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(54) **HEAT PUMP DEVICE**

(57) A heat pump device includes: a housing accommodating a compressor configured to compress a refrigerant, a first heat exchanger configured to exchange heat between the refrigerant and air, a blower, and a second heat exchanger configured to exchange heat between the refrigerant and a heat medium; a partition plate configured to partition a space in the housing into a machine compartment in which the compressor is accommodated, and a blower compartment in which the first heat exchanger, the blower, and the second heat exchanger are accommodated; and an internal heat exchanger accommodated in the machine compartment, the internal heat exchanger exchanging heat between the refrigerant having passed through the first heat exchanger and the refrigerant having passed through the second heat exchanger. The internal heat exchanger is supported by the partition plate.

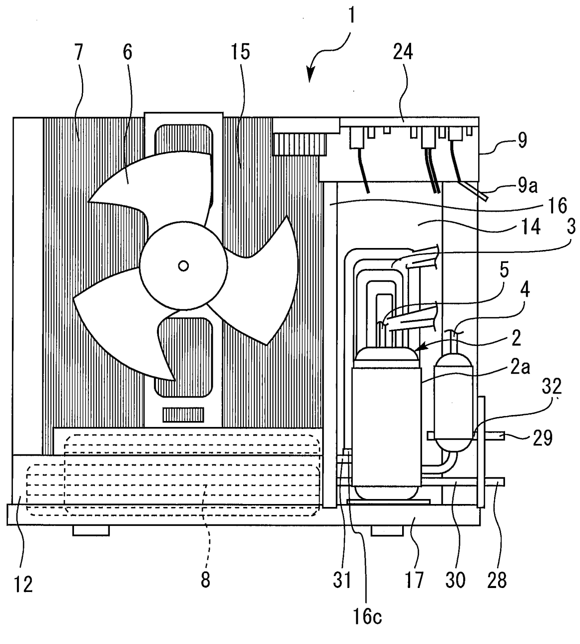

Fig. 1

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Description

[Technical Field]

[0001] The present invention relates to a heat pump device.

[Background Art]

[0002] A heat pump device that heats a liquid heat medium such as water with use of heat absorbed from outside air is widely used. As a heat pump device as above, PTL 1 discloses a heat pump heat source machine including a water-refrigerant heat exchanger, an air-refrigerant heat exchanger, blowing means for blowing air to the air-refrigerant heat exchanger, and a housing in which a refrigerant circuit and the blowing means are provided. The heat pump heat source machine has a configuration in which the water-refrigerant heat exchanger long in the horizontal direction is accommodated in a protective cover, and the vibration of the water-refrigerant heat exchanger is suppressed.

[Citation List]

[Patent Literature]

[0003] [PTL 1] Japanese Patent Application Publication No. 2011-226733

[Summary of Invention]

[Technical Problem]

[0004] A compressor of the heat pump device is driven at a frequency of from about several dozen rps (Hz) to about several hundred rps (Hz) during operation. Therefore, a large vibration occurs in the compressor by a frequency component that is an integral multiple of the frequency. The vibration that has occurred is transmitted to components such as a heat exchanger via a suction pipe and a discharge pipe connected to the compressor. In particular, in a heat pump device including an internal heat exchanger in the suction pipe of the compressor, there is a problem in that the vibration, the low frequency sound, and the noise of the heat pump device increase when the vibration of the compressor is transmitted to the internal heat exchanger.

[0005] The present invention has been made in view of the problem as above, and an object thereof is to provide a heat-pump water-heater outdoor unit capable of suppressing, by a simple configuration, the increase of vibration and noise caused by the transmission of the vibration of a compressor to an internal heat exchanger.

[Solution to Problem]

[0006] A heat pump device according to the present invention includes: a housing accommodating a compressor configured to compress a refrigerant, a first heat exchanger configured to exchange heat between the refrigerant and air, a blower, and a second heat exchanger configured to exchange heat between the refrigerant and a heat medium; a partition plate configured to partition a space in the housing into a machine compartment in which the compressor is accommodated, and a blower compartment in which the first heat exchanger, the blower, and the second heat exchanger are accommodated; and an internal heat exchanger accommodated in the machine compartment, the internal heat exchanger exchanging heat between the refrigerant having passed through the first heat exchanger and the refrigerant having passed through the second heat exchanger, and the internal heat exchanger is supported by the partition plate.

[Advantageous Effects of Invention]

[0007] According to the heat pump device of the present invention, the internal heat exchanger is supported by the partition plate. According to the configuration as above, the vibration transmitted to the internal heat exchanger from the compressor is transmitted to the housing after being attenuated by the partition plate. Therefore, according to the heat pump device of the present invention, the increase of the vibration and the noise of the heat pump device can be suppressed.

[Brief Description of Drawings]

[0008]

Fig. 1 is a front view illustrating the internal structure of a heat pump device of a first embodiment.

Fig. 2 is an external perspective view of the heat pump device of the first embodiment seen obliquely from the front.

Fig. 3 is an external perspective view of the heat pump device of the first embodiment seen obliquely from the back.

Fig. 4 is a diagram illustrating a refrigerant circuit and a water circuit of a heat pump hot-water supply system including the heat pump device of the first embodiment.

Fig. 5 is a plan view of an internal heat exchanger and a partition plate included in the heat pump device of the first embodiment.

Fig. 6 is a view illustrating a cross section of the internal heat exchanger and the partition plate in Fig. 5 taken along A-A in Fig. 5.

Fig. 7 is a plan view of an internal heat exchanger and a partition plate included in a heat pump device of a second embodiment.

Fig. 8 is a view illustrating a cross section of the internal heat exchanger and the partition plate in Fig. 7 taken along B-B in Fig. 7.

Fig. 9 is a plan view of an internal heat exchanger and a partition plate included in a heat pump device of a third embodiment.

Fig. 10 is a view illustrating a cross section of the internal heat exchanger and the partition plate in Fig. 9 taken along C-C in Fig. 9.

[Description of Embodiments]

[0009] Embodiments are described below with reference to the drawings. Elements that are common across the drawings are denoted by the same reference symbols, and overlapping descriptions are simplified or omitted. The present disclosure may include every combination of the combinable configurations out of the configurations described in the embodiments below.

First Embodiment

[0010] Fig. 1 is a front view illustrating the internal structure of a heat pump device 1 of a first embodiment. Fig. 2 is an external perspective view of the heat pump device 1 of the first embodiment seen obliquely from the front. Fig. 3 is an external perspective view of the heat pump device 1 of the first embodiment seen obliquely from the back. Fig. 4 is a diagram illustrating a refrigerant circuit and a water circuit of a heat pump hot-water supply system including the heat pump device 1 of the first embodiment.

[0011] The heat pump device 1 of this embodiment is installed outdoors. The heat pump device 1 heats a liquid heat medium. The heat medium in this embodiment is water. The heat pump device 1 generates hot water by heating the water. The heat medium in the present invention may be brine other than water such as calcium chloride solution, ethylene glycol solution, and alcohol.

