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(72) Inventors:
• **Takada, Kouhei**
Isesaki-shi Gunma 372-8502 (JP)
• **Kobayashi, Koji**
Isesaki-shi Gunma 372-8502 (JP)

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(74) Representative: **Haley, Stephen**
Gill Jennings & Every LLP
Broadgate House
7 Eldon Street
London EC2M 7LH (GB)

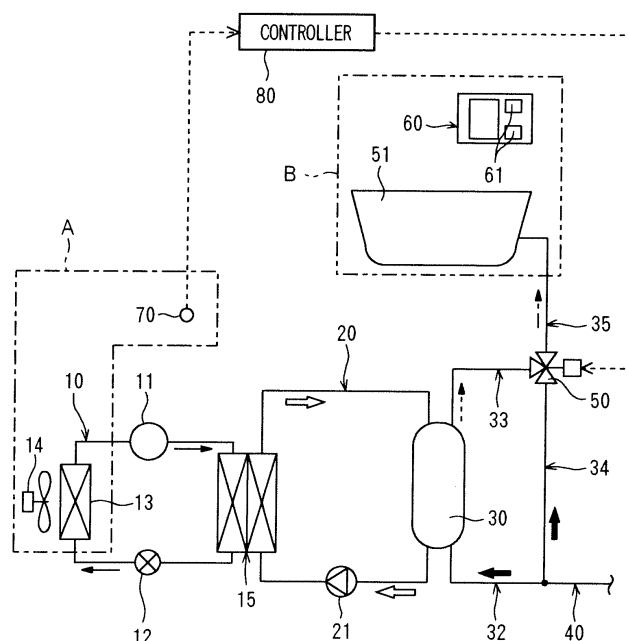
(71) Applicant: **Sanden Corporation**
Isesaki-shi,
Gunma 372-8502 (JP)

(54) **Hot water device for bathtub**

(57) The present invention provides a hot water device for bathtub in which water is not wasted to allow energy saving and at the same time it is possible to save a trouble of adjusting the temperature of water for bathtub supplied to the bathtub to a temperature desired by the user during bathing. In the hot water device for bathtub of the invention, the water for bathtub having its temper-

ature varied by the controller 80 to temperature desired by the user during bathing is supplied to a bathtub 51. Accordingly, the temperature adjustment using hot water is not needed, and thus water is not wasted to allow energy saving and at the same time it is possible to save a trouble of adjusting the temperature of hot water in the bathtub to a temperature desired by the user during bathing.

Fig. 1



Description

[0001] The present invention relates to a hot water device for bathtub for home or professional use.

[0002] As a hot water device for bathtub of this type, there has been known one which includes a hot water storage tank which stores high-temperature water, water supplying means for supplying low-temperature water, a temperature sensor which detects an outdoor air temperature, a timer which detects a time zone of day, and control means for controlling the operation of a compressor (for example, Japanese Patent Publication 2001-201177).

[0003] In the hot water device for bathtub having the above configuration, the control means controls the operation of the compressor based on an outdoor air temperature detected by the temperature sensor and a time zone of day detected by the timer, whereby high-temperature water is stored in the hot water storage tank.

[0004] However, in the hot water device for bathtub, while energy saving in storing high-temperature water in the hot water storage tank is considered, no consideration is given to energy saving in using high-temperature water stored in the hot water storage tank.

[0005] Particularly, in the hot water device for bathtub, high-temperature water stored in the hot water storage tank and low-temperature water supplied from the water supplying means are mixed to obtain water for bathtub of a preliminarily determined preset temperature, and thereafter the water for bathtub of the preset temperature is supplied to the bathtub. However, for example, when the outdoor air temperature is high in summer or the like, the preset temperature of water for bathtub may be higher than a temperature desired by the user during bathing. In this case, adjustment must be made to obtain the temperature desired by the user by further supplying low-temperature water from the water supplying means to the bathtub. Similarly, for example, when the outdoor air temperature is low in winter or the like, the preset temperature of water for bathtub may be lower than a temperature desired by the user during bathing. In this case, adjustment must be made to obtain the temperature desired by the user by further supplying high-temperature water stored in the hot water storage tank to the bathtub.

[0006] That is, in the hot water device for bathtub, it takes labor to adjust the temperature of water for bathtub supplied to the bathtub to a temperature desired by the user during bathing, and at the same time water consumption in adjusting the temperature of water for bathtub increases, so energy saving cannot be achieved.

