



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

(43) Date of publication:
02.08.2017 Bulletin 2017/31

(51) Int Cl.:
F24H 1/18 (2006.01) **F24D 3/18** (2006.01)
F24H 1/00 (2006.01)

(21) Application number: **14902428.3**

(86) International application number:
PCT/JP2014/075703

(22) Date of filing: **26.09.2014**

(87) International publication number:
WO 2016/046978 (31.03.2016 Gazette 2016/13)

(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

- **MATSUMURA, Yasunari**
Tokyo 100-8310 (JP)
- **IIDA, Kyohei**
Tokyo 100-8310 (JP)
- **SAKUMA, Toshiyuki**
Tokyo 100-8310 (JP)

(71) Applicant: **Mitsubishi Electric Corporation**
Chiyoda-ku
Tokyo 100-8310 (JP)

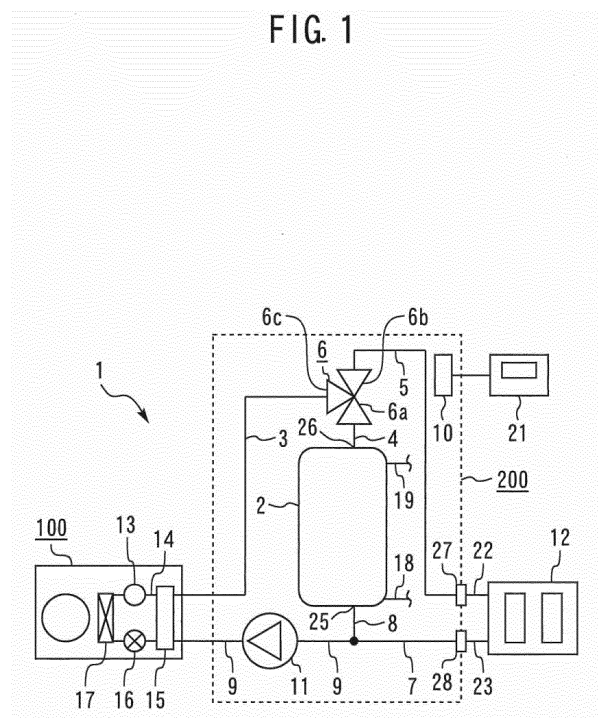
(74) Representative: **Pfenning, Meinig & Partner mbB**
Patent- und Rechtsanwälte
Joachimsthaler Straße 12
10719 Berlin (DE)

(72) Inventors:
• **NAITO, Shuhei**
Tokyo 100-8310 (JP)

(54) **HOT-WATER SUPPLY AND HEATING SYSTEM**

(57) A hot-water supply and heating system capable of adequately increasing the temperature of hot water that flows into a hot water storage tank during a heat accumulating operation, in a configuration in which a single water pump is used for both the heat accumulating operation and an indoor-heating operation, is provided. The hot-water supply and heating system includes: a heat accumulating water path that connects a first water outlet 25 of a hot water storage tank 2, a water pump 11, a water heater 100, and a first water inlet 26 of the hot water storage tank 2 in this order; an indoor-heating water path that connects a second water inlet 28, the water pump 11, the water heater 100, and a second water outlet 27 from which water to be supplied to an indoor-heating device comes out in this order; and a switching valve 6 configured to switch between the heat accumulating water path and the indoor-heating water path. An overlap portion in which the heat accumulating water path overlaps the indoor-heating water path is provided. A pressure loss of the heat accumulating water path is higher than a pressure loss of the indoor-heating water path.

FIG. 1



Description

[Technical Field]

5 **[0001]** The present invention relates to a hot-water supply and heating system.

[Background Art]

10 **[0002]** A hot-water storage type heater disclosed in PTL 1 shown below includes a heating circulation circuit that connects a heating unit such as a heat pump and a hot water storage tank such that water can be circulated, a heat exchanger that heats secondary water supplied to an external indoor-heating device, and a heat exchange circulation circuit that connects the heat exchanger and the heating unit such that water can be circulated. The hot-water storage type heater includes a distribution ratio adjustment unit that adjusts a distribution ratio between an amount of water circulated to the hot water storage tank and an amount of water circulated to the heat exchanger at a junction between
15 the heating circulation circuit and the heat exchange circulation circuit.

[Citation List]

[Patent Literature]

20 **[0003]** [PTL 1] Japanese Patent Application Laid-open No. 2006-46800

[Summary of Invention]

25 [Technical Problem]

[0004] The conventional hot-water storage type heater described above does not supply hot water to the external indoor-heating device from the heating unit directly, but supplies secondary hot water that is heated in the heat exchanger to the indoor-heating device. The hot-water storage type heater requires a pump that circulates the secondary hot water of the heat exchanger to the indoor-heating device in addition to a heating circulation pump that circulates water to the heating unit.
30

[0005] When a heat accumulating water circuit performing a heat accumulating operation of accumulating heat in the hot water storage tank by circulating water between a water heater and the hot water storage tank, and an indoor-heating water circuit performing an indoor-heating operation of circulating water between the water heater and the external indoor-heating device share a single water pump, it is possible to reduce the number of water pumps and reduce the cost. However, in such a case, the following problem may arise. In the indoor-heating water circuit, the length, number, and connection method of internal pipes and indoor-heating devices vary from one installation site to another. There are cases where the pressure loss of the indoor-heating water circuit becomes significantly higher than the pressure loss of the heat accumulating water circuit. Accordingly, the performance of a single water pump needs to satisfy a flow rate required in the indoor-heating water circuit having a high pressure loss. When water is circulated to the heat accumulating water circuit having a low pressure loss using a water pump that exhibits the level of performance indicated above, water is circulated at a flow rate exceeding an appropriate flow rate, the temperature of hot water coming out of the water heater is reduced, and it is therefore not possible to adequately increase the temperature of hot water flowing into the hot water storage tank.
40

[0006] The present invention has been made in order to solve the above problem, and an object thereof is to provide a hot-water supply and heating system capable of adequately increasing the temperature of hot water that flows into a hot water storage tank during a heat accumulating operation, in a configuration in which a single water pump is used for both the heat accumulating operation and an indoor-heating operation.
45

50 [Solution to Problem]

[0007] A hot-water supply and heating system of the invention includes: a hot water storage tank; a first water outlet from which water inside the hot water storage tank comes out; a first water inlet through which water enters into the hot water storage tank; a water heater configured to heat water; a water pump; a heat accumulating water path that connects the first water outlet, the water pump, the water heater, and the first water inlet in this order; a second water outlet from which water to be supplied to an external indoor-heating device comes out; a second water inlet into which water returned from the indoor-heating device enters; an indoor-heating water path that connects the second water inlet, the water pump, the water heater, and the second water outlet in this order; and a switching valve configured to switch between
55

the heat accumulating water path and the indoor-heating water path. An overlap portion in which the heat accumulating water path overlaps the indoor-heating water path is provided. A pressure loss of the heat accumulating water path is higher than a pressure loss of the indoor-heating water path.

5 [Advantageous Effects of Invention]

10 **[0008]** With the hot-water supply and heating system according to the present invention, it becomes possible to adequately increase the temperature of hot water that flows into the hot water storage tank during the heat accumulating operation in a configuration in which a single water pump is used for both the heat accumulating operation and the indoor-heating operation.

[Brief Description of Drawings]

15 **[0009]**

Fig. 1 is a configuration diagram showing a hot-water supply and heating system according to Embodiment 1 of the present invention.

Fig. 2 is a view showing a circulation circuit of water during a heat accumulating operation of the hot-water supply and heating system according to Embodiment 1.