[0012] As illustrated in Fig. 1, the heat pump device 1 includes a base 17 that forms a bottom portion of a housing. On the base 17, a machine compartment 14 is formed on the right side and a blower compartment 15 is formed on the left side when seen from the front. The machine compartment 14 and the blower compartment 15 are separated from each other by a partition plate 16 extending in a vertical direction. As illustrated in Fig. 2 and Fig. 3, the housing forming the outline of the heat pump device 1 further includes a housing front surface portion 18, a housing rear surface portion 19, a housing upper surface portion 20, the housing right side-surface portion 21, and a housing left side-surface portion 22. Those components of the housing are molded from a sheet metal material, for example. The outer surface of the heat pump device 1 is covered with the housing besides an air-refrigerant heat exchanger 7 provided on the rear surface side. An opening for exhausting air having passed through a blower compartment 15 is formed in the housing front surface portion 18, and a grille 18a is mounted on the opening. Fig. 1 illustrates a state in which portions of the housing other than the base 17 are removed. Further, the illustration of some component devices is omitted in Fig. 1.

[0013] As illustrated in Fig. 1, a compressor 2 that compresses the refrigerant, an expansion valve 10 (not shown in Fig. 1) that decompresses the refrigerant, refrigerant pipes such as a suction pipe 4 and a discharge pipe 5 that connect those components with each other, and the like are integrated in the machine compartment 14 as refrigerant circuit components.

[0014] The compressor 2 includes a cylindrical shell 2a. The compressor 2 includes a compression unit (not shown) and a motor (not shown) in the shell 2a. The compression unit performs a compressing operation of the refrigerant. The motor drives the compression unit. The motor of the compressor is driven by electric power supplied from the outside. The refrigerant is sucked into the compressor 2 through the suction pipe 4. The discharge pipe 5 that discharges the refrigerant compressed in the compressor 2 is connected to an upper portion of the compressor 2. A coil integration member is mounted on an outer side surface of the main body of the expansion valve 10. By energizing a coil from the outside, a flow path resistance regulating unit on the inside is operated. As a result, the flow path resistance of the refrigerant is regulated. The pressure of a high-pressure refrigerant upstream the expansion valve 10 and the pressure of a low-pressure refrigerant downstream the expansion valve 10 can be regulated by the expansion valve 10. The expansion valve 10 is an example of a decompression device that decompresses the refrigerant.

[0015] The blower compartment 15 has a space larger than that of the machine compartment 14 in order to secure an air course. A blower 6 is integrated in the blower compartment 15. The blower 6 includes two to three propeller blades and a motor that drives the propeller blades to rotate. The motor and the propeller blades rotate by electric power supplied from the outside. The air-refrigerant heat exchanger 7 serving as a first heat exchanger is installed on the rear surface side of the blower compartment 15 so as to face the blower 6. The air-refrigerant heat exchanger 7 includes a large number of aluminum sheet fins, and a long refrigerant pipe that extends forward and backward a several times so as to be in close contact with the aluminum sheet fins at many places. The air-refrigerant heat exchanger 7 has a flat plate-like shape bent in an L-shape. The air-refrigerant heat exchanger 7 is installed on a rear surface to a left side surface of the heat pump device 1. An end portion of the air-refrigerant heat exchanger 7 on the rear surface side thereof extends to the rear side of the machine compartment 14. Therefore, the partition plate 16 has a flat plate-like shape bent in an L-shape, and is installed so as to partition a space from a front surface of the heat pump device 1 to the end portion of the air-refrigerant heat exchanger 7 on the rear surface side thereof. In the air-refrigerant heat exchanger 7, heat is exchanged between the refrigerant in the refrigerant pipe and the air around the fins. By the blower 6, the air volume of the air that flows and passes through the fins is regulated by being increased, and the heat exchange amount is regulated by being increased. The air-refrigerant heat exchanger 7 is an example of an evaporator that evaporates the refrigerant.

[0016] A water-refrigerant heat exchanger 8 serving as a second heat exchanger is installed on the base 17 below the blower compartment 15. The water-refrigerant heat exchanger 8 is installed by being accommodated in a rectangular accommodation container 12 while being covered with an insulating material. The water-refrigerant heat exchanger 8 is bent so that the water-refrigerant heat exchanger 8 can be accommodated in the accommodation container 12 in a state in which a long water pipe and a long refrigerant pipe are in close contact with each other. In the water-refrigerant heat exchanger 8, heat is exchanged between the refrigerant in the refrigerant pipe and the water, that is, the heat medium in the water pipe. In the water-refrigerant heat exchanger 8, the water, that is, the heat medium is heated. The blower 6 is provided above the water-refrigerant heat exchanger 8.

[0017] An internal heat exchanger 3 is installed in the machine compartment 14. The internal heat exchanger 3 is bent into a rectangular shape in a state in which long high-pressure refrigerant piping and long low-pressure refrigerant piping are in close contact with each other. In the internal heat exchanger 3, heat is exchanged between the refrigerant in the high-pressure refrigerant piping and the refrigerant in the low-pressure refrigerant piping. As a result, the low-pressure refrigerant is heated in the internal heat exchanger 3. As illustrated in Fig. 1, the machine compartment 14 is formed as a space long in the vertical direction. Therefore, the internal heat exchanger 3 is installed in the machine compartment 14 in an orientation in which the longitudinal direction of the rectangle is in the vertical direction of the machine compartment 14. The installation structure of the internal heat exchanger 3 is described in detail below.

[0018] An outlet portion of the compressor 2 is connected to a refrigerant inlet portion of the water-refrigerant heat exchanger 8 via the discharge pipe 5. A refrigerant outlet portion of the water-refrigerant heat exchanger 8 is connected to a high-pressure refrigerant inlet portion of the internal heat exchanger 3 in the machine compartment 14 via a refrigerant pipe. A high-pressure refrigerant outlet portion of the internal heat exchanger 3 is connected to an inlet portion of the expansion valve 10 in the machine compartment 14 via a refrigerant pipe. An outlet portion of the expansion valve 10 is connected to a refrigerant inlet portion of the air-refrigerant heat exchanger 7 via a refrigerant pipe. A refrigerant outlet portion of the air-refrigerant heat exchanger 7 is connected to a low-pressure refrigerant inlet portion of the internal heat exchanger 3 via a refrigerant pipe. A low-pressure refrigerant outlet portion of the internal heat exchanger 3 is connected to an inlet portion of the compressor 2 via the suction pipe 4. Other refrigerant circuit components may be provided in the middle of the refrigerant pipes.

[0019] An electrical item accommodation box 9 is installed on an upper portion of the machine compartment 14. An electronic board 24 is accommodated in the electrical item accommodation box 9. Electronic components, electrical components, and the like forming modules that drive and control the compressor 2, the expansion valve 10, the blower 6, and the like are mounted on the electronic board 24. The modules are controlled as the following, for example. The number of rotations of the motor of the compressor 2 is changed to a number of rotations of from about several dozen rps (Hz) to about several hundred rps (Hz). The opening of the expansion valve 10 is changed. The number of rotations of the blower 6 is changed to a number of rotations of from about several hundred rps (Hz) to about several thousand rps (Hz). A terminal block 9a that connects external electrical wiring is provided in the electrical item accommodation box 9. As illustrated in Fig. 2 and Fig. 3, a service panel 27 for protecting the terminal block 9a and a water inlet valve 28 and a hot-water outlet valve 29 described below is mounted on the housing right side-surface portion 21.

