(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 269 904 A1**

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

(43) Date of publication:
01.11.2023 Bulletin 2023/44

(21) Application number: **20967022.3**

(22) Date of filing: **25.12.2020**

(51) International Patent Classification (IPC):
F24H 9/06 *(2006.01)* ***F24H 9/16*** *(2022.01)*
F24H 4/02 *(2022.01)*

(52) Cooperative Patent Classification (CPC):
F24H 4/02; F24H 9/06; F24H 9/16

(86) International application number:
PCT/JP2020/048830

(87) International publication number:
WO 2022/137536 (30.06.2022 Gazette 2022/26)

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

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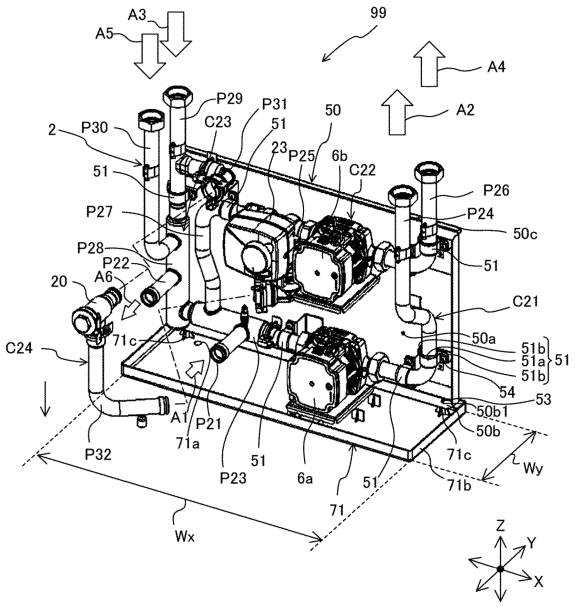
(54) HEAT-PUMP WATER HEATER, HEAT PUMP DEVICE EQUIPPED WITH HEAT-PUMP WATER HEATER, AND METHOD FOR ASSEMBLING HEAT-PUMP WATER HEATER

(57) A heat pump water heater and a heat pump apparatus each include: a first circuit unit in which water is circulated, and which heats the water by heat exchange between the water and refrigerant; a second circuit unit including a plurality of flow passage components, connected to an external heating load, and provided to cause the water heated by the first circuit unit to flow to the heating load and to release heat at the heating load, and mix the water heated by the first circuit unit with return water that has transferred heat; a housing unit in which the first circuit unit and the second circuit unit are housed; and a fixation sheet metal to which the flow passage components of the second circuit unit are fixed, and which is attached to the housing unit.

FIG. 3



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Description

Technical Field

[0001] The present disclosure relates to a heat pump water heater that supplies hot water, a heat pump apparatus, and an assembly method of the heat pump water heater.

Background Art

[0002] There are provided existing heat pump water heaters which are connected to a target device to be supplied with hot water, such as a shower, and a heating appliance such as radiator; and which supply the target device with hot water, and supply the heating appliance with mixed hot water having different temperatures (see, for example, Patent Literature 1). A heat pump water heater described in Patent Literature 1 includes a circuit which produces a target device with hot water to be supplied to a target device (which will be hereinafter referred to a high-temperature water producing and supplying circuit) and a circuit which produces warm water to be supplied to the heater (which will be hereinafter referred to as a low-temperature water producing and supplying circuit). The high-temperature water producing and supplying circuit of Patent Literature 1 includes a hot-water storage tank, a plurality of pipes, etc. The low-temperature water producing and supplying circuit of Patent Literature 1 includes an upper hot-water supply pipe, an intermediate hot-water supply pipe, a return pipe, a mixing valve, a heating outward pipe which causes the mixing valve and an inlet of the heat to communicate with each other, a heating circulation pump, and a bypass pipe which connects an intermediate part of the return pipe and the mixing valve. The mixing valve of Patent Literature 1 mixes high-temperature water in an uppermost part of the hot-water storage tank that is taken out from the upper hot-water supply water pipe with medium-temperature water in an intermediate part of the hot-water storage tank that is taken out from the intermediate hot-water supply pipe, thereby obtaining mixed water, further mixes the mixed water with low-temperature water that passes through a heating appliance, thereby obtaining further mixed water, adjusts the temperature of the further mixed water to cause it to reach to a predetermined temperature, and then causes the adjusted hot water to the heating appliance.

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2010-84974

Summary of Invention

Technical Problem

[0004] In a heat pump water heater that includes a high-temperature water producing and supplying circuit and a low-temperature water producing and supplying circuit as in Patent Literature 1, components in the low-temperature water producing and supplying circuit are not united to each other, and when the low-temperature water producing and supplying circuit is incorporated into a unit provided with the high-temperature water producing and supplying circuit, it is necessary to incorporate each of the components of the low-temperature water producing and supplying circuit into the unit provided with the high-temperature water producing and supplying circuit. Thus, in such a heat pump water heater as described in Patent Literature 1, the number of the steps of a work for incorporating the low-temperature water producing and supplying circuit into the unit provided with the high-temperature water producing and supplying circuit depends on the number of the components, and is thus large. Thus, the assembling efficiency may be reduced.

[0005] The present disclosure is applied to solve the above problem, and relates to a heat pump water heater, a heat pump apparatus, and an assembly method of the heat pump water heater, which can reduce a decrease in an assembling efficiency in the case where a high-temperature water producing and supplying circuit and a low-temperature water producing and supplying circuit are provided.

Solution to Problem

[0006] A heat pump water heater according to an embodiment of the present disclosure includes: a first circuit unit in which water is circulated, the first circuit unit being configured to heat the water by heat exchange between the water and refrigerant; a second circuit unit including a plurality of flow passage components, connected to an external heating load, and configured to cause the water heated by the first circuit unit to flow to the heating load and to release heat at the heating load, and mix the water heated by the first circuit unit with return water that has transferred heat; a housing unit in which the first circuit unit and the second circuit unit are housed; and a fixation sheet metal to which the flow passage components of the second circuit unit are fixed, and which is attached to the housing unit.

[0007] A heat pump apparatus according to another embodiment of the present disclosure includes the above heat pump water heater and an outdoor unit provided with an air-to-refrigerant heat exchanger configured to cause heat exchange to be performed between the refrigerant and air.

[0008] A assembly method of a heat pump water heater, according to still another embodiment of the present disclosure, which includes: a first circuit unit in which wa-

ter is circulated, the first circuit unit being configured to heat the water by heat exchange between the water and refrigerant; a second circuit unit including a plurality of flow passage components, connected to an external heating load, and configured to cause the water heated by the first circuit unit to flow to the heating load and to release heat at the heating load, and mix the water heated by the first circuit unit with return water that has transferred heat; a housing unit in which the first circuit unit and the second circuit unit are housed; and a fixation sheet metal to which the flow passage components of the second circuit unit are fixed, and which is attached to the housing unit, includes a step of incorporating the fixation sheet metal to which the flow passage components of the second circuit unit is fixed, into the housing unit in which the first circuit unit is housed.

Advantageous Effects of Invention

[0009] According to each of the embodiments of the present disclosure, since the fixation sheet metal to which the flow passage components included in the second circuit unit are fixed is provided, and is also attached to the housing unit, the second circuit unit is united to the fixation sheet metal in advance, and it is therefore unnecessary to fix each of the flow passage components of the second circuit unit to the housing unit. Thus, it is possible to prevent the number of the steps of the work for incorporating the second circuit unit into the housing unit in which the first circuit unit is provided, from being increased depending on the number of the flow passage components, and reduce a decrease in the assembly efficiency even in the case where the first circuit unit and the second circuit unit are provided, as compared with an existing heat pump water heater, an existing heat pump apparatus, and an existing assembly method of a heat pump water heater.

Brief Description of Drawings

[0010]

[Fig. 1] Fig. 1 is a perspective view illustrating an appearance of a heat pump water heater according to Embodiment 1.

[Fig. 2] Fig. 2 is a perspective view illustrating an internal configuration of the heat pump water heater as illustrated in Fig. 1.

[Fig. 3] Fig. 3 is a perspective view illustrating a configuration of a second circuit unit of the heat pump water heater as illustrated in Fig. 2.

[Fig. 4] Fig. 4 is an exploded perspective view illustrating the second circuit unit of the heat pump water heater as illustrated in Fig. 2.

[Fig. 5] Fig. 5 is a partial perspective view illustrating a configuration of an upper part of the heat pump water heater as illustrated in Fig. 2.

[Fig. 6] Fig. 6 is a right-side view illustrating a configuration of a connection portion between the second circuit unit and a first circuit unit that is located in the upper part of the heat pump water heater 1 as illustrated in Fig. 5.

[Fig. 7] Fig. 7 is a left-side view of the heat pump water heater as illustrated in Fig. 2.

[Fig. 8] Fig. 8 is a partial enlarged view illustrating a peripheral configuration of a connection portion between a first drain hose and a first drain pan in the heat pump water heater as illustrated in Fig. 7.

[Fig. 9] Fig. 9 is a circuit configuration view of a heat pump apparatus according to Embodiment 2.

Description of Embodiments

Embodiment 1

[0011] Fig. 1 is a perspective view illustrating an appearance of a heat pump water heater 1 according to Embodiment 1. As illustrated in Fig. 1, the heat pump water heater 1 includes a housing unit 40 as its outer shell. In an example illustrated in Fig. 1, the housing unit 40 is formed in the shape of a vertically long cuboid.

[0012] In Fig. 1, of directions indicated by arrows, an X direction is a width direction of the heat pump water heater 1, a Y direction is a depth direction of the heat pump water heater 1, and a Z direction is a height direction of the heat pump water heater 1. The heat pump water heater 1 according to each of embodiments of the present disclosure will be described with reference to the drawings. In the following description, in order that the embodiments be easily understood, terms related to directions (such as "upper", "lower", "right", "left", front", and "rear") are used as appropriate. However, these terms are used only for explanation, that is, they do not limit the contents of the embodiments. The terms indicate respective directions in a frontal view of the heat pump water heater 1, that is, as viewed in a direction toward the front side of the pump water heater 1, unless otherwise described. In each of figures which will be referred to, components that are the same as or equivalent to those in a previous figure or previous figures are denoted by the same reference signs. The same is true of the entire text of the specification.

[0013] Fig. 2 is a perspective view illustrating an internal configuration of the heat pump water heater 1 as illustrated in Fig. 1. The housing unit 40 is made up of a plurality of plate-like members. The housing unit 40 includes a rear sheet metal 43, a bottom plate 44, a front plane 41, two side panels 42, and a top panel 45. The rear sheet metal 43 forms a rear surface of the housing unit 40; the bottom plate 44 forms a lower surface of the housing unit 40; the front panel 1, as illustrated in Fig. 1, forms a front surface of the housing unit 40; the two side panels 42 form a left side surface and a right side surface of the housing unit 40, respectively; and the top panel 45 forms an upper surface of the housing unit 40. The rear sheet metal 43 has screw holes 43a which allow screws

to be inserted thereinto to fix a base sheet metal 52 to be described later (Fig. 4) to the rear sheet metal 43. In the rear sheet metal 43, a drainage outlet (not illustrated) for drain water is formed.

