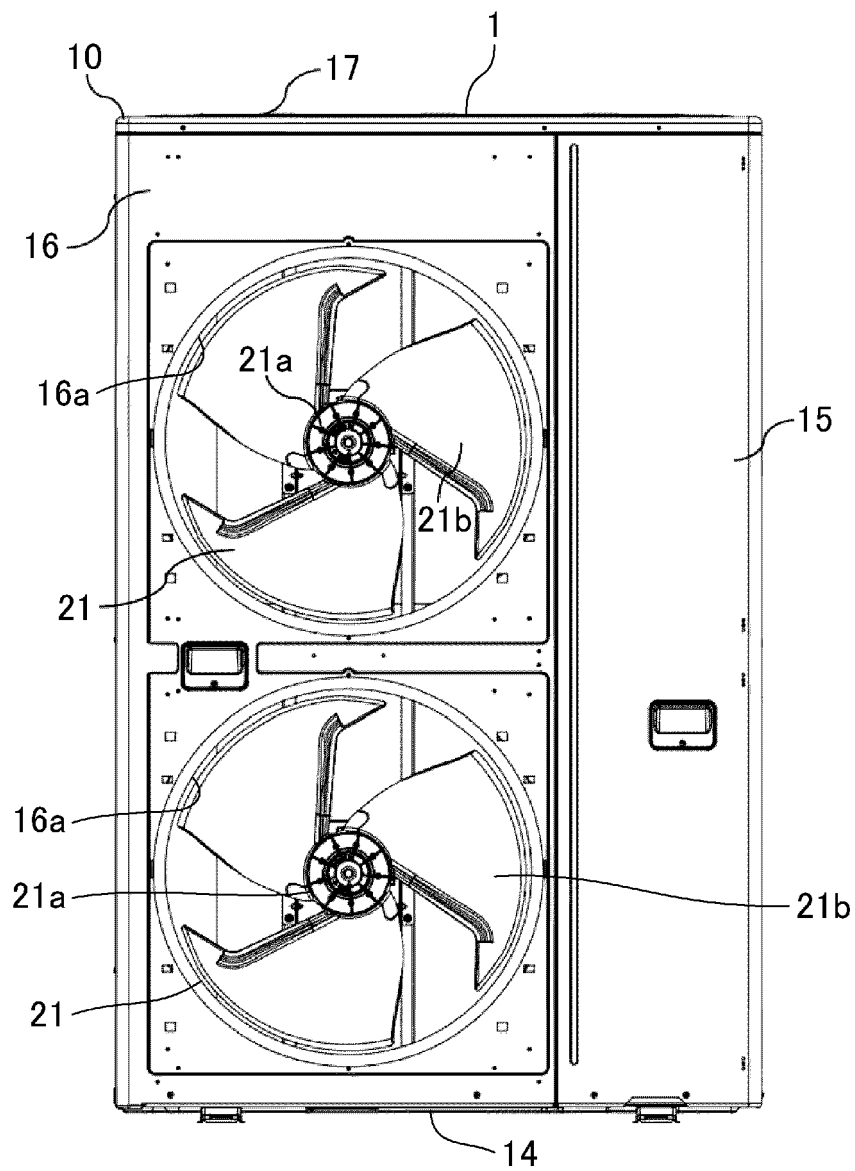


FIG.2

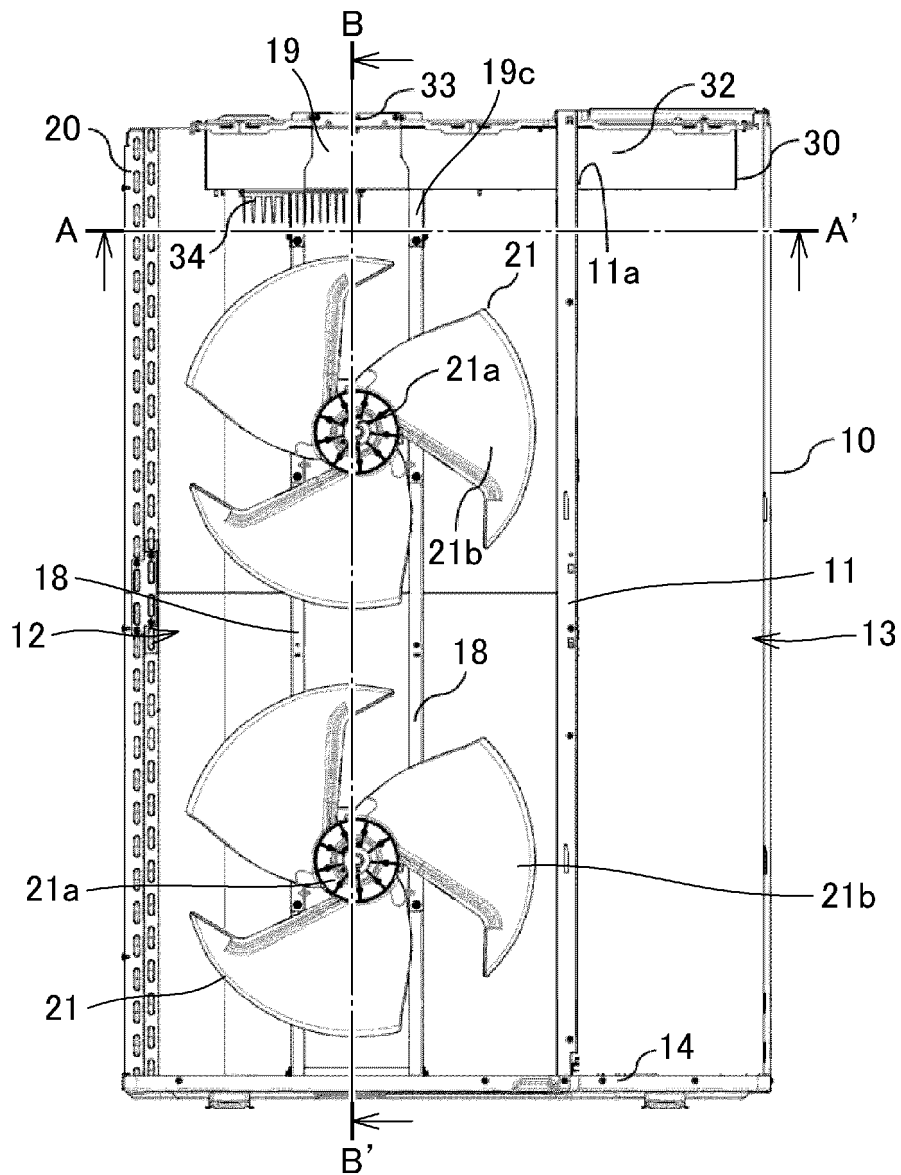


FIG.3

