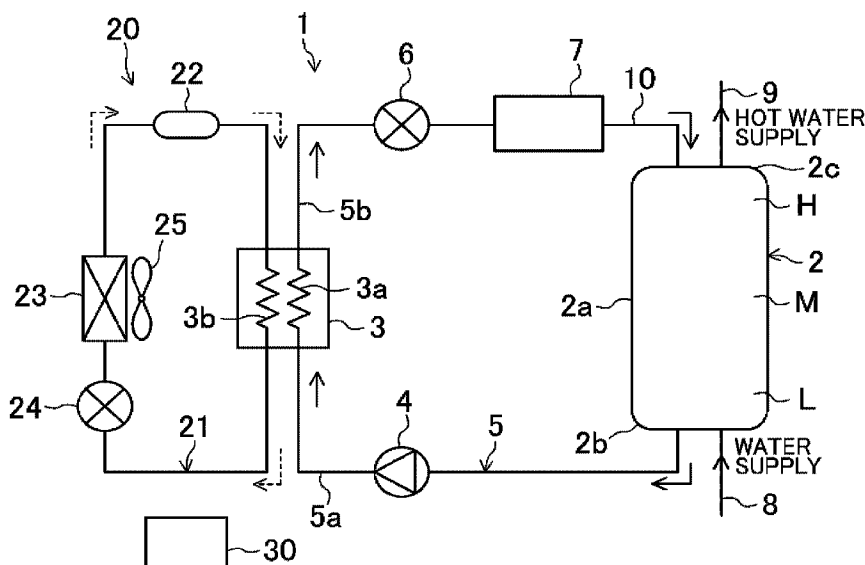


(74) Agent: KIRBY EADES GALE BAKER

(54) Title: HOT WATER SUPPLY DEVICE



The hot water supply apparatus (1) includes a heat exchanger (3) configured to heat water for hot water supply, and a pressure controller (6) provided in a subsequent stage of the heat exchanger (3) and configured to pressurize the water for hot water supply. The hot water supply apparatus (1) further includes a trap (7) for promoting deposition of scale, in a subsequent stage of the pressure controller (6).

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Abstract:

The hot water supply apparatus (1) includes a heat exchanger (3) configured to heat water for hot water supply, and a pressure controller (6) provided in a subsequent stage of the heat exchanger (3) and configured to pressurize the water for hot water supply. The hot water supply apparatus (1) further includes a trap (7) for promoting deposition of scale, in a subsequent stage of the pressure controller (6).

DESCRIPTION

HOT WATER SUPPLY DEVICE

TECHNICAL FIELD

5 [0001]

The present disclosure relates to a hot water supply apparatus.

BACKGROUND ART

[0002]

A heat pump hot water supply apparatus configured to deliver water that has
10 heated in a heat exchanger to a tank has been known. Patent Document 1 proposes
pressurizing of heated water by a valve mechanism located just before the tank in the heat
pump hot water supply apparatus to reduce scale precipitation in a pressurizing area.

[0003]

In the hot water supply apparatus of Patent Document 1, in order to prevent
15 significant scale precipitation due to significant depressurization of heated water that has
passed through the pressurizing area, the valve mechanism has an internal structure which
achieves a pressurization behavior with a gentle gradient.

CITATION LIST

20 PATENT DOCUMENT

[0004]

PATENT DOCUMENT 1: Japanese Unexamined Patent Publication No. 2011-
27279

SUMMARY

TECHNICAL PROBLEM

[0005]

However, adjustment of the depressurization gradient by the structure of the valve
5 in Patent Document 1 is effective only at a certain point on design. Changes in the flow rate
of water actually occur in accordance with various operation conditions. Thus, it is difficult
to reduce, by the hot water supply apparatus of Patent Document 1, scale precipitation at the
time when depressurization is performed. In addition, such a structure of valve is costly in
manufacturing itself, and is effective only at a certain flow rate design point as mentioned
10 above. A cost reduction effect due to the advantage of scale thus cannot be obtained by
common use in many models. Accordingly, the hot water supply apparatus of Patent
Document 1 is really expensive.

[0006]

Further, Patent Document 1 proposes depressurization at an inlet of the tank based
15 on the consideration that there is no problem in precipitation of scale in the tank due to
significant depressurization of heated water. However, in reality, precipitation of scale
inside the tank causes a comfort problem such as mixing of scale into available hot water to
be supplied, and a reliability problem such as causing pump failure due to mixing of scale,
which has been accumulated in the bottom of the tank and discharged from the lower side
20 of the tank, into a pump or the like provided in a channel provided in a subsequent stage of
the tank.

[0007]

An object of the present disclosure is to provide a hot water supply apparatus
capable of reducing scale precipitation at low cost without impairing comfort and reliability.

SOLUTION TO THE PROBLEM

[0008]

5 A first aspect of the present disclosure is directed to a hot water supply apparatus including: a heat exchanger (3) configured to heat water for hot water supply; a pressure controller (6) provided in a subsequent stage of the heat exchanger (3) and configured to pressurize the water for hot water supply; and a trap (7) for promoting deposition of scale, the trap (7) being provided in a subsequent stage of the pressure controller (6).

[0009]

10 In the first aspect, the pressurization of water by the pressure controller (6) allows reduction in scale precipitation, and the trap (7) can capture scale precipitated by depressurization in a subsequent stage of the pressure controller (6). Therefore, scale precipitation can be reduced at low cost without impairing comfort and reliability.

[0010]

15 A second aspect of the present disclosure is an embodiment of the first aspect. In the second aspect, an inner diameter of the trap (7) is larger than an inner diameter of a water pipe (10) before and after the trap (7).

[0011]

20 In the second aspect, the increase in the inner diameter of the trap (7) leads to further decrease in the water pressure and decrease in the flow velocity of the water. Scale is thus easily precipitated in the trap (7), and the precipitated scale is easily deposited. This improves the effect of capturing scale.

[0012]

A third aspect of the present disclosure is an embodiment of the first or second

aspect. In the third aspect, a surface roughness of an inner peripheral surface of the trap (7) is larger than a surface roughness of an inner peripheral surface of a water pipe (10) before and after the trap (7).

[0013]

5 In the third aspect, the scale precipitated on the inner peripheral surface of the trap (7) is deposited further easily. This further improves the effect of capturing scale by the trap (7).

[0014]

10 A fourth aspect of the present disclosure is an embodiment of any one of the first to third aspects. In the fourth aspect, the trap (7) is configured to be able to supply water from outside and discharge water to outside.

[0015]

 In the fourth aspect, the scale deposited in the trap (7) can be discharged without construction work.

15 [0016]

 A fifth aspect of the present disclosure is an embodiment of any one of the first to fourth aspects. In the fifth aspect, the trap (7) is configured to be detachable and replaceable.

[0017]

20 The fifth aspect enables maintenance of the hot water supply apparatus by simply replacing the trap (7).

[0018]

 A sixth aspect of the present disclosure is an embodiment of any one of the first to fifth aspects. In the sixth aspect, at least part of the pressure controller (6) is integral with the trap (7).

[0019]

In the sixth aspect, the trap (7) partially functions to perform depressurization. This facilitates selection of a valve or the like serving as the pressure controller (6).

[0020]

5 A seventh aspect of the present disclosure is an embodiment of any one of the first to sixth aspects. In the seventh aspect, the hot water supply apparatus further includes a tank (2) for storing the water for hot water supply, in a subsequent stage of the trap (7).

[0021]

In the seventh aspect, scale is substantially prevented from entering the tank (2).

10 [0022]

An eighth aspect of the present disclosure is an embodiment of any one of the first to seventh aspects. In the eighth aspect, the hot water supply apparatus further includes a pressurization mechanism (14) configured to pressurize the water for hot water supply over the water circuit (5) entirely.

15 [0023]

In the eighth aspect, it is not necessary to perform a high lift operation using a pump. Thus, a pump input is reduced, and the efficiency of the hot water supply apparatus can be increased. Further, it is not necessary to make the pump have high lift specifications. This can downsize the pump and reduce the cost of the pump.

20 [0024]

A ninth aspect of the present disclosure is an embodiment of any one of the first to eighth aspects. In the eighth aspect, the hot water supply apparatus further includes an eddy current heater (15) that is provided between the heat exchanger (3) and the pressure controller (6) and is configured to heat the water for hot water supply.

[0025]

In the ninth aspect, heating of the water for hot water supply (more specifically, the water pipe) and applying of an electromagnetic field to the water for hot water supply can be performed in parallel by heating by the eddy current heater (15). This allows highly
5 efficient production of high-temperature water while the scale precipitation is reduced.

[0026]

A tenth aspect of the present disclosure is an embodiment of the ninth aspect. In the tenth aspect, the heat exchanger (3) heats the water for hot water supply to a temperature in a temperature range where scale is not precipitated, and the eddy current heater (15) heats
10 the water for hot water supply to a temperature higher than the temperature range.

[0027]

The tenth aspect allows further reliable reduction in the scale precipitation.

[0028]

An eleventh aspect of the present disclosure is an embodiment of the ninth or tenth
15 aspect. In the eleventh aspect, a material of a portion of pipe heated by the eddy current heater (15) is stainless steel.