20 Fig. 3 is a view showing the circulation circuit of water during an indoor-heating operation of the hot-water supply and heating system according to Embodiment 1.

Fig. 4 is a view showing an example of a configuration of an indoor-heating terminal.

Fig. 5 is a view showing an example of a configuration of an indoor-heating terminal.

Fig. 6 is a view showing an example of a configuration of an indoor-heating terminal.

25 Fig. 7 is a view showing an example of a configuration of an indoor-heating terminal.

Fig. 8 is a longitudinal sectional view of an upper pipe of the hot-water supply and heating system according to Embodiment 1.

Fig. 9 is a longitudinal sectional view of an upper pipe of a hot-water supply and heating system according to Embodiment 2.

30 Fig. 10 is a cross-sectional view of a switching valve of a hot-water supply and heating system according to Embodiment 3.

Fig. 11 is a cross-sectional view of a switching valve of a hot-water supply and heating system according to Embodiment 4.

35 [Description of Embodiments]

[0010] Embodiments of the present invention will be described below with reference to the drawings. In the drawings, the same reference numerals refer to the same elements, and redundant descriptions thereof are omitted. In the present description, "water" is a concept that encompasses water of every temperature, from cold water having a low temperature to hot water having a high temperature.

Embodiment 1.

45 **[0011]** Fig. 1 is a configuration diagram showing a hot-water supply and heating system according to Embodiment 1 of the present invention. As shown in Fig. 1, a hot-water supply and heating system 1 according to Embodiment 1 includes a water heater 100 and a tank unit 200. The water heater 100 and the tank unit 200 are connected via a first common pipe 9, a second common pipe 3, and electrical wiring (not shown). Although the hot-water supply and heating system 1 according to Embodiment 1 has a configuration in which the water heater 100 is separate from the tank unit 200, in the present invention, the water heater 100 and the tank unit 200 may be integrated with each other.

50 **[0012]** The water heater 100 according to Embodiment 1 is a heat pump type water heater. The water heater 100 includes a compressor 13 that compresses a refrigerant, a water-refrigerant heat exchanger 15, a decompressor 16 that decompresses the refrigerant, a low-temperature-side heat exchanger 17 (evaporator) that causes the refrigerant to absorb heat of a low-temperature heat source (e.g., outside air), and a refrigerant pipe 14 forming a refrigerant circuit by connecting these devices annularly. The water heater 100 heats water by executing operation of a heat pump cycle (refrigeration cycle) using the refrigerant circuit. The water heater 100 heats water by exchanging heat between the high-temperature high-pressure refrigerant compressed by the compressor 13 and water in the water-refrigerant heat exchanger 15.

55 **[0013]** The water heater in the present invention is not limited to the heat pump type water heater described above,

and may be the water heater of any type. For example, the water heater in the present invention may be a solar water heater that heats water with solar heat, or may also be a combustion water heater that heats water with combustion heat of fuel (e.g., gas, kerosene, heavy oil, or coal).

[0014] The tank unit 200 includes a hot water storage tank 2, a switching valve 6, and a water pump 11. Water is stored in the hot water storage tank 2. In the hot water storage tank 2, it is possible to form thermal stratification in which an upper side has a high temperature and a lower side has a low temperature due to a difference in the density of water caused by a difference in temperature. A feed-water pipe 18 is connected to a lower portion of the hot water storage tank 2. Water supplied from a water source such as a city water supply is supplied into the hot water storage tank 2 through the feed-water pipe 18. A hot-water supply pipe 19 is connected to an upper portion of the hot water storage tank 2. When hot water is supplied to the outside, hot water stored in the hot water storage tank 2 is fed into the hot-water supply pipe 19.

[0015] The hot water storage tank 2 has a first water outlet 25 and a first water inlet 26. Water inside the hot water storage tank 2 comes out of the first water outlet 25. Hot water heated in the water heater 100 enters into the hot water storage tank 2 from the first water inlet 26. The first water outlet 25 is positioned in the lower portion of the hot water storage tank 2. The first water inlet 26 is positioned in the upper portion of the hot water storage tank 2. The switching valve 6 has a first port 6a, a second port 6b, and a third port 6c. The switching valve 6 can switch between a state in which the third port 6c is caused to communicate with the first port 6a and the second port 6b is closed and a state in which the third port 6c is caused to communicate with the second port 6b and the first port 6a is closed.

[0016] A lower pipe 8 connects the first water outlet 25 of the hot water storage tank 2 and an upstream end of the first common pipe 9. A downstream end of the first common pipe 9 is connected to the water inlet of the water-refrigerant heat exchanger 15 provided in the water heater 100. The water pump 11 is connected to the middle of the first common pipe 9. In Embodiment 1, the water pump 11 is included in the tank unit 200, but the water pump 11 may be installed on the side of the water heater 100 in the present invention. The second common pipe 3 connects the water outlet of the water-refrigerant heat exchanger 15 provided in the water heater 100 and the third port 6c of the switching valve 6.

An upper pipe 4 connects the first port 6a of the switching valve 6 and the first water inlet 26 of the hot water storage tank 2.

[0017] An indoor-heating terminal 12 is provided outside the water heater 100 and the tank unit 200. The tank unit 200 and the indoor-heating terminal 12 are connected via a first external pipe 22 and a second external pipe 23. The tank unit 200 has a second water outlet 27 and a second water inlet 28. Water to be supplied from the tank unit 200 to the indoor-heating terminal 12 flows to the outside of the tank unit 200 via the second water outlet 27. A first internal pipe 5 connects the second port 6b of the switching valve 6 and the second water outlet 27 inside the tank unit 200. The upstream end of the first external pipe 22 is connected to the second water outlet 27 from the outside of the tank unit 200. The downstream end of the first external pipe 22 is connected to the inlet side of the indoor-heating terminal 12. The upstream end of the second external pipe 23 is connected to the outlet side of the indoor-heating terminal 12. The downstream end of the second external pipe 23 is connected to the second water inlet 28 from the outside of the tank unit 200. A second internal pipe 7 connects the second water inlet 28 and the upstream end of the first common pipe 9 inside the tank unit 200. Water returning from the indoor-heating terminal 12 to the tank unit 200 enters into the tank unit 200 from the second water inlet 28.

[0018] The tank unit 200 includes a control section 10. The control section 10 and a remote controller 21 are connected so as to be able to communicate with each other. A user can input, for instance, a change in set values and a command related to the operation of the hot-water supply and heating system 1 from the remote controller 21. Although the depiction thereof is omitted, the control section 10 has a storage section that includes ROM (read-only memory), RAM (random access memory), and non-volatile memory, a CPU (central processing unit) that executes arithmetic processing based on a program stored in the storage section, and an input/output port that inputs and outputs an external signal to and from the CPU. Actuators and sensors included in the hot-water supply and heating system 1 are electrically connected to the control section 10. The control section 10 controls the operation of the hot-water supply and heating system 1 based on values detected by the sensors and signals from the remote controller 21. Although the depiction thereof is omitted, the remote controller 21 is equipped with a display section that displays information such as conditions of the hot-water supply and heating system 1, an operation section such as a switch operated by the user, a speaker, a microphone, etc.

[0019] A plurality of temperature sensors are mounted on the surface of the hot water storage tank 2 at intervals in a vertical direction. The control section 10 detects a temperature distribution along the vertical direction in the hot water storage tank 2 by using the temperature sensors, whereby it is possible to calculate a hot water storage amount, a heat storage amount, and a remaining hot water amount in the hot water storage tank 2. The control section 10 controls, for instance, the start and stop timings of a heat accumulating operation described later based on the hot water storage amount, the heat storage amount, or the remaining hot water amount in the hot water storage tank 2.