[0014] As illustrated in Fig. 2, the heat pump water heater 1 includes a first circuit unit 3 and a second circuit unit 2. The first circuit unit 3 is connected to the second circuit unit 2. The first circuit unit 3 includes a connection circuit C12 in which water serving as a heat medium flows, and heats the water by heat exchange that is performed between the water and refrigerant. The first circuit unit 3 includes a hot-water supply side circuit C11 in which water for hot-water supply flows. The first circuit unit 3 supplies heated water for hot-water supply to a target external device or equipment such as a shower or a kitchen. The hot-water supply side circuit C11 includes a water storage tank 31 that stores water supplied from a water source such as a water supply. To a lower part of the water storage tank 31, an inflow pipe P11 for water for hot-water supply is connected; and to an upper part of the water storage tank 31, an outflow pipe P12 for water for hot-water supply is connected. The second circuit unit 2 is connected to the connection circuit C12 of the first circuit unit 3, and also connected to external heating loads (not illustrated) having different operating temperatures such as a radiator and floor heating.

[0015] Fig. 3 is a perspective view illustrating a configuration of the second circuit unit 2 of the heat pump water heater 1 as illustrated in Fig. 2. As illustrated in Fig. 3, the second circuit unit 2 includes a high-temperature side hot-water supply circuit C21, a low-temperature side hot-water supply circuit C22, a returning circuit C23, and a bypass circuit C24, and mixes water heated by the first circuit unit 3 (which may be hereinafter referred to as high-temperature water) with return water which has released heat. In the second circuit unit 2, high-temperature water is supplied from the high-temperature side hot-water supply circuit C21 to a high-temperature side heating load (not illustrated), and water which is mixed water of high-temperature water and return water from the high-temperature side heating load (and which may be referred to as low-temperature water) is supplied from the low-temperature side hot-water supply circuit C22 to a low-temperature side heating load (not illustrated).

[0016] In Fig. 3, the flow direction of hot-temperature water that flows from the first circuit unit 3 into the second circuit unit 2 is indicated by an outlined arrow A1, and the flow direction of return water that flows out from the second circuit unit 2 into the first circuit unit 3 is indicated by an outlined arrow A6. Furthermore, in Fig. 3, the flow direction of high-temperature water that is sent out from the second circuit unit 2 to the high-temperature side heating load is indicated by an outlined arrow A2, and the flow direction of return water that returns from the high-temperature side heating load to the second circuit unit 2 is indicated by an outlined arrow A3. In addition, in Fig. 3, the flow direction of low-temperature water that is mixed water of high-temperature water and return water and flows from the second circuit unit 2 toward the low-temperature side heating load 104 is indicated by an outlined arrow A4, and the flow direction of return water that returns from the low-temperature side heating load 104 to the second circuit unit 2 is indicated by an outlined arrow A5.

[0017] As illustrated in Fig. 2, flow-passage components included in the second circuit unit 2 and flow passage components included in the first circuit unit 3 are housed in the housing unit 40. In the housing unit 40, the second circuit unit 2 is located above the first circuit unit 3, especially, above the water storage tank 31 which is larger in volume than any of the flow passage components in the first circuit unit 3. The heat pump water heater 1 includes a drainage portion 70 (see Fig. 7) for draining dew condensation water (hereinafter referred to as drain water) generated in the housing unit 40 to the outside thereof.

[0018] In the first circuit unit 3, the hot-water supply side circuit C11 causes water for hot-water supply to be heated by heat exchange with high-temperature water in the connection circuit C12, and sends the heated water to a target device or equipment for hot-water supply. The hot-water supply side circuit C11 includes: the water storage tank 31 to which the inflow pipe P11 for water for hot-water supply and the outflow pipe P12 for water for hot-water supply are connected; a pipe P13 that connects an upper part and a lower part of the water storage tank 31; a pump 6c for hot-water supply; and a water-to-water heat exchanger 30. The water-to-water heat exchanger 30 causes heat exchange to be performed between high-temperature water in the first circuit unit 3, high-temperature water in the hot-water supply side circuit C11, and water for hot-water supply in the connection circuit C12.

[0019] The connection circuit C12 of the first circuit unit 3 causes water serving as a heat medium to be heated by heat exchange with refrigerant; sends out the heated water, that is, high-temperature water, to the second circuit unit 2; and also causes the high-temperature water to flow in the water-to-water heat exchanger 30 to heat water for hot-water supply in the hot-water supply side circuit C11. The connection circuit C12 includes a water pump 6d, a refrigerant-to-water heat exchanger 32, the above water-to-water heat exchanger 30, a three-way valve 33, a first outflow pipe P14 from which water flows to the second circuit unit 2, a first inflow pipe P15 into which water flows from the second circuit unit 2, etc. An outlet side of the first outflow pipe P14 is connected with a second inflow pipe P21 of the second circuit unit 2, and the first inflow pipe P15 is connected with the second outflow pipe P22 of the second circuit unit 2.

[0020] As illustrated in Fig. 3, the returning circuit C23 of the second circuit unit 2 returns to the first circuit unit 3, high-temperature water that is unused water of return water that returns from the external heating load and high-temperature water that has flowed from the first circuit unit 3 into the second circuit unit 2. The bypass circuit C24 of the second circuit unit 2 is connected to an inter-

mediate portion of the returning circuit C23 and an intermediate portion of the low-temperature side hot-water supply circuit C22, and is configured to use return water from the high-temperature side heating load in the supply of water to the low-temperature side heating load.

[0021] The second circuit unit 2 includes flow passage components such as a plurality of pipes, a mixing valve 23, the first water pump 6a, and the second water pump 6b. The second circuit unit 2 may include a strainer 20 that removes unnecessary material in water. In the second circuit unit 2, the pipes are joined to each other by, for example, brazing.

[0022] The pipes included in the second circuit unit 2 include a high-temperature-side main pipe P23, the second inflow pipe P21 which is connected to an intermediate part of the high-temperature-side main pipe P23, a high-temperature-side outward pipe P24 which is connected to one end of the high-temperature-side main pipe P23, etc. The pipes included in the second circuit unit 2 include a low-temperature-side main pipe P25, a low-temperature-side outward pipe P26 which is connected to one end of the low-temperature-side main pipe P25, a high-temperature water flow pipe P27, etc. The high-temperature water flow pipe P27 connects the other end of the low-temperature-side main pipe P25 and part of the high-temperature-side main pipe P23 that is closer to the other end of the high-temperature-side main pipe P23 than part thereof to which the second inflow pipe P21 is connected.

[0023] The first water pump is provided at part of the high-temperature-side main pipe P23 that is closer to the one end of the high-temperature-side main pipe P23 than the part thereof to which the second inflow pipe P21 is connected. Part of the high-temperature-side main pipe P23 that is closer to the one end of the high-temperature-side main pipe P23 than the part thereof to which the second inflow pipe P21 is connected, the first water pump 6a, and the high-temperature-side outward pipe P24 form the high-temperature side hot-water supply circuit C21.

[0024] The mixing valve 23 is provided at part of the low-temperature-side main pipe P25 that is close to the high-temperature water flow pipe P27, and the first water pump 6a is provided at part of the low-temperature-side main pipe P25 that is closer to the low-temperature-side outward pipe P26 than to the mixing valve 23. Part of the high-temperature-side main pipe P23 that is located between the part of the high-temperature-side main pipe P23 to which the second inflow pipe P21 is connected and the part of the high-temperature-side main pipe P23 to which the high-temperature water flow pipe P27 is connected, the high-temperature water flow pipe P27, the mixing valve 23, the second water pump 6b, and the low-temperature-side outward pipe P26 form the low-temperature side hot-water supply circuit C22.

[0025] Furthermore, the pipes included in the second circuit unit 2 include a return main pipe P28, the second outflow pipe P22 which is connected to an intermediate part of the return main pipe P28, a high-temperature-side return pipe P29 which is connected to one end of the return main pipe P28, etc. Furthermore, the pipes included in the second circuit unit 2 include a low-temperature-side return pipe P30 which is connected to part of the return main pipe P28 that is closer to the one end of the return main pipe P28 than part thereof to which the second outflow pipe P22 is connected, etc. The high-temperature-side return pipe P29, the low-temperature-side return pipe P30, the return main pipe P28, and the second outflow pipe P22 form the returning circuit C23.

[0026] The pipes included in the second circuit unit 2 include a return branch pipe P31 which is connected to an intermediate part of the high-temperature-side return pipe P29 and a return water flow pipe P32 which connects the return branch pipe P31 and the mixing valve 23. The return branch pipe P31, the strainer 20, and the return water flow pipe P32 form the bypass circuit C24.

[0027] An operation of the second circuit unit 2 will be described with reference to Fig. 3. High-temperature water produced by the first circuit unit 3 (Fig. 2) flows into the second circuit unit 2 through the second inflow pipe P21; and part of the high-temperature water flows into the high-temperature side hot-water supply circuit C21, and the remaining part of the high-temperature water flows into the low-temperature side hot-water supply circuit C22. The high-temperature water that has flowed into the high-temperature side hot-water supply circuit C21 flows into the high-temperature-side outward pipe P24 through the first water pump 6a provided at the high-temperature-side main pipe P23, and is sent from the outlet of the high-temperature-side outward pipe P24 to the high-temperature side heating load. The high-temperature water sent out from the high-temperature-side outward pipe P24 releases heat at the high-temperature side heating load and then flows out from the high-temperature side heating load, thereby fulfilling a heating function at a high temperature. The water which has released heat at the high-temperature side heating load (which will be hereinafter referred to as high-temperature-water return water) flows into the returning circuit C23 of the second circuit unit 2 though the high-temperature-side return pipe P29. Part of the high-temperature-water return water that has flowed into the returning circuit C23 flows into the mixing valve 23 though the bypass circuit C24, and the remaining part of the high-temperature-water return water flows into the return main pipe P28. When the high-temperature-water return water passes through the bypass circuit C24, unnecessary material in the high-temperature-water return water is removed by the strainer 20. The high-temperature-water return water that has flowed into the mixing valve 23 though the bypass circuit C24, in the mixing valve 23 provided in the low-temperature side hot-water supply circuit C22, mixes with high-temperature water that has flowed into the low-temperature side hot-water supply circuit C22 through the second inflow pipe P21, thereby changing into low-temperature water that is lower in temperature than the high-temperature water. The low-tem-

perature water that has flowed out from the mixing valve 23 of the low-temperature side hot-water supply circuit C22 flows into the low-temperature-side outward pipe P26 through the second water pump 6b, and is sent from the outlet of the low-temperature-side outward pipe P26 to the low-temperature side heating load 104. The low-temperature water sent out from the outlet of the low-temperature-side outward pipe P26 releases heat at the low-temperature side heating load 104 and then flows out from the low-temperature side heating load 104, thereby fulfilling a heating function at a low temperature. The water which has released heat at the low-temperature side heating load 104 (which will be hereinafter referred to as low-temperature-water return water) flows into the returning circuit C23 of the second circuit unit 2 through the low-temperature-side return pipe P30. The low-temperature-water return water that has flowed into the returning circuit C23 joins the remaining part of the high-temperature-water return water in the return main pipe P28, and is then re-sent to the first circuit unit 3 through the second outflow pipe P22.