[0029]

Among material candidates (copper, aluminum, stainless steel, and the like) that can be used for the water pipe, stainless steel can further improve the thermal efficiency of
20 the eddy current heater (15). The eleventh aspect thus allows efficient water heating.

[0030]

A twelfth aspect of the present disclosure is an embodiment of any one of the first to eleventh aspects. In the eleventh aspect, the heat source device (20) of the heat exchanger (3) is a heat pump.

[0031]

The twelfth aspect allows highly efficient heating operation in the entire hot water supply apparatus.

5 BRIEF DESCRIPTION OF THE DRAWINGS

[0032]

FIG. 1 is a schematic piping system diagram illustrating a hot water supply apparatus according to an embodiment.

FIG. 2 is a diagram illustrating cross-sectional configurations of a trap and a water
10 pipe before and after the trap according to a first variation.

FIG. 3 is a diagram illustrating a state where a scale adsorbent is provided on the inner peripheral surface of the trap illustrated in FIG. 2.

FIG. 4 is a diagram illustrating cross-sectional configurations of a trap and a water pipe before and after the trap according to a second variation.

15 FIG. 5 is a diagram illustrating an arrangement of a water supply-discharge mechanism relative to a trap in a hot water supply apparatus according to a third variation.

FIG. 6 is a diagram illustrating a cross-sectional configuration of a trap and a water pipe before and after the trap according to a fourth variation.

FIG. 7 is a diagram illustrating a state where an orifice is provided at an inlet of
20 the trap illustrated in FIG. 6.

FIG. 8 is a diagram illustrating a state where an orifice is provided in a water pipe in a preceding stage of the trap illustrated in FIG. 6.

FIG. 9 is a schematic piping system diagram of a hot water supply apparatus according to a fifth variation.

FIG. 10 is a schematic piping system diagram of a hot water supply apparatus according to a sixth variation.

FIG. 11 is a schematic piping system diagram of a hot water supply apparatus according to a reference example.

5 FIG. 12 is a schematic piping system diagram of a hot water supply apparatus according to a seventh variation.

DESCRIPTION OF EMBODIMENTS

[0033]

10 An embodiment of the present disclosure will be described below with reference to the drawings. The following embodiment is a merely preferred example in nature, and is not intended to limit the scope, applications, or use of the invention.

[0034]

«Embodiment»

15 <Configuration of Hot Water Supply Apparatus>

FIG. 1 is a schematic piping system diagram of a hot water supply apparatus (1) according to the present embodiment. As illustrated in FIG. 1, the hot water supply apparatus (1) heats water for hot water supply (hereinafter also referred to as water) supplied from a water source (not shown) through a water supply pipe (8) and stores the heated water
20 in a tank (2). The hot water stored in the tank (2) is supplied to a predetermined hot water supply target (not shown) through a hot water supply pipe (9). The water source includes water supplies. The hot water supply target includes a shower, a faucet, and a bathtub. The hot water supply apparatus (1) includes: a heat source device (20); a tank (2); a water pump (4); a water circuit (5); a pressure controller (6); a trap (7); and a controller (30). The water

circuit (5) is constituted by connecting the heat source device (20), the tank (2), the water pump (4), the pressure controller (6), and the trap (7) via a water pipe (10).

[0035]

The heat source device (20) is, for example, a heat pump heat source device. The heat source device (20) produces warm thermal energy for heating water. The heat source device (20) is a vapor compression heat source device. The heat source device (20) includes a refrigerant circuit (21). The refrigerant circuit (21) is filled with a refrigerant. The refrigerant circuit (21) includes a compressor (22), a heat-source-side heat exchanger (23), an expansion valve (24), and an utilization-side heat exchanger (3). The compressor (22) compresses a refrigerant sucked thereinto and discharges the compressed refrigerant. The heat-source-side heat exchanger (23) is, for example, an air-cooled heat exchanger. The heat-source-side heat exchanger (23) is disposed outdoors. The heat source device (20) has a fan (25). The fan (25) is disposed near the heat-source-side heat exchanger (23). The heat-source-side heat exchanger (23) exchanges heat between air transferred by the fan (25) and the refrigerant. The expansion valve (24) is a depressurization mechanism that depressurizes the refrigerant. The expansion valve (24) is provided between the liquid end of the utilization-side heat exchanger (3) and the liquid end of the heat-source-side heat exchanger (23). The depressurization mechanism is not limited to an expansion valve, and may be a capillary tube, an expander, and the like. The expander recovers the energy of the refrigerant as power.

[0036]

The utilization-side heat exchanger (3) constituting the heat source device (20) is a heat exchanger that heats water in the hot water supply apparatus (1). The utilization-side heat exchanger (3) (hereinafter also referred to as a heat exchanger (3)) is a liquid-cooled

heat exchanger, for example. The heat exchanger (3) has a first channel (3a) and a second channel (3b). The first channel (3a) is connected to the water circuit (5). The second channel (3b) is connected to the refrigerant circuit (21). The heat exchanger (3) exchanges heat between water flowing through the first channel (3a) and the refrigerant flowing through the second channel (3b). In the heat exchanger (3), the first channel (3a) is formed along the second channel (3b). In the present embodiment, during a heating operation, the direction of the refrigerant flowing through the second channel (3b) is substantially opposite to the direction of the water flowing through the first channel (3a). In other words, the heat exchanger (3) during the heating operation functions as an opposite-flow heat exchanger. In FIG. 1, the direction of the water flowing through the water circuit (5) is indicated by solid line arrows, and the direction of the refrigerant flowing through the refrigerant circuit (21) is indicated by broken line arrows.

[0037]

The tank (2) is a container for storing water. The tank (2) is formed in a vertically long cylindrical shape, for example, and has a cylindrical barrel (2a), a bottom portion (2b) closing the lower end of the barrel (2a), and a top portion (2c) closing the upper end of the barrel (2a). Inside the tank (2), a low-temperature portion (L), a medium-temperature portion (M), and a high-temperature portion (H) are formed. The low-temperature portion (L) stores low-temperature water. The high-temperature portion (H) stores high-temperature water. The medium-temperature portion (M) stores medium-temperature water. The medium-temperature water has a temperature lower than the temperature of the high-temperature water and higher than the temperature of the low-temperature water. Water is supplied to the bottom portion (2b) of the tank (2) through the water supply pipe (8) from a water source such as a water pipe or the like (not shown). The high-temperature water is

supplied to the hot water supply target (not shown) through the hot water supply pipe (9) from the top portion (2c) of the tank (2).

[0038]

In the water circuit (5), water in the tank (2) circulates. The first channel (3a) of the heat exchanger (3) is connected to the water circuit (5). The water circuit (5) has an upstream channel (5a) and a downstream channel (5b). An inflow end of the upstream channel (5a) is connected to the bottom portion (2b) of the tank (2), i.e., the low-temperature portion (L). An outflow end of the upstream channel (5a) is connected to an inflow end of the first channel (3a) of the heat exchanger (3). An inflow end of the downstream channel (5b) is connected to an outflow end of the first channel (3a). An outflow end of the downstream channel (5b) is connected to the top portion (2c) of the tank (2), i.e., the high-temperature portion (H).

[0039]

The water pump (4) is provided in the upstream channel (5a) of the water circuit (5), i.e., a preceding stage to the heat exchanger (3). The water pump (4) causes water in the water circuit (5) to circulate. Specifically, the water pump (4) transfers the water in the tank (2) to the first channel (3a) of the heat exchanger (3), and returns the water transferred to the first channel (3a) to the tank (2).

[0040]

The pressure controller (6) is provided in the downstream channel (5b) of the water circuit (5), i.e., the subsequent stage to the heat exchanger (3). The pressure controller (6) pressurizes the water flowing through the downstream channel (5b), i.e., the water heated in the heat exchanger (3). Assuming that the pressure of water flowing through the downstream channel (5b) without the pressure controller (6) is, for example, less than about

0.05 MPa, the pressure controller (6) controls the pressure of the water flowing through the downstream channel (5b) between the heat exchanger (3) and the pressure controller (6) to, for example, about 0.05 MPa or more, preferably about 0.05 MPa to about 0.30 MPa, more preferably about 0.15 MPa to about 0.30 MPa. The pressurization of heated water allows
5 reduction in the amount of carbon dioxide gas generated in the downstream channel (5b) and in the first channel (3a) of the heat exchanger (3) connected to the downstream channel (5b), thereby reducing precipitation of calcium carbonate scale. In the present embodiment, in consideration of the load on the pressure controller (6), the upper limit of the pressure applied in pressurization is set to, for example, about 0.30 MPa.

10 [0041]

As the pressure controller (6), a pressure control valve capable of easily controlling the pressure by controlling a cross-sectional area of the channel may be used. In addition to the pressure controller (6) provided in a subsequent stage of the heat exchanger (3), a water pump (4) provided in a preceding stage of the heat exchanger (3), a
15 depressurization valve (not shown) disposed in the water supply pipe (8) for supplying water to the tank (2), and the like can also be used as other pressure controllers.

[0042]

If a pressure control valve (specifically, a gate valve) is used as a pressure controller (6), a cross-sectional area of the channel inside the valve is made smaller on the
20 heat exchanger (3) side, thereby increasing the pressure at the downstream channel (5b). On the other hand, the cross-sectional area of the channel inside the valve is larger on the tank (2) side, thereby decreasing the pressure at the channel. As a result, solubility of carbon dioxide gas decreases, and the amount of carbon dioxide gas generated increases, making it easier for calcium carbonate scale to generate.