[0007] The present invention has been achieved in view of the above-mentioned circumstances, and has an object to provide a hot water device for bathtub in which water is not wasted to allow energy saving and at the same time it is possible to save a trouble of adjusting the temperature of water for bathtub supplied to the bathtub to a temperature desired by the user during bathing.

[0008] According to the present invention, there is pro-

vided a hot water device for bathtub which includes a hot water storage tank which stores high-temperature water, water supplying means for supplying low-temperature water, and temperature setting means allowing setting of the temperature of water for bathtub to be supplied to a bathtub, the hot water device for bathtub mixing high-temperature water supplied from the hot water storage tank and low-temperature water supplied from the water supplying means and then supplying water for bathtub of a preset temperature to the bathtub, and the hot water device for bathtub including outdoor air temperature information acquiring means for acquiring prescribed information on outdoor air temperature, and control means for varying the temperature of water for bathtub to a temperature lower than the preset temperature when the outside air temperature acquired by the outdoor air temperature information acquiring means is higher than a prescribed reference temperature, or varying the temperature of water for bathtub to a temperature higher than the preset temperature when the outside air temperature acquired by the outdoor air temperature information acquiring means is lower than the prescribed reference temperature.

[0009] According to the inventive hot water device for bathtub, prescribed information on outdoor air temperature is acquired by the outdoor air temperature information acquiring means, and when the outdoor air temperature acquired by the outdoor air temperature information acquiring means is higher or lower than a prescribed reference temperature, water for bathtub having its temperature varied by the control means to a temperature desired by the user during bathing is supplied to the bathtub. Accordingly, temperature adjustment which uses water is not needed, so water is not wasted to achieve energy saving, and at the same time it is possible to save a trouble of adjusting the water in the bathtub to a temperature desired by the user during bathing.

IN THE DRAWINGS:

[0010]

FIG. 1 is a schematic configuration view of a hot water device for bathtub according to an embodiment of the present invention; and

FIG. 2 is a flowchart illustrating the control of the hot water device for bathtub.

[0011] FIGS. 1 and 2 illustrate a hot water device for bathtub according to an embodiment of the present invention. The hot water device for bathtub includes: a refrigerant circuit 10 in which refrigerant circulates; hot water circuit 20 in which hot water circulates; a hot water storage tank 30 which stores high-temperature water; water supplying tube 40 acting as means for supplying low-temperature water; a mixing valve 50 which mixes high-temperature water supplied from the hot water storage tank 30 and low-temperature water supplied from

the water supplying tube 40; a remote controller 60 acting as temperature setting means allowing setting of the temperature of water for bathtub to be supplied to a later described bathtub 51; an outdoor air temperature sensor 70 acting as outdoor air temperature information acquiring means for acquiring information on outdoor air temperature; and a controller 80 acting as control means.

[0012] The refrigerant circuit 10 is constituted of a compressor 11, an expansion valve 12 acting as an expansion mechanism, an air heat exchanger 13 and a water heat exchanger 15; refrigerant circulates through the compressor 11, the water heat exchanger 15, the expansion valve 12, the air heat exchanger 13 and the compressor 11 in this order. The air heat exchanger 13 is arranged in an outdoor site A (refer to a part surrounded by the dashed-dotted line in FIG. 1), and there is provided a fan 14 for carrying out heat exchange between the refrigerant and outside air in the air heat exchanger 13. The refrigerant used in the refrigerant circuit 10 is natural one (for example, carbon dioxide).

[0013] The hot water circuit 20 is constituted of a first pump 21, the hot water storage tank 30 and the water heat exchanger 15; hot water circulates through the hot water storage tank 30, the first pump 21, the water heat exchanger 15 and the hot water storage tank 30 in this order. That is, the water heat exchanger 15 is shared by the refrigerant circuit 10 and the hot water circuit 20; heat exchange is carried out between the refrigerant circulating in the refrigerant circuit 10 and the hot water circulating in the hot water circuit 20.

[0014] The hot water storage tank 30 is connected to the hot water circuit 20, and via a first flow path 32 to the water supplying tube 40, and via a second flow path 33 to the mixing valve 50. Accordingly, low-temperature water is supplied from the water supplying tube 40 via the first flow path 32 to the hot water storage tank 30 and then circulates in the hot water circuit 20, so that the low-temperature water changes to high-temperature water, and thereafter returns to the hot water storage tank 30 to be sent via the second flow path 33 to the mixing valve 50.

