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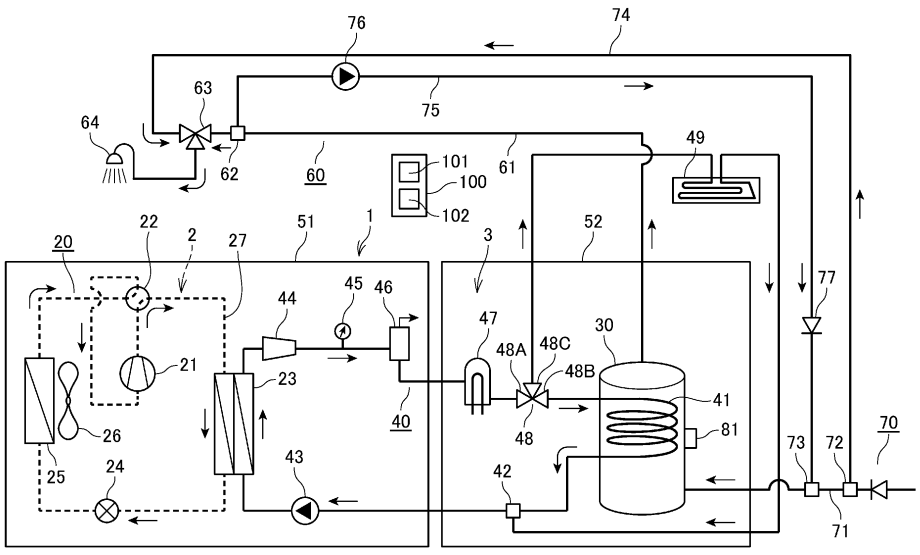
(54) WATER HEATER

(57) There is provided a water heater that can prevent propagation of Legionella bacteria and the like. A water heater includes: a hot water storage tank that stores hot water heated by a heat source; a hot water supply circuit that supplies hot water from the hot water storage tank to a supply port; a return pipe that returns hot water in the hot water supply circuit to the hot water storage tank; a return pump provided in the return pipe; and a control unit, wherein the control unit executes a hot water storage tank sterilization mode that: boils hot water in the hot water storage tank to a temperature that can kill Legionella bacteria and the like; and sterilizes the hot water storage tank for a predetermined time, and executes, after the predetermined time has elapsed, a hot water supply circuit sterilization mode that: controls the return pump to be ON; circulates hot water in the hot water storage tank through the hot water supply circuit; and sterilizes the hot water supply circuit.

FIG.1



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present disclosure relates to a water heater.

Description of the Related Art

[0002] Japanese Patent Laid-Open No. 2015-187511 discloses a water heater that includes a hot water storage tub that stores hot water heated by a heat source, a supply passage that supplies hot water from the hot water storage tub to a supply port, a return passage that returns hot water in the supply passage to the hot water storage tub, and a return pump provided in the return passage.

[0003] The present disclosure provides a water heater that can prevent propagation of Legionella bacteria and the like.

SUMMARY OF THE INVENTION

[0004] A water heater in the present disclosure includes: a hot water storage tank that stores hot water heated by a heat source; a hot water supply circuit that supplies hot water from the hot water storage tank to a supply port; a return pipe that returns hot water in the hot water supply circuit to the hot water storage tank; a return pump provided in the return pipe; and a control unit, wherein the control unit executes a hot water storage tank sterilization mode that: boils hot water in the hot water storage tank to a temperature that can kill Legionella bacteria and the like; and sterilizes the hot water storage tank for a predetermined time, and executes, after the predetermined time has elapsed, a hot water supply circuit sterilization mode that: controls the return pump to be ON; circulates hot water in the hot water storage tank through the hot water supply circuit; and sterilizes the hot water supply circuit.