[0043]

In the present embodiment, therefore, a trap (7) for promoting the deposition of scale is provided in a subsequent stage of the pressure controller (6). The configuration of the trap (7) is not particularly limited as long as deposition of scale can be promoted. For example, as the trap (7), a porous material such as zeolite or a strainer may be attached to part of the inner peripheral surface of the water pipe (10) constituting the water circuit (5). Alternatively, the trap (7) may be configured to be detachable and replaceable by providing valves in the water pipe (10) before and after the trap (7). This enables maintenance of the hot water supply apparatus (1) by simply replacing the trap (7).

10 [0044]

Although not shown, the water circuit (5) may be provided with sensors such as a pressure sensor and a temperature sensor. The pressure sensor detects pressures of water in the water circuit (5) such as the downstream channel (5b) and the first channel (3a) of the heat exchanger (3) connected to the downstream channel (5b), for example. The temperature sensor detects temperatures of water in the water circuit (5) such as the downstream channel (5b) and the first channel (3a), for example. The temperature sensor may detect directly the temperature of water in the water circuit (5). Alternatively, the temperature sensor may be attached to the surface of the water pipe (10) and indirectly detect the temperature of water in the water circuit (5) via the water pipe (10).

20 [0045]

The controller (30) includes a microcomputer and a memory device (specifically, a semiconductor memory) that stores software for operating the microcomputer. The controller (30) controls components constituting the heat source device (20), the water pump (4) of the water circuit (5), various sensors mentioned above, and the like. The controller

(30) is connected to the heat source device (20) and the like via wiring (not shown), and signals are exchanged between the controller (30) and the heat source device (20) and the like. The controller (30) performs a heating operation of generating hot water and storing the generated hot water in the tank (2). The heating operation of the present embodiment is
5 an operation in which water is directly heated by the heat source device (20).

[0046]

<Heating Operation of Hot Water Supply Apparatus>

In the heating operation, the controller (30) operates the compressor (22) and the fan (25). The controller (30) appropriately adjusts the opening degree of the expansion valve
10 (24). The controller (30) operates the water pump (4).

[0047]

The heat source device (20) performs a refrigeration cycle. In the refrigeration cycle, the refrigerant dissipates heat in the utilization-side heat exchanger (3). More specifically, in the refrigeration cycle, the refrigerant compressed in the compressor (22)
15 flows through the second channel (3b) of the utilization-side heat exchanger (3). In the utilization-side heat exchanger (3), the refrigerant in the second channel (3b) dissipates heat to water in the first channel (3a). The refrigerant that has dissipated heat or has been condensed in the second channel (3b) is decompressed in the expansion valve (24), and then flows through the heat-source-side heat exchanger (23). In the heat-source-side heat
20 exchanger (23), the refrigerant absorbs heat from the outdoor air and evaporates. The refrigerant that has evaporated in the heat-source-side heat exchanger (23) is sucked into the compressor (22).

[0048]

In the water circuit (5), the water in the low-temperature portion (L) of the tank

(2) flows out to the upstream channel (5a). The water in the upstream channel (5a) flows through the first channel (3a) of the utilization-side heat exchanger (3). The water in the first channel (3a) is heated by the refrigerant of the heat source device (20). The water that has heated in the first channel (3a) flows through the downstream channel (5b) into the high-
5 temperature portion (H) of the tank (2).

[0049]

—Advantages of Embodiment—

According to the hot water supply apparatus (1) of the present embodiment described above, the pressure controller (6) pressurizes water for hot water supply in a
10 subsequent stage of the heat exchanger (3) configured to heat the water for hot water supply. This allows reduction in scale precipitation in a pressurizing area. Further, scale precipitated, by depressurization, from the water for hot water supply that has passed through the pressure controller (6) is trapped in the trap (7). Thus, an expensive valve capable of controlling depressurization and the like does not have to be used as the pressure controller (6).
15 Moreover, scale is substantially prevented from reaching the water circuit (5) subsequent to the trap (7), such as a tank (2) and a water pump (4), for example. This improves comfort of available hot water to be supplied and reliability of the water pump (4) and the like. Therefore, scale precipitation can be reduced at low cost without impairing comfort and reliability.

20 [0050]

<First Variation>

FIG. 2 is a diagram illustrating example cross-sectional configurations of a trap (7) and a water pipe (10) before and after the trap (7) according to a first variation. In FIG. 2, the flow of water is indicated by arrows.

[0051]

As illustrated in FIG. 2, in the present variation, the inner diameter d1 of the trap (7) is made larger than the inner diameter d2 of the water pipe (10) before and after the trap (7). Such a trap (7) may be formed by, for example, enlarging the diameter of part of the water pipe (10).

[0052]

According to this variation, the following effects can be obtained in addition to the effects of the above-described embodiment. Specifically, the increase in the inner diameter of the trap (7) leads to further decrease in the water pressure, whereby scale is easily precipitated in the trap (7). Further, the flow velocity of the water in the trap (7) decreases due to the increase in the cross-sectional area of the trap (7), whereby the scale precipitated on the inner peripheral surface of the trap (7) is easily deposited. This improves the effect of capturing scale by the trap (7). Further, the inner diameter of the trap (7) is made larger than the inner diameter of the water pipe (10) before and after the trap (7). Thus, even if a certain amount of scale is deposited in the trap (7), internal clogging and pressure loss hardly occur.

[0053]

In the present variation, as illustrated in FIG. 3, a scale adsorbent (7a) made of a porous material such as zeolite may be provided on the inner peripheral surface of the trap (7) having an enlarged diameter. This further improves the effect of capturing scale by the trap (7). In this case, a similar effect can be obtained even if a strainer is disposed instead of the scale adsorbent (7a).

[0054]

<Second Variation>

FIG. 4 is a diagram illustrating example cross-sectional configurations of a trap (7) and a water pipe (10) before and after the trap (7) according to a second variation. In FIG. 4, the flow of water is indicated by arrows.

[0055]

5 As illustrated in FIG. 4, in the present variation, the inner peripheral surface of the trap (7) is a rough surface (7b). In other words, the surface roughness of the inner peripheral surface of the trap (7) is larger than the surface roughness of the inner peripheral surface of the water pipe (10) before and after the trap (7). The type of the surface roughness is not particularly limited, but may be, for example, an arithmetic mean roughness (R_a).

10 Alternatively, the surface roughness may be a maximum height (R_{max}), a ten-point mean roughness (R_z), an average spacing of unevenness, an average spacing between local peaks, a load length ratio, or the like.

[0056]

 In the present variation, the inner diameter of the trap (7) may be the same as the

15 inner diameter of the water pipe (10) before and after the trap (7), or may be larger than the inner diameter of the water pipe (10) before and after the trap (7) as in the first variation. In the former case, the trap (7) may be configured so that part of the water pipe (10) is provided with a rough surface (7b). FIG. 4 shows the latter case.

[0057]

20 According to this variation, the following effects can be obtained in addition to the effects of the above-described embodiment. Specifically, the scale precipitated on the inner peripheral surface of the trap (7) is deposited further easily. This further improves the effect of capturing scale by the trap (7).

[0058]

<Third Variation>

The third variation is different from the embodiment illustrated in FIG. 1 in that the trap (7) is configured to be capable of supplying water from outside and discharging
5 water to outside.

[0059]

FIG. 5 is a diagram illustrating an arrangement of a water supply-discharge mechanism relative to the trap (7) in a hot water supply apparatus (1) according to a third variation. In FIG. 5, the same components as those of the embodiment illustrated in FIG. 1
10 are denoted by the same reference numerals.

[0060]

As a water supply mechanism for the trap (7), as illustrated in FIG. 5, for example, a water supply port (11A) may be provided between the water pump (4) and the heat exchanger (3), a water supply port (11B) may be provided between the pressure controller
15 (6) and the trap (7), or a water supply port (11C) may be provided in the trap (7) itself. If the water supply port (11A) is provided between the water pump (4) and the heat exchanger (3), not only the trap (7) but also the heat exchanger (3) can be washed. As a water supply mechanism for the trap (7), the water supply pipe (8) of the hot water supply apparatus (1) of the embodiment illustrated in FIG. 1 may be used.

20 [0061]

In addition, as illustrated in FIG. 5, as a water discharge mechanism for the trap (7), for example, a water discharge port (12A) may be provided in the trap (7) itself, or a water discharge port (12B) may be provided in a subsequent stage of the trap (7) (between the trap (7) and the tank (2) (not shown)).

[0062]

According to this variation, the following effects can be obtained in addition to the effects of the above-described embodiment. Specifically, the scale deposited in the trap (7) can be discharged without construction work.

5 [0063]

<Fourth Variation>

FIG. 6 is a diagram illustrating a cross-sectional configuration of a trap (7) and the water pipe (10) before and after the trap (7) according to a fourth variation. In FIG. 6, the flow of water is indicated by arrows.

10 [0064]

As illustrated in FIG. 6, in the present variation, the pressure controller (6) and the trap (7) are integral with each other. Specifically, a pressure control valve capable of controlling a cross-sectional area of water channel is provided as a pressure controller (6) at the inlet of the trap (7). Similarly to the first variation, the inner diameter of the trap (7) may be made larger than the inner diameter of the water pipe (10) before and after the trap (7) in the present variation.