[0028] Fig. 4 is an exploded perspective view illustrating the second circuit unit 2 of the heat pump water heater 1 as illustrated in Fig. 2. Fig. 5 is a partial perspective view illustrating a configuration of an upper part of the heat pump water heater 1 as illustrated in Fig. 2. A peripheral configuration of the second circuit unit 2 in the heat pump water heater 1 will be described with reference to Figs. 3 to 5.

[0029] As illustrated in Fig. 4, the heat pump water heater 1 includes a fixation sheet metal 50 to which the flow passage components included in the second circuit unit 2 are fixed, a fixing component 51 that fixes the flow passage components to the fixation sheet metal 50, and the base sheet metal 52 that attaches the fixation sheet metal 50 to the rear sheet metal 43. The flow passage components of the second circuit unit 2 are provided on a front surface side of the fixation sheet metal 50. At not all the flow passage components which are united to the fixation sheet metal 50, a fixing component 51 needs to be provided. That is, the fixing component or fixing components 51 may be provided only at one or more of the flow passage components. In an example illustrated in Fig. 3, of the flow passage components which are united to the fixation sheet metal 50 in advance, only a plurality of pipes arranged along the front surface of the fixation sheet metal 50, such as the high-temperature-side main pipe P23 and the low-temperature-side main pipe P25, are fixed to the fixation sheet metal 50 by the fixing component 51. By contrast, the fixing component 51 is not provided at any of flow passage components provided at the return water flow pipe P32 and the return water flow pipe P32, such as the strainer 20, the first water pump 6a, the second water pump 6b, and the mixing valve 23. Furthermore, in an example illustrated in Fig. 4, before an incorporation step, all the flow passage components included in the second circuit unit 2 are united to the fixation sheet metal 50; however, it suffices that at least two of the flow passage components are united to the fixation sheet metal 50.

[0030] As illustrated in Fig. 3, the fixing component 51 is configured to fix, for example, the pipes of the flow passage components included in the second circuit unit 2 to the fixation sheet metal 50. In this case, the fixing component 51 can be formed of a metal band. The fixing component 51 which fixes the pipes includes, for example, a U-shaped peripheral portion 51a that contacts an outer periphery of a pipe, and fixation portions 51b that extend from both end portions of the peripheral portion 51a and are fixed to the fixation sheet metal 50 by fixation screws 54.

[0031] By virtue of the above configuration, as illustrated in Fig. 4, the pipes of the second circuit unit 2 which are connected together by brazing are fixed to the fixation sheet metal 50 by the fixing component 51, and the flow passage components included in the second circuit unit 2 and the fixation sheet metal 50 are united. Therefore, it is not necessary to fix each of the flow passage components of the second circuit unit 2 to the housing unit 40. Thus, it is possible to prevent the number of the steps of the work for incorporating the second circuit unit 2 into the housing unit 40 in which the first circuit unit 3 is provided, from being increased depending on the number of the flow passage components, and reduce a decrease in the assembly efficiency, as compared with an existing heat pump water heater.

[0032] As indicated by dash-dot-dash lines in Fig. 4, the base sheet metal 52 is fixed to the rear sheet metal 43 of the housing unit 40 by screws. The base sheet metal 52 includes a flat plate portion 52a to which the fixation sheet metal 50 is fixed to face the flat plate portion 52a, connection portions 52c that extend rearward from both sides of the flat plate portion 52a in a width direction thereof (the X direction), and base fixation portions 52b that extend outward from rear ends of the connection portions 52c.

[0033] In the example illustrated in Fig. 4, the flat plate portion 52a has a rectangular shape in a frontal view of the flat plate portion 52a, that is, as viewed in a direction toward the front side of the flat plate portion 52a. The flat plate portion 52a has the screw holes 43a into which screws are inserted to fix the fixation sheet metal 50 to the flat plate portion 52a.

[0034] Of the two connection portions 52c, a right connection portion 52c extends rearward from a right end of the flat plate portion 52a to connect with a left end of the right one of the base fixation portions 52b, and a left connection portion 52c extends rearward from a left end of the flat plate portion 52a to connect with a right end of the left one of the base fixation portions 52b. The base sheet metal 52 is fixed to the housing unit 40 such that the base fixation portions 52b face an inner surface of the rear sheet metal 43.

[0035] In the base fixation portions 52b, screws 52b1 are formed at positions each of which corresponds to an associated one of the screw holes 4a formed in the rear

sheet metal 43. In the example illustrated in Fig. 4, the screw holes 43a of the rear sheet metal 43 are provided in an upper part of the rear sheet metal 43 such that two of the screw holes 43a are arranged in an up-down direction on a left side of the upper portion of the rear sheet metal 43 and the other two of the screw holes 43a are arranged in the up-down direction on a right side of the upper portion of the rear sheet metal 43; and the holes 52b1 of each of the base fixation portions 52b are provided at two positions in the up-down direction. In the holes 52b1 of the base fixation portions 52b and the screw holes 43a of the rear sheet metal 43, respective screws are inserted to fix the base sheet metal 52 to the rear sheet metal 43.

[0036] Between the flat plate portion 52a of the base sheet metal 52, the two connection portions 52c, and the rear sheet metal 43, a space is provided. Thus, as illustrated in Fig. 5, through the above space, which is provided on a rear side in an upper region in the housing unit 40, pipes which are to be connected to the outside of the first circuit unit 3 located in a lower region in the housing unit 40 can be pulled to the upper region in the housing unit 40.

[0037] In the example illustrated in Fig. 4, the fixation sheet metal 50 has a rectangular shape in a frontal view of the fixation sheet metal 50, that is, as viewed a direction toward the front side of the fixation sheet metal 50. In the fixation sheet metal 50, holes 50a are provided at respective positions which correspond to positions of screw holes 52a1 formed in the flat plate portions 52a of the base sheet metal 52. In the example illustrated in Fig. 4, the screw holes 52a1 of the flat plate portion 52a of the base sheet metal 52 are provided such that two of the screw holes 52a1 are arranged in the up-down direction on the left side of the flat plate portion 52a and the other two of the screw holes 52a1 are arranged in the up-down direction on the right side of the flat portion 52a; and likewise, the holes 50a of the fixation sheet metal 50 are provided such that two of the holes 50a are arranged in the up-down direction on the left side of the fixation sheet metal 50 and the other two of the holes 50a are arranged in the up-down direction on the right side of the fixation sheet metal 50. In the holes 50a of the fixation sheet metal 50 and the screw holes 52a1 of the flat plate portion 52a of the base sheet metal 52, respective screws are inserted to fix the fixation sheet metal 50 to the base sheet metal 52. It should be noted that regarding the above matter, it suffices that the fixation sheet metal 50 can be stably fixed to the base sheet metal 52, and the numbers and positions of the holes 50a and the screw holes 52a1 are not limited to the above numbers and positions.

[0038] As illustrated in Fig. 3, at an upper edge of the fixation sheet metal 50, an upper flange 50 is formed in such a manner to extend rearward. As illustrated in Fig. 4, in the case where the fixation sheet metal 50 which is united to the second circuit unit 2 is attached to the rear sheet metal 43, with the base sheet metal 52 interposed between the fixation sheet metal 50 and the rear sheet metal 43, when the upper flange 50c of the fixation sheet metal 50 is pulled to an upper end of the base sheet metal 52, in the up-down direction (the Z direction), the fixation sheet metal 50 is positioned. Then, when the fixation sheet metal 50 to which the flow passage components of the second circuit unit 2 are fixed is fixed to the base sheet metal 52 which is fixed to the rear sheet metal 43, by a plurality of screws, the fixation sheet metal 50 is fixedly supported by the base sheet metal 52 fixedly because of provision of the plurality of screws and the upper flange 50c of the fixation sheet metal 50. Thus, at the rear sheet metal 43, a load is dispersed. In the housing unit 40, the fixation sheet metal 50 is provided substantially parallel to the rear sheet metal 43.

[0039] As illustrated in Fig. 3, it is preferable that all the flow passage components included in the second circuit unit 2 be united to the fixation sheet metal 50, before the second circuit unit 2 is set in the housing unit 40 (Fig. 4). However, it should be noted that in the case where two or more of the flow passage components included in the second circuit unit 2 are united to the fixation sheet metal 50, the assembly efficiency can be improved, as compared with the existing heat pump water heater. In this case, especially, the flow passage components to be fixed to the fixation sheet metal 50 by the fixing component 51, preferably, should be united to the fixation sheet metal 50 in advance. Furthermore, of the flow passage components included in the second circuit unit 2, flow passage components which can be easily attached to and detached from the second circuit unit 2 from a position located in front of the housing unit 40 may be attached to the fixation sheet metal 50 after the incorporation step; that is, they may not be fixed to the fixation sheet metal 50 in advance.

[0040] Furthermore, as illustrated in Fig. 3, at a lower end portion of the fixation sheet metal 50, a lower flange 50b is formed in such a manner to extend forward. In the lower flange 50b, a hole 50b1 is provided to allow a screw 53 to be inserted thereinto, and a first drain pan 71, which will be described later, is attached to a lower end portion of the fixation sheet metal 50 by the screw 53 inserted in the hole 50b1 of the lower flange 50b. A configuration of the first drain pan 71 will be described later.

[0041] In the following description, as illustrated in Fig. 3, the fixation sheet metal 50 to which the first drain pan 71 is attached, to which the second circuit unit 2 is fixed by the fixing component 51, and which is united to the first drain pan 71 and the second circuit unit 2 as illustrated in Fig. 3 may be referred to as a second circuit assembly 99.

[0042] The layout of the flow passage components included in the second circuit unit 2 in the second circuit assembly 99 will be described with reference to Fig. 3. The flow passage components included in the second circuit unit 2 are arranged at two stages, that is, an upper stage and a lower stage, as a whole, on the front side of the fixation sheet metal 50. That is, the high-temperature

side hot-water supply circuit C21 and the low-temperature side hot-water supply circuit C22 of the second circuit unit 2 are arranged at the upper stage and the lower stage, respectively. To be more specific, the high-temperature-side main pipe P23 at which the first water pump 6a of the high-temperature side hot-water supply circuit C21 is provided and the low-temperature-side main pipe P25 at which the second water pump 6b and the mixing valve 23 of the low-temperature side hot-water supply circuit C22 are provided are arranged such that their axes extend in the width direction (the X direction) and are substantially parallel to each other. That is, of the flow passages included in the second circuit unit 2, especially, the second water pump 6b, the mixing valve 23, and the first water pump 6a which are thicker than the pipes, are arranged at the two stages in the up-down direction. In the second circuit unit 2, the first water pump 6a of the high-temperature side hot-water supply circuit C21 and the second water pump 6b of the low-temperature side hot-water supply circuit C22, which are connected parallel to each other, are arranged in the up-down direction; and the mixing valve 23 is provided at a position which is located on an upstream one of the left side and right side of the second water pump 6b in the low-temperature side hot-water supply circuit C22.

[0043] In the example illustrated in Fig. 3, in the second circuit unit 2, the low-temperature-side main pipe P25 at which the second water pump 6b of the low-temperature side hot-water supply circuit C22 configured to supply low-temperature water is provided is provided above the high-temperature-side main pipe P23 at which the first water pump 6a of the high-temperature side hot-water supply circuit C21 is provided. Furthermore, the second inflow pipe P21 is connected to part of the high-temperature-side main pipe P23 that is closer to the left side than part thereof at which the first water pump 6a is provided, and the mixing valve 23 is provided at part of the low-temperature-side main pipe P25 that is closer to the left side than part thereof at which the second water pump 6b is provided.