[0020] Next, the heat accumulating operation of the hot-water supply and heating system 1 will be described with reference to Fig. 2. Fig. 2 is a view showing a circulation circuit of water during the heat accumulating operation of the hot-water supply and heating system 1 according to Embodiment 1. Arrows in Fig. 2 indicate the direction in which water

flows. In the heat accumulating operation, the switching valve 6 is controlled such that the third port 6c is caused to communicate with the first port 6a and the second port 6b is closed, and the water pump 11 is driven. In the heat accumulating operation, water having a low temperature in the lower portion of the hot water storage tank 2 is fed to the water-refrigerant heat exchanger 15 of the water heater 100 through the first water outlet 25, the lower pipe 8, and the first common pipe 9. Subsequently, water that is heated in the water-refrigerant heat exchanger 15 and has a high temperature flows into the upper portion of the hot water storage tank 2 through the second common pipe 3, the third port 6c and the first port 6a of the switching valve 6, the upper pipe 4, and the first water inlet 26. In the heat accumulating operation, water having a high temperature is gradually accumulated inside the hot water storage tank 2 downwardly from above due to the circulation of water described above, and the heat storage amount of the hot water storage tank 2 is increased.

[0021] The circulation circuit of water during the heat accumulating operation described above is referred to as "a heat accumulating water circuit". In addition, a path from the first water outlet 25 to the first water inlet 26 through the lower pipe 8, the first common pipe 9, the water-refrigerant heat exchanger 15, the second common pipe 3, the third port 6c and the first port 6a of the switching valve 6, and the upper pipe 4 is referred to as "a heat accumulating water path".

[0022] Next, the indoor-heating operation of the hot-water supply and heating system 1 will be described with reference to Fig. 3. Fig. 3 is a view showing the circulation circuit of water during the indoor-heating operation of the hot-water supply and heating system 1 according to Embodiment 1. Arrows in Fig. 3 indicate the direction in which water flows. In the indoor-heating operation, the switching valve 6 is controlled such that the third port 6c is caused to communicate with the second port 6b and the first port 6a is closed, and the water pump 11 is driven. In the indoor-heating operation, water heated in the water-refrigerant heat exchanger 15 of the water heater 100 is fed to the indoor-heating terminal 12 through the second common pipe 3, the third port 6c and the second port 6b of the switching valve 6, the first internal pipe 5, the second water outlet 27, and the first external pipe 22. Subsequently, in the indoor-heating terminal 12, heat is dissipated from this water by indoor air or a floor, and the temperature of the water is thereby reduced. The water having a reduced temperature then returns to the water-refrigerant heat exchanger 15 of the water heater 100 through the second external pipe 23, the second water inlet 28, the second internal pipe 7, and the first common pipe 9. The water having returned to the water-refrigerant heat exchanger 15 is then reheated and recirculated.

[0023] The circulation circuit of water during the indoor-heating operation described above is referred to as "an indoor-heating water circuit". In addition, a path from the second water inlet 28 to the second water outlet 27 through the second internal pipe 7, the first common pipe 9, the water-refrigerant heat exchanger 15, the second common pipe 3, the third port 6c and the second port 6b of the switching valve 6, and the first internal pipe 5 is referred to as "an indoor-heating water path". The switching valve 6 can switch between the heat accumulating water path and the indoor-heating water path.

[0024] The first common pipe 9, the water-refrigerant heat exchanger 15, the second common pipe 3, and the third port 6c correspond to an overlap portion in which the heat accumulating water path overlaps the indoor-heating water path. The first common pipe 9 and the second common pipe 3 correspond to pipes that form the overlap portion. The upper pipe 4 and the lower pipe 8 correspond to pipes that form the heat accumulating water path other than the overlap portion. The first internal pipe 5 and the second internal pipe 7 correspond to pipes that form the indoor-heating water path other than the overlap portion.

[0025] The indoor-heating terminal 12 includes one or a plurality of indoor-heating devices 24. By circulating water heated in the water heater 100 to the indoor-heating device 24, the temperature of indoor air is increased. As the indoor-heating device 24, at least, for example, one of a floor heating panel installed under a floor, a radiator or a panel heater installed on an indoor wall, and a fan convector can be used. The fan convector, which includes a fan for indoor air circulation and a heat exchanger that exchanges heat between the indoor air and liquid, performs heating by forced convection. In the case where the indoor-heating terminal 12 includes a plurality of the indoor-heating devices 24, each of the indoor-heating devices 24 may be of the same type or may also be different from each other.

[0026] There are cases where the indoor-heating terminal 12 includes a plurality of the indoor-heating devices 24 depending on the type of the indoor-heating terminal 12. In addition, there are cases where a plurality of the indoor-heating terminals 12 are connected in parallel. The length, number, and connection method of the internal pipes of the indoor-heating terminal 12, and the length, number, and connection method of the indoor-heating devices 24 vary from one installation site of the indoor-heating terminal 12 to another. Figs. 4 to 7 are views showing examples of the configuration of the indoor-heating terminal 12. For the sake of convenience, in Figs. 4 to 7 the indoor-heating terminals 12 are distinguished from each other by adding uppercase letters of the alphabet to the reference numeral of the indoor-heating terminal 12. An indoor-heating terminal 12A shown in Fig. 4 includes the single indoor-heating device 24. The indoor-heating terminal 12 in each of Figs. 5 to 7 includes a plurality of the indoor-heating devices 24. For the sake of convenience, in Figs. 5 to 7 the indoor-heating devices 24 are distinguished from each other by adding lowercase letter of the alphabet to the reference numeral of the indoor-heating device 24.

[0027] An indoor-heating terminal 12B shown in Fig. 5 includes five indoor-heating devices 24a, 24b, 24c, 24d, and 24e. The indoor-heating devices 24c and 24d are connected in series. The indoor-heating devices 24a, 24b, and 24e

are connected in parallel to the indoor-heating devices 24c and 24d.

[0028] An indoor-heating terminal 12C shown in Fig. 6 includes five indoor-heating devices 24a, 24b, 24c, 24d, and 24e, and the connection method thereof is the same as that of the indoor-heating terminal 12B in Fig. 5. However, in the indoor-heating terminal 12C shown in Fig. 6, the length of the internal pipe connected to the indoor-heating device 24e is longer than that of the indoor-heating terminal 12B in Fig. 5.

[0029] In the example configuration shown in Fig. 7, two indoor-heating terminals 12D and 12E are connected in parallel to each other between the first external pipe 22 and the second external pipe 23. The indoor-heating terminal 12D includes four indoor-heating devices 24a, 24b, 24c, and 24d. The indoor-heating devices 24a and 24b connected in series are connected in parallel to the indoor-heating devices 24c and 24d connected in series. The indoor-heating terminal 12E includes five indoor-heating devices 24e, 24f, 24g, 24h, and 24i. The indoor-heating devices 24g and 24h are connected in series. The indoor-heating devices 24e, 24f, and 24i are connected in parallel to the indoor-heating devices 24g and 24h.

[0030] In the case where the indoor-heating terminal 12 shown in each of Figs. 5 to 7 is connected, the pressure loss of the indoor-heating water circuit may become significantly higher than the pressure loss of the heat accumulating water circuit. Note that the pressure loss corresponds to an energy loss per unit time and unit flow rate as the fluid is flowing. Pressure loss, from the internal flow within a pipe or the like, is defined as a difference between the total pressure at an entrance and the total pressure at an exit.