[0065]

According to this variation, the following effects can be obtained in addition to the effects of the above-described embodiment. Specifically, the trap (7) partially functions to perform depressurization. This further facilitates selection of a valve or the like serving as the pressure controller (6).

[0066]

In the present variation, for example, as illustrated in FIG. 7, by providing an orifice (7c) in a water channel at the inlet of the trap (7) as another pressure controller,

selection of a valve or the like serving as the pressure controller (6) is further facilitated. Alternatively, as illustrated in FIG. 8, by providing an orifice (13) in the water pipe (10) in a preceding stage of the trap (7) (between the trap (7) and the heat exchanger (3) (not shown)), selection of a valve serving as the pressure controller (6) is further facilitated.

5 [0067]

«Fifth Variation»

FIG. 9 is a schematic piping system diagram of a hot water supply apparatus (1) according to a fifth variation. In FIG. 9, the same components as those of the embodiment illustrated in FIG. 1 are denoted by the same reference numerals.

10 [0068]

The fifth variation is different from the embodiment illustrated in FIG. 1 in that the hot water supply apparatus (1) further includes a pressurization mechanism (14) configured to pressurize the water for hot water supply over the water circuit (5) entirely, as illustrated in FIG. 9. The pressurization mechanism (14) used may be of a cylinder type, for example. The pressurization mechanism (14) may be provided in the water pipe (10) between the tank (2) and the water pump (4).

[0069]

According to the present variation, the pressurization mechanism (14) can serve to raise the water pressure in the entire water circuit (5). It is thus not necessary to perform a high lift operation using the water pump (4). Accordingly, a pump input is reduced, and the efficiency of the hot water supply apparatus (1) can be increased. Further, it is not necessary to make the water pump (4) have high lift specifications. This can downsize the water pump (4) and reduce the cost of the pump.

[0070]

«Sixth Variation»

FIG. 10 is a schematic piping system diagram of a hot water supply apparatus (1) according to a sixth variation. In FIG. 10, the same components as those of the embodiment
5 illustrated in FIG. 1 are denoted by the same reference numerals.

[0071]

The sixth variation differs from the embodiment illustrated in FIG. 1 in that the hot water supply apparatus (1) further includes an eddy current heater (15) configured to heat water for hot water supply between the heat exchanger (3) and the pressure controller
10 (6), as illustrated in FIG. 10.

[0072]

According to the present variation, heating of the water for hot water supply (more specifically, the water pipe (10)) and applying of an electromagnetic field to the water for hot water supply can be performed in parallel by heating by the eddy current heater (15).
15 This allows highly efficient production of high-temperature water while the scale precipitation is reduced.

[0073]

In the present variation, the heat exchanger (3) heats the water for hot water supply to a temperature in a temperature range where scale is not precipitated with the pressure
20 controller (6) is performing pressurization, and the eddy current heater (15) heats the water for hot water supply to a temperature higher than the temperature range. In this way, scale precipitation can be reliably reduced.

[0074]

Further, in the present variation, the material of a portion of the water pipe (10)

heated by the eddy current heater (15) may be stainless steel. Among material candidates (copper, aluminum, stainless steel, and the like) that can be used for the water pipe (10), stainless steel can further improve the thermal efficiency of the eddy current heater (15). The present variation thus allows efficient water heating.

5 [0075]

If the eddy current heater (15) can sufficiently reduce the scale precipitation, the hot water supply apparatus (1) may have a configuration where the pressure controller (6) and the trap (7) have been removed from the hot water supply apparatus (1) according to the present variation illustrated in FIG. 10, as illustrated in FIG. 11 as a reference example.

10 With this configuration, high-temperature water can be produced highly efficiently while scale precipitation is reduced without maintenance.

[0076]

〈Seventh Variation〉

FIG. 12 is a schematic piping system diagram of a hot water supply apparatus (1) according to a seventh variation. In FIG. 12, the same components as those of the embodiment illustrated in FIG. 1 are denoted by the same reference numerals.

[0077]

The present variation differs from the embodiment illustrated in FIG. 1 in that a pressure controller (6) is provided in a subsequent stage (i.e., in the hot water supply pipe (9)) of the tank (2) for storing hot water heated in the heat exchanger (3), and the water pump (16) is provided in the water supply pipe (8), as illustrated in FIG. 12. This makes it possible to pressurize the water circuit (5) including the tank (2).

[0078]

In the present variation, a trap (7) for promoting the deposition of scale may be

provided in a subsequent stage of the pressure controller (6) in the hot water supply pipe (9) to obtain the similar effect as in the above-described embodiment.

[0079]

According to this variation, the following effects can be obtained in addition to the effects of the above-described embodiment. Specifically, the pressure controller (6) provided in a subsequent stage of the tank (2) and the water pump (16) provided in the water supply pipe (8) allows pressurization of the water circuit (5) including the tank (2). This makes it possible to reduce scale precipitation inside the tank (2). Accordingly, the comfort problem such as mixing of scale into available hot water to be supplied is less likely to occur.

Further, a reliability problem such as causing pump failure due to mixing of scale, which has been accumulated in the bottom of the tank (2) and discharged from the lower side of the tank (2) to the water circuit (5), into the water pump (4) or the like is less prone to occur.

[0080]

<<Other Embodiments>>

In the embodiment and variations, a heat pump device is used as a heat source device (20). However, the heat source device (20) is not limited to the heat pump device, and may be a fuel-based device that heats water through heat exchange with combustion gas, a Peltier element, or the like.

[0081]

Further, in the embodiment and variations, water heated by the heat source device (20) is once stored in the tank (2) and is then supplied to a hot water supply target. However, instead of this, hot water may be supplied to the hot water supply target without being stored in the tank (2).

[0082]

In the embodiment and variations, a single controller (30) controls the heat source device (20) and the water circuit (5). However, instead of this, respective dedicated controllers may control the heat source device (20) and the water circuit (5).

5 [0083]

While the embodiments and variations have been described above, it will be understood that various changes in form and details can be made. The above embodiments and variations may be appropriately combined or replaced as long as the functions of the target of the present disclosure are not impaired. In addition, the expressions of “first,”
10 “second,” . . . described above are used to distinguish the terms to which these expressions are given, and do not limit the number and order of the terms.

INDUSTRIAL APPLICABILITY

[0084]

15 As can be seen from the foregoing description, the present disclosure is useful for a hot water supply apparatus.

DESCRIPTION OF REFERENCE CHARACTERS

[0085]

- | | | |
|----|----|----------------------------|
| 20 | 1 | Hot Water Supply Apparatus |
| | 2 | Tank |
| | 2a | Barrel |
| | 2b | Bottom Portion |

	2c	Top Portion
	3	Heat Exchanger (Utilization-Side Heat Exchanger)
	3a	First Channel
	3b	Second Channel
5	4	Water Pump
	5	Water Circuit
	5a	Upstream Channel
	5b	Downstream Channel
	6	Pressure Controller
10	7	Trap
	7a	Scale Adsorbent
	7b	Rough Surface
	7c	Orifice
	8	Water Supply Pipe
15	9	Hot Water Supply Pipe
	10	Water Pipe
	11A, 11B, 11C	Water Supply Port
	12A, 12B	Drain Port
	13	Orifice
20	14	Pressurization Mechanism
	15	Eddy Current Heater
	16	Water Pump
	20	Heat Source Device
	21	Refrigerant Circuit