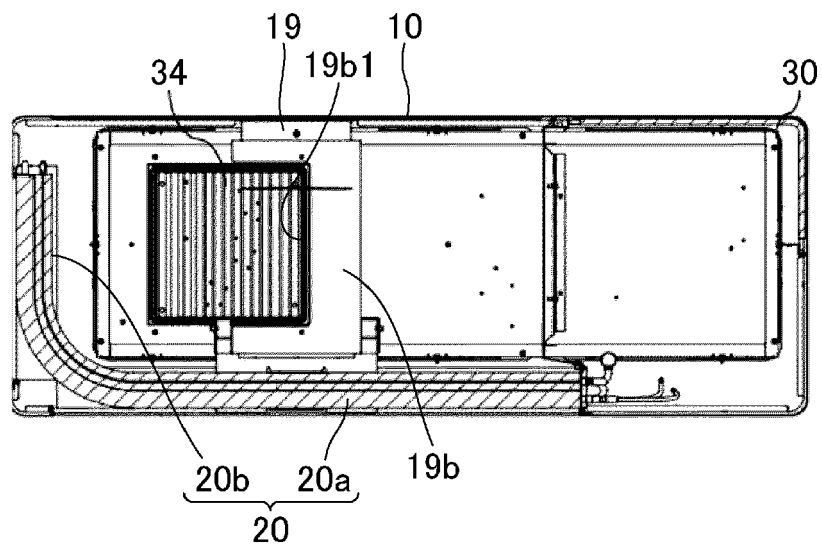


FIG.4

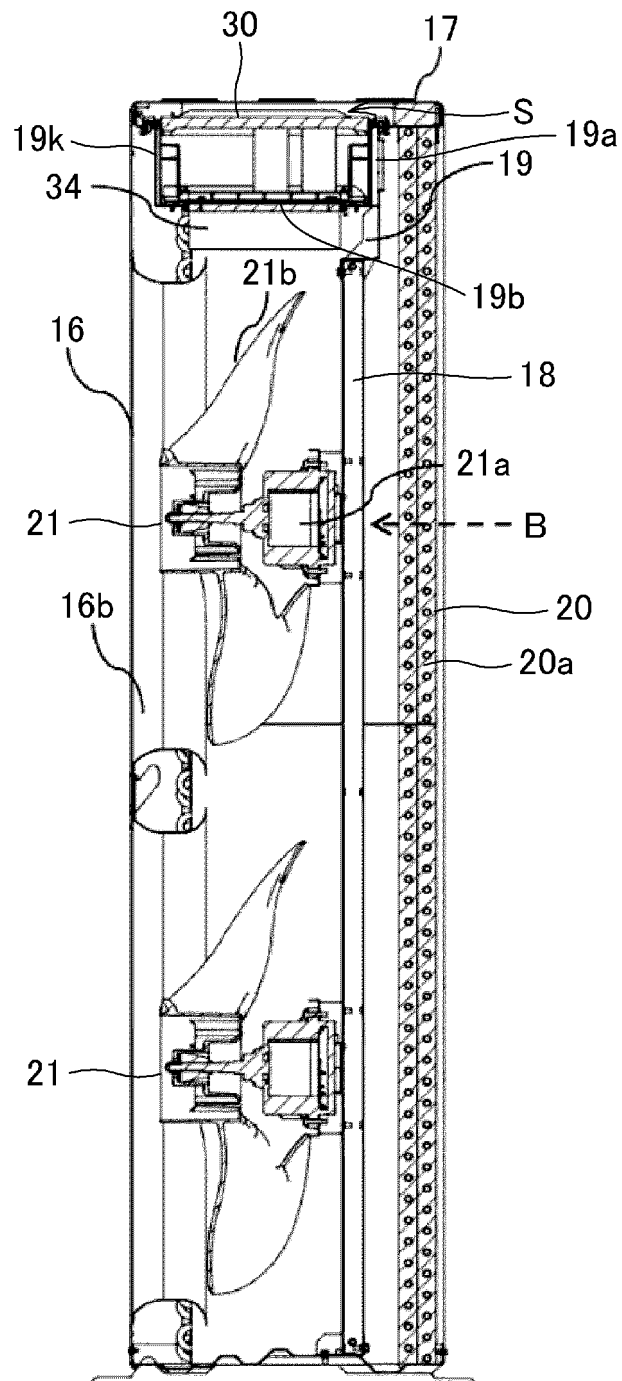


FIG. 5