[0044] Of the flow passage components included in the second circuit unit 2, pipes at which none of the first water pump 6a, the second water pump 6b, and the mixing valve 23 are provided are arranged in the front of the fixation sheet metal 50 and at two stages in a front-back direction.

[0045] More specifically, the pipes connected to the external heating load, such as the high-temperature-side outward pipe P24, the low-temperature-side outward pipe P26, the high-temperature-side return pipe P29, and the low-temperature-side return pipe P30, are arranged in the front-back direction in units of one pair of pipes such that, for example, the high-temperature-side outward pipe P24 and the low-temperature-side outward pipe P26 are arranged in the front-back direction and the high-temperature-side return pipe P29 and the low-temperature-side return pipe P30 are arranged in the front-back direction. To be more specific, the high-temperature-side outward pipe P24 which is connected to the high-temperature-side main pipe P23 and the low-temperature-side outward pipe P26 which is connected to the low-temperature-side main pipe P25 are arranged substantially in the front-back direction and in parallel with each other such that for example, their axes extend in the height direction (the Z direction). The high-temperature-side return pipe P29 and the low-temperature-side return pipe P30 which are connected to the other end of the high-temperature-side main pipe P23 by the return main pipe P28 are arranged in the front-back direction and substantially in parallel with each other such that, for example, their axes extend in the height direction (the Z direction).

[0046] In the example illustrated in Fig. 3, the high-temperature-side outward pipe P24 is located in the front of the low-temperature-side outward pipe P26, and is bent in such a manner as to connect to one end of the high-temperature-side main pipe P23. Also, in the example illustrated in Fig. 3, the low-temperature-side return pipe P30 is located in the front of the high-temperature-side return pipe P29, and is L-shaped in such a manner as to connect to an intermediate part of the return main pipe P28. In addition, the high-temperature-side outward pipe P24 and the low-temperature-side outward pipe P26 are located in the front of the right side of the front surface of the fixation sheet metal 50, and the high-temperature-side return pipe P29 and the low-temperature-side return pipe P30 are located in the front of the left side of the front surface of the fixation sheet metal 50.

[0047] Furthermore, of the pipes included in the second circuit unit 2, the return water flow pipe P32 of the bypass circuit C24, at which the first water pump 6a, etc., are not provided, is located in the front of the high-temperature water flow pipe P27 which connects an intermediate part of the high-temperature-side main pipe P23 and the other end of the low-temperature-side main pipe P25. The return water flow pipe P32 is L-shaped in such a manner as connect to mixing valve 23 provided at the low-temperature-side main pipe P25.

[0048] A configuration of the first drain pan 71 will be described with reference to Fig. 3. The first drain pan 71 is provided under the flow passage components included in the second circuit unit 2, and collects drain water which is generated at the second circuit unit 2. The first drain pan 71 forms part of the drainage portion 70 (Fig. 7).

[0049] The first drain pan 71 is formed of resin, etc., and has, for example, a rectangular shape as viewed in plan view. The first drain pan 71 has a length Wx in the X direction that is equal to or slightly greater than that of the second circuit unit 2 thereof which includes the flow passage components. Furthermore, the first drain pan 71 has a width Wy in the Y direction that is equal to or slightly greater than that of the second circuit unit 2 which includes the flow passage components.

[0050] Therefore, as illustrated in Fig. 5, in a configuration in which the flow passage components of the second circuit unit 2 are fixed to the fixation sheet metal 50

which is substantially parallel to the rear sheet metal 43, the width Wy (Fig. 3) of the first drain pan 71 in the Y direction can be reduced as compared with the existing heat pump water heater. Furthermore, by virtue of the above configuration, it is possible to reduce the depth of the heat pump water heater 1, that is, the width of the heat pump water heater 1 in the depth direction thereof (the Y direction), as compared with the exiting heat pump water heater, and more easily achieve the access to each of components provided in the housing unit 40 from the front side thereof and improve the assembly efficiency.

[0051] As illustrated in Fig. 3, at an outer peripheral edge of the first drain pan 71, a flange 71b is provided in such a manner as to extend upward, and on an upper surface of the first drain pan 71, projections 71c having respective screw holes are provided close to a rear side of the flange 71b. Regarding the projections 71c and the holes 50b1, in the example illustrated in Fig. 3, two projections 71c are provided at a left position and a right position, respectively, on a rear part of the upper surface of the first drain pan 71, and two holes 50b1 are provided at a left position and a right position, respectively, in the lower flange 50b of the fixation sheet metal 50. In the holes 50b1 of the lower flange 50b of the fixation sheet metal 50 and the screw holes of the projections 71c of the first drain pan 71, respective screws are inserted, thereby attaching the first drain pan 71 to the fixation sheet metal 50.

[0052] In the first drain pan 71, the drain outlet 71a is formed. As illustrated in Fig. 5, the first drain pan 71 is provided substantially horizontally, with the second circuit assembly 99 set at the housing unit 40 in which the first circuit unit 3 is mounted. The drain outlet 71a is formed in lowermost part of the first drain pan 71. For example, the first drain pan 71 is slightly inclined relative to a horizontal plane such that in the depth direction (the Y direction), the rear side of the first drain pan 71 is located at a lower level than the front side thereof, and the drain outlet 71a is formed in the lowermost part of the first drain pan 71, which is close to a rear edge thereof.

[0053] As illustrated in Fig. 4, an assembly method of the heat pump water heater 1 includes a step of incorporating the fixation sheet metal 50 to which the flow passage components of the second circuit unit 2 are fixed, into the housing unit 40 in which the first circuit unit 3 is housed. To be more specific, since the flow passage components of the second circuit unit 2 are fixed to the fixation sheet metal 50 and the flow passage components and the fixation sheet metal 50 are united, when the fixation sheet metal 50 is fixed to the base sheet metal 52 fixed to the rear sheet metal 43, the second circuit unit 2 is easily incorporated into the heat pump water heater 1. Furthermore, since the second circuit unit 2 is fixed to the fixation sheet metal 50, and the first drain pan 71 is further fixed to the fixation sheet metal 50, thereby forming the second circuit assembly 99, the second circuit unit 2 and the first drain pan 71 can be incorporated into the heat pump water heater 1 at the same time, thus improving the assembly efficiency.

[0054] Fig. 6 is a right-side view illustrating a configuration of a connection portion R1 between the second circuit unit 2 and the first circuit unit 3 that is located in the upper part of the heat pump water heater 1 as illustrated in Fig. 5. The configuration of the connection portion R1 between the second circuit unit 2 and the first circuit unit 3 will be described with reference to Figs. 5 and 6. The second circuit unit 2 and the first circuit unit 3 are connected by the pipes. In this case, preferably, this pipe connection should be achieved by a connection method in which pipes can be connected to and disconnected from each other without using a tool.

[0055] In an example illustrated in Fig. 5, the heat pump water heater 1 includes two fasteners 13 formed of sheet metal, and the first circuit unit 3 and the second circuit unit 2 are quickly connected by the fasteners 13. One of the two fasteners 13, as illustrated in Fig. 6, connects the first outflow pipe P14 of the first circuit unit 3 and the second inflow pipe P21 of the second circuit unit 2, and the other, as illustrated in Fig. 5, connects the second outflow pipe P22 of the second circuit unit 2 and the first inflow pipe P15 of the second outflow pipe P22.

[0056] The configuration of the connection portion R1 in the case where the first outflow pipe P14 of the first circuit unit 3 and the second inflow pipe P21 of the second circuit unit 2 are quickly connected by the fasteners will be described with reference to Fig. 6. A water outlet side of the first outflow pipe P14 of the first circuit unit 3 and a water inlet side of the second inflow pipe P21 of the second circuit unit 2 form respective joints 15, and O-rings 14 are provided at inner parts of the joints 15. The joints 15 of the first outflow pipe P14 of the first circuit unit 3 and the second inflow pipe P21 of the second circuit unit 2 are brought into contact with each other, and fixed and connected by the fasteners 13 (quick fastener connection). The O-ring 14 is provided in the inner part of the joint 15, thereby sealing the joint 15 to prevent water from leaking from a connection portion between C1 joints. Also, connection between the second outflow pipe P22 of the second circuit unit 2 and the first inflow pipe P15 of the first circuit unit 3 is achieved by the quick fastener connection, as well as the connection between the first outflow pipe P14 of the first circuit unit 3 and the second inflow pipe P21 of the second circuit unit 2.

[0057] As illustrated in Fig. 5, the first circuit unit 3 and the second circuit unit 2 are connected by the fasteners 13. When the first circuit unit 3 and the second circuit unit 2 are connected, with the second circuit assembly 99 fixed to the housing unit 40 in which the first circuit unit 3 is mounted, this connection is achieved without a tool, and the work for the connection can be simplified.

[0058] Fig. 7 is a left-side view of the heat pump water heater 1 as illustrated in Fig. 2. In many cases, the heat pump water heater 1 is used in a region which is relatively low in temperature, and drain water is generated in the heat pump water heater 1 because of the temperature difference between the temperature in the heat pump

water heater 1 and an outside temperature. The drain water is generated, especially, in the first circuit unit 3 and the second circuit unit 2 which include the pipes, etc. In view of this point, a heat pump apparatus 100 is formed to have the drainage portion 70 which causes the drain water to be drained from the housing unit 40 to the outside of the housing unit 40.

[0059] As illustrated in Fig. 7, the drainage portion 70 includes, for example, a first drain pan 71, a second drain pan 72, a first drain hose 74, a second drain hose 75, etc. As described above, the first drain pan 71 is provided under the second circuit unit 2 and above the first circuit unit 3, especially, the water storage tank 31; and collects drain water generated in the second circuit unit 2. The second drain pan 72 collects drain water generated in the first circuit unit 3, and is provided at a lower position than the first drain pan 71. In an example illustrated in Fig. 7, the second drain pan 72 is provided on the bottom plate 44 of the housing unit 40. The first drain hose 74 is provided between the first drain pan 71 and the second drain pan 72, and guides drain water from the second circuit unit 2 that is collected by the first drain pan 71 to an upper surface of the second drain pan 72. An upper end of the first drain hose 74 is connected to the first drain pan 71, and a lower end of the first drain hose 74 is located at a slightly upper position than the second drain pan 72. The second drain hose 75 is connected to drain outlets (not illustrated) that are formed in the second drain pan 72 and the rear sheet metal 43 of the housing unit 40, and is intended to let out drain water collected at the second drain pan 72 to the outside of the housing unit 40.

[0060] Fig. 8 is a partial enlarged view illustrating a peripheral configuration of a connection portion R2 between the first drain hose 74 and the first drain pan 71 in the heat pump water heater 1 as illustrated in Fig. 7. As illustrated in Fig. 8, the heat pump water heater 1 includes a socket portion 73 that communicates with the drain outlet 71a of the first drain pan 71. The socket portion 73 extends to a lower region located below the first drain pan 71. To the socket portion 73, an upper end portion of the first drain hose 74 is attached.