[0020] A refrigerant is encapsulated in a closed space of the refrigerant circuit included in the heat pump device 1. The refrigerant may be a CO_2 refrigerant, for example.

[0021] Next, a water circuit of the heat pump device 1 and the hot-water storage device 33 is described. As illustrated in Fig. 1, water circuit components including an internal pipe 30 and an internal pipe 31 are integrated in the machine compartment 14. The water inlet valve 28 and the hot-water outlet valve 29 are provided together on a right side portion of the base 17 so that the water inlet valve 28 is on the lower side and the hot-water outlet valve 29 is on the upper side. The internal pipe 30 connects the water inlet valve 28 and a water inlet portion of the water-refrigerant heat exchanger 8 to each other. The internal pipe 31 connects a hot-water outlet portion of the water-refrigerant heat exchanger 8 and the hot-water outlet valve 29 to each other.

[0022] As illustrated in Fig. 4, the heat pump hot-water supply system is formed by the heat pump device 1 and the hot-water storage device 33. The hot-water storage device 33 includes a hot-water storage tank 34 having a capacity of about several hundred liters, for example, and a water pump 35 for sending the water in the hot-water storage tank 34 to the heat pump device 1. The heat pump device 1 and the hot-water storage device 33 are connected to each other via an external pipe 36, an external pipe 37, and electric wiring (not shown).

[0023] A lower portion of the hot-water storage tank 34 is connected to an inlet of the water pump 35 via a pipe 38. The external pipe 36 connects an outlet of the water pump 35 and the water inlet valve 28 of the heat pump device 1 to each other. The external pipe 37 connects the hot-water outlet valve 29 of the heat pump device 1 and the hot-water storage device 33 to each other. The external pipe 37 can communicate with the hot-water storage tank 34 via a pipe 39 in the hot-water storage device 33.

[0024] The hot-water storage device 33 further includes a mixing valve 40. A hot-water supply pipe 41 that has branched off from the pipe 39, a water supply pipe 42 through which water supplied from a water source such as water supply passes, and a hot-water supply pipe 43 through which hot water to be supplied to the user side passes are connected to the mixing valve 40. The mixing valve 40 regulates the hot-water supply temperature by adjusting a mixture ratio between hot water, that is, high-temperature water flowing into the mixing valve 40 from the hot-water supply pipe 41, and water, that is, low-temperature water flowing into the mixing valve 40 from the water supply pipe 42. The hot water mixed by the mixing valve 40 is sent to a terminal on the user side such as a bathtub, a shower, a faucet, and a dishwasher, for example, through the hot-water supply pipe 43. A water supply pipe 44 that has branched off from the water supply pipe 42 is connected to the lower portion of the hot-water storage tank 34. Water flowing into the hot-water storage tank 34 from the water supply pipe 44 is accumulated in the hot-water storage tank 34 on the lower side thereof.

[0025] Next, the operation of the heat pump device 1 in a heat storage operation is described. The heat storage operation is an operation that accumulates hot water in the hot-water storage tank 34 by sending hot water heated in the heat pump device 1 to the hot-water storage device 33. In the heat storage operation, the following is performed. The compressor 2, the blower 6, and the water pump 35 are operated. The rotational speed of the motor of the compressor 2 can be changed in a range of from about several dozen rps (Hz) to about several hundred rps (Hz). As a result, the heating capacity can be regulated and controlled by changing the flow rate of the refrigerant.

[0026] The rotational speed of the motor of the blower 6 changes to from about several hundred rpm to about several thousand rpm, and the heat exchange amount between the refrigerant and the air in the air-refrigerant heat exchanger 7 can be regulated and controlled by changing the flow rate of the air that passes through the air-refrigerant heat exchanger 7. The air is sucked from the back of the air-refrigerant heat exchanger 7 installed behind the blower 6, passes through the air-refrigerant heat exchanger 7, passes through the blower compartment 15, and is exhausted to the front of the housing front surface portion 18 on a side opposite to the air-refrigerant heat exchanger 7.

[0027] The expansion valve 10 regulates the flow path resistivity of the refrigerant. As a result, the pressure of the high-pressure refrigerant upstream the expansion valve 10 and the pressure of the low-pressure refrigerant downstream the expansion valve 10 can be regulated and controlled. The rotational speed of the compressor 2, the rotational speed of the blower 6, and the flow path resistivity of the expansion valve 10 are controlled in accordance with the installation environment, the conditions of use, and the like of the heat pump device 1.

[0028] The low-pressure refrigerant is sucked into the compressor 2 through the suction pipe 4. The low-pressure refrigerant is compressed by the compression unit in the compressor 2, and becomes a high-temperature and high-pressure refrigerant. The high-temperature and high-pressure refrigerant is discharged from the compressor 2 to the discharge pipe 5. The high-temperature and high-pressure refrigerant flows into the refrigerant inlet portion of the water-refrigerant heat exchanger 8 through the discharge pipe 5. The high-temperature and high-pressure refrigerant generates hot water by exchanging heat with water in the water-refrigerant heat exchanger 8 and heating the water. The enthalpy and the temperature of the refrigerant is reduced while the refrigerant passes through the water-refrigerant heat exchanger 8. The high-pressure refrigerant of which temperature is reduced flows into the high-pressure refrigerant inlet portion of the internal heat exchanger 3 from the refrigerant outlet portion of the water-refrigerant heat exchanger 8 through the refrigerant pipe. The high-pressure refrigerant exchanges heat with the low-pressure refrigerant in the internal heat exchanger 3. As a result, the enthalpy of the high-pressure refrigerant is reduced, and hence the temperature of the high-pressure refrigerant is further reduced. The high-pressure refrigerant of which temperature is reduced flows into the inlet portion of the expansion valve 10 from the high-pressure refrigerant outlet portion of the internal heat exchanger 3 through the refrigerant pipe. The temperature of the high-pressure refrigerant drops by being decompressed by the expansion valve 10. As a result, the high-pressure refrigerant becomes a low-temperature and low-pressure refrigerant. The low-temperature and low-pressure refrigerant flows into the inlet portion of the air-refrigerant heat exchanger 7 from the outlet portion of the expansion valve 10 through the refrigerant pipe. The low-temperature and low-pressure refrigerant exchanges heat with air in the air-refrigerant heat exchanger 7. As a result, the enthalpy of the low-temperature and low-pressure refrigerant increases. Then, the refrigerant flows in the refrigerant pipe from the outlet portion of the air-refrigerant heat exchanger 7, and flows into the low-pressure refrigerant inlet portion of the internal heat exchanger 3. The low-pressure refrigerant exchanges heat with the high-pressure refrigerant in the internal heat exchanger 3. As a result, the enthalpy of the low-pressure refrigerant increases. The low-pressure refrigerant that has flowed into the suction pipe 4 from the outlet portion of the internal heat exchanger 3 is sucked into the compressor 2. The heat pump cycle is performed by the circulation of the refrigerant as above.

[0029] At the same time, the water in the lower portion of the hot-water storage tank 34 flows into the water inlet portion of the water-refrigerant heat exchanger 8 through the pipe 38, the external pipe 36, the water inlet valve 28, and the internal pipe 30 by driving the water pump 35. The water exchanges heat with the refrigerant in the water-refrigerant heat exchanger 8, to be thereby heated.