[0031] In the hot-water supply and heating system 1 according to Embodiment 1, the heat accumulating water circuit and the indoor-heating water circuit share the single water pump 11. In other words, the indoor-heating water circuit does not need a dedicated water pump. As a result, it is possible to reduce the number of water pumps and reduce the cost. The performance (head) of the water pump 11 satisfies the flow rate required by the indoor-heating water circuit having a high pressure loss. When water is circulated to the heat accumulating water circuit having a low pressure loss using the water pump 11, there is a possibility that water may be circulated at a flow rate exceeding an appropriate flow rate. When the circulation flow rate of water during the heat accumulating operation exceeds the appropriate flow rate, the temperature of hot water coming out of the water heater 100 is reduced, and it is therefore not possible to adequately increase the temperature of hot water flowing into the hot water storage tank 2.

[0032] In the hot-water supply and heating system 1 according to Embodiment 1, the pressure loss of the heat accumulating water path from the first water outlet 25 to the first water inlet 26 is higher than the pressure loss of the indoor-heating water path from the second water inlet 28 to the second water outlet 27. Fig. 8 is a longitudinal sectional view of the upper pipe 4 of the hot-water supply and heating system 1 according to Embodiment 1. As shown in Fig. 8, a narrowed portion 30 is provided inside the upper pipe 4. The flow channel cross-sectional area of the narrowed portion 30 is smaller than each of the flow channel cross-sectional areas of the first common pipe 9 and the second common pipe 3. The flow channel cross-sectional area of the narrowed portion 30 is also smaller than each of the flow channel cross-sectional areas of the first internal pipe 5 and the second internal pipe 7. The narrowed portion 30 is a tubular member having an outer diameter substantially same as the inner diameter of the upper pipe 4. The narrowed portion 30 is fixed inside the upper pipe 4.

[0033] By providing the narrowed portion 30 in the upper pipe 4 forming the heat accumulating water path other than the overlap portion between the heat accumulating water path and the indoor-heating water path, it is possible to make the pressure loss of the heat accumulating water path higher than the pressure loss of the indoor-heating water path using a simple configuration. During the heat accumulating operation, water passes through the narrowed portion 30, whereby the high pressure loss occurs. Water does not pass through the narrowed portion 30 during the indoor-heating operation, and hence the high pressure loss by the narrowed portion 30 does not occur. The high pressure loss by the narrowed portion 30 occurs during the heat accumulating operation, whereby it is possible to reduce the circulation flow rate of the heat accumulating water circuit. Accordingly, it is possible to control the circulation flow rate of water during the heat accumulating operation to the appropriate flow rate, and adequately increase the temperature of hot water coming out of the water heater 100. As a result, it is possible to adequately increase the temperature of hot water stored in the hot water storage tank 2. As the high pressure loss by the narrowed portion 30 does not occur during the indoor-heating operation, it is possible to adequately secure the flow rate required by the indoor-heating water circuit.

[0034] In Embodiment 1, the narrowed portion 30 is provided in the upper pipe 4. However, the present invention is not limited to the configuration, and the narrowed portion 30 may be provided in the lower pipe 8 forming the heat accumulating water path other than the overlap portion between the heat accumulating water path and the indoor-heating water path. This configuration also allows the above-described effect to be obtained.

[0035] In Embodiment 1, the narrowed portion 30 is provided in the upper pipe 4, and the narrowed portion 30 is not provided in the lower pipe 8. As a result, the following effect is obtained. When the hot-water supply and heating system 1 is repaired, or when the use of the hot-water supply and heating system 1 is suspended, there are cases where water needs to be drained from the hot water storage tank 2 and the hot water storage tank 2 is emptied. A configuration in which a drain valve (not shown) for performing the above drainage is connected to the first common pipe 9 or the second internal pipe 7 is conceivable. In such a configuration, when the drain valve is opened, water inside the hot water storage

tank 2 is drained from the drain valve through the lower pipe 8. In the case where the narrowed portion 30 is provided in the lower pipe 8, it takes a longer time to drain the hot water storage tank 2. In contrast to this, in Embodiment 1, the narrowed portion 30 is provided in the upper pipe 4 and the narrowed portion 30 is not provided in the lower pipe 8, and hence it does not take a long time to drain the hot water storage tank 2.

[0036] A water pump having a variable rotation speed may also be used as the water pump 11. In this case, a water pump including, e.g., a pulse width modulation control (PWM control) DC motor capable of changing the rotation speed with a speed command voltage from the control section 10 is preferably for use as the water pump 11. When the pressure loss of the heat accumulating water path is not more than the pressure loss of the indoor-heating water path, there are cases where, even when the rotation speed of the water pump 11 is controlled so as to run at the lowest speed, the circulation flow rate of water during the heat accumulating operation exceeds the appropriate flow rate. In contrast to this, In Embodiment 1, by making the pressure loss of the heat accumulating water path higher than the pressure loss of the indoor-heating water path, it is possible to reliably control the circulation flow rate of water during the heat accumulating operation to the appropriate flow rate.

[0037] In the hot-water supply and heating system 1, when it is assumed that the value of the pressure loss of the heat accumulating water path is P1 and the value of the pressure loss of the indoor-heating water path is P2, the value of P1/P2 is preferably not less than 2.0 and more preferably not less than 2.4. In addition, the value of P1/P2 is preferably not more than 6.0 and more preferably not more than 4.3. By setting the value of P1/P2 to a value within this range, it is possible to prevent an increase in the power consumption of the water pump 11 while reliably controlling the circulation flow rate of water during the heat accumulating operation to the appropriate flow rate.

[0038] When the water pump 11 used in the hot-water supply and heating system 1 is selected, the pressure losses of the indoor-heating water circuit in cases where the indoor-heating terminals 12 having various configurations described above are used are actually measured or calculated on a provisional basis, and the pressure loss of the heat accumulating water circuit that changes according to the lengths of the first common pipe 9 and the second common pipe 3 is actually measured or calculated on a provisional basis. The water pump 11 is selected, which has the maximum head that achieves a predetermined value (e.g., 10 liters per minute) for the circulation flow rate of water in the indoor-heating water circuit even for the configuration in which the pressure loss of the indoor-heating water circuit is assumed to be maximal in the actual measurement or provisional calculation. In addition, the water pump 11 is selected, has the minimum head that achieves a predetermined value (e.g., one liter per minute) for the circulation flow rate of water in the heat accumulating water circuit even for the configuration in which the pressure loss of the indoor-heating water circuit is assumed to be minimal in the actual measurement or provisional calculation. Typically, a problem arises in that, as a head width (a difference between the maximum head and the minimum head) of the water pump 11 is increased, the size of the water pump 11 is increased and the required installation space of the water pump 11 is increased. By setting the value of P1/P2 to the value within the above-described range, it is possible to reliably prevent the size of the water pump 11 from becoming excessively large while reliably controlling the circulation flow rate of water during the heat accumulating operation to the appropriate flow rate.

Embodiment 2.

[0039] Next, Embodiment 2 of the present invention will be described with reference to Fig. 9. The description will focus on points that differ from the above-described embodiment, and portions identical or equivalent to those in the above-described embodiment will be designated by the same reference numerals and description thereof omitted. Fig. 9 is a longitudinal sectional view of the upper pipe 4 of the hot-water supply and heating system 1 according to Embodiment 2.