[0015] The water supplying tube 40 has one end thereof connected to a supply source such as a water line (not illustrated). And the water supplying tube 40 has the other end thereof branching into the first flow path 32 and a third flow path 34, the water supplying tube 40 is connected via the first flow path 32 to the hot water storage tank 30, and via the third flow path 34 to the mixing valve 50. Accordingly, low-temperature water is supplied to both the hot water storage tank 30 and the mixing valve 50 (refer to the arrow of thick line in FIG. 1).

[0016] The mixing valve 50 is connected via the second flow path 33 to the hot water storage tank 30, and via the third flow path 34 to the water supplying tube 40, and via a fourth flow path 35 to a bathtub 51. Accordingly, high-temperature water supplied via the second flow path 33 from the hot water storage tank 30 and low-temperature water supplied via the third flow path 34 from the

water supplying tube 40 are mixed at the mixing valve 50 to provide water for bathtub. The water for bathtub provided at the mixing valve 50 is supplied via the fourth flow path 35 to the bathtub 51.

[0017] The remote controller 60 is arranged within a bathroom B (refer to a part surrounded by the two-dot chain line in FIG. 1) along with the bathtub 51. The remote controller 60 is provided with an operating switch 61 used to start the operation, to adjust the temperature of water for bathtub filling the bathtub 51, or to make a water filling reservation. Operating the operating switch 61 of the remote controller 60, the user can start the operation of the hot water device for bathtub, set preset temperature T_b of hot water to be filled into the bathtub 51, or set a start time of filling hot water.

[0018] The outdoor air temperature sensor 70 serves to detect outdoor air temperature T_a being information on outdoor air temperature. The temperature of water for bathtub to be supplied to the bathtub 51 is varied according to outdoor air temperature T_a detected by the outdoor air temperature sensor 70. As the outdoor air temperature sensor 70, any existing temperature sensor can be used.

[0019] The control-system configuration of the hot water device for bathtub illustrated in FIG. 1 will now be described. The controller 80 acting as control means for controlling the operation of the hot water device for bathtub includes a microcomputer and various types of drivers. A detection signal is sent to the controller 80 based on outdoor air temperature T_a detected by the outdoor air temperature sensor 70. Also, a detection signal is sent to the controller 80 based on a water filling reservation time detected by a timer (not illustrated). According to the detection signal, the controller 80 controls the opening of the mixing valve 50 and the supplying of power to the compressor 11, so that the temperature of water for bathtub to be supplied to the bathtub 51 is varied as described later.

[0020] The operation of the hot water device for bathtub illustrated in FIG. 1 will now be described. The control of the hot water device for bathtub by the controller 80 will also be described together.

[0021] The refrigerant of the refrigerant circuit 10 circulates through the compressor 11, the water heat exchanger 15, the expansion valve 12, the air heat exchanger 13 and the compressor 11 in this order (refer to the arrow of solid line in FIG. 1). The hot water of the hot water circuit 20 circulates through the hot water storage tank 30, the first pump 21, the water heat exchanger 15 and the hot water storage tank 30 in this order (refer to the outlined arrow in FIG. 1).

[0022] When the refrigerant and hot water circulate in the respective circuits 10 and 20 in this manner, heat exchange is carried out at the water heat exchanger 15 between the refrigerant discharged from the compressor 11 and low-temperature water circulating in the hot water circuit 20. When heat exchange is carried out at the water heat exchanger 15, the temperature of hot water circu-

lating in the hot water circuit 20 rises and the high-temperature water is stored in the hot water storage tank 30. The high-temperature water stored in the hot water storage tank 30 is supplied via the second flow path 33 to the mixing valve 50 (refer to the arrow of dashed line in FIG. 1).

[0023] At the mixing valve 50, the high-temperature water supplied from the hot water storage tank 30 and the low-temperature water supplied from the water supplying tube 40 are mixed. In this case, the opening of the mixing valve 50 is controlled by the controller 80 according to outdoor air temperature Ta detected by the outdoor air temperature sensor 70, so that the temperature of water for bathtub to be supplied to the bathtub 51 is varied. The control of the opening of the mixing valve 50 by the controller 80 will be described below.

[0024] First the user operates the operating switch 61 to set preset temperature Tb of hot water filled into the bathtub 51 (step S1).

[0025] Subsequently, the controller 80 determines whether the operating switch 61 of the remote controller 60 has been turned on by the user (step S2).

[0026] At step S2, if the operating switch 61 of the remote controller 60 has been turned on by the user, the controller 80 determines whether or not the outdoor air temperature sensor 70 has been turned on during the past hour (step S3). That is, the controller 80 determines whether or not the outdoor air temperature sensor 70 has been in a state capable of detecting outdoor air temperature Ta during the past hour.