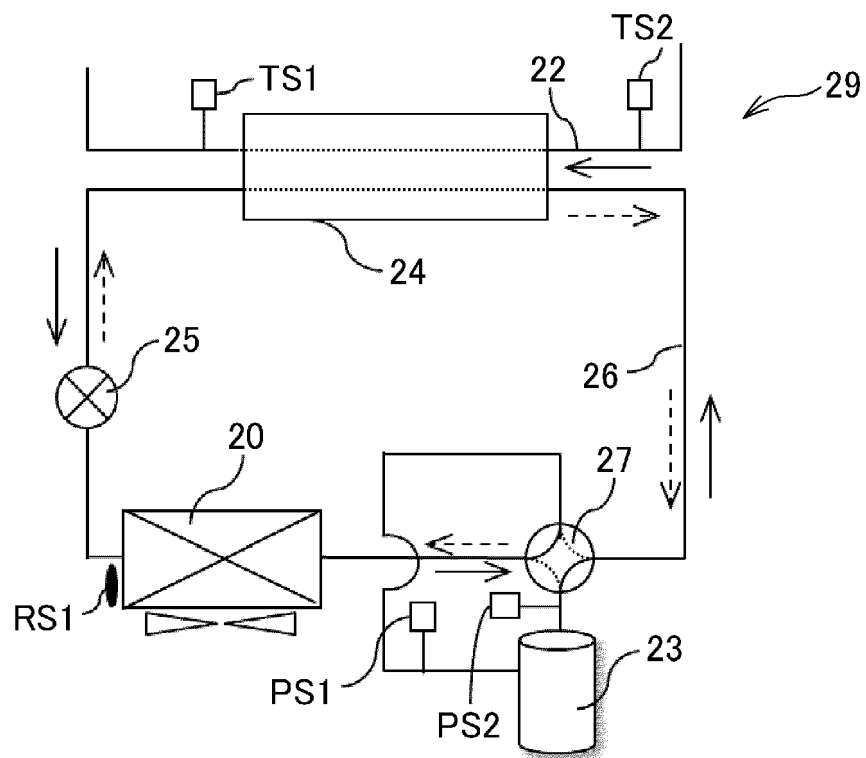


FIG.6

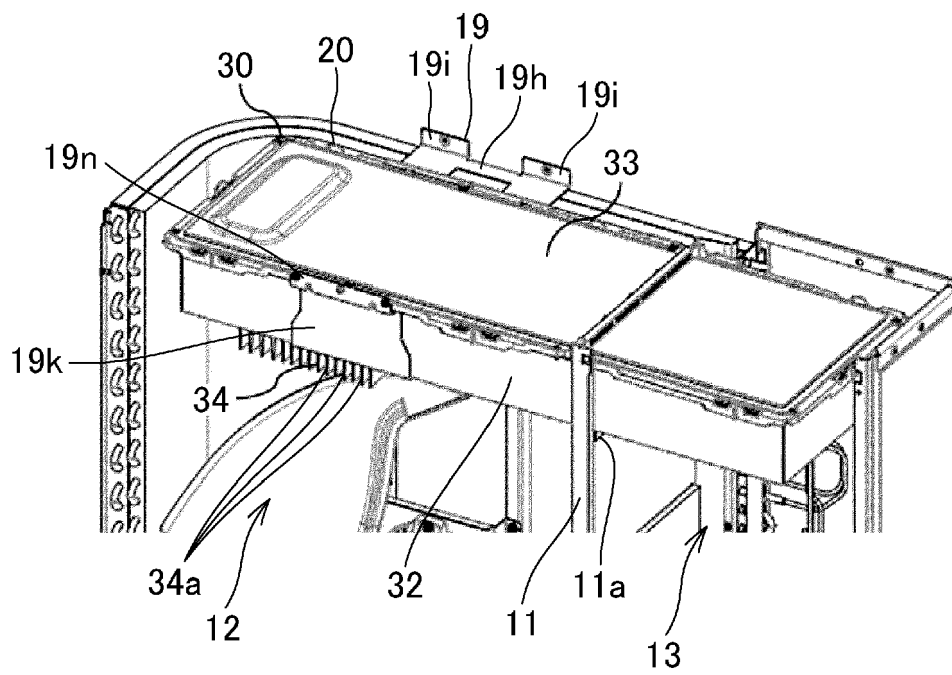


FIG. 7

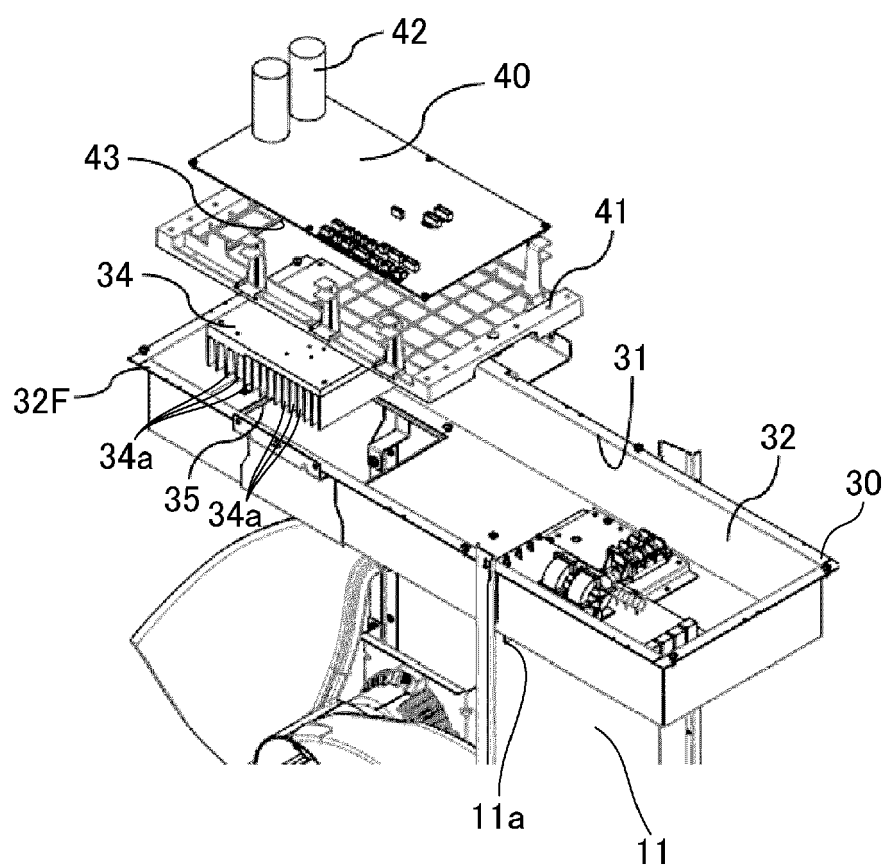