[0040] The flow channel cross-sectional area of the upper pipe 4 shown in Fig. 9 is smaller than each of the flow path cross-section areas of the first common pipe 9 and the second common pipe 3, and is smaller than each of the flow channel cross-sectional areas of the first internal pipe 5 and the second internal pipe 7. The upper pipe 4 according to Embodiment 2 is thinner than the first common pipe 9 and the second common pipe 3, and is thinner than the first internal pipe 5 and the second internal pipe 7. In this embodiment, by using the thin upper pipe 4, the upper pipe 4 itself forms the narrowed portion. Accordingly, a separate member such as the narrowed portion 30 according to Embodiment 1 is not necessary, making it possible to reduce the cost. The hot-water supply and heating system 1 according to Embodiment 2 achieves the same effect as that according to Embodiment 1. The upper pipe 4 itself forms the narrowed portion, whereby it is possible to make the pressure loss of the heat accumulating water path higher than the pressure loss of the indoor-heating water path using the simple configuration.

Embodiment 3.

[0041] Next, Embodiment 3 of the present invention will be described with reference to Fig. 10. The description will focus on points that differ from the above-described embodiments, and portions identical or equivalent to those in the

above-described embodiments will be designated by the same reference numerals and descriptions thereof omitted. Fig. 10 is a cross-sectional view of the switching valve 6 of the hot-water supply and heating system 1 according to Embodiment 3.

[0042] As shown in Fig. 10, the switching valve 6 has a movable element 32, and a housing element that houses the movable element 32. The movable element 32 is, e.g., a substantially spherical ball valve. The movable element 32 has an L-shaped through channel 34. Both ends of the through channel 34 form openings in the surface of the movable element 32. The movable element 32 can rotate about a rotation axis perpendicular to the sheet on which Fig. 10 is presented. In the case where the movable element 32 is configured so as to be rotated by a stepping motor (not shown), it is possible to easily control the rotation angle of the movable element 32.

[0043] The housing element of the switching valve 6 has the first port 6a, the second port 6b, the third port 6c, O-rings 31, and seal members 33. The O-rings 31 and the seal members 33 are provided respectively in the first port 6a, the second port 6b, and the third port 6c. The seal members 33 come in contact with the surface of the movable element 32 to prevent liquid leakage from gaps between the seal members 33 and the movable element 32. The O-rings 31 prevent liquid leakage from gaps between the seal members 33 and the first port 6a, the second port 6b, and the third port 6c respectively. Fig. 10 shows a state in which the control section 10 has switched the switching valve 6 to the heat accumulating water path. In this state, the first port 6a communicates with the third port 6c via the through channel 34. In this state, the surface of the movable element 32 comes in contact with the seal member 33 provided in the second port 6b, and the second port 6b is thereby closed.

[0044] The narrowed portion 30 is provided inside the first port 6a of the switching valve 6. The flow channel cross-sectional area of the narrowed portion 30 is smaller than the flow channel cross-sectional area of the second port 6b. The narrowed portion 30 is a tubular member having an outer diameter substantially equal to the inner diameter of the first port 6a. The narrowed portion 30 is fixed inside the first port 6a. By providing the narrowed portion 30, the pressure loss of the first port 6a is made higher than the pressure loss of the second port 6b. Thus, by making the pressure loss of the first port 6a linked to the heat accumulating water path higher than the pressure loss of the second port 6b linked to the indoor-heating water path, it is possible to make the pressure loss of the heat accumulating water path higher than the pressure loss of the indoor-heating water path using the simple configuration. The hot-water supply and heating system 1 according to Embodiment 3 achieves the same effect as that according to Embodiment 1. The narrowed portion 30 may also be formed integrally with the first port 6a.

Embodiment 4.

[0045] Next, Embodiment 4 of the present invention will be described with reference to Fig. 11. The description will focus on points that differ from the above-described embodiments, and portions identical or equivalent to those in the above-described embodiments will be designated by the same reference numerals and descriptions thereof omitted. Fig. 11 is a cross-sectional view of the switching valve 6 of the hot-water supply and heating system 1 according to Embodiment 4. Fig. 11 shows a state in which the control section 10 has switched the switching valve 6 to the heat accumulating water path.

[0046] The switching valve 6 has the movable element 32, and the housing element that houses the movable element 32. The movable element 32 is, e.g., a substantially spherical ball valve. The movable element 32 has the L-shaped through channel 34. Both ends of the through channel 34 form openings in the surface of the movable element 32. The movable element 32 can rotate about the rotation axis perpendicular to the sheet on which Fig. 11 is presented. The housing element of the switching valve 6 has the first port 6a, the second port 6b, the third port 6c, the O-rings 31, and the seal members 33. The O-rings 31 and the seal members 33 are provided in the first port 6a, the second port 6b, and the third port 6c respectively. The seal members 33 come in contact with the surface of the movable element 32 to prevent liquid leakage from the gaps between the seal members 33 and the movable element 32. The O-rings 31 prevent liquid leakage from the gaps between the seal members 33 and the first port 6a, the second port 6b, and the third port 6c.

[0047] When the switching valve 6 is switched to the heat accumulating water path, as shown in Fig. 11, part of the openings at both ends of the through channel 34 in the movable element 32 are covered with the seal members 33 of the housing element. Part of the opening of one end of the through channel 34 is covered with the seal member 33 provided in the first port 6a. Part of the opening of the other end of the through channel 34 is covered with the seal member 33 provided in the third port 6c.

[0048] In Embodiment 4, when the switching valve 6 is switched to the heat accumulating water path, part of the openings at both ends of the through channel 34 in the movable element 32 are covered with the seal members 33, whereby the flow channel of water is narrowed and the high pressure loss occurs. Accordingly, it is possible to make the pressure loss of the heat accumulating water path higher than the pressure loss of the indoor-heating water path. The hot-water supply and heating system 1 according to Embodiment 4 achieves the same effect as that according to Embodiment 1. According to Embodiment 4, the same effect as that according to Embodiment 1 can be obtained by controlling the rotation angle of the movable element 32, and hence it is not necessary to add a new component, making

it possible to reduce the cost.

[0049] Although the depiction thereof is omitted, when the control section 10 switches the switching valve 6 to the indoor-heating water path, the rotation position of the movable element 32 is controlled such that neither of the openings at both ends of the through channel 34 in the movable element 32 are covered with the seal members 33. As a result, when the switching valve 6 is switched to the indoor-heating water path, the entire opening of one end of the through channel 34 overlaps the central hole of the seal member 33 provided in the second port 6b, and the entire opening of the other end of the through channel 34 overlaps the central hole of the seal member 33 provided in the third port 6c. When the switching valve 6 is switched to the indoor-heating water path, the high pressure loss does not occur.

[0050] Thus, the embodiments of the present invention have been described, and the present invention may encompass any combination of the embodiments described above.

[Reference Signs List]

[0051]

1	hot-water supply and heating system
2	hot water storage tank
3	second common pipe
4	upper pipe
5	first internal pipe
6	switching valve
6a	first port
6b	second port
6c	third port
7	second internal pipe
8	lower pipe
9	first common pipe
10	control section
11	water pump
12, 12A, 12B, 12C, 12D, 12E	indoor-heating terminal
13	compressor
14	refrigerant pipe
15	water-refrigerant heat exchanger
16	decompressor
17	low-temperature-side heat exchanger
18	feed-water pipe
19	hot-water supply pipe
21	remote controller
22	first external pipe
23	second external pipe
24, 24a, 24b, 24c, 24d, 24e, 24f, 24g, 24h, 24i	indoor-heating device
25	first water outlet
26	first water inlet
27	second water outlet
28	second water inlet
30	narrowed portion
31	O-ring
32	movable element
33	seal member
34	through channel
100	water heater
200	tank unit

Claims

1. A hot-water supply and heating system comprising:

a hot water storage tank;
a first water outlet from which water inside the hot water storage tank comes out;
a first water inlet through which water enters into the hot water storage tank;
a water heater configured to heat water;
5 a water pump;
a heat accumulating water path that connects the first water outlet, the water pump, the water heater, and the first water inlet in this order;
a second water outlet from which water to be supplied to an external indoor-heating device comes out;
a second water inlet into which water returned from the indoor-heating device enters;
10 an indoor-heating water path that connects the second water inlet, the water pump, the water heater, and the second water outlet in this order; and
a switching valve configured to switch between the heat accumulating water path and the indoor-heating water path, wherein
an overlap portion in which the heat accumulating water path overlaps the indoor-heating water path is provided,
15 and
a pressure loss of the heat accumulating water path is higher than a pressure loss of the indoor-heating water path.