As a result, hot water is generated. The hot water flows into an upper portion of the hot-water storage tank 34 through the internal pipe 31, the hot-water outlet valve 29, the external pipe 37, and the pipe 39. By performing the heat storage operation as above, hot water of which temperature is high is accumulated in the hot-water storage tank 34 from the upper portion to the lower portion.

[0030] The hot water heated by the heat pump device 1 may be directly supplied to the user side without being accumulated in the hot-water storage tank 34. The heat medium heated by the heat pump device 1 may be used in space heating and the like.

[0031] According to this embodiment, the following effects are obtained by including the internal heat exchanger 3. Heat can be exchanged from the high-pressure refrigerant having passed through the water-refrigerant heat exchanger 8 to the low-pressure refrigerant having passed through the air-refrigerant heat exchanger 7. As a result, the thermal efficiency of the heat pump cycle can be increased.

[Fixing Structure of Internal Heat Exchanger]

[0032] The heat pump device 1 of the first embodiment is characterized by the structure in which the internal heat exchanger 3 is installed on the partition plate 16. Fig. 5 is a plan view of the internal heat exchanger 3 and the partition plate 16 included in the heat pump device 1 of the first embodiment. Fig. 6 is a view illustrating a cross section of the internal heat exchanger 3 and the partition plate 16 in Fig. 5 taken along A-A in Fig. 5. As illustrated in Fig. 5 and Fig. 6, the internal heat exchanger 3 is installed on the partition plate 16 in an orientation in which the longitudinal direction thereof is in the vertical direction of the heat pump device 1. An installation portion 16b protruding with respect to the extending direction of the partition plate 16 is formed on a lower end portion 16a of the partition plate 16. An installation surface 16c including a horizontal surface and a supporting portion 16d that supports the installation surface 16c are formed by bending the installation portion 16b into a U-shape through bending. The internal heat exchanger 3 is fixed to the partition plate 16 in a state in which a lower end portion 3a is installed on the installation surface 16c. The structure for fixing the internal heat exchanger 3 on the partition plate 16 is not particularly limited, and well-known means such as screwing and riveting can be used.

[0033] In the heat pump device 1 of the first embodiment, the following effects are obtained by installing the internal heat exchanger 3 on the installation portion 16b of the partition plate 16. The heat pump device 1 drives the compression unit in the compressor 2 at a low frequency of from about several dozen rps (Hz) to about several hundred rps (Hz) during operation. Therefore, a large vibration occurs in the compressor 2 by a frequency component that is an integral multiple of the operation frequency, in particular, a frequency component that is a low integral multiple of the operation frequency. The vibration that has occurred in the compressor 2 is transmitted to the internal heat exchanger 3 via the suction pipe 4 connected to the compressor 2.

[0034] When the internal heat exchanger 3 is directly installed on the base 17 of the heat pump device 1, the vibration of the internal heat exchanger 3 is directly transmitted to the base 17. The vibration transmitted to the housing of the heat pump device 1 increases as the vibration transmitted to the base 17 increases. Therefore, directly transmitting the vibration of the internal heat exchanger 3 to the base 17 causes low frequency sound and noise to increase.

[0035] In the heat pump device 1 of the first embodiment, the internal heat exchanger 3 is installed on the installation portion 16b of the partition plate 16, and hence the vibration of the internal heat exchanger 3 is transmitted to the base 17 after being attenuated by the partition plate 16. As a result, the vibration transmitted to the base 17 can be suppressed, and hence the occurrence of the low frequency sound and the noise from the heat pump device 1 can be suppressed. Further, in the heat pump device 1 of the first embodiment, the vibration transmitted to the base 17 can be suppressed by a simple configuration without providing a special vibration attenuation member such as a spring to the internal heat exchanger 3. As a result, the increase in the material cost and the assembly cost can be suppressed. In this way, a heat pump device excellent in terms of quietness and cost can be provided. Users particularly have a high interest in the quietness of the heat pump device that is frequently operated in the nighttime. The heat pump device 1 of the present invention is capable of responding to the interests and expectations of the users as above.

[0036] The shape of the installation portion 16b formed on the lower end portion 16a of the partition plate 16 is not limited. That is, when the shape of the installation portion 16b changes, the frequency component to be attenuated out of the natural frequency of the object obtained by combining the partition plate 16 and the internal heat exchanger 3 changes. Therefore, it is preferred that the relationship between the shape such as the position, the width, and the height of the installation portion 16b and the frequency component to be attenuated be verified in advance through an experiment and the like, and the installation portion 16b be set to have a shape for attenuating a specific frequency component corresponding to the vibration to be suppressed. As a result, the low frequency sound and the noise of the heat pump device 1 can be efficiently suppressed. The same applies to the installation portion 16b of a second embodiment and a third embodiment described below.

Second Embodiment

[0037] Next, the second embodiment is described with reference to Fig. 7 and Fig. 8. In the description of the second embodiment, features that are different from the abovementioned first embodiment are mainly described, and the description of the same parts or the corresponding parts is simplified or omitted.

[0038] Fig. 7 is a plan view of the internal heat exchanger 3 and the partition plate 16 included in the heat pump device 1 of the second embodiment. Fig. 8 is a view illustrating a cross section of the internal heat exchanger 3 and the partition plate 16 in Fig. 7 taken along B-B in Fig. 7. As illustrated in Fig. 7 and Fig. 8, the internal heat exchanger 3 is installed on the partition plate 16 in an orientation in which the longitudinal direction thereof is in the vertical direction of the heat pump device 1. The installation portion 16b protruding with respect to the extending direction of the partition plate 16 is formed on an intermediate portion 16e of the partition plate 16. An installation surface 16f including a horizontal surface and a supporting portion 16g that supports the installation surface 16f are formed in the installation portion 16b by cutting and raising a cut and raised portion formed in the intermediate portion 16e of the partition plate 16 through bending. The intermediate portion 16e is not limited to a central portion of the partition plate 16, and includes a wide area between an upper end portion and a lower end portion of the partition plate 16. The internal heat exchanger 3 is fixed to the partition plate 16 in a state in which an upper end portion 3b of a rectangular hole formed in a centroid portion thereof is installed on the installation surface 16f. The structure for fixing the internal heat exchanger 3 on the partition plate 16 is not particularly limited, and well-known means such as screwing and riveting can be used.

[0039] A hole portion 16h is formed in the intermediate portion 16e of the partition plate 16 by cutting and raising the installation portion 16b. The hole portion 16h is closed from the rear surface side of the partition plate 16 by a cover member 23. The cover member 23 is formed by a sound insulating material molded into a rectangular shape, for example. For example, a sheet metal, butyl rubber, or other rubber can be employed as the sound insulating material.

[0040] In the heat pump device 1 of the second embodiment, the following effects are obtained by installing the internal heat exchanger 3 on the installation portion 16b of the partition plate 16. In the heat pump device 1 of the second embodiment, the vibration of the internal heat exchanger 3 is transmitted to the base 17 after being attenuated by the partition plate 16. As a result, the vibration transmitted to the base 17 can be suppressed, and hence the occurrence of the low frequency sound and the noise from the heat pump device 1 can be suppressed. Further, in the heat pump device 1 of the second embodiment, the vibration transmitted to the base 17 can be suppressed by a simple configuration without providing a special vibration attenuation member such as a spring to the internal heat exchanger 3. As a result, the increase in the material cost and the assembly cost can be suppressed. The centroid portion of the internal heat exchanger 3 is installed on the installation portion 16b of the partition plate 16, and hence stable installation becomes possible. The hole portion 16h is closed by the cover member 23, and hence sound insulation can be enhanced.