FIG.8

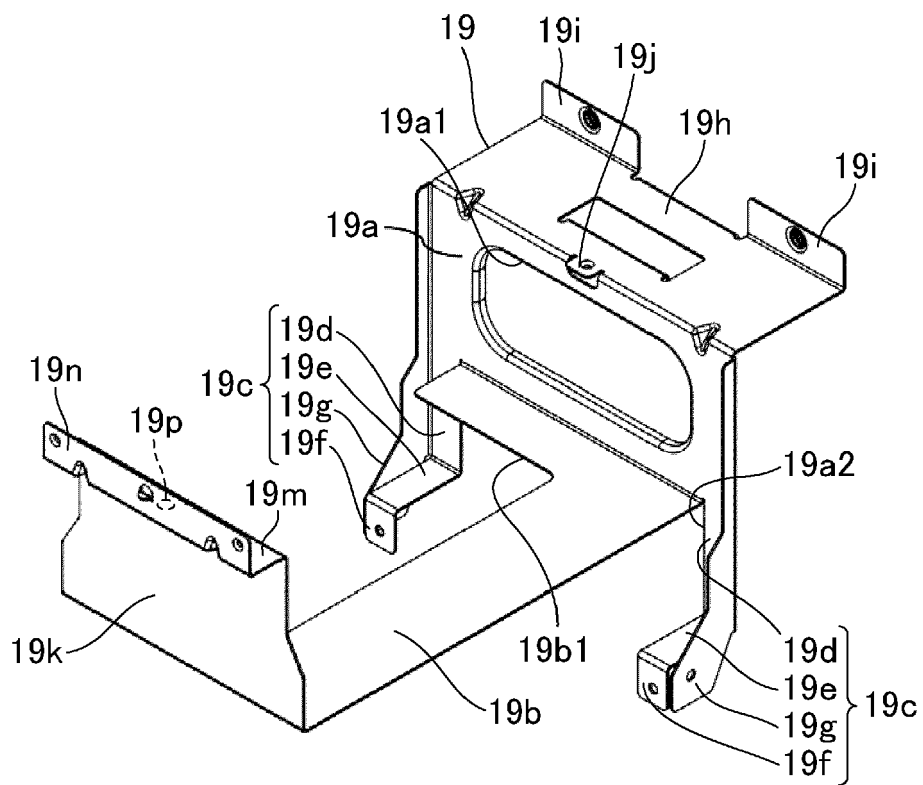


FIG.9

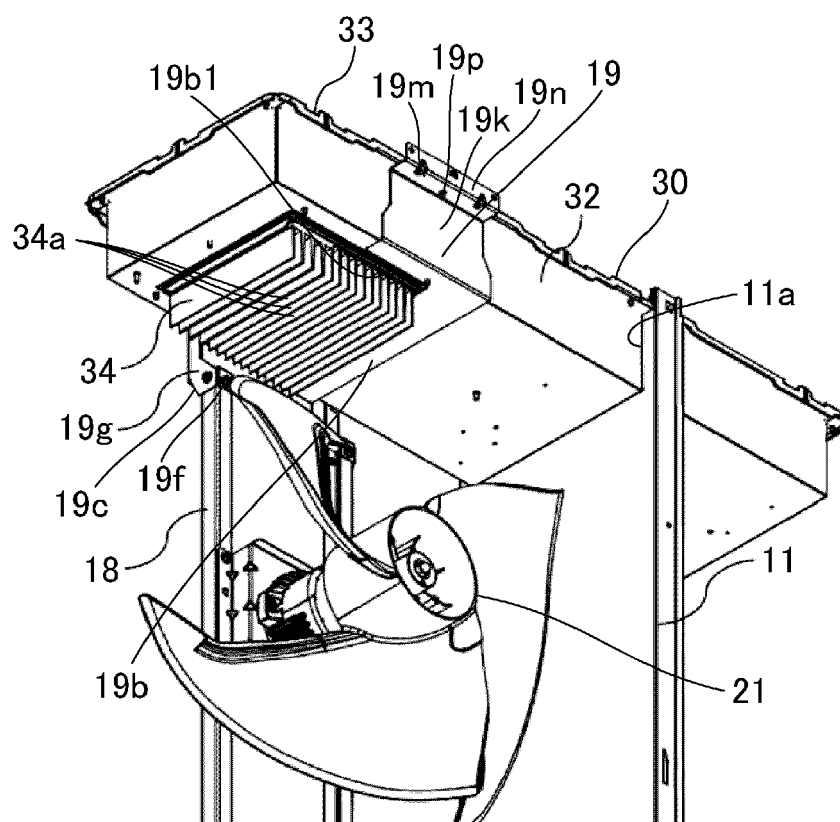