[0061] As illustrated in Fig. 7, drain water from the second circuit unit 2 which is located above the first circuit unit 3 in the housing unit 40 is temporarily collected at the first drain pan 71. Then, the drain water temporarily collected at the first drain pan 71 flows to the first drain hose 74 through the drain outlet 71a of the first drain pan 71 and the socket portion 73 (Fig. 8), passes through the first drain hose 74, and is then temporarily collected at the second drain pan 72. Furthermore, drain water from the first circuit unit 3 is temporarily collected at the second drain pan 72. When the amount of the drain water collected at the second drain pan 72 exceeds a given amount, the drain water passes through the second drain hose 75, and is let out to the outside through the drain outlet of the housing unit 40.

[0062] By virtue of such a configuration as described above, the housing unit 40 does not need to have a drain outlet between the first circuit unit 3 and the second circuit unit 2, and it is possible to let out the drain water from the second circuit unit 2, along with the drain water from the first circuit unit 3.

[0063] As described above, the heat pump water heater 1 according to Embodiment 1 includes the first circuit unit 3, the second circuit unit 2 including the flow passage components, the housing unit 40 which houses the first circuit unit 3 and the second circuit unit 2, and the fixation sheet metal 50. In the first circuit unit 3, water is circulated, and heated by heat exchange with refrigerant. The second circuit unit 2 is connected to the external heating load, causes the water heated by the first circuit unit 3 to flow to the external heating load and release heat at the external heating load, and mixes the water heated by the first circuit unit 3 and return water that has released heat at the heating load with each other. To the fixation sheet metal 50, the flow passage components of the second circuit unit 2 are fixed. The fixation sheet metal 50 is attached to the housing unit 40.

[0064] In such a manner, since the fixation sheet metal 50 to which the flow passage components of the second circuit unit 2 are fixed is attached to the housing unit 40, the second circuit unit 2 and the fixation sheet metal 50 are united in advance, and it is not necessary to fix each of the flow passage components of the second circuit unit 2 to the housing unit 40. Therefore, it is possible to prevent the number of steps of the work for incorporating the second circuit unit 2 into the housing unit 40 in which the first circuit unit 3 is provided, from being increased depending on the number of the flow passage components, and also reduce a decrease in the assembly efficiency even in the case where in the first circuit unit 3 and the second circuit unit 2 are provided, as compared with the existing heat pump water heater.

[0065] The second circuit unit 2 is provided above the first circuit unit 3. Thus, the flow passage components of the second circuit unit 2 are located in an upper region in the housing unit 40, and a worker can easily see where to set the flow passage components, and can thus easily carry out a work for setting the flow passage components.

[0066] In the heat pump water heater 1, the first drain pan 71 is provided at the fixation sheet metal 50 and below the second circuit unit 2 to collect drain water generated in the second circuit unit 2. Thus, it is possible to prevent drain water which generates in the flow passage components of the second circuit unit 2 in which water serving as a heat medium flows, from collecting in the housing unit 40, and thus reduce the probability with which various components provided in the housing unit 40 will corrode. for example.

[0067] Furthermore, the second circuit unit 2 is provided above the first circuit unit 3, and the heat pump water heater 1 includes the first drain pan 71 which collects drain water generated in the second circuit unit 2, the second drain pan 72 which collects drain water generated in the first circuit unit 3, and the first drain hose 74. The

first drain hose 74 is connected to the first drain pan 71, and guides the drain water sent from the second circuit unit 2 to the upper surface of the second drain pan 72.

[0068] By virtue of the above configuration, drain water from the second circuit unit 2 which is collected at the first drain pan 71 can be made to join drain water from the first circuit unit 3, through the first drain hose 74. Thus, the drain outlet of the housing unit 40 can also be used in the above case. Therefore, it is not necessary to increase the number of drain outlets.

[0069] The second circuit unit 2 includes, as flow passage components, the high-temperature-side main pipe P23 in which water heated by the first circuit unit 3 (high-temperature water) flows and the low-temperature-side main pipe P25 in which mixed water (low-temperature water) flows. Furthermore, the second circuit unit 2 includes, as flow passage components, the first water pump 6a provided at the high-temperature-side main pipe P23 and the second water pump 6b provided at the low-temperature-side main pipe P25. The high-temperature-side main pipe P23 and the low-temperature-side main pipe P25 are provided in an upper region and a lower region, respectively, and extend in the lateral direction (the X direction).

[0070] Therefore, the first water pump 6a and the second water pump 6b are arranged in the up-down direction (the Z direction), and the heat pump water heater 1 can be made thinner, as a result of which the worker can easily reach a deep portion of the housing unit 40, and can easily perform maintenance and work for assembly, etc. Furthermore, in the above configuration, in the case where the first drain pan 71 is provided, the width Wy of the first drain pan 71 in the depth direction (the Y direction) can be reduced, as compared with that in the existing heat pump water heater, and the heat pump water heater 1 can be made thinner, and the cost of the first drain pan 71 can be reduced.

[0071] To the heat pump water heater 1, the fixation sheet metal 50 is attached. The heat pump water heater 1 includes the base sheet metal 52 which is provided at the inner surface of the rear sheet metal 43 of the housing unit 40. Thus, the fixation sheet metal 50 to which the second circuit unit 2 is united can be set in the front of the rear sheet metal 43 in the housing unit 40, thereby improving the assembly efficiency.

[0072] Furthermore, the heat pump water heater 1 includes the fasteners 13 which is made of sheet metal, and which connects a pipe (for example, the second inflow pipe P21) of the second circuit unit 2, and a pipe (for example, the first outflow pipe P14) of the first circuit unit 3. Therefore, the pipe connection between the second circuit unit 2 and the first circuit unit 3 can be achieved by the fasteners 13, and thus, a tool is not necessary for the pipe connection, and the work for the above setting can be easily performed.

[0073] The assembly method of the heat pump water heater 1 according to Embodiment 1 includes a step of setting the fixation sheet metal 50 to which the flow passage components of the second circuit unit 2 are fixed, in the housing unit 40 which houses the first circuit unit 3. Therefore, in the assembly method of the heat pump water heater 1, it is possible to reduce a decrease in the assembly efficiency.

Embodiment 2

[0074] Fig. 9 is a circuit configuration view of a heat pump apparatus 100 according to Embodiment 2. As illustrated in Fig. 9, ⓒ the heat pump apparatus 100 according to Embodiment 2 includes the heat pump water heater 1 according to Embodiment 1 and an outdoor unit 37.

[0075] The outdoor unit 37 include a compressor 34 that compresses refrigerant, an air-to-refrigerant heat exchanger 36 that causes heat exchange to be performed between the refrigerant and air, and an expansion valve 35 that reduces the pressure of the refrigerant. The compressor 34 of the outdoor unit 37, the refrigerant-to-water heat exchanger 32 of the heat pump water heater 1, the expansion valve 35 of the outdoor unit 37, and the air-to-refrigerant heat exchanger 36 of the outdoor unit 37, are connected by refrigerant pipes, whereby a refrigerant circuit is formed.

[0076] In the heat pump water heater 1, in the connection circuit C12 of the first circuit unit 3, water is circulated as a heat medium by the water pump 6d, and is heated by heat exchange with refrigerant at the refrigerant-to-water heat exchanger 32. The water heated by the refrigerant, that is, high-temperature water, flows from the three-way valve 33 to the water-to-water heat exchanger 30 and the second circuit unit 2. The high-temperature water that has flowed from the three-way valve 33 to the water-to-water heat exchanger 30 transfers heat to water for hot-water supply that circulates in the hot-water supply side circuit C11, at the water-to-water heat exchanger 30, then joins return water from the second circuit unit 2, and re-flows into refrigerant-to-water heat exchanger 32 and is heated thereat.

[0077] In the heat pump water heater 1, running water is supplied from a water supply side 101 to the water storage tank 31 of the hot-water supply side circuit C11 of the first circuit unit 3 through the inflow pipe P11 for water for hot-water supply. Furthermore, water for hot-water supply which is stored in the water storage tank 31 is supplied to a hot-water supply side 102 through the outflow pipe P12 for water for hot-water supply. The water for hot-water supply that is stored in the water storage tank 31 is circulated between the water-to-water heat exchanger 30 and the water storage tank 31 by the pump 6c for hot-water supply, through the pipe P13 which connects an upper part and a lower part of the water storage tank 31. At the water-to-water heat exchanger 30, the water for hot-water supply that flows through the pipe P13 of the hot-water supply side circuit C11 exchanges heat with high-temperature water that flows into the wa-

ter-to-water heat exchanger 30 from the three-way valve 33 of the connection circuit C12, and as a result, the water for hot-water supply is heated.

[0078] In the second circuit unit 2 of the heat pump water heater 1, high-temperature water is sent to a high-temperature side heating load 103 by the first water pump 6a through the high-temperature-side outward pipe P24, and low-temperature water is sent to a low-temperature side heating load 104 by the second water pump 6b through the low-temperature-side outward pipe P26. In Fig. 9, the flow direction of high-temperature water that flows from the first circuit unit 3 into the second circuit unit 2 is indicated by an outlined arrow A1, and the flow direction of return water that flows from the second circuit unit 2 into the first circuit unit 3 is indicated by an outlined arrow A6. Furthermore, in Fig. 9, the flow direction of high-temperature water that is sent from the second circuit unit 2 to the high-temperature side heating load 103 is indicated by an outlined arrow A2, and the flow direction of return water that flows from the high-temperature side heating load 103 to the second circuit unit 2 is indicated by an outlined arrow A3. In addition, high-temperature water and high-temperature return water are mixed with each other, the flow direction of low-temperature water that flows from the second circuit unit 2 toward the low-temperature side heating load 104 is indicated by an outlined arrow A4, and the flow direction of low-temperature-water return water that returns from the low-temperature side heating load 104 to the second circuit unit 2 is indicated by an outlined arrow A5. An operation of the second circuit unit 2 is the same as that of Embodiment 1, and its description will thus be omitted.

[0079] As described above, the heat pump apparatus 100 according to Embodiment 2 includes an outdoor unit 37 that is provided with the heat pump water heater 1 and the air-to-refrigerant heat exchanger 36 which causes heat exchange to be performed between the refrigerant and air. Thus, the heat pump apparatus 100 can also obtain the same advantages as the heat pump water heater 1 according to Embodiment 1.

[0080] It should be noted that the above embodiments can be combined, and each of the embodiments can be modified or omitted as appropriate. For example, the configuration of the housing unit 40 is limited to such a configuration thereof as described above. For example, the housing unit 40 may further include a support rod.

[0081] In addition, for example, the connection configuration of the pipes of the second circuit unit 2 is not limited to such a connection configuration as illustrated in Fig. 3.