[0027] Meanwhile, at step S2, if the operating switch 61 of the remote controller 60 has not been turned on by the user, the controller 80 determines whether or not a water filling reservation time has been set (step S4).

[0028] At step S4, if a water filling reservation time has been set, the controller 80 determines whether there remain 30 minutes or less until the water filling reservation time (step S5). At step S4, if no water filling reservation time has been set, the flow returns to step S2.

[0029] At step S5, if there remain 30 minutes or less until the water filling reservation time, the flow returns to step S3. Also, at step S5, if no water filling reservation time has been set, the flow returns to step S2.

[0030] At step S3, if the outdoor air temperature sensor 70 has been turned on during the past hour, the controller 80 causes the outdoor air temperature sensor 70 to detect outdoor air temperature Ta (step S6) and thereafter determines whether or not the detected outdoor air temperature Ta is equal to or higher than prescribed outdoor air reference temperature T1 (for example, T1 = 35°C) (step S7).

[0031] Meanwhile, at step S3, if the outdoor air temperature sensor 70 has not been turned on during the past hour, the outdoor air temperature sensor 70 is turned on so that outdoor air temperature Ta can be detected (step S8), and the flow returns to step S6.

[0032] At step S7, if the detected outdoor air temperature Ta is equal to or higher than a prescribed outdoor

air reference temperature T1, the controller 80 controls the opening of the mixing valve 50 so that the temperature of water for bathtub becomes lower by a predetermined value (for example, 2°C) than hot water filling preset temperature Tb, and varies the temperature of water for bathtub to temperature Tc desired by the user during bathing (step S9). That is, when high-temperature water and low-temperature water is mixed at the mixing valve 50, the opening of the mixing valve 50 is controlled by the controller 80 so that the temperature of water for bathtub to be supplied to the bathtub 51 becomes Tc lower by 2°C than hot water filling preset temperature Tb, and thus more low-temperature water is imported.

[0033] Meanwhile, at step S7, if the detected outdoor air temperature Ta is not equal to or higher than prescribed outdoor air reference temperature T1, it is determined whether the detected outdoor air temperature Ta is equal to or higher than prescribed outdoor air reference temperature T2 (for example, T2 = 30°C) and at the same time lower than prescribed outdoor air reference temperature T1 (step S10).

[0034] At step S10, if the detected outdoor air temperature Ta is equal to or higher than prescribed outdoor air reference temperature T2 and at the same time lower than prescribed outdoor air reference temperature T1, the controller 80 controls the opening of the mixing valve 50 so that the temperature of water for bathtub becomes lower by a predetermined value (for example, 1°C) than hot water filling preset temperature Tb, and varies the temperature of water for bathtub to temperature Td desired by the user during bathing (step S11). That is, when high-temperature water and low-temperature water is mixed at the mixing valve 50, the opening of the mixing valve 50 is controlled by the controller 80 so that the temperature of water for bathtub to be supplied to the bathtub 51 becomes Td lower by 1°C than hot water filling preset temperature Tb, and thus more low-temperature water is imported.

[0035] Meanwhile, at step S10, if the detected outdoor air temperature Ta is equal to or higher than prescribed outdoor air reference temperature T2 and at the same time not lower than prescribed outdoor air reference temperature T1, it is determined whether or not the detected outdoor air temperature Ta is equal to or higher than prescribed outdoor air reference temperature T3 (for example, T3 = 20°C) and at the same time lower than prescribed outdoor air reference temperature T2 (step S12).

[0036] At step S12, if the detected outdoor air temperature Ta is equal to or higher than prescribed outdoor air reference temperature T3 and at the same time lower than prescribed outdoor air reference temperature T2, the temperature of water for bathtub is varied to temperature Te equal to hot water filling preset temperature Tb (step S13). That is, if the detected outdoor air temperature Ta is equal to or higher than prescribed outdoor air reference temperature T3 and at the same time lower than prescribed outdoor air reference temperature T2, the temperature adjustment relative to hot water filling

preset temperature T_b is not made.

[0037] Meanwhile, at step S12, if the detected outdoor air temperature T_a is equal to or higher than prescribed outdoor air reference temperature T_3 and at the same time not lower than prescribed outdoor air reference temperature T_2 , it is determined whether or not the detected outdoor air temperature T_a is equal to or higher than prescribed outdoor air reference temperature T_4 (for example, $T_4 = 10^\circ\text{C}$) and at the same time lower than prescribed outdoor air reference temperature T_3 (step S14).