FIG.10

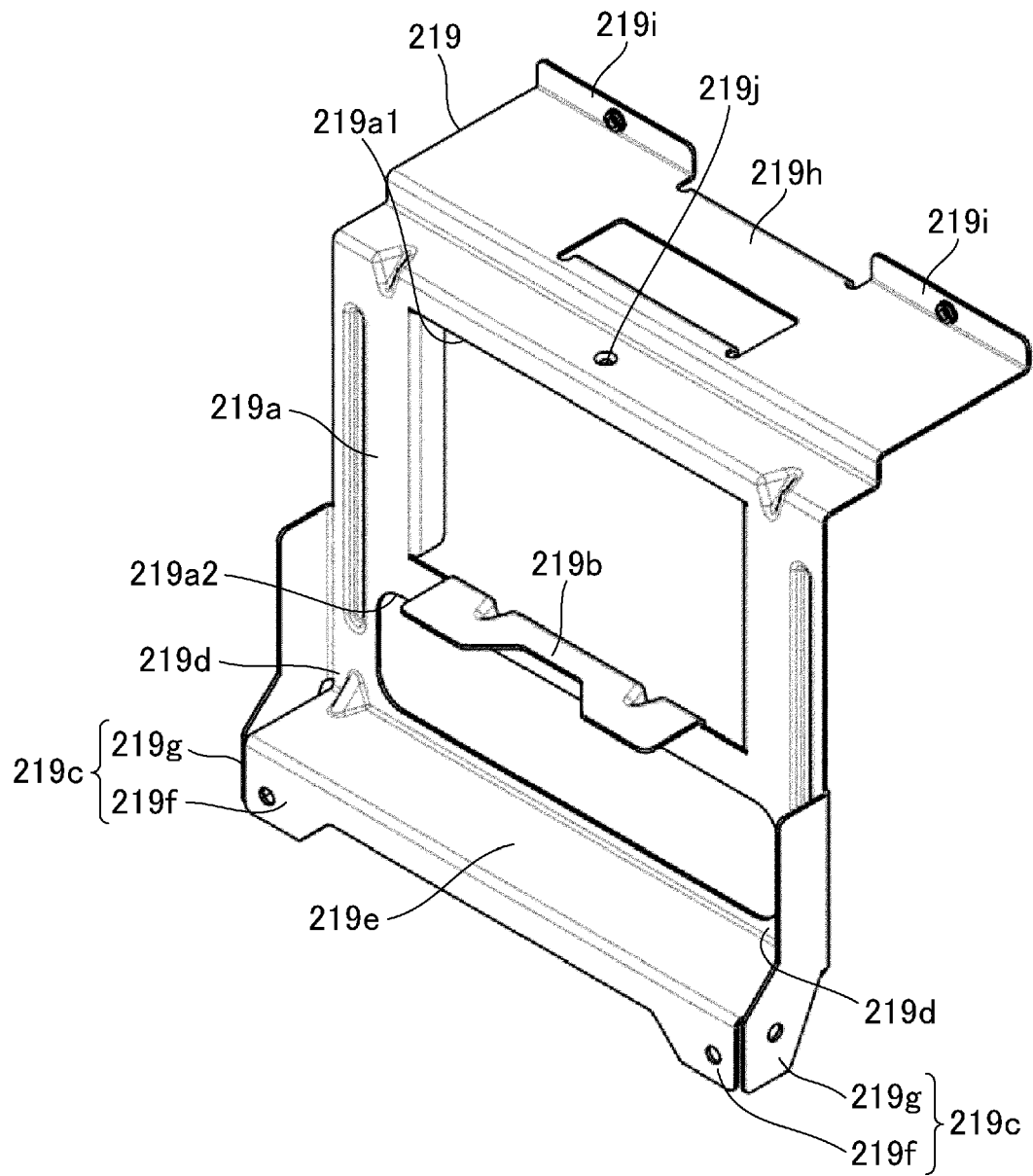
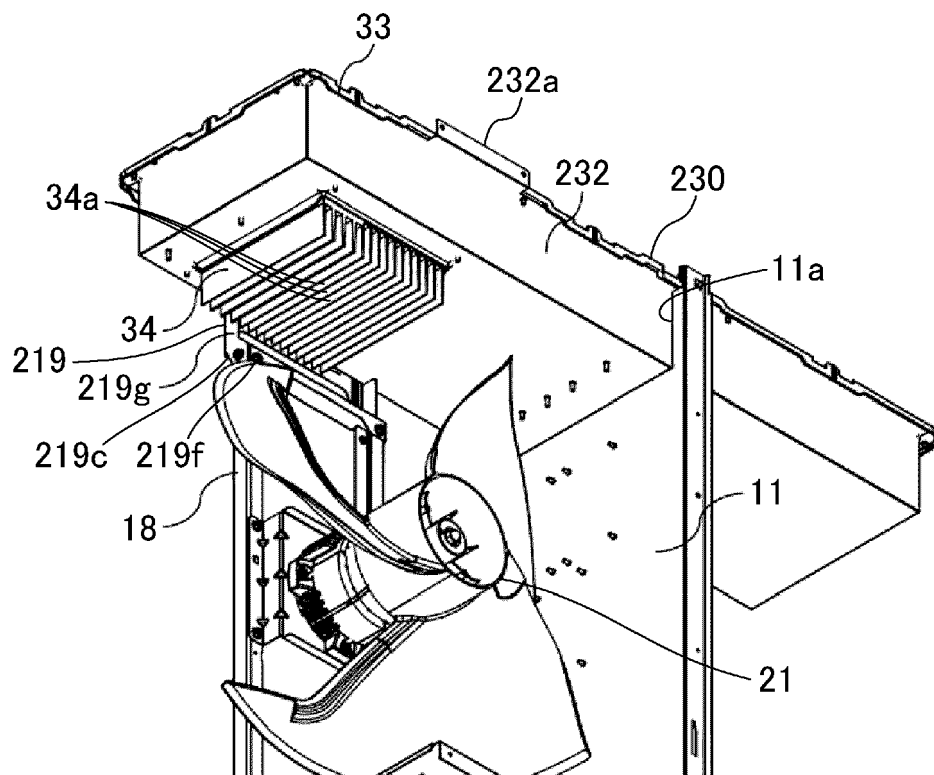


FIG.11





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Place of search Munich		Date of completion of the search 22 October 2024	Examiner Valenza, Davide
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