	22	Compressor
	23	Heat-Source-Side Heat Exchanger
	24	Expansion Valve
	25	Fan
5	30	Controller

CLAIMS

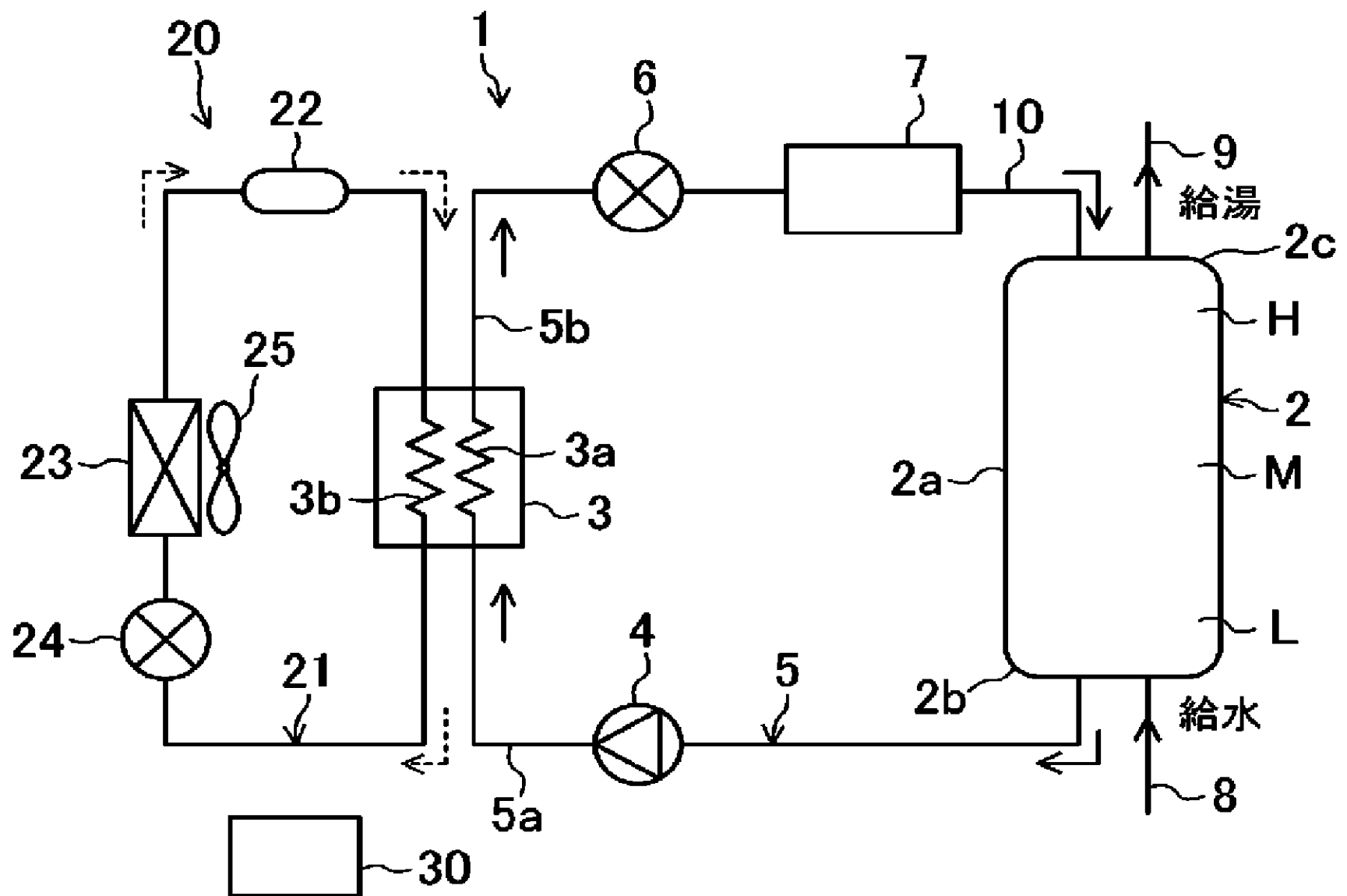
1. A hot water supply apparatus comprising:
a heat exchanger configured to heat water for hot water supply;
a pressure controller provided in a subsequent stage of the heat exchanger and configured to pressurize the water for hot water supply,
the water for hot water supply pressurized by the pressure controller flowing between the heat exchanger and the pressure controller; and
a trap for promoting deposition of scale, the trap being provided in a subsequent stage of the pressure controller.
2. The hot water supply apparatus of claim 1, wherein
an inner diameter of the trap is larger than an inner diameter of a water pipe before and after the trap.
3. The hot water supply apparatus of claim 1, wherein
a surface roughness of an inner peripheral surface of the trap is larger than a surface roughness of an inner peripheral surface of a water pipe before and after the trap.
4. The hot water supply apparatus of any one of claims 1 to 3, wherein
the trap is configured to be able to supply water from outside and discharge water to outside.

5. The hot water supply apparatus of any one of claims 1 to 4, wherein the trap is configured to be detachable and replaceable.
6. The hot water supply apparatus of any one of claims 1 to 5, wherein at least part of the pressure controller is integral with the trap.
7. The hot water supply apparatus of any one of claims 1 to 6, further comprising
a tank for storing the water for hot water supply in a subsequent stage of the trap.
8. The hot water supply apparatus of any one of claims 1 to 7, further comprising
a pressurization mechanism configured to pressurize the water for hot water supply over the water circuit entirely.
9. The hot water supply apparatus of any one of claims 1 to 8, further comprising
an eddy current heater that is provided between the heat exchanger and the pressure controller and is configured to heat the water for hot water supply.
10. The hot water supply apparatus of claim 9, wherein
the heat exchanger heats the water for hot water supply to a temperature in a temperature range where scale is not precipitated, and the eddy current heater heats the water for hot water supply to a temperature higher than the temperature range.

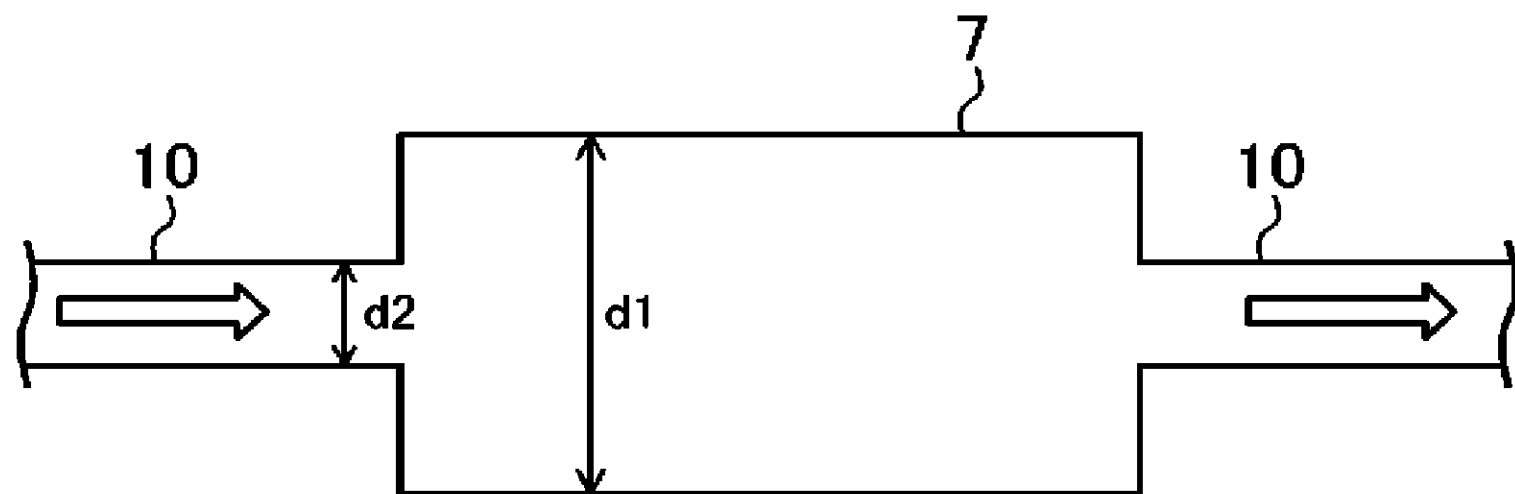
11. The hot water supply apparatus of claim 9 or 10, wherein
a material of a portion of the water pipe heated by the eddy current heater is
stainless steel.

12. The hot water supply apparatus of any one of claims 1 to 11, wherein
the heat source device of the heat exchanger is a heat pump.

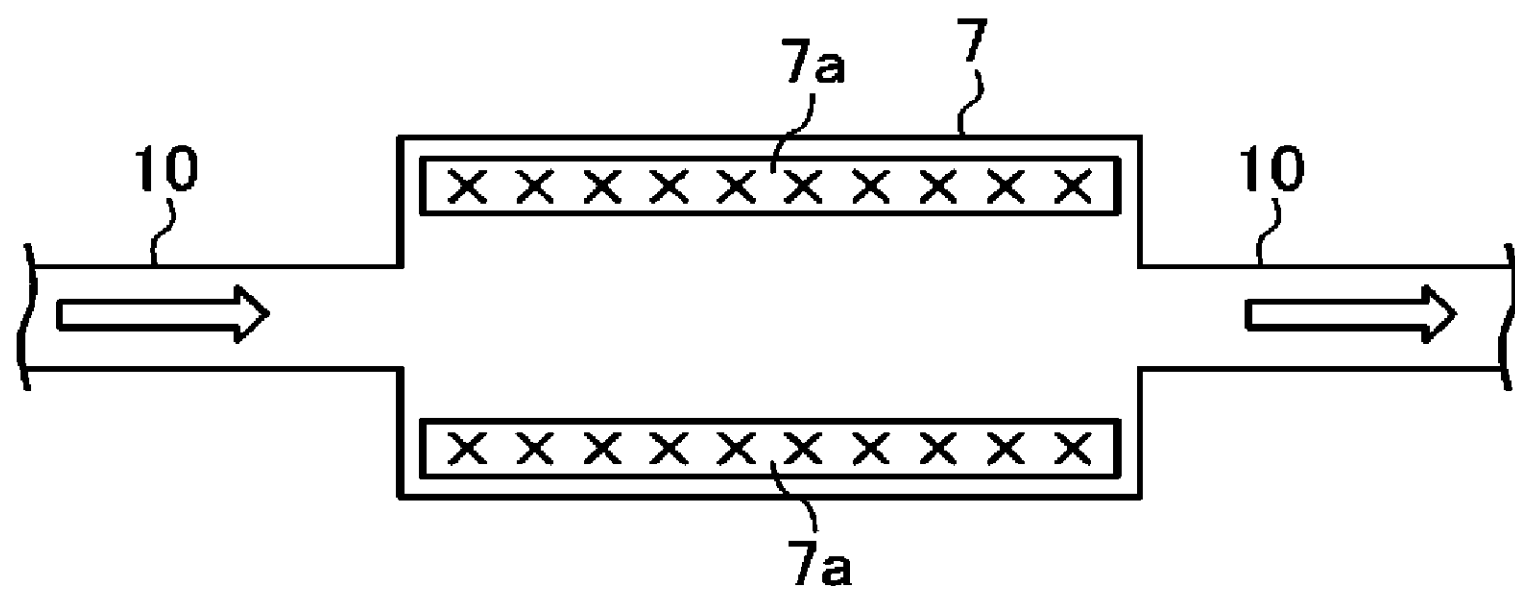
[図1]