2. The hot-water supply and heating system according to Claim 1, wherein
20 a narrowed portion is provided in a pipe that forms the heat accumulating water path other than the overlap portion, and a flow channel cross-sectional area of the narrowed portion is smaller than a flow channel cross-sectional area of a pipe that forms the overlap portion.

3. The hot-water supply and heating system according to Claim 2, wherein
25 the first water outlet is positioned in a lower portion of the hot water storage tank, the first water inlet is positioned in an upper portion of the hot water storage tank, the heat accumulating water path other than the overlap portion includes a lower pipe connected to the first water outlet and an upper pipe connected to the first water inlet, and the narrowed portion is not provided in the lower pipe but is provided in the upper pipe.

4. The hot-water supply and heating system according to Claim 1, wherein
the switching valve includes:

a first port linked to the heat accumulating water path;
35 a second port linked to the indoor-heating water path; and
a narrowed portion configured to make a pressure loss of the first port higher than a pressure loss of the second port.

5. The hot-water supply and heating system according to Claim 1, wherein
40 the switching valve includes:

a movable element that has a through channel, the through channel forming an opening in a surface of the movable element; and
45 a housing element that has a plurality of ports and houses the movable element, wherein part of the opening of the through channel of the movable element is covered with the housing element when the switching valve switches to the heat accumulating water path.