Third Embodiment

[0041] Next, the third embodiment is described with reference to Fig. 9 and Fig. 10. In the description of the third embodiment, features that are different from the abovementioned second embodiment are mainly described, and the description of the same parts or the corresponding parts is simplified or omitted.

[0042] Fig. 9 is a plan view of the internal heat exchanger 3 and the partition plate 16 included in the heat pump device 1 of the third embodiment. Fig. 10 is a view illustrating a cross section of the internal heat exchanger 3 and the partition plate 16 in Fig. 9 taken along C-C in Fig. 9. As illustrated in Fig. 9 and Fig. 10, the internal heat exchanger 3 is installed on the partition plate 16 in an orientation in which the longitudinal direction thereof is in the vertical direction of the heat pump device 1. The installation portion 16b protruding with respect to the extending direction of the partition plate 16 is formed on the intermediate portion 16e of the partition plate 16. In the installation portion 16b, an installation surface 16j is formed by bending and drawing a rectangular drawn portion that is formed in the intermediate portion 16e of the partition plate 16. The internal heat exchanger 3 is fixed on the partition plate 16 in a state in which the upper end portion 3b of a rectangular hole formed in a centroid portion thereof is installed on the installation surface 16j. The structure for fixing the internal heat exchanger 3 on the partition plate 16 is not particularly limited, and well-known means such as screwing and riveting can be used.

[0043] In the heat pump device 1 of the third embodiment, the following effects are obtained by installing the internal heat exchanger 3 on the installation portion 16b of the partition plate 16. In the heat pump device 1 of the second embodiment, the vibration of the internal heat exchanger 3 is transmitted to the base 17 after being attenuated by the partition plate 16. As a result, the vibration transmitted to the base 17 can be suppressed, and hence the occurrence of the low frequency sound and the noise from the heat pump device 1 can be suppressed. Further, in the heat pump device 1 of the third embodiment, the vibration transmitted to the base 17 can be suppressed by a simple configuration without providing a special vibration attenuation member such as a spring to the internal heat exchanger 3. As a result, the increase in the material cost and the assembly cost can be suppressed. The centroid portion of the internal heat exchanger 3 is installed on the installation surface 16j of the partition plate 16, and hence stable installation becomes possible. The installation portion 16b is formed by bending and drawing, and hence a hole portion is not formed in the intermediate portion 16e of the partition plate 16. Therefore, in the heat pump device 1 of the third embodiment, a cover member for closing the hole is unnecessary, and hence the material cost and the assembly cost for including the cover member is reduced as compared to the heat pump device 1 of the second embodiment.

[Reference Signs List]

[0044]

1	Heat pump device
2	Compressor
2a	Shell
3	Internal heat exchanger
3a	Lower end portion
3b	Upper end portion of hole
4	Suction pipe
5	Discharge pipe
6	Blower
7	Air-refrigerant heat exchanger
8	Water-refrigerant heat exchanger
9	Electrical item accommodation box
9a	Terminal block
10	Expansion valve
12	Accommodation container
14	Machine compartment
15	Blower compartment
16	Partition plate
16a	Lower end portion
16b	Installation portion
16c	Installation surface
16d	Supporting portion
16e	Intermediate portion
16f	Installation surface
16g	Supporting portion
16h	Hole portion
16j	Installation surface
17	Base
18	Housing front surface portion
18a	Grille
19	Housing rear surface portion
20	Housing upper surface portion
21	Housing right side-surface portion
22	Housing left side-surface portion
23	Cover member
24	Electronic board
27	Service panel
28	Water inlet valve
29	Hot-water outlet valve
30,31	Internal pipe
33	Hot-water storage device
34	Hot-water storage tank
35	Water pump
36, 37	External pipe
38, 39	Pipe
40	Mixing valve
41	Hot-water supply pipe
42	Water supply pipe
43	Hot-water supply pipe
44	Water supply pipe

Claims

1. A heat pump device, comprising:

   a housing accommodating a compressor configured to compress a refrigerant, a first heat exchanger configured to exchange heat between the refrigerant and air, a blower, and a second heat exchanger configured to exchange heat between the refrigerant and a heat medium;
   a partition plate configured to partition a space in the housing into a machine compartment in which the compressor is accommodated, and a blower compartment in which the first heat exchanger, the blower, and the second heat exchanger are accommodated; and
   an internal heat exchanger accommodated in the machine compartment, the internal heat exchanger exchanging heat between the refrigerant having passed through the first heat exchanger and the refrigerant having passed through the second heat exchanger,
   wherein the internal heat exchanger is supported by the partition plate.

2. The heat pump device according to claim 1, wherein:

   the partition plate includes an installation portion protruding with respect to an extending direction of the partition plate; and
   the internal heat exchanger is supported by the installation portion.

3. The heat pump device according to claim 2, wherein the installation portion has a shape that is bent at a lower end portion of the partition plate with respect to the extending direction of the partition plate.

4. The heat pump device according to claim 3, wherein the internal heat exchanger has a lower end portion installed on the installation portion.

5. The heat pump device according to claim 2, wherein:

   the installation portion includes a cut and raised portion provided in an intermediate portion of the partition plate; and
   the cut and raised portion has a shape that is bent with respect to the extending direction of the partition plate.

6. The heat pump device according to claim 5, wherein the internal heat exchanger has a centroid portion installed on the installation portion.

7. The heat pump device according to claim 5 or 6, further comprising a cover member configured to close a hole portion formed in the intermediate portion of the partition plate.

8. The heat pump device according to claim 2, wherein:

the installation portion includes a drawn portion provided in an intermediate portion of the partition plate; and
the drawn portion has a shape that is drawn with respect to the extending direction of the partition plate.

9. The heat pump device according to claim 8, wherein the internal heat exchanger has a centroid portion installed on the installation portion.