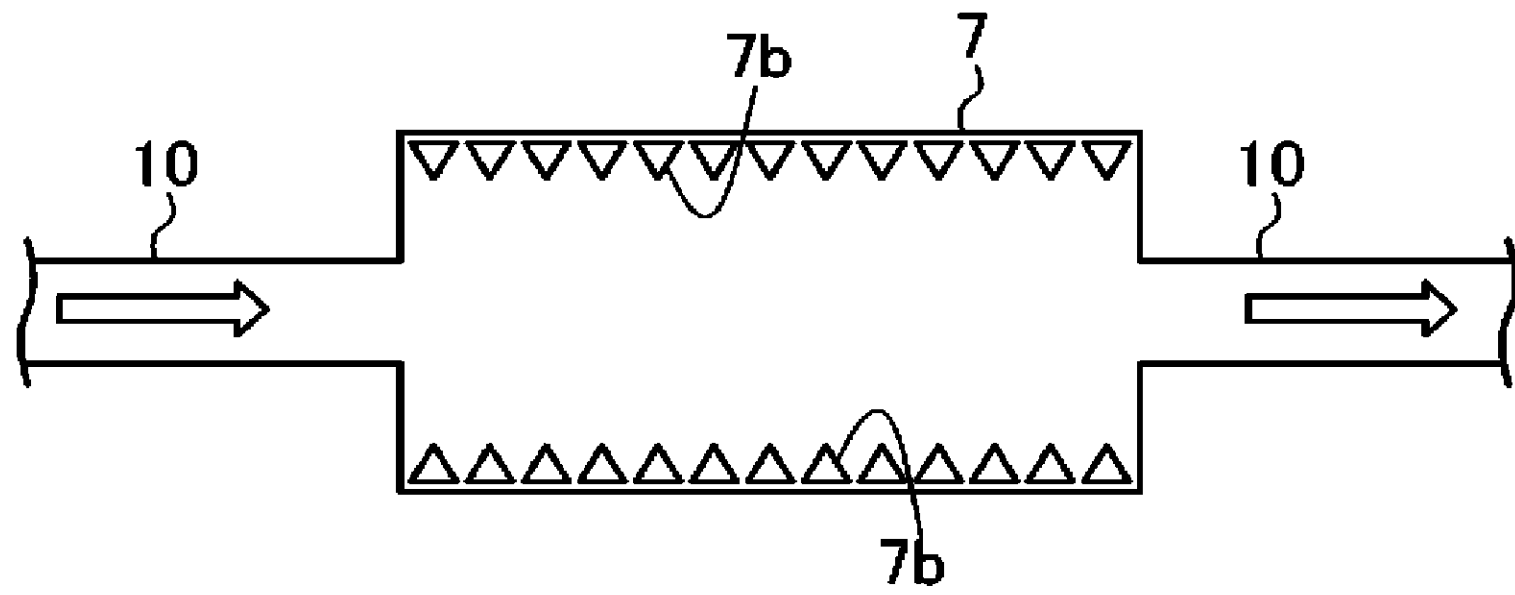
[図2]