Reference Signs List

[0082] 1: heat pump water heater, 2: second circuit unit, 3: first circuit unit, 6a: first water pump, 6b: second water pump, 6c: pump for hot-water supply, 6d: water pump, 13: fastener, 14: O-ring, 15: Joint, 20: strainer, 23: mixing valve, 30: water heat exchanger, 31: water storage tank, 32: water heat exchanger, 33: three-way valve, 34: compressor, 35: expansion valve, 36: refrigerant heat exchanger, 37: outdoor unit, 40: housing unit, 41: front panel, 42: side panel, 43: rear sheet metal, 43a: screw hole, 44: bottom plate, 45: top panel, 50: fixation sheet metal, 50a; hole, 50b: lower flange, 50b1: hole, 50c: upper flange, 51: fixing component, 51a; peripheral portion, 51b: fixation portion, 52: base sheet metal, 52a: flat plate portion, 52a1: screw hole, 52b: base fixation portions, 52b1: hole, 52c: connection portion, 53: screw, 54: fixation screw, 70: drainage portion, 71: first drain pan, 71a: drain outlet, 71b: flange, 71c: projection, 72: second drain pan, 73: socket portion, 74: first drain hose, 75: second drain hose, 99: second circuit assembly, 100: heat pump apparatus, 101: water supply side, 102: hot-water supply side, 103: heating load, 104: heating load, C11: hot-water supply side circuit, C12: connection circuit, C21: high-temperature side hot-water supply circuit, C22: low-temperature side hot-water supply circuit, C23: returning circuit, C24: bypass circuit, P11: inflow pipe for water for hot-water supply, P12: outflow pipe for water for hot-water supply, P13: pipe, P14: first outflow pipe, P15: first inflow pipe, P21: second inflow pipe, P22: second outflow pipe, P23: high-temperature-side main pipe, P24: high-temperature-side outward pipe, P25: low-temperature-side main pipe, P26: low-temperature-side outward pipe, P27: high-temperature water flow pipe, P28: return main pipe, P29: high-temperature-side return pipe, P30: low-temperature-side return pipe, P31: return branch pipe, P32: return water flow pipe

Claims

1. A heat pump water heater comprising:

a first circuit unit in which water is circulated, the first circuit unit being configured to heat the water by heat exchange between the water and refrigerant;
a second circuit unit including a plurality of flow passage components, connected to an external heating load, and configured to cause the water heated by the first circuit unit to flow to the heating load and to release heat at the heating load, and mix the water heated by the first circuit unit with return water that has transferred heat;
a housing unit in which the first circuit unit and the second circuit unit are housed; and
a fixation sheet metal to which the flow passage components of the second circuit unit are fixed, and which is attached to the housing unit.

2. The heat pump water heater of claim 1, wherein the second circuit unit is provided above the first circuit unit.

3. The heat pump water heater of claim 1 or 2, further

comprising a first drain pan provided at the fixation sheet metal in a lower region of the second circuit unit, and configured to collect drain water generated at the second circuit unit.

4. The heat pump water heater of claim 1, further comprising:

a first drain pan provided at the fixation sheet metal and in a lower region of the second circuit unit, and configured to collect drain water generated at the second circuit unit;
a second drain pan provided in a lower region of the first circuit unit, and configured to collect drain water generated at the first circuit unit; and
a drain hose connected to the first drain pan, and configured to guide the drain water collected at the second circuit unit to an upper surface of the second drain pan,
wherein the second circuit unit is provided above the first circuit unit.

5. The heat pump water heater of any one of claims 1 to 4,

wherein the second circuit unit includes, as the flow passage components,
a high-temperature-side main pipe through which the water heated by the first circuit unit flows, and which extends in a lateral direction,
a low-temperature-side main pipe through which mixed water that is a mixture of the heated water and the return water flows, and which extends in the lateral direction,
a first water pump provided at the high-temperature-side main pipe, and
a second water pump provided at the low-temperature-side main pipe, and
wherein the high-temperature-side main pipe and the low-temperature-side main pipe are arranged in an up-down direction.

6. The heat pump water heater of any one of claims 1 to 5, further comprising a base sheet metal to which the fixation sheet metal is attached, and which is provided on an inner surface of a rear sheet metal of the housing unit.

7. The heat pump water heater of any one of claims 1 to 6, further comprising a fastener made of sheet metal and configured to connect a pipe of the second circuit unit and a pipe of the first circuit unit.

8. A heat pump apparatus comprising:

the heat pump water heater of any one of claims 1 to 7; and
an outdoor unit provided with an air-to-refrigerant heat exchanger configured to cause heat exchange to be performed between the refrigerant and air.

9. An assembly method of a heat pump water heater that includes: a first circuit unit in which water is circulated, the first circuit unit being configured to heat the water by heat exchange between the water and refrigerant; a second circuit unit including a plurality of flow passage components, connected to an external heating load, and configured to cause the water heated by the first circuit unit to flow to the heating load and to release heat at the heating load, and mix the water heated by the first circuit unit with return water that has transferred heat; a housing unit in which the first circuit unit and the second circuit unit are housed; and a fixation sheet metal to which the flow passage components of the second circuit unit are fixed, and which is attached to the housing unit the assembly method comprising incorporating the fixation sheet metal to which the flow passage components of the second circuit unit is fixed, into the housing unit in which the first circuit unit is housed.

FIG. 1

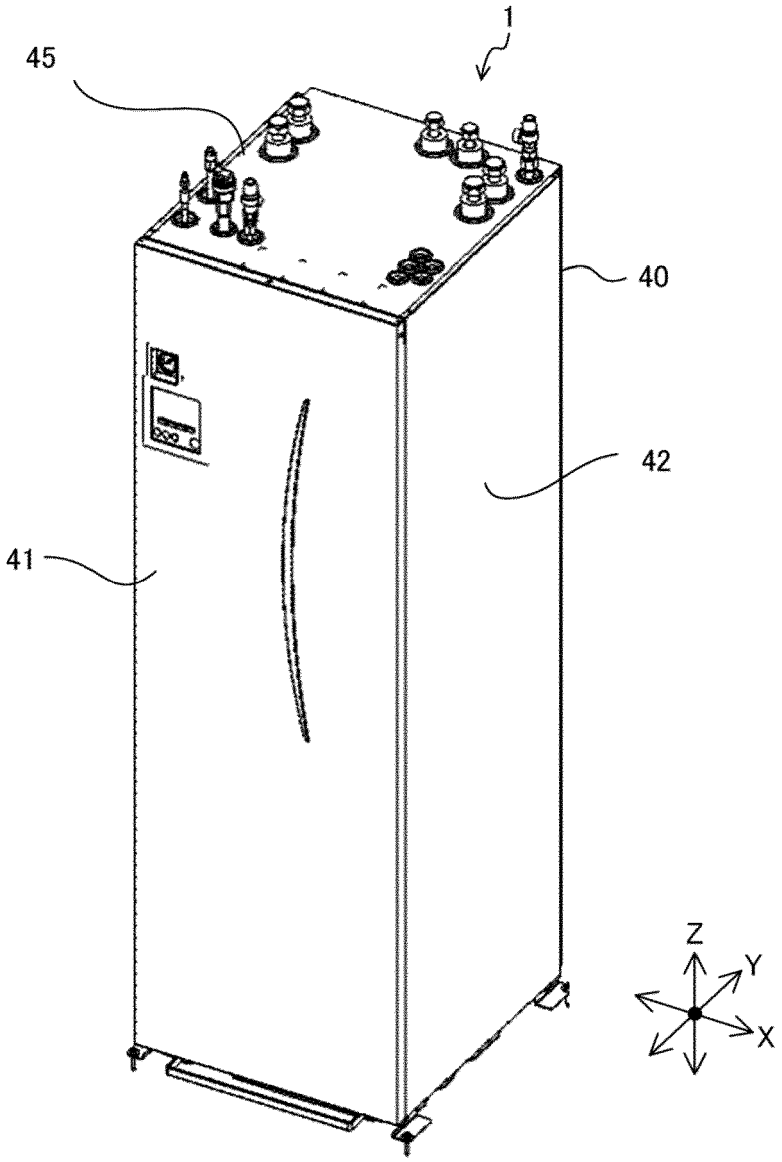

FIG. 2

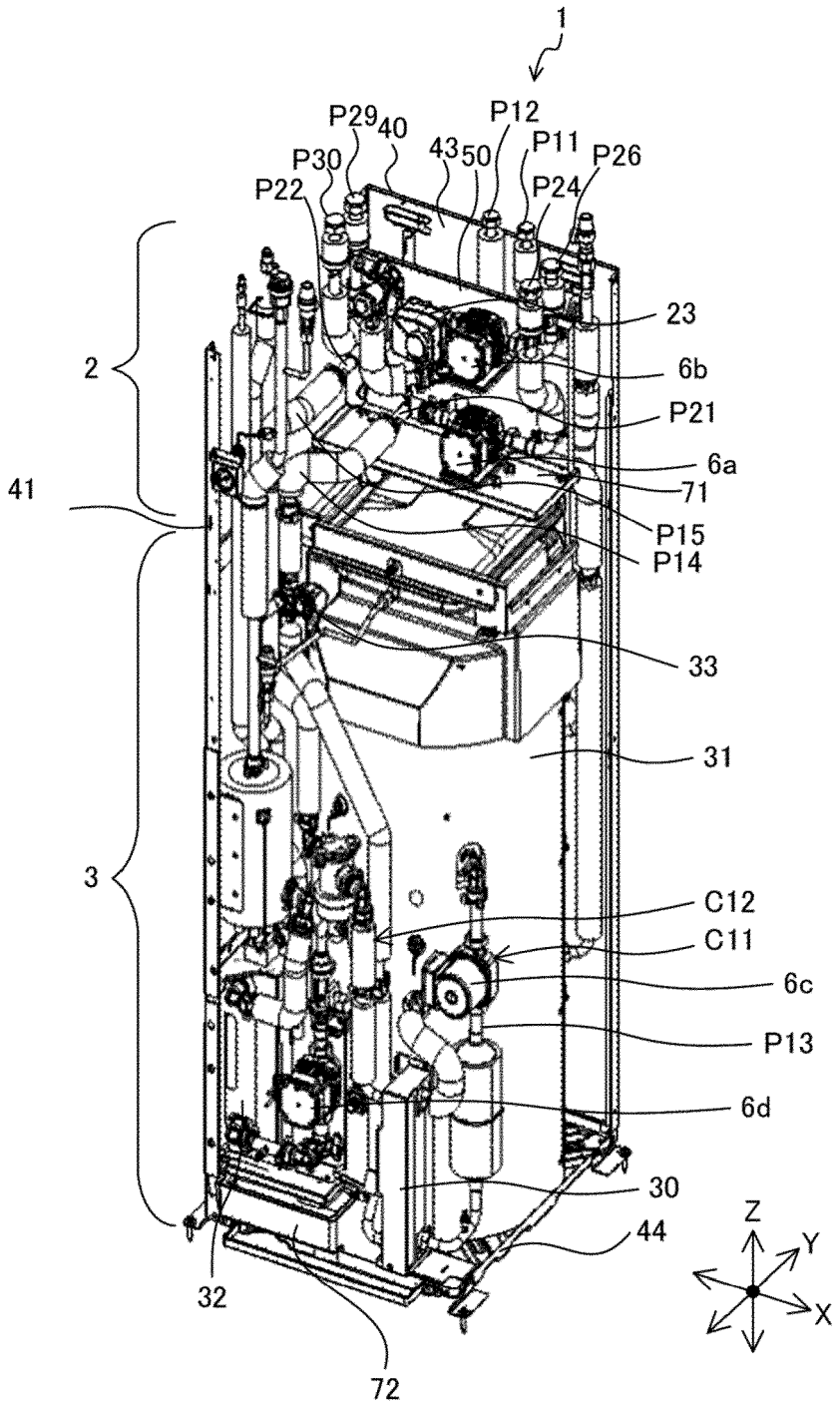
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FIG. 3