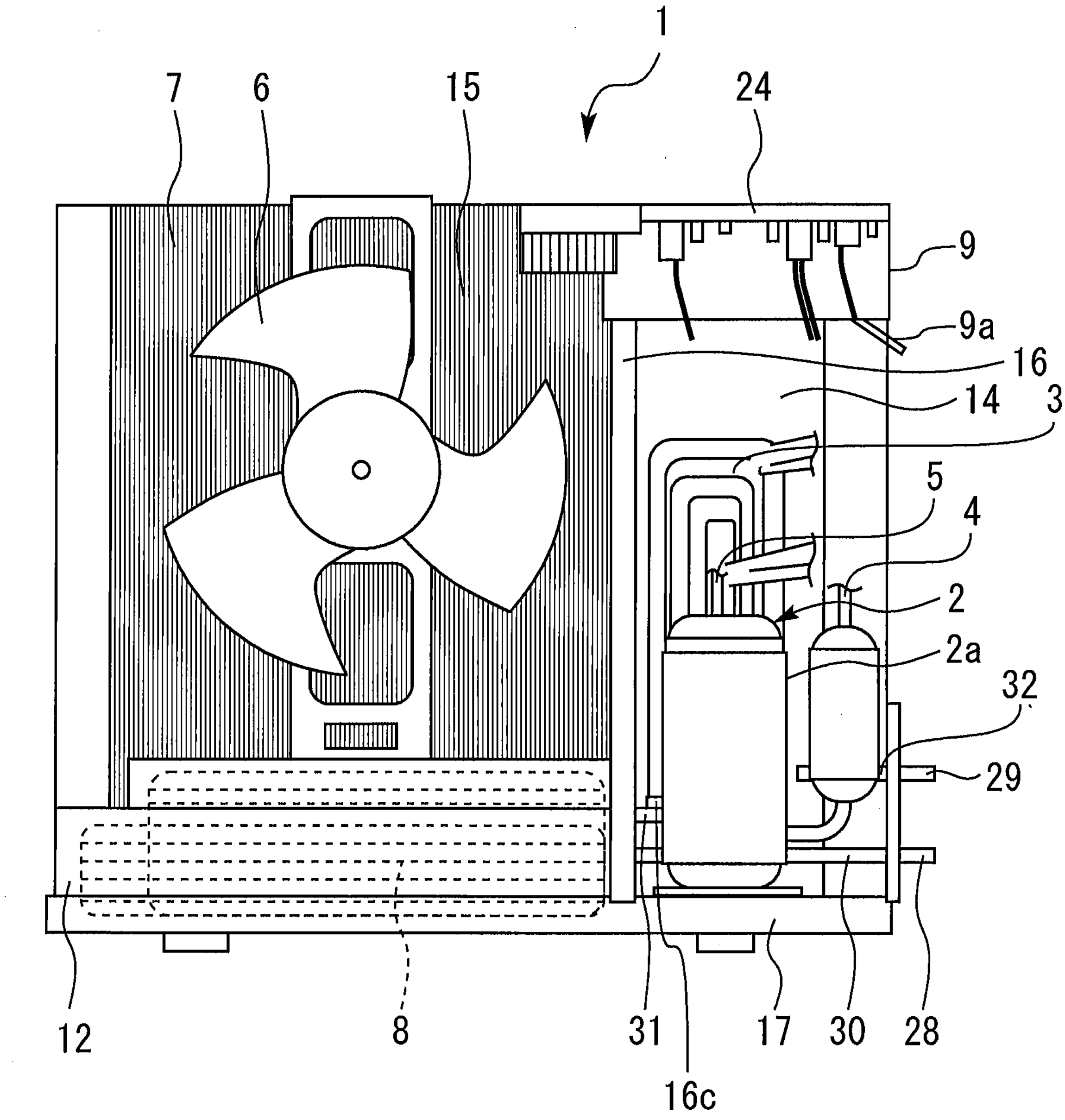

Fig. 1

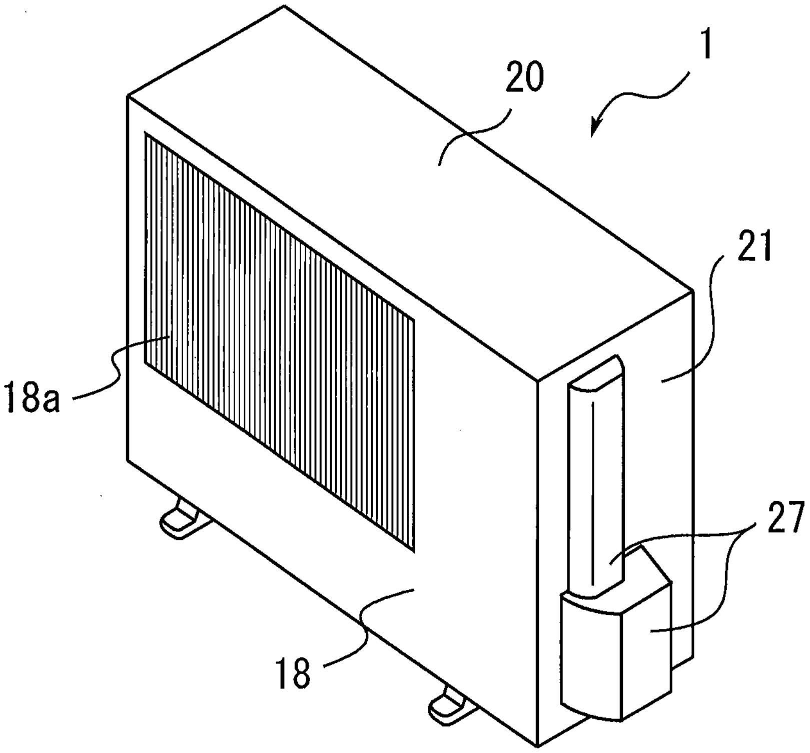

Fig. 2

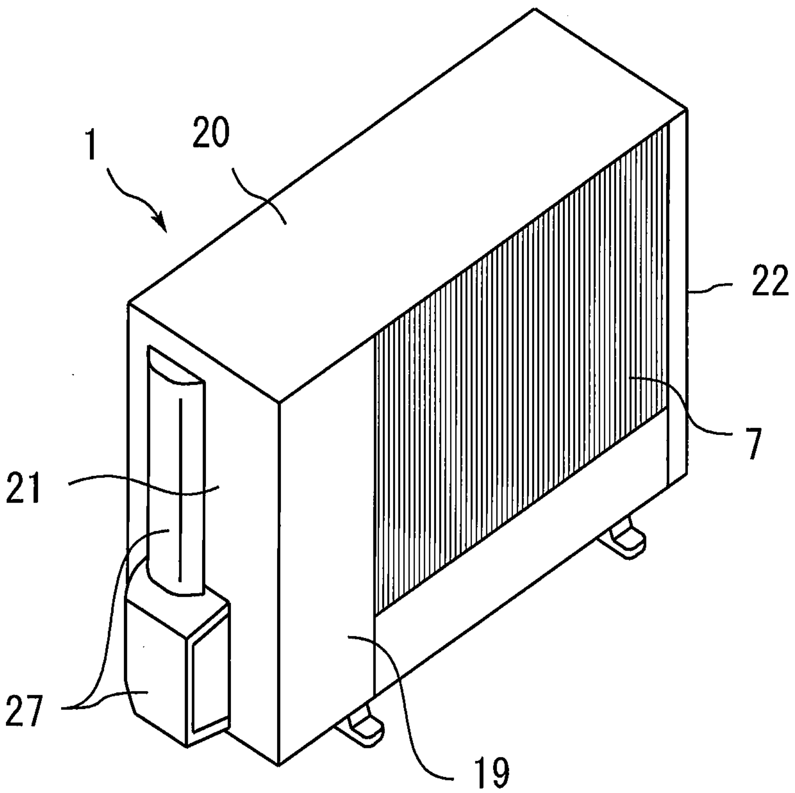

Fig. 3