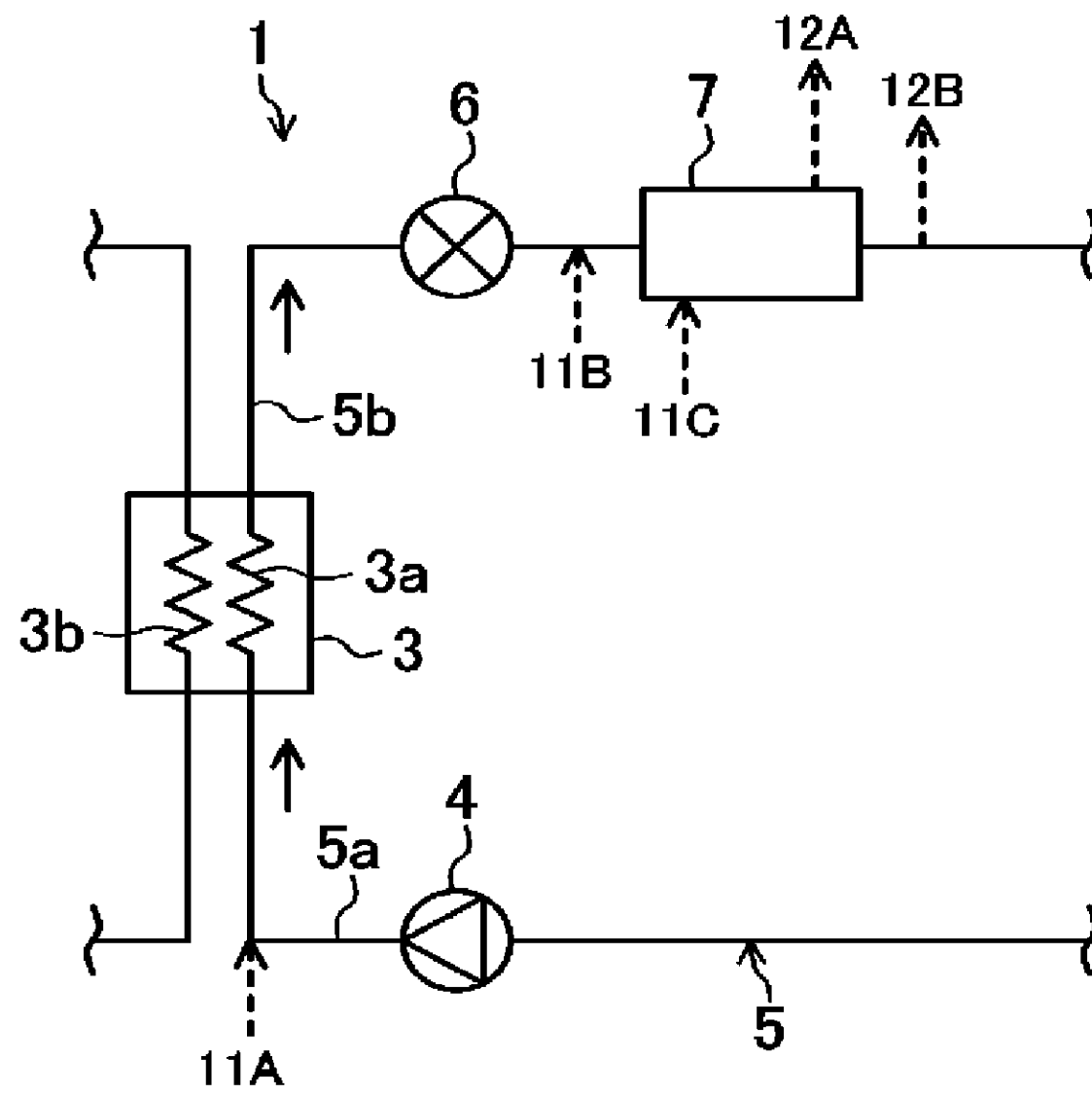
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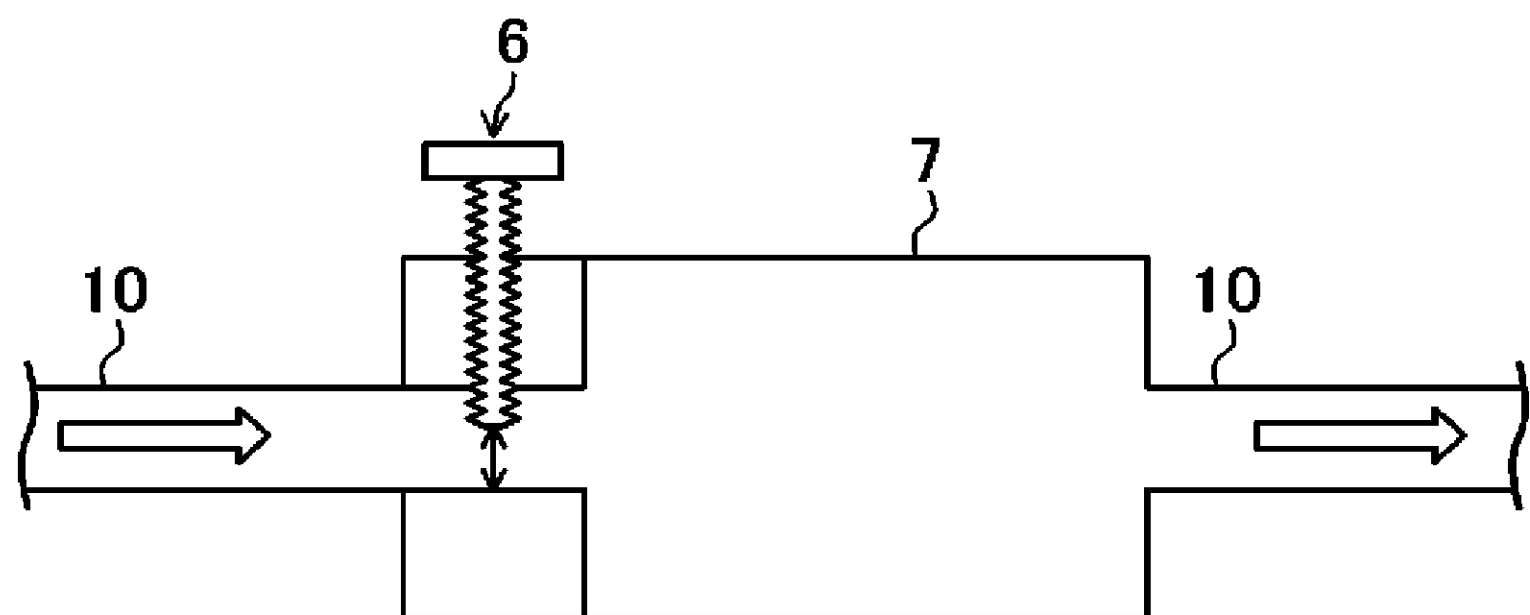
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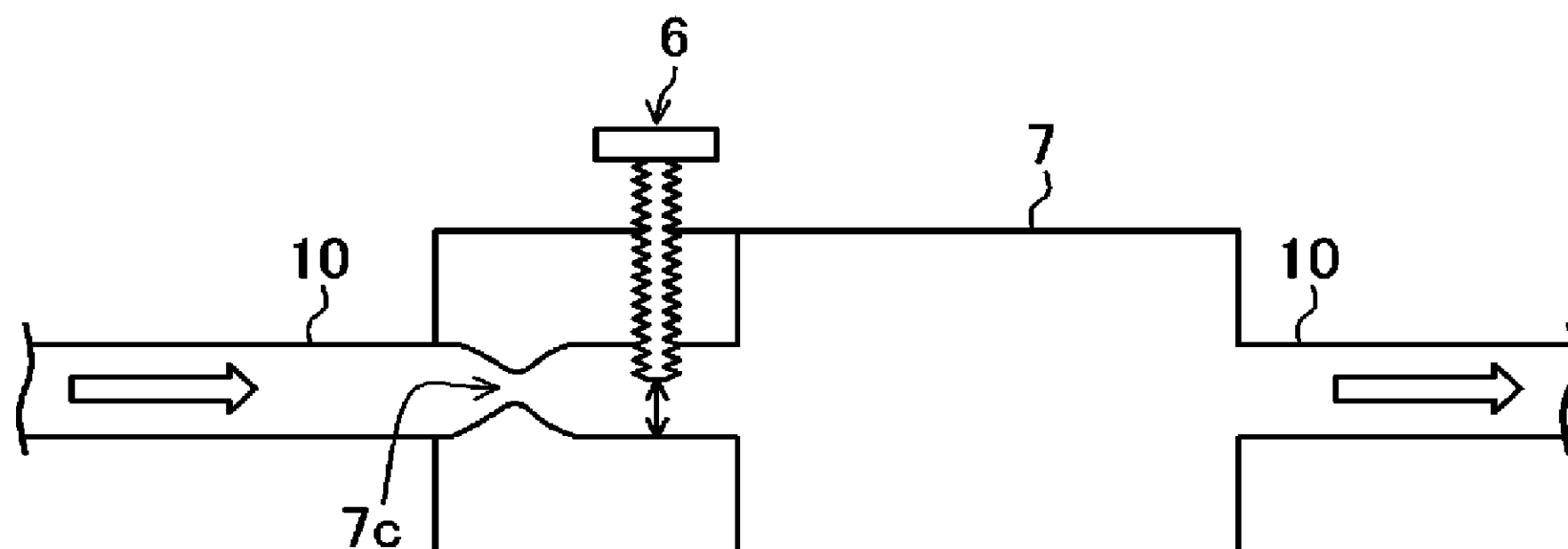
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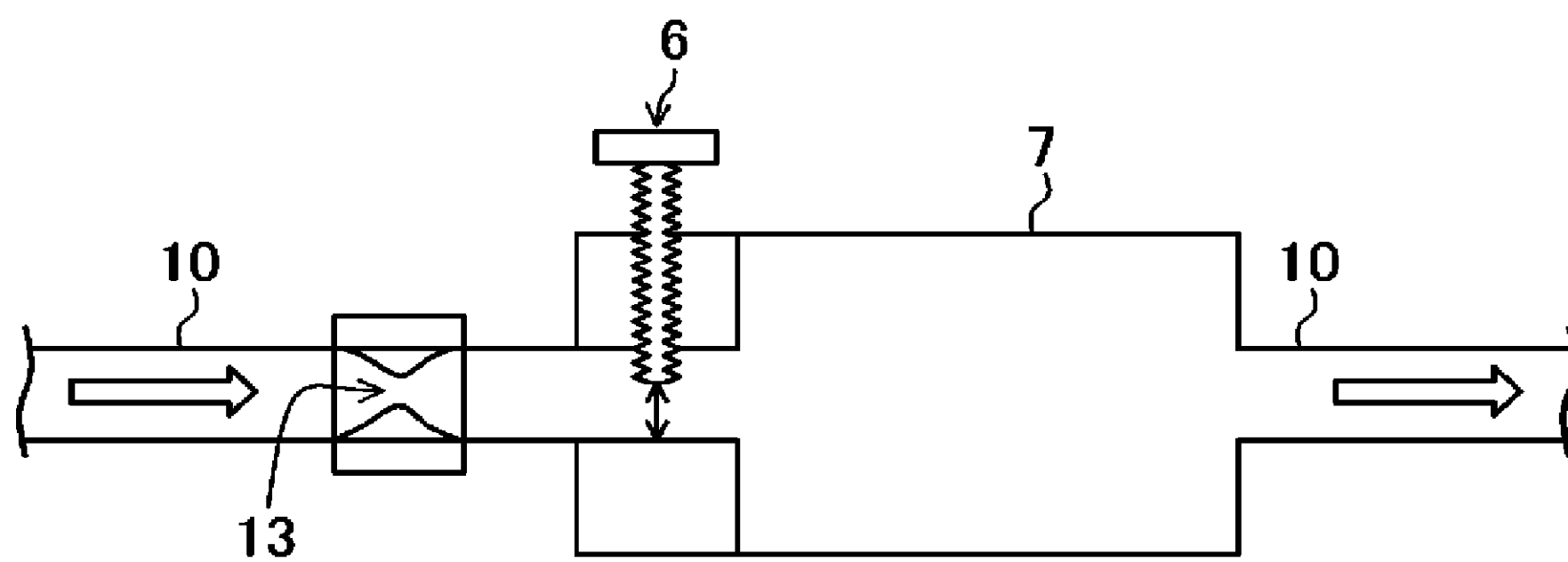
[図6]



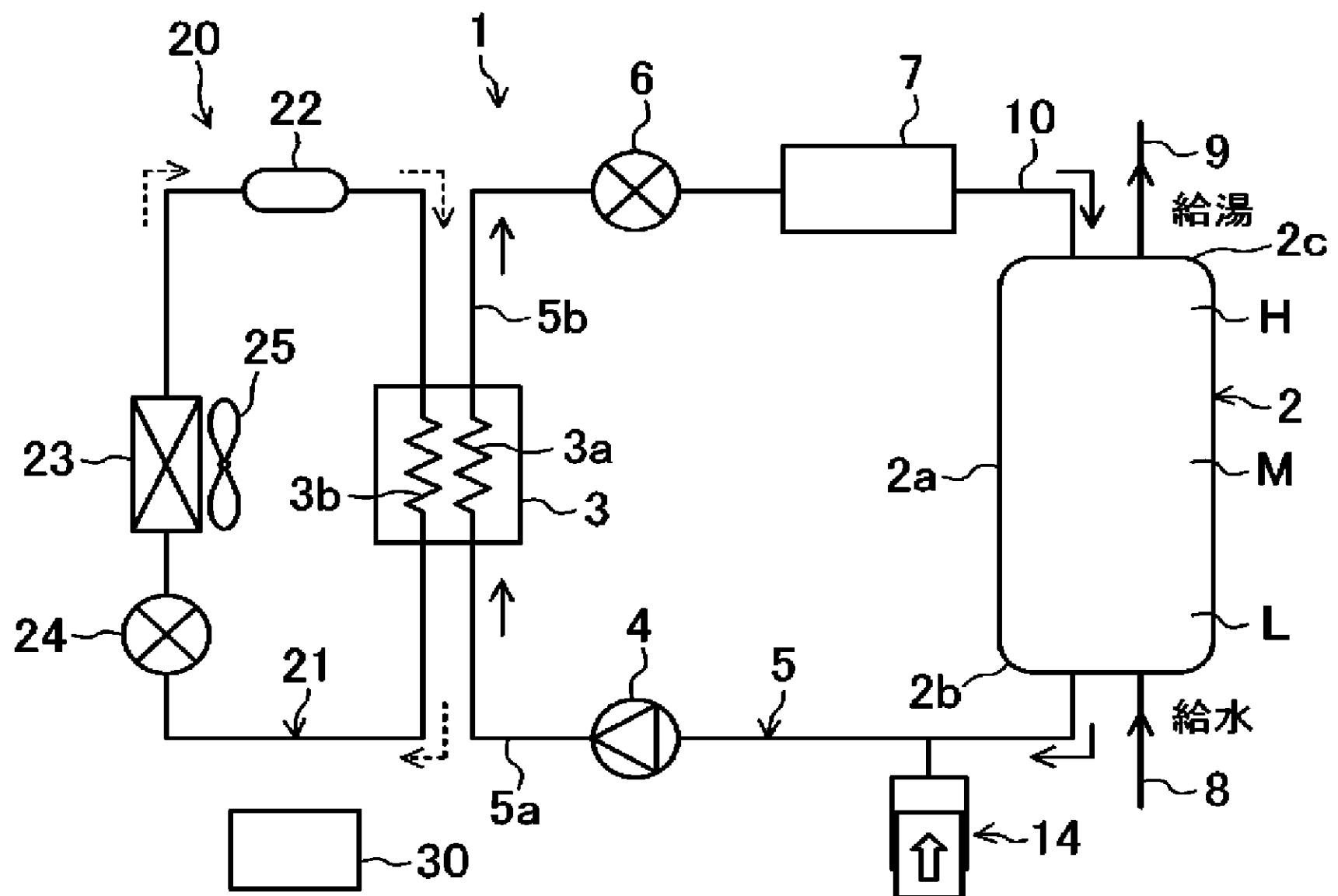
[図7]