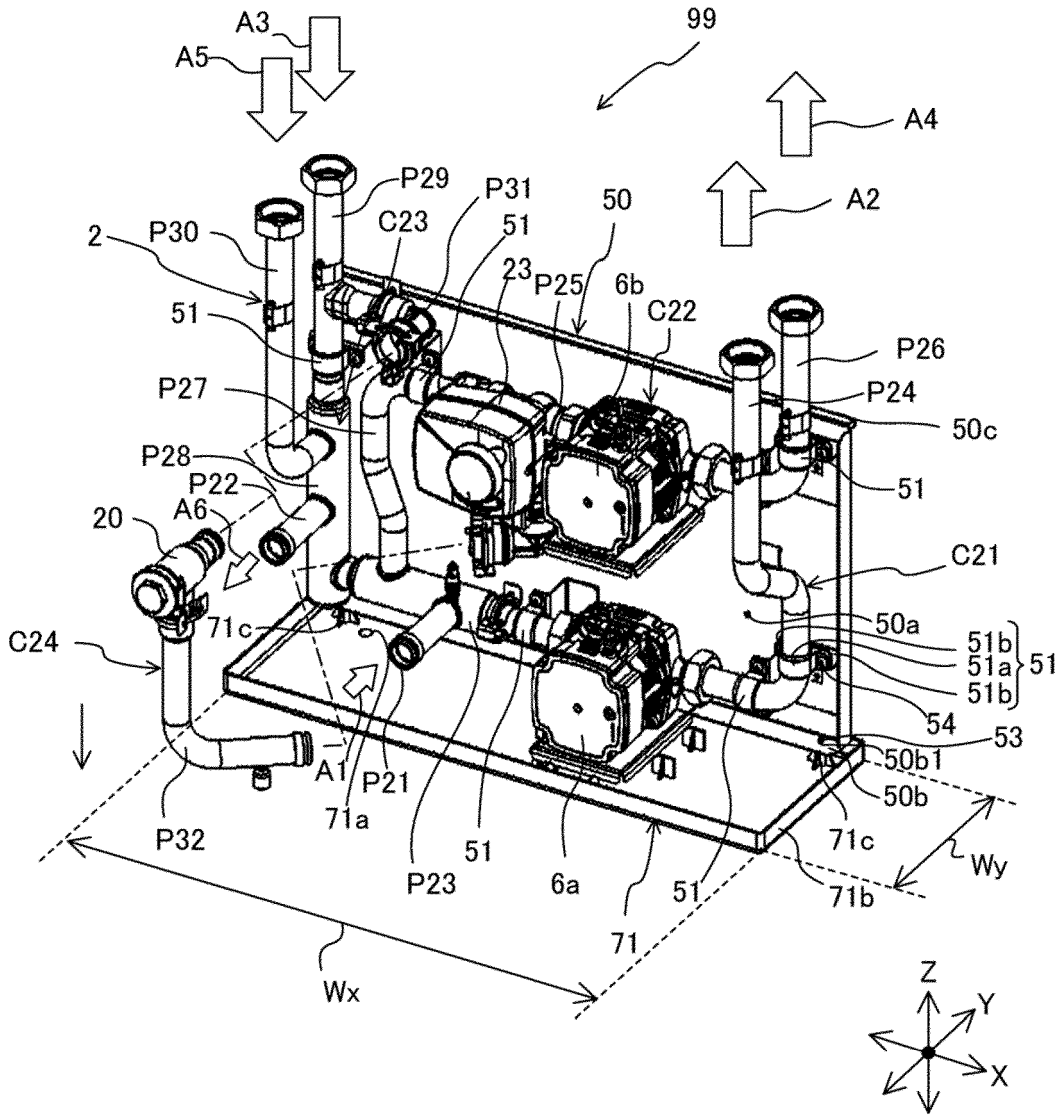
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FIG. 4

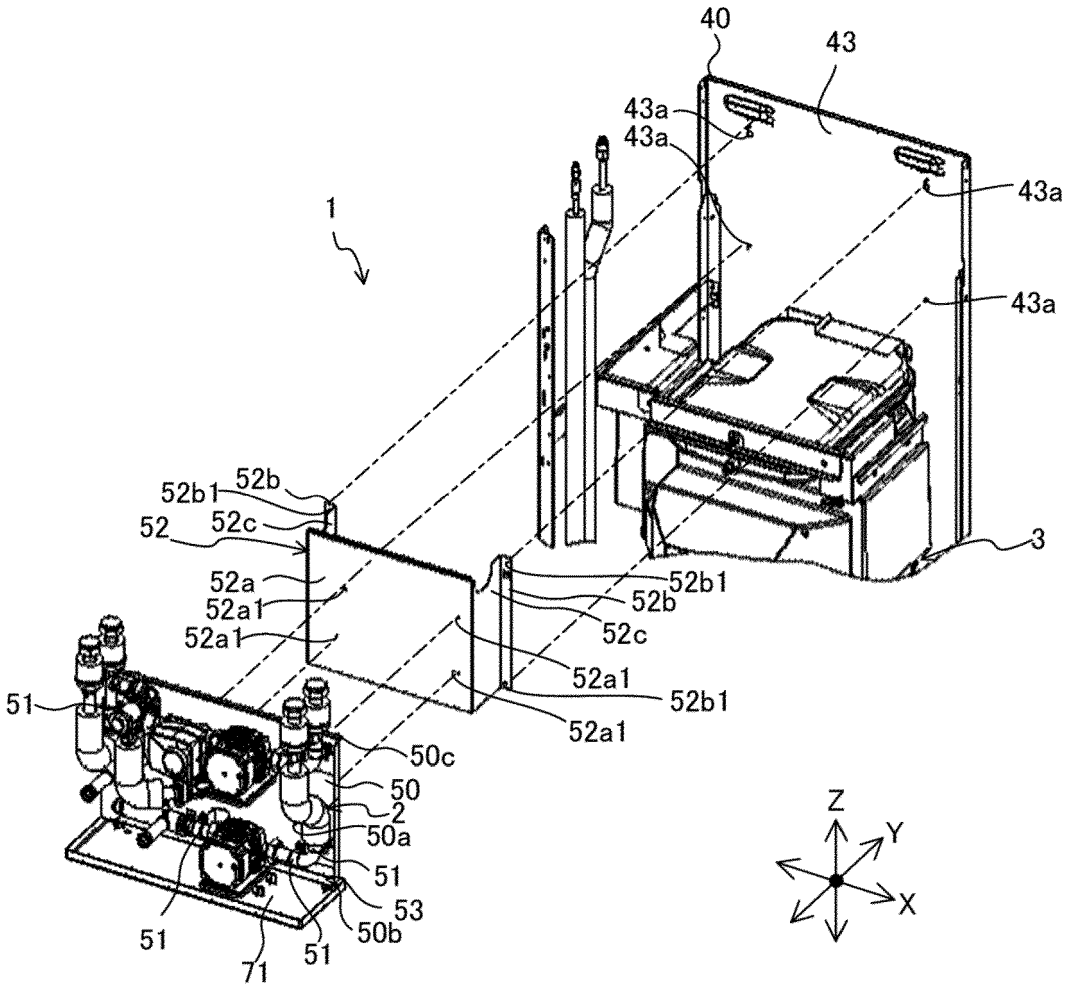
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FIG. 5