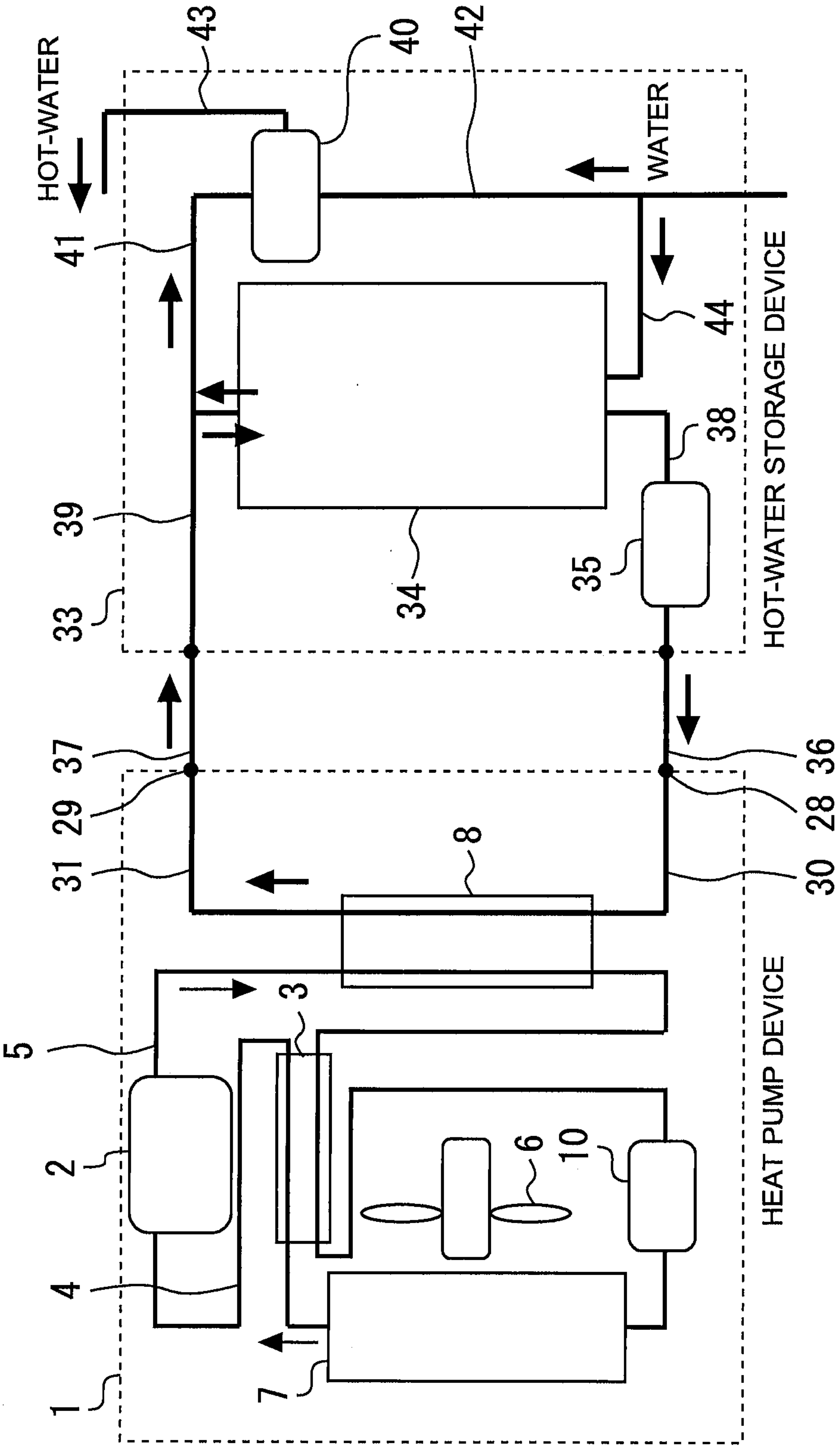
HOT-WATER
WATER
HOT-WATER STORAGE DEVICE
HEAT PUMP DEVICE
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Fig. 4