[0005] According to the present disclosure, execution of the hot water storage tank sterilization mode and the hot water supply circuit sterilization mode allows for preventing propagation of Legionella bacteria and the like.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

Fig. 1 is a circuit diagram in an embodiment; and
Fig. 2 is a diagram showing a relationship between pipe length and ON time of a return pump.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

(Knowledge and the like on which the present disclosure is based)

[0007] At the time when the inventors came up with the present disclosure, there was a water heater including a hot water storage tub that stores hot water heated by a heat source, a supply passage that supplies hot water from the hot water storage tub to a supply port, a return passage that returns hot water in the supply passage to the hot water storage tub, and a return pump provided in the return passage. The inventors have discovered a problem in which this water heater is configured to return hot water in the supply passage to the hot water storage tub through a return passage, and therefore needs to prevent Legionella bacteria and the like from propagation in the return passage. In order to solve the problem, the inventors have come to configure the subject matter of the present disclosure.

[0008] In this circumstance, the present disclosure provides a water heater that executes a hot water storage tank sterilization mode and a hot water supply circuit sterilization mode, and thereby allows for preventing propagation of Legionella bacteria and the like.

[0009] Hereinafter, an embodiment will be described in detail with reference to the drawings. However, more detailed description than necessary may be omitted. For example, detailed description of already well-known matters or duplicate description of substantially the same configuration may be omitted.

[0010] Note that the attached drawings and the following description are provided to enable those skilled in the art to fully understand the present disclosure, and are not intended to limit the subject matter described in the claims.

(Embodiment)

[Configuration]

[0011] Fig. 1 is a diagram showing a configuration of a water heater 1.

[0012] As shown in Fig. 1, the water heater 1 includes a heat pump unit 2 and a hot water storage unit 3.

[0013] The heat pump unit 2 includes a heat pump circuit 20.

[0014] The heat pump circuit 20 includes a compressor 21, a four-way valve 22, a first heat exchanger 23, a pressure reducing device 24, a second heat exchanger 25, and a blower fan 26.

[0015] The compressor 21, the four-way valve 22, the first heat exchanger 23, the pressure reducing device 24, and the second heat exchanger 25 are connected by a refrigerant pipe 27.

[0016] The hot water storage unit 3 includes a hot water storage tank 30.

[0017] The hot water storage tank 30 is connected to a boiling circuit 40, a hot water supply circuit 60, and a water supply circuit 70 that supplies city water to the hot water

storage tank 30.

[0018] The boiling circuit 40 is a circuit that connects the hot water storage tank 30 and the first heat exchanger 23. The hot water storage tank 30 is provided with a heating pipe 41 that heats hot water and cold water. An outlet of the heating pipe 41 is connected to a first junction 42 and a circulation pump 43, in this order. The circulation pump 43 is connected to the first heat exchanger 23, and the first heat exchanger 23 is connected to a flow rate sensor 44, a pressure sensor 45, a bubble separator 46, and a heater 47 in this order. The heater 47 is connected to a first connection port 48A of a first three-way valve 48, and the heating pipe 41 is connected to a second connection port 48B of the first three-way valve 48. A third connection port 48C of the first three-way valve 48 is connected to a heat radiation panel 49 for heating, and the heat radiation panel 49 is connected to the first junction 42.

[0019] The first heat exchanger 23 uses a plate-type heat exchanger or a double-pipe type heat exchanger. In the first heat exchanger 23, heat exchange takes place between a refrigerant flowing through the heat pump circuit 20 and a heat medium of the boiling circuit 40.

[0020] The heat pump circuit 20 and a part of the boiling circuit 40 are housed in a first housing 51 and placed outside of a house. The hot water storage tank 30 and the remaining part of the boiling circuit 40 are housed in a second housing 52 and placed in, for example, an underground machine room of the house.

[0021] The hot water supply circuit 60 includes a hot water supply pipe 61 for high-temperature water, and the hot water supply pipe 61 is connected to an upper part of the hot water storage tank 30. The hot water supply pipe 61 is connected to a first branch 62 and a temperature control valve 63 in this order, and the temperature control valve 63 is connected to a hot water supply equipment 64 for a kitchen, a bath, etc.