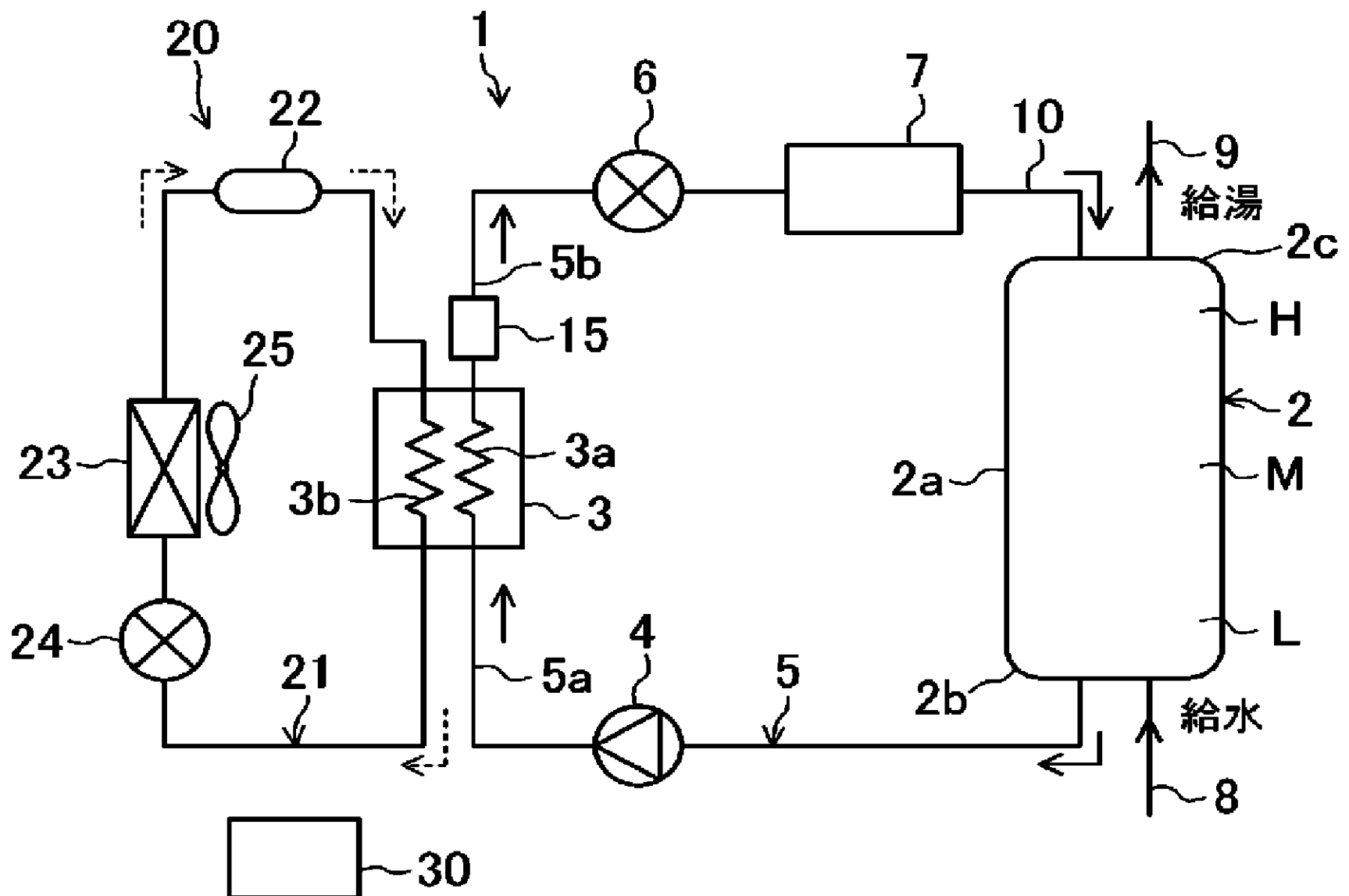
[図8]



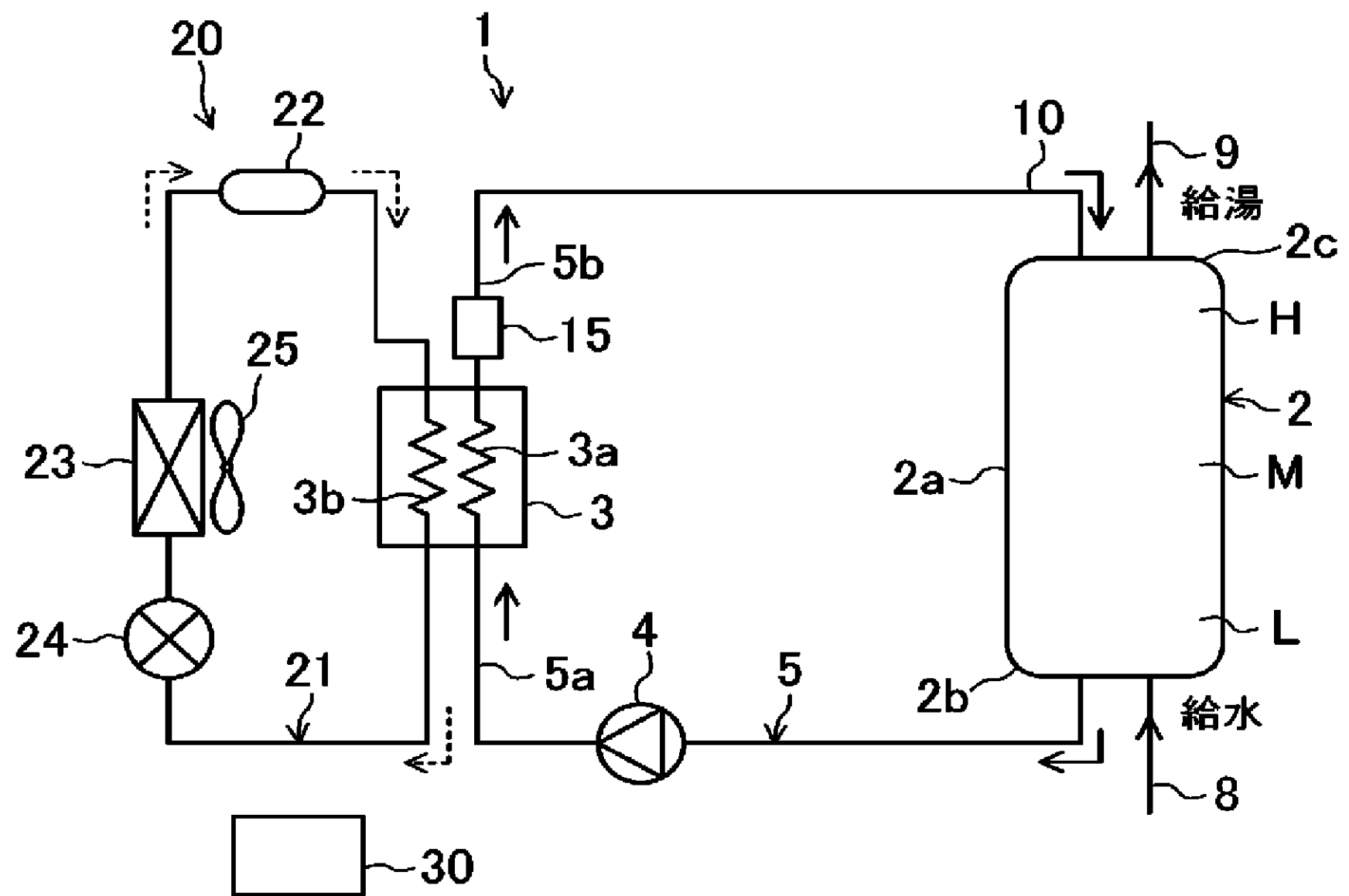
[図9]



[図10]



[図11]



[図12]