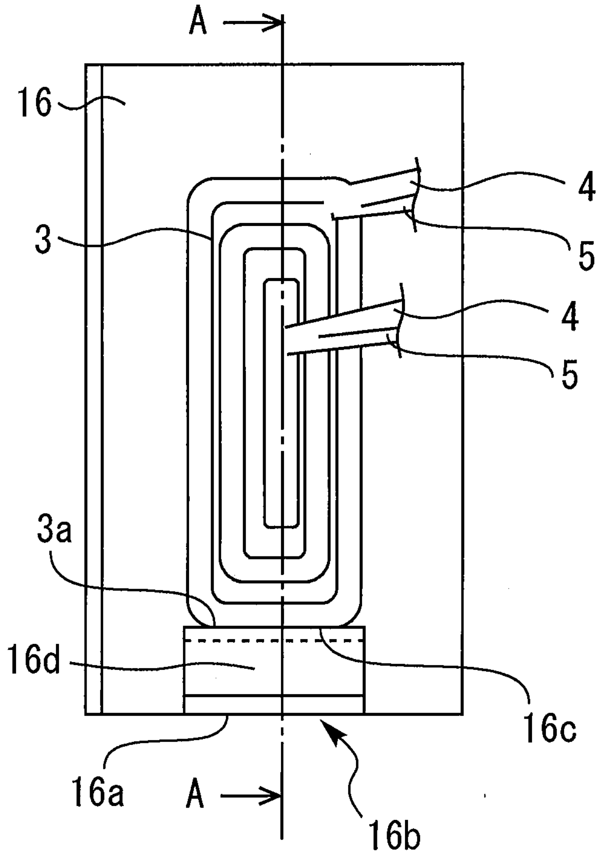

Fig. 5

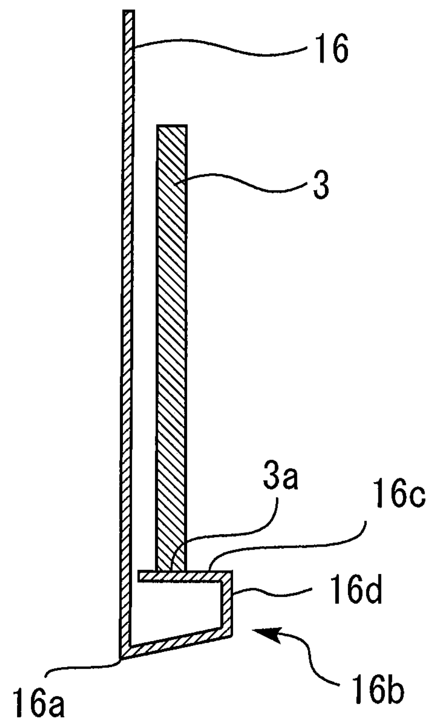

Fig. 6

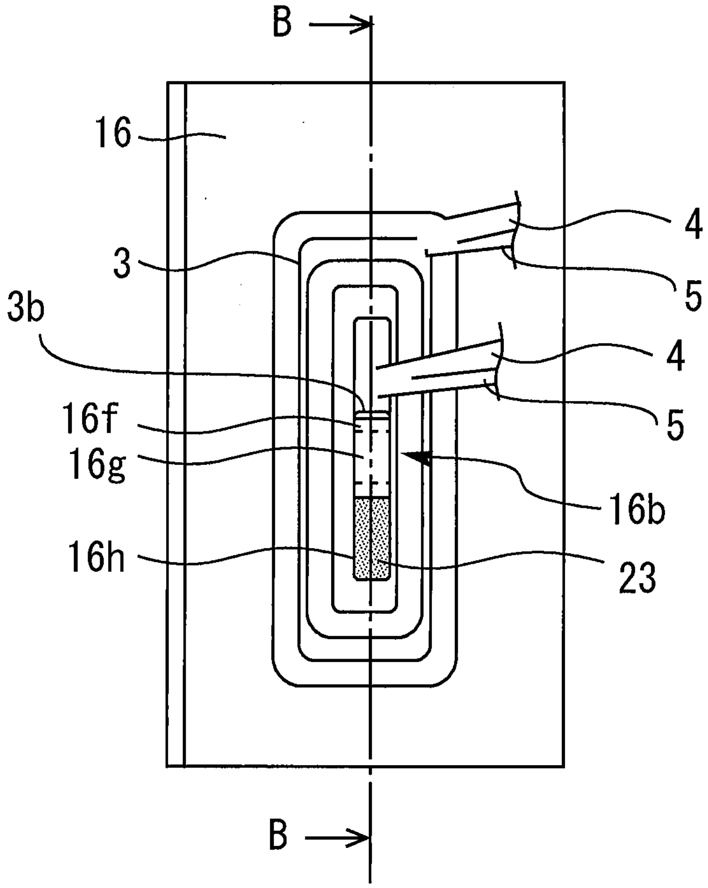

Fig. 7

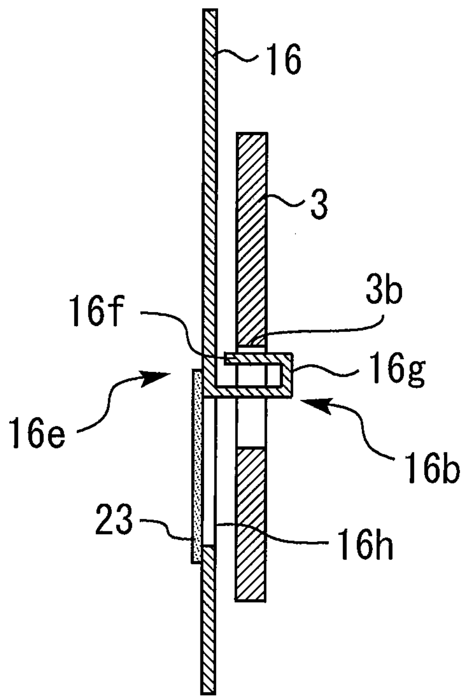

Fig. 8

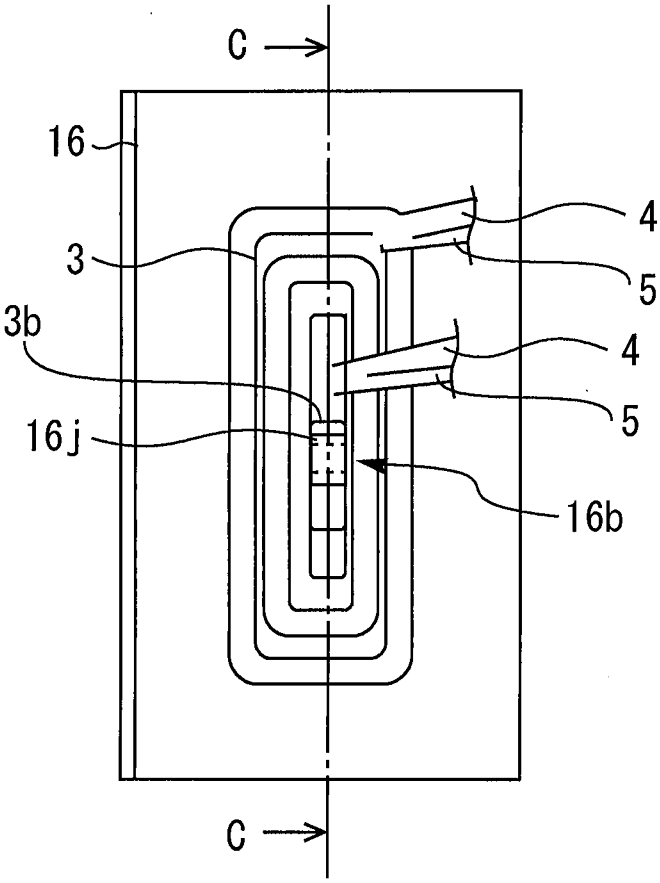

Fig. 9

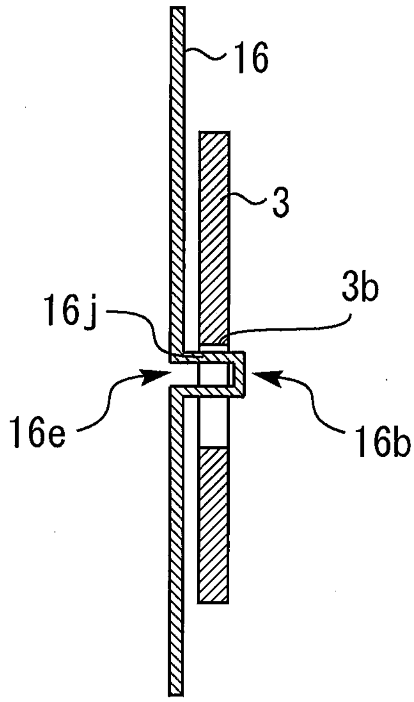

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/081009

A. CLASSIFICATION OF SUBJECT MATTER
F25B1/00(2006.01)i, *F24H4/02*(2006.01)i, *F25B30/02*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F25B1/00, F25B30/02, F24H4/02, F24F1/16

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2016
Kokai Jitsuyo Shinan Koho	1971-2016	Toroku Jitsuyo Shinan Koho	1994-2016

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2010-121844 A (Panasonic Corp.), 03 June 2010 (03.06.2010), paragraphs [0003] to [0032], [0037]; fig. 1, 6 (Family: none)	1-5,7-8 6,9
Y A	JP 2004-85183 A (Denso Corp.), 18 March 2004 (18.03.2004), paragraphs [0026] to [0034], [0056] to [0058]; fig. 1, 8 to 9 (Family: none)	1-5,7-8 6,9
Y A	JP 2005-69623 A (Toshiba Carrier Corp.), 17 March 2005 (17.03.2005), paragraphs [0010] to [0011]; fig. 1 to 5 (Family: none)	1-5,7-8 6,9

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 December 2016 (20.12.16)	27 December 2016 (27.12.16)

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

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/081009

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2002-61889 A (Daikin Industries, Ltd.), 28 February 2002 (28.02.2002), paragraphs [0009] to [0015]; fig. 1 to 3 (Family: none)	1-5,7-8 6,9
Y A	JP 2007-303793 A (Sanyo Electric Co., Ltd.), 22 November 2007 (22.11.2007), paragraphs [0080] to [0090]; fig. 6 to 9 & US 2009/0113917 A1 paragraphs [0091] to [0101]; fig. 6 to 9 & WO 2007/132804 A1 & EP 2019270 A1 & KR 10-2009-0008341 A & CN 101443603 A	4 1-3,5-9
A	CN 204128085 U (ZHUHAI GREE ELECTRICAL APPLIANCES INC.), 28 January 2015 (28.01.2015), entire text; all drawings (Family: none)	1-9
A	JP 2-45643 Y2 (Sanden Corp.), 03 December 1990 (03.12.1990), entire text; all drawings (Family: none)	6,9

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2011226733 A **[0003]**