[0022] The water supply circuit 70 has a water supply pipe 71 that supplies city water to the hot water storage tank 30. The water supply pipe 71 is connected to a second branch 72 and a second junction 73 in this order from upstream. The second branch 72 and the temperature control valve 63 are connected by a branched water supply pipe 74 that supplies city water to the temperature control valve 63. In the present embodiment, the first branch 62 and the second junction 73 are connected by a return pipe 75. The first branch 62 is located between the temperature control valve 63 and the hot water storage tank 30. The return pipe 75 is connected to a return pump 76 and a check valve 77 in this order from upstream.

[0023] The water heater 1 includes the hot water storage tank 30 that stores hot water heated by the heat pump unit (heat source) 2, the hot water supply circuit 60 that supplies hot water from the hot water storage tank 30 to the hot water supply equipment (supply port) 64 for a kitchen, a bath, etc., the return pipe 75 that returns hot water in the hot water supply circuit 60 to the hot water storage tank 30, the return pump 76 provided in the return pipe 75, and the control unit 100. The hot water storage tank 30 is fitted with the sensor 81 for measuring the hot water temperature in the hot water storage tank 30.

[0024] The control unit 100 executes the hot water storage tank sterilization mode TM and the hot water supply circuit sterilization mode KM. Each mode TM and KM is executed about once a week.

[0025] In the hot water storage tank sterilization mode TM, the hot water in the hot water storage tank 30 is boiled to a hot water temperature (60°C or higher) that can kill Legionella bacteria and the like, to sterilize an inside of the hot water storage tank 30 for a predetermined time T. In the hot water supply circuit sterilization mode KM, after the above-described predetermined time T has elapsed, the return pump 76 is controlled to be ON, and the high-temperature hot water from the hot water storage tank 30 is circulated through the hot water supply circuit 60, to sterilize an inside of the hot water supply circuit 60. The ON time of the return pump 76 at this time is preset in consideration of a pipe length, and is stored in a memory unit 101 of the control unit 100.

[0026] Furthermore, the control unit 100 includes a correction unit 102 that corrects the ON time of the return pump 76 according to the measured value of the sensor 81. For example, if the hot water temperature in the hot water storage tank 30 is high and the measured value of the sensor 81 is high, the ON time of the return pump 76 can be corrected to be shorter, and if the measured value of the sensor 81 is low, the ON time of the return pump 76 can be corrected to be longer.

[0027] In addition to executing each of the modes TM and KM, the control unit 100 executes a control mode SM that controls operation of the return pump 76 to be ON/-OFF while hot water supply to the hot water supply equipment 64 is stopped. The state, in which hot water supply is stopped, is detected, for example, by a flow rate sensor (not shown) placed in the hot water supply circuit 60. The ON time and OFF time at this time are preset in consideration of the pipe length and are stored in the memory unit 101 of the control unit 100. The correction unit 102 may correct the ON time in the control mode SM according to the measured value of the sensor 81, as described above.

[Boiling operation]

[0028] The control unit 100 drives the compressor 21 of the heat pump circuit 20 and the circulation pump 43 of the boiling circuit 40. When the compressor 21 of the heat pump circuit 20 is driven, high-temperature, high-pressure refrigerant flows into the first heat exchanger 23 through the four-way valve 22. This refrigerant is decompressed by the pressure reducing device 24 and evaporates in the second heat exchanger 25, to become low-temperature, low-pressure refrigerant. The refrigerant is returned to a suction port of the compressor 21 through the four-way valve 22. When the circulation pump 43 of the boiling circuit 40 is driven, the heat medium returns

through the first heat exchanger 23 to the heating pipe 41 in the hot water storage tank 30, and is returned to a suction port of the circulation pump 43 through the first junction 42.