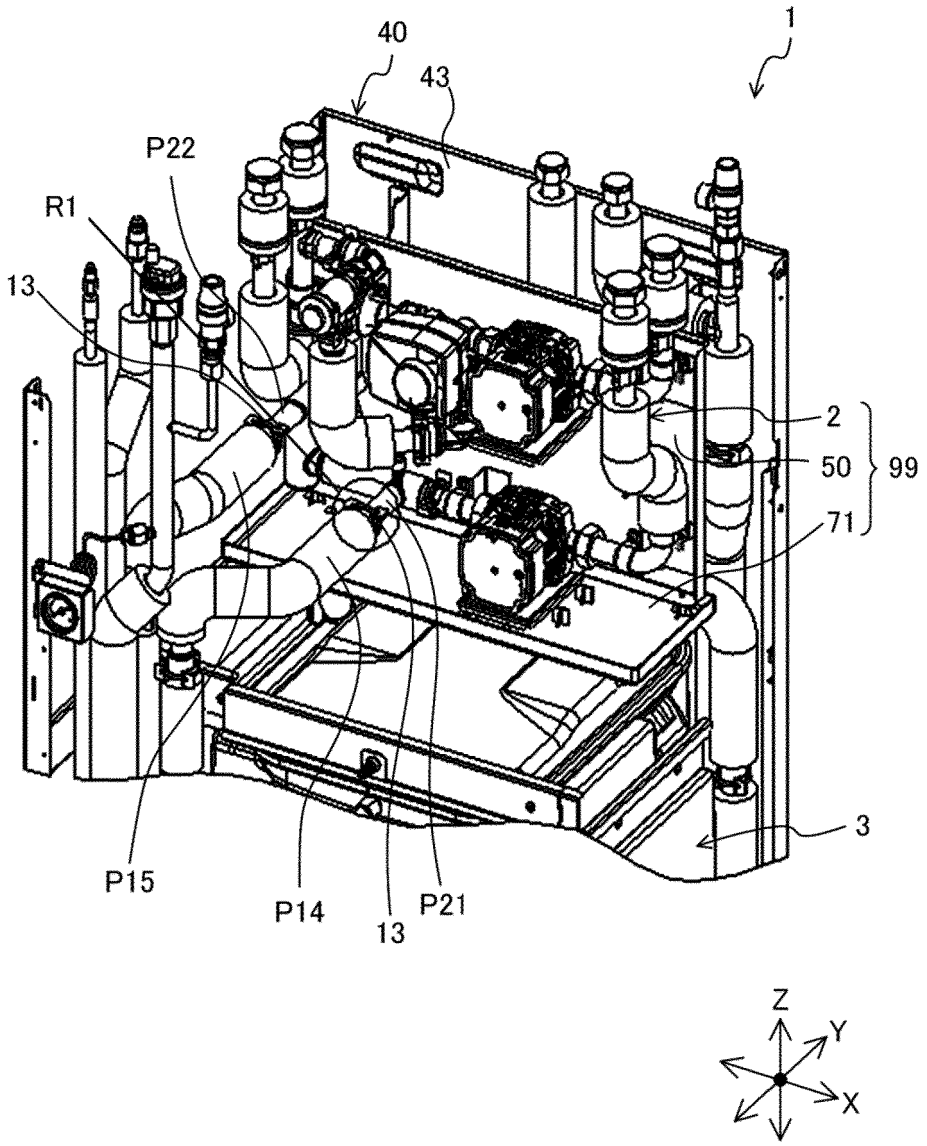

FIG. 6

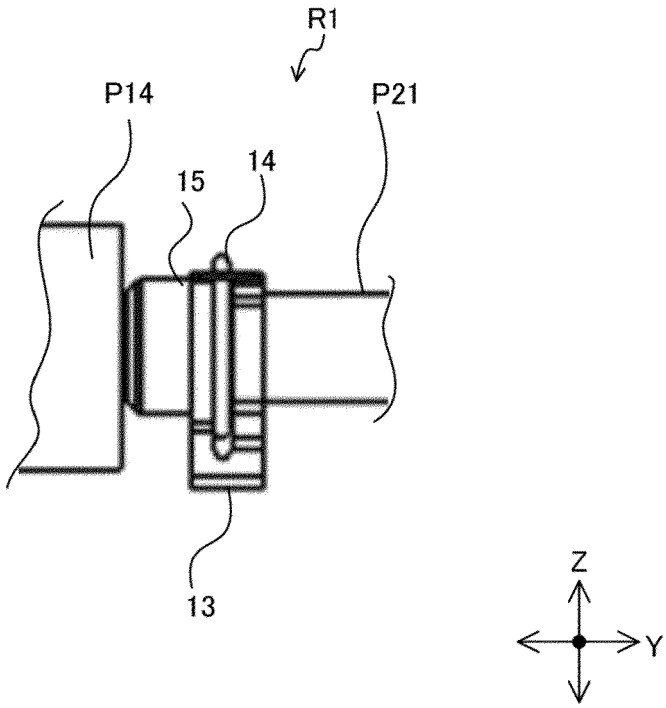

FIG. 7

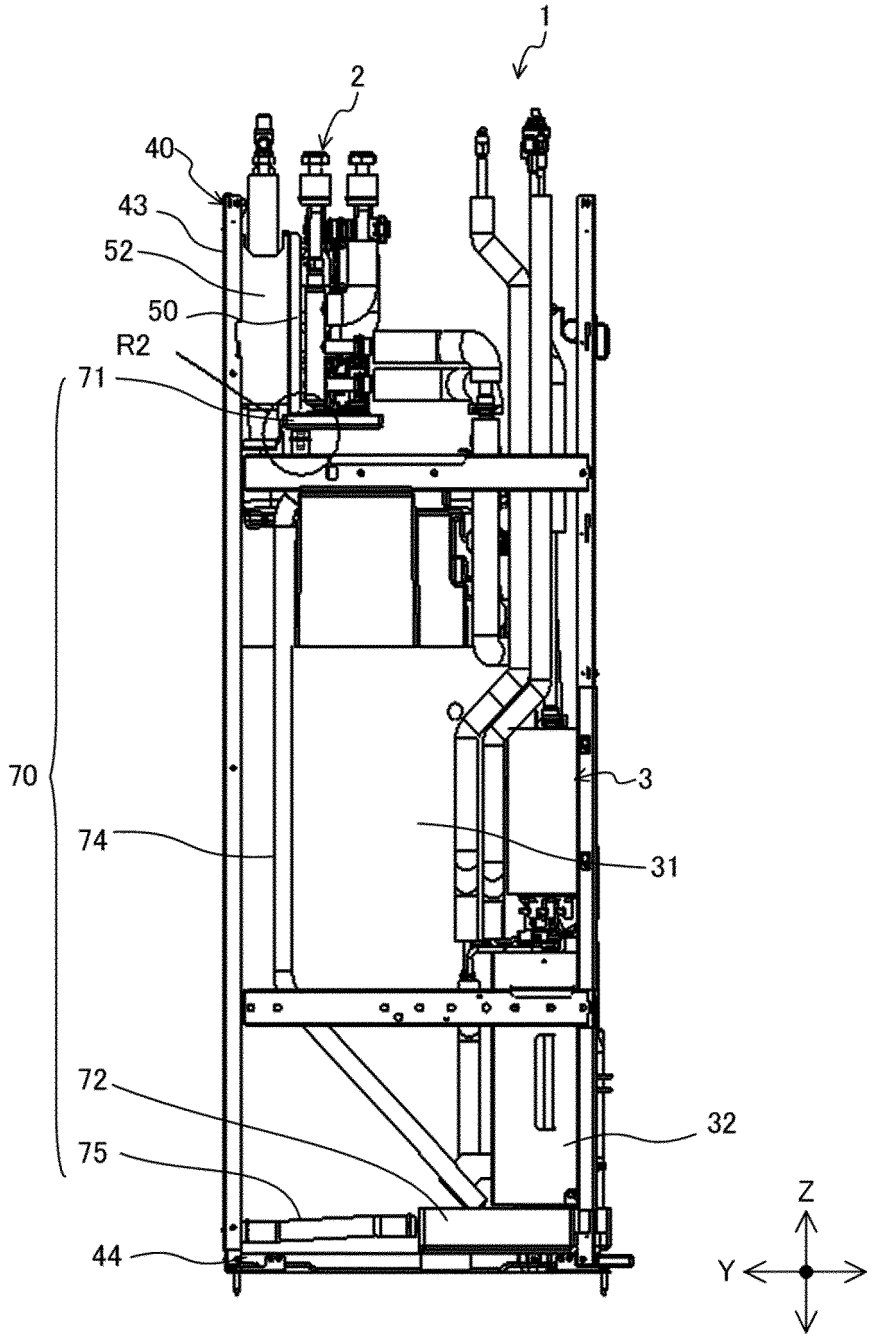

FIG. 8

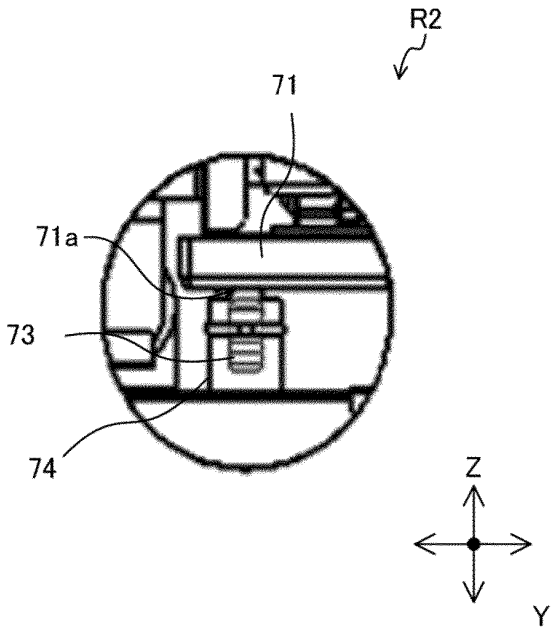
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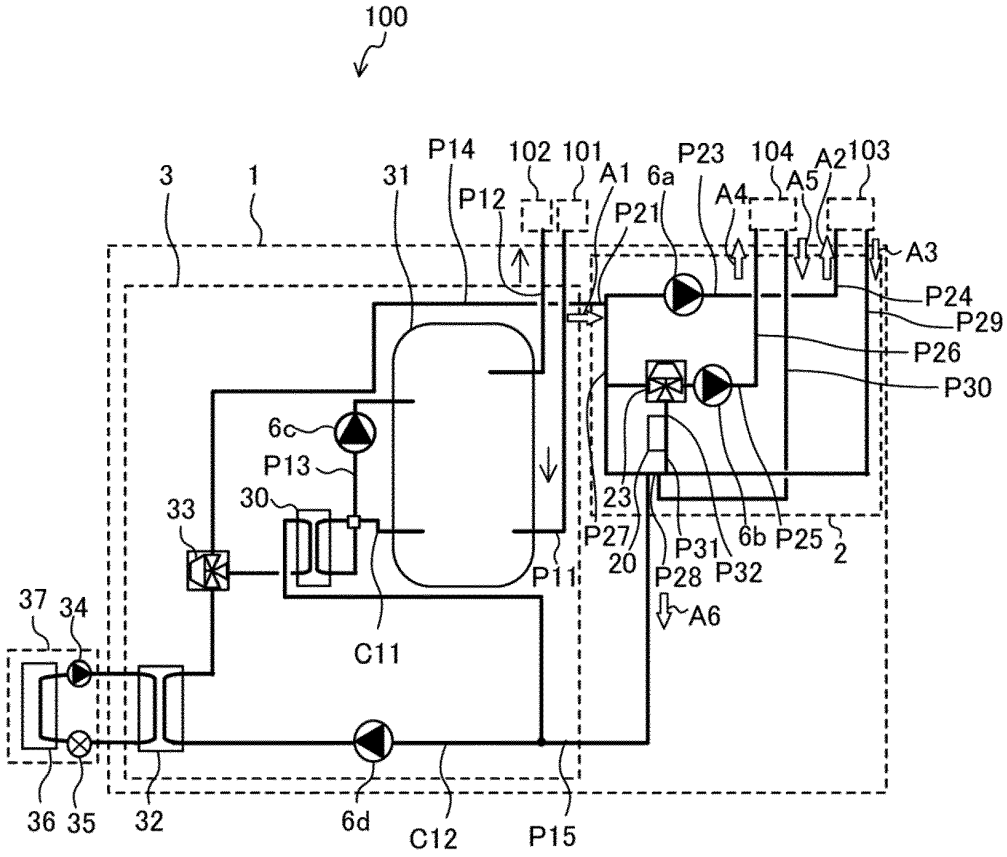
FIG. 9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P15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/048830

A. CLASSIFICATION OF SUBJECT MATTER
F24H 9/06(2006.01)i; F24H 9/16(2006.01)i; F24H 4/02(2006.01)i
FI: F24H4/02 A; F24H4/02 D; F24H9/06 301Z; F24H9/16 E

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)
F24H9/06; F24H9/16; F24H4/02

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2010-84974 A (SANYO ELECTRIC CO., LTD.) 15 April 2010 (2010-04-15) paragraphs [0001]-[0071], fig. 1	1, 7-9
A	paragraphs [0001]-[0071], fig. 1	2-6
Y	JP 2006-275412 A (NORITZ CORPORATION) 12 October 2006 (2006-10-12) paragraphs [0001]-[0047], fig. 1-5	1, 7-9
A	paragraphs [0001]-[0047], fig. 1-5	2-6
A	JP 2010-281487 A (MITSUBISHI ELECTRIC CORP.) 16 December 2010 (2010-12-16) paragraphs [0001]-[0043], fig. 1-4	1-9
A	US 2019/0128565 A1 (RHEEM MANUFACTURING COMPANY) 02 May 2019 (2019-05-02) paragraphs [0001]-[0079], fig. 1A-6	1-9

☒ 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 28 January 2021 (28.01.2021)	Date of mailing of the international search report 09 February 2021 (09.02.2021)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/048830

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2011-145018 A (MITSUBISHI ELECTRIC CORP.) 28 July 2011 (2011-07-28) paragraphs [0001]-[0034], fig. 1-6	1-9
A	JP 2007-85656 A (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 05 April 2007 (2007-04-05) paragraphs [0001]-[0031], fig. 1-4	1-9

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/048830

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
JP 2010-84974 A	15 Apr. 2010	(Family: none)	
JP 2006-275412 A	12 Oct. 2006	(Family: none)	
JP 2010-281487 A	16 Dec. 2010	(Family: none)	
US 2019/0128565 A1	02 May 2019	CA 3079401 A	
JP 2011-145018 A	28 Jul. 2011	(Family: none)	
JP 2007-85656 A	05 Apr. 2007	(Family: none)	

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2010084974 A **[0003]**