FIG. 1

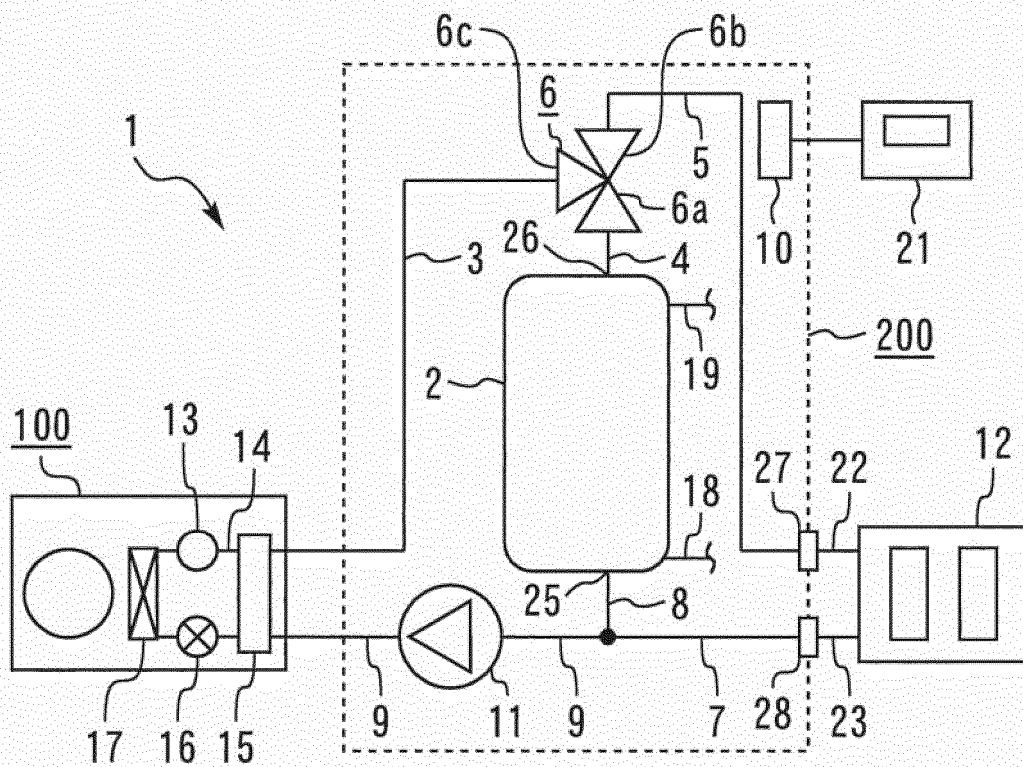


FIG. 2

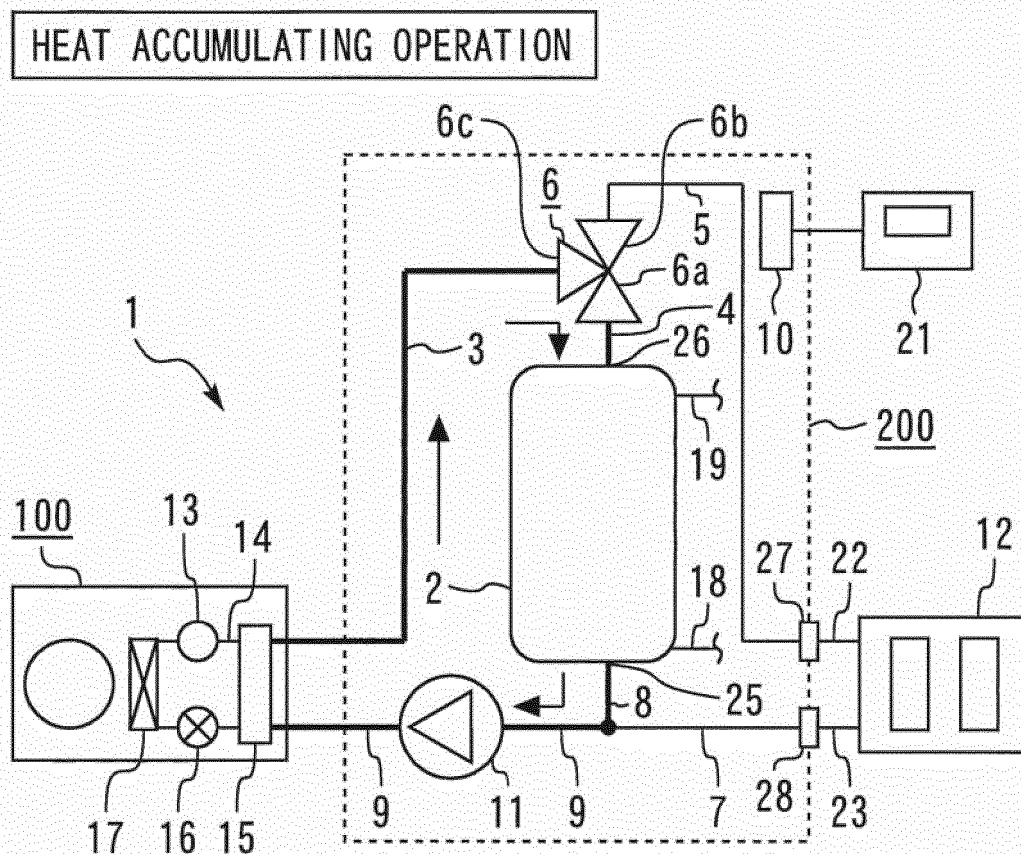


FIG. 3

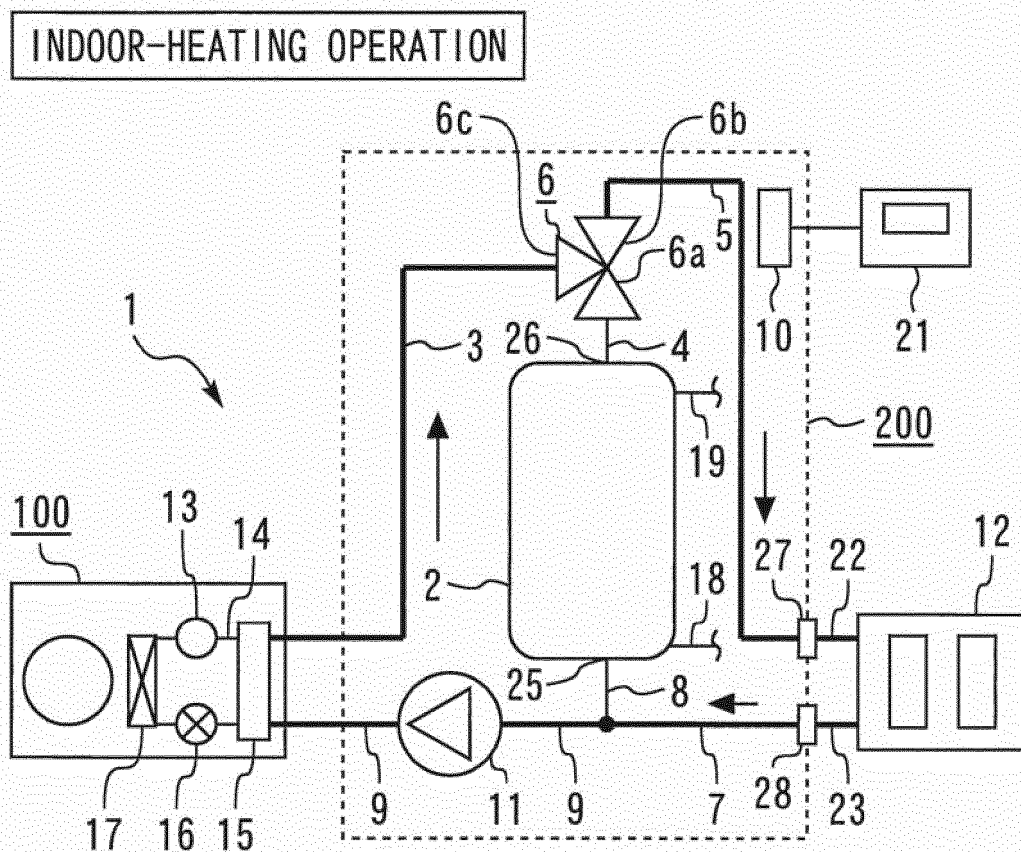


FIG. 4

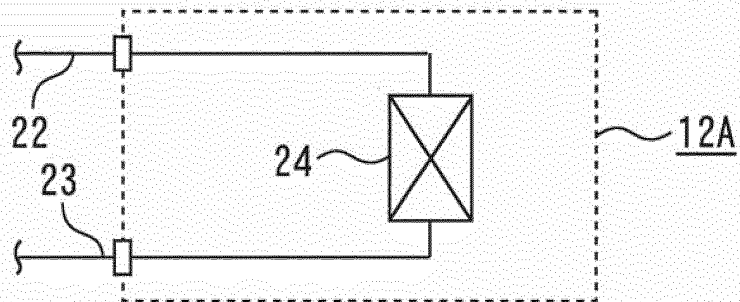


FIG. 5

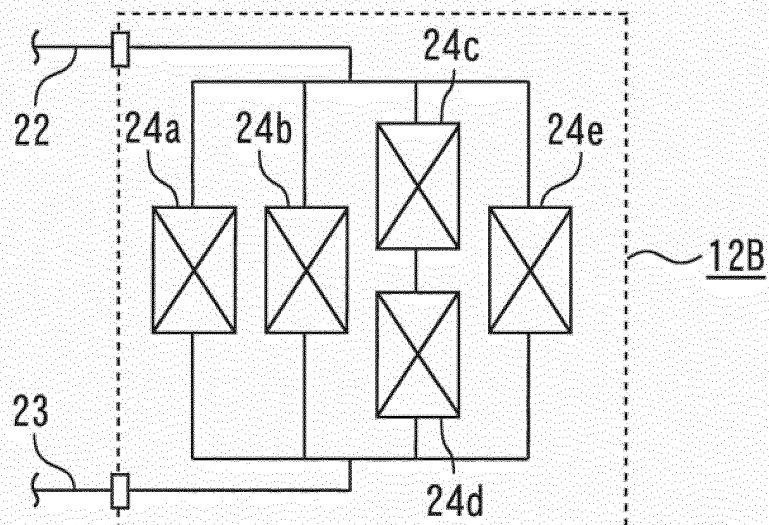


FIG. 6

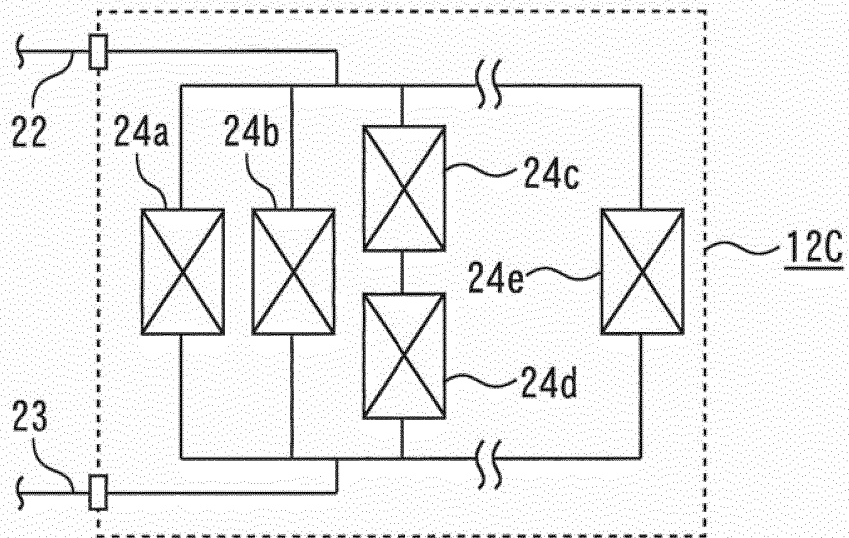


FIG. 7

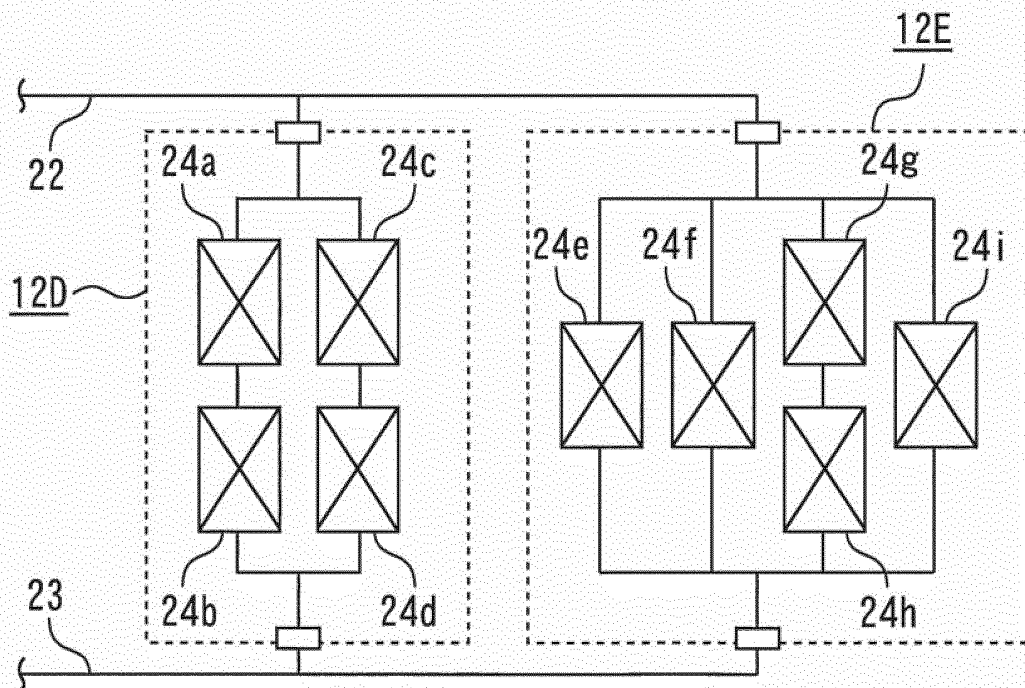


FIG. 8

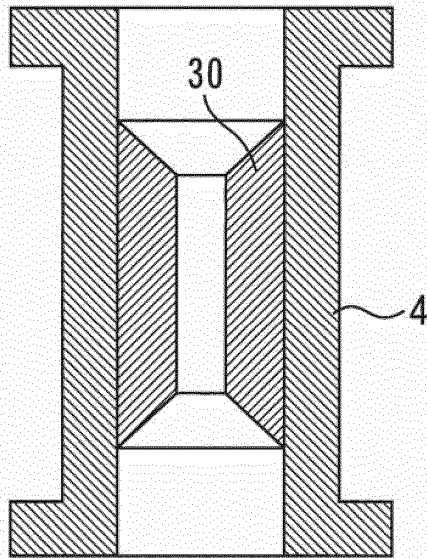


FIG. 9

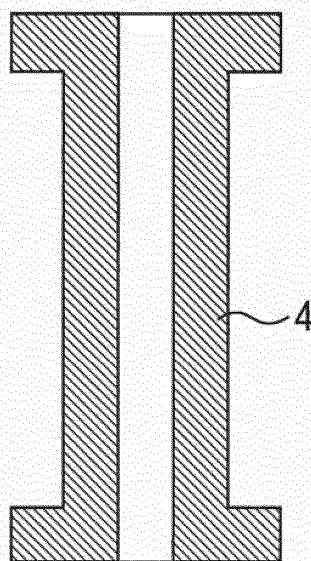


FIG. 10

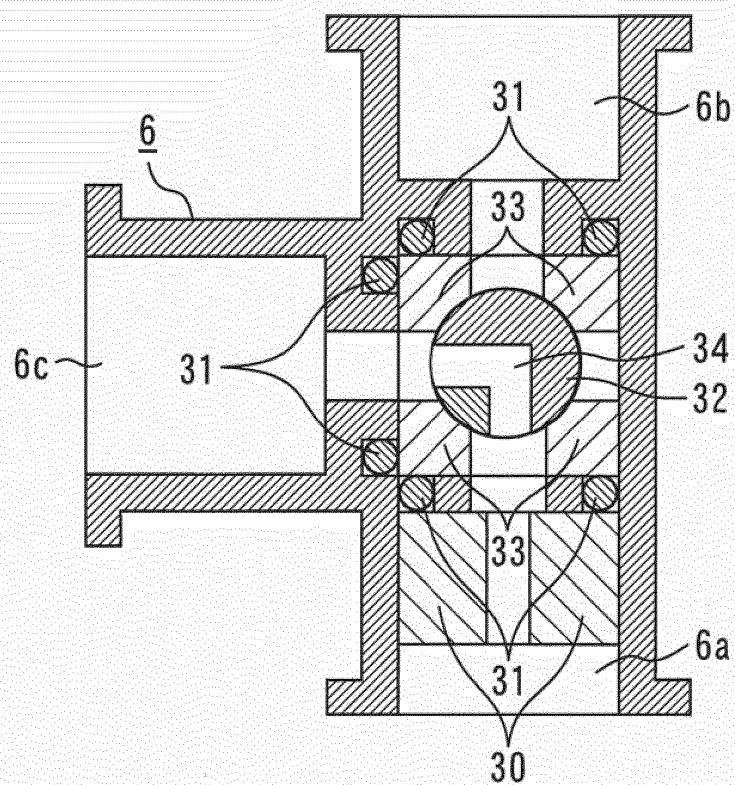
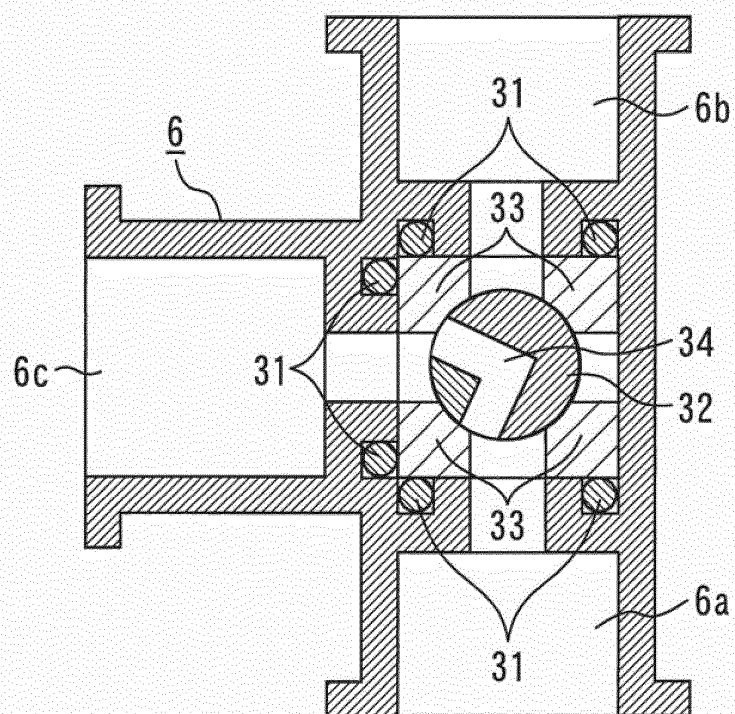


FIG. 11



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/075703

A. CLASSIFICATION OF SUBJECT MATTER

F24H1/18(2006.01)i, F24D3/18(2006.01)i, F24H1/00(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)

F24H1/18, F24D3/18, F24H1/00

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 1996-2014

Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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.
A	JP 2006-10187 A (Corona Corp.), 12 January 2006 (12.01.2006), paragraphs [0029], [0039], [0042]; fig. 4, 6 (Family: none)	1-5
A	JP 11-153329 A (Mitsubishi Electric Corp.), 08 June 1999 (08.06.1999), paragraphs [0007], [0022] to [0023]; fig. 1 to 4 (Family: none)	1-5

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&" document member of the same patent family

Date of the actual completion of the international search
16 December 2014 (16.12.14)Date of mailing of the international search report
06 January 2015 (06.01.15)Name and mailing address of the ISA/
Japan Patent Office

Authorized officer

Facsimile No.

Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2006046800 A [0003]