[0029] In the first heat exchanger 23, heat is exchanged between the refrigerant flowing through the heat pump circuit 20 and the heat medium flowing through the boiling circuit 40. The high-temperature heat medium then returns to the heating pipe 41, and boils the hot water in the hot water storage tank 30.

[Hot water supply operation]

[0030] When, for example, a faucet (supply port) is opened in the hot water supply equipment 64, the hot water in the hot water storage tank 30 passes through the hot water supply pipe 61 and the first branch 62 to the temperature control valve 63. The temperature control valve 63 mixes the hot water in the hot water storage tank 30 supplied through the hot water supply pipe 61 with city water supplied through the branched water supply pipe 74, and controls the temperature of the mixture and supplies the mixture from the faucet.

[Sterilization operation]

[0031] If the hot water storage tank 30 has not been heated for a certain period of time, and the measured value of the sensor 81 attached to the hot water storage tank 30 falls below 60 to 65°C, the drop in the hot water temperature in the hot water storage tank 30 can disadvantageously lead to the generation of Legionella bacteria and other bacteria.

[0032] In the present embodiment, the control unit 100 periodically executes the hot water storage tank sterilization mode TM about once a week, and then executes the hot water supply circuit sterilization mode KM.

[0033] First, the hot water storage tank 30 is forcibly heated. In the hot water storage tank sterilization mode TM, the hot water storage tank 30 is heated to a temperature of 60°C or higher that can kill Legionella bacteria and the like, and the hot water storage tank 30 is sterilized for a predetermined time T. In the hot water supply circuit sterilization mode KM, after the above-described predetermined time T has elapsed, the return pump 76 is controlled to be ON, and the high-temperature hot water from the hot water storage tank 30 is circulated through the hot water supply circuit 60, to sterilize the hot water supply circuit 60.

[0034] In the present embodiment, the hot water storage tank sterilization mode TM can sterilize the hot water storage tank 30, and the hot water supply circuit sterilization mode KM can raise the hot water temperature in the hot water supply pipe 61 to a temperature range that can kill Legionella bacteria and the like. This allows the hot water supply pipe 61 to be sterilized.

[0035] The control unit 100 may display "Sterilization in progress" on a display unit (not shown) of a remote controller while executing the hot water storage tank sterilization mode TM and the hot water supply circuit sterilization mode KM. Displaying "Sterilization in progress" or the like on the display unit (not shown) allows the user to recognize whether either the hot water storage tank sterilization mode TM or the hot water supply circuit sterilization mode KM is being executed, improving usability.

[Pipe length]

[0036] Fig. 2 shows the relationship between the pipe length and the ON time (predetermined time T) of the return pump 76 in the hot water supply circuit sterilization mode KM.

[0037] The pipe length (m) is the total of the pipe length of the hot water supply pipe 61, the pipe length of the return pipe 75, and the pipe length of the water supply pipe 71 from the second junction 73 to the hot water storage tank 30, and the discharge capacity of the return pump 76 is 5 liter/minute. The ON time (minute) of the return pump 76 is set to a time for circulating the hot water through the total pipe length of the hot water supply pipe 61, the return pipe 75, and part of the water supply pipe 71 at least five times, taking into account heat dissipation into the pipes.

[0038] If the pipe length is about 5m, the required operating time (predetermined time T: ON time) may be about 30 to 40 seconds. As the pipe length increases, the required operating time increases. When the pipe length is 55m, the required operating time is 6 minutes or more. In other words, the predetermined time T changes according to the pipe length (m), and is preferably set to a time that circulates the hot water at least five times within the pipe length by controlling the return pump 76 to be ON.

[Return operation]

[0039] When the hot water supply operation described above stops, at least the temperature of the hot water remaining in the hot water supply pipe 61 drops due to the influence of the environmental temperature. When the hot water supply operation restarts after stopping for a long time, cold water may be supplied to the faucet (supply port) through the hot water supply pipe 61, causing the user to feel uncomfortable. In the present embodiment, the control unit 100 controls the operation of the return pump 76 to be ON or OFF while hot water supply from the supply port is stopped, and executes the control mode SM. The ON time of the return pump 76 is set to a time for circulating the hot water through the hot water supply pipe 61 about five times.

[0040] When the return pump 76 is controlled to be ON, the hot water remaining in the hot water supply pipe 61 passes through the return pipe 75 and enters the hot water storage tank 30 from the second junction 73, and high-temperature hot water returns from the upper part of

the hot water storage tank 30 to the hot water supply pipe 61. This maintains the hot water temperature in the hot water supply pipe 61 at a high temperature. Therefore, when the hot water supply operation restarts after stopping for a long time, cold water is not supplied to the faucet (supply port) through the hot water supply pipe 61, but high-temperature hot water is supplied to the faucet (supply port) from the time when the hot water supply operation restarts.

[0041] In addition, the ON time of the return pump 76 is set to a time for circulating the hot water through the hot water supply pipe 61 at least five times, and the operation of the return pump 76 is stopped in the remaining OFF time, allowing for reducing power consumption.

[0042] In other words, in the present embodiment, it is possible to achieve both maintenance of temperature in the hot water supply pipe 61 and reduction in power consumption while hot water supply is stopped.

[0043] In addition, in the present embodiment, if the hot water in the hot water storage tank 30 has not been boiled for a certain period of time, the control unit 100 forcibly boils the hot water in the hot water storage tank 30 before controlling the return pump 76 to be ON or OFF. Therefore, the control unit 100 can supply high-temperature hot water from the hot water storage tank 30 to the hot water supply pipe 61 at the same time as controlling the return pump 76 to be ON, allowing for shortening ON time of the return pump 76 and reducing power consumption.

[0044] In control mode SM, the control unit 100 may correct the ON time of the return pump 76 according to the measured value of the sensor 81. If the hot water temperature in the hot water storage tank 30 is higher than a predetermined temperature, the ON time of the return pump 76 is corrected to be shorter than the preset predetermined time T. If the hot water temperature is lower than the predetermined temperature, the ON time of the return pump 76 is corrected to be longer than the preset predetermined time T. If the hot water temperature in the hot water storage tank 30 is high, the return pump 76 may be stopped immediately.

[0045] As described above, the above embodiment has been described as an example disclosed in the present application. However, the technique in the present disclosure is not limited to this, and can be applied to embodiments in which changes, substitutions, additions, omissions, etc. are made.

[0046] It is also possible to combine the components described in the above embodiment to create a new embodiment.

[0047] In the present embodiment, the heat source uses the heat pump circuit 20, but the heat source can also have heaters, gas appliances, etc. to be applied thereto.

(Supplementary notes)

[0048] The following technique is disclosed based on the description of the above embodiment.

[0049] (Technique 1) A water heater including: a hot water storage tank that stores hot water heated by a heat source; a hot water supply circuit that supplies hot water from the hot water storage tank to a supply port; a return pipe that returns hot water in the hot water supply circuit to the hot water storage tank; a return pump provided in the return pipe; and a control unit, wherein the control unit executes a hot water storage tank sterilization mode that: boils hot water in the hot water storage tank to a temperature that can kill Legionella bacteria and the like; and sterilizes the hot water storage tank for a predetermined time, and executes, after the predetermined time has elapsed, a hot water supply circuit sterilization mode that: controls the return pump to be ON; circulates hot water in the hot water storage tank through the hot water supply circuit; and sterilizes an inside of the hot water supply circuit.

[0050] This allows for sterilization within the hot water storage tank as well as within the hot water supply circuit.

[0051] (Technique 2) The water heater according to Technique 1, wherein ON time of the return pump is set to a time for controlling the return pump to be ON to circulate hot water at least five times within a pipe length in which hot water is circulated.

[0052] This allows for sterilization within the hot water storage tank as well as within the hot water supply circuit.

[0053] (Technique 3) The water heater according to Technique 1, including a sensor that measures hot water temperature in the hot water storage tank, wherein the control unit includes a correction unit that corrects ON time of the return pump according to a measured value of the sensor.

[0054] Accordingly, correcting the ON time of the return pump allows for an appropriate sterilization whether the hot water temperature within the hot water storage tank is high or low.

[0055] (Technique 4) The water heater according to Technique 1, wherein the control unit displays, on a display unit of a remote controller, that the hot water storage tank sterilization mode and the hot water supply circuit sterilization mode are being executed.

[0056] This allows the user to recognize whether either the hot water storage tank sterilization mode or the hot water supply circuit sterilization mode is being executed, improving usability.

[0057] (Technique 5) The water heater according to Technique 1, wherein the control unit controls the return pump to be ON or OFF while hot water supply from the supply port is stopped.

[0058] This allows for achieving both maintenance of temperature in the hot water supply pipe and reduction in power consumption while hot water supply is stopped.

[0059] (Technique 6) The water heater according to any one of Techniques 1 to 5, wherein if the hot water storage tank has not been heated for a certain period of time, the control unit executes the hot water storage tank sterilization mode and the hot water supply circuit sterilization mode after forcibly heating the hot water tank.

[0060] This allows for reliably realizing sterilization effect with the hot water storage tank sterilization mode and the hot water supply circuit sterilization mode.

[0061] (Technique 7) The water heater according to Technique 6, wherein the temperature of heating the hot water tank is 60°C or higher.

[0062] This allows for reliably realizing sterilization effect with the hot water storage tank sterilization mode and the hot water supply circuit sterilization mode.

Industrial Applicability

[0063] The present invention can be used in a water heater including: a return pipe for returning hot water in a hot water supply circuit to a hot water storage tank; and a return pump provided in the return pipe.

Reference Signs List

[0064]

1 water heater
2 heat pump unit
3 hot water storage unit
20 heat pump circuit
30 hot water storage tank
40 boiling circuit
51 first housing
52 second housing
60 hot water supply circuit
61 hot water supply pipe
63 temperature control valve
70 water supply circuit
71 water supply pipe
74 branched water supply pipe
75 return pipe
76 return pump
100 control unit
101 memory unit
102 correction unit

Claims

1. A water heater **characterized by** comprising:

a hot water storage tank (30) that stores hot water heated by a heat source (2);
a hot water supply circuit (60) that supplies hot water from the hot water storage tank to a supply port;
a return pipe (75) that returns hot water in the hot water supply circuit to the hot water storage tank;
a return pump (76) provided in the return pipe; and
a control unit (100),
wherein the control unit
executes a hot water storage tank sterilization mode (TM) that: boils hot water in the hot water storage tank to a temperature that can kill Legionella bacteria and the like; and sterilizes the hot water storage tank for a predetermined time, and
executes, after the predetermined time has elapsed, a hot water supply circuit sterilization mode (KM) that: controls the return pump to be ON; circulates hot water in the hot water storage tank through the hot water supply circuit; and sterilizes an inside of the hot water supply circuit.

2. The water heater according to claim 1, wherein ON time of the return pump is set to a time for controlling the return pump to be ON to circulate hot water at least five times within a pipe length in which hot water is circulated.

3. The water heater according to claim 1, comprising a sensor (81) that measures hot water temperature in the hot water storage tank,
wherein the control unit includes a correction unit (102) that corrects ON time of the return pump according to a measured value of the sensor.

4. The water heater according to claim 1, wherein the control unit displays, on a display unit of a remote controller, that the hot water storage tank sterilization mode and the hot water supply circuit sterilization mode are being executed.

5. The water heater according to claim 1, wherein the control unit controls the return pump to be ON and OFF while hot water supply from the supply port is stopped.

6. The water heater according to any one of claims 1 to 5, wherein if the hot water storage tank has not been heated for a certain period of time, the control unit executes the hot water storage tank sterilization mode and the hot water supply circuit sterilization mode after forcibly heating the hot water tank.

7. The water heater according to claim 6, wherein the temperature of heating the hot water tank is 60°C or higher.

FIG.1

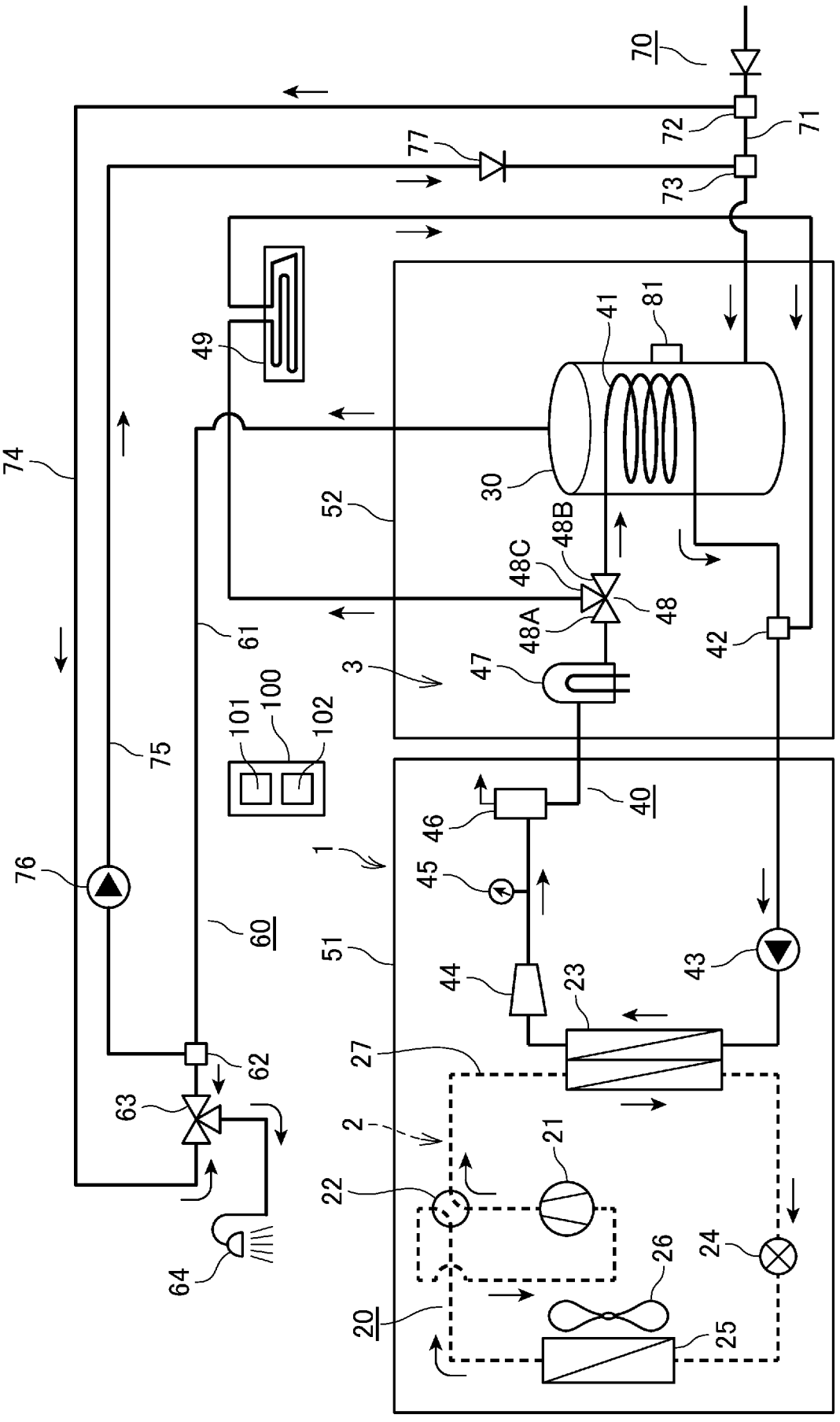
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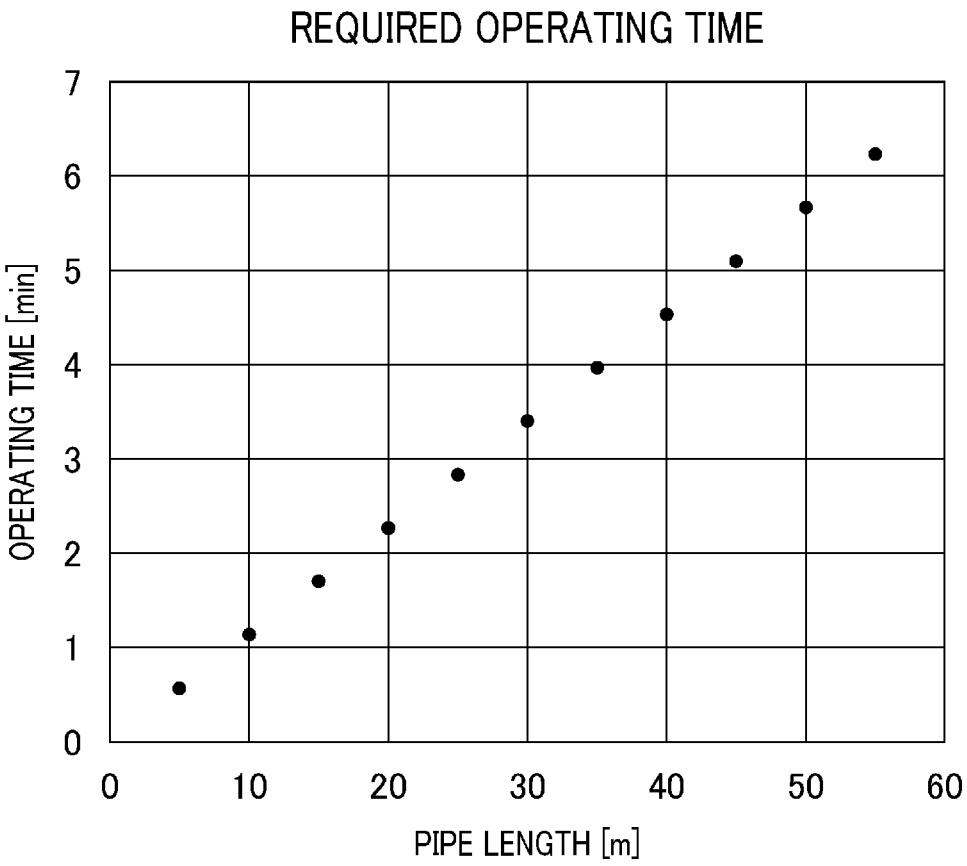
FIG.2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EUROPEAN SEARCH REPORT

Application Number
EP 24 21 5024

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	EP 4 130 584 A1 (EXERGENE TECH GMBH [DE]) 8 February 2023 (2023-02-08) * figures 1-3 *	1	
Y	EP 1 681 515 B1 (FISCHER GEORG JRG AG [CH]) 2 May 2012 (2012-05-02) * paragraph [0013] - paragraph [0021]; figures 1-5 *	1	
A	EP 2 458 291 B1 (BOSCH GMBH ROBERT [DE]) 19 October 2016 (2016-10-19) * the whole document *	1	TECHNICAL FIELDS SEARCHED (IPC) F24D F24H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	27 March 2025	Ast, Gabor

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 24 21 5024

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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