[0038] At step S14, if the detected outdoor air temperature T_a is equal to or higher than prescribed outdoor air reference temperature T_4 and at the same time lower than prescribed outdoor air reference temperature T_3 , the controller 80 controls the opening of the mixing valve 50 so that the temperature of water for bathtub becomes higher by a predetermined value (for example, 1°C) than hot water filling preset temperature T_b , and varies the temperature of water for bathtub to temperature T_f desired by the user during bathing (step S15). That is, when high-temperature water and low-temperature water is mixed at the mixing valve 50, the opening of the mixing valve 50 is controlled by the controller 80 so that the temperature of water for bathtub to be supplied to the bathtub 51 becomes T_f higher by 1°C than hot water filling preset temperature T_b , and thus more high-temperature water is imported.

[0039] Meanwhile, at step S14, if the detected outdoor air temperature T_a is equal to or higher than prescribed outdoor air reference temperature T_4 and at the same time not lower than prescribed outdoor air reference temperature T_3 , it is determined whether or not the detected outdoor air temperature T_a is lower than prescribed outdoor air reference temperature T_4 (step S16).

[0040] At step S16, if the detected outdoor air temperature T_a is lower than prescribed outdoor air reference temperature T_4 , the controller 80 controls the opening of the mixing valve 50 so that the temperature of water for bathtub becomes higher by a predetermined value (for example, 2°C) than hot water filling preset temperature T_b , and varies the temperature of water for bathtub to temperature T_g desired by the user during bathing (step S17). That is, when high-temperature water and low-temperature water is mixed at the mixing valve 50, the opening of the mixing valve 50 is controlled by the controller 80 so that the temperature of water for bathtub to be supplied to the bathtub 51 becomes T_g higher by 2°C than hot water filling preset temperature T_b , and thus more high-temperature water is imported. Meanwhile, at step S16, if the detected outdoor air temperature T_a is not lower than prescribed outdoor air reference temperature T_4 , and the flow returns to step S7.

[0041] The water for bathtub having its temperature varied as described above to temperature T_c , T_d , T_e , T_f or T_g ($T_c < T_d < T_e < T_f < T_g$) desired by the user during bathing in the mixing valve 50 according to the detected outdoor air temperature T_a is supplied via the fourth flow path 35 to the bathtub 51 (refer to the arrow of dashed-

dotted line in FIG. 1) to start automatic filling of hot water.

[0042] In this way, according to the hot water device for bathtub of the present embodiment, the water for bathtub having its temperature varied by the controller 80 to temperature T_c , T_d , T_e , T_f or T_g desired by the user during bathing is supplied to the bathtub 51. Accordingly, the temperature adjustment using water is not needed, and thus water is not wasted to allow energy saving and at the same time it is possible to save a trouble of adjusting the temperature of hot water in the bathtub to a temperature desired by the user during bathing.

[0043] Also, according to the hot water device for bathtub of the present embodiment, since any existing temperature sensor can be used as the outdoor air temperature sensor 70, component cost can be suppressed.

[0044] According to the above embodiment, as the outdoor air temperature information acquiring means, the outdoor air temperature sensor 70 detecting outdoor air temperature T_a is used, but the outdoor air temperature information acquiring means is not limited thereto as long as information on outdoor air temperature T_a can be acquired. For example, the outdoor air temperature information acquiring means may acquire outdoor air temperature $1a$ from predetermined meteorological data.

[0045] According to the above embodiment, the temperature of water for bathtub supplied to the bathtub 51 is varied according to outdoor air temperature T_a detected by the outdoor air temperature sensor 70, but the present invention is not limited thereto. For example, the operation of the compressor 11 or the first pump 21 may be controlled according to outdoor air temperature T_a detected by the outdoor air temperature sensor 70, in this case, energy saving can also be achieved in storing high-temperature water in the hot water storage tank 30.

[0046] Further, according to the above embodiment, heat exchange is carried out between the refrigerant circulating in the refrigerant circuit 10 using external heat and the hot water circulating in the hot water circuit 20, but the present invention is not limited thereto. For example, the heat exchange of hot water may be carried out by a gas hot water device or the like.

Claims

1. A hot water device for bathtub comprising: a hot water storage tank (30) which stores high-temperature water; water supplying means (40) for supplying low-temperature water; and temperature setting means (60) allowing setting of the temperature of water for bathtub to be supplied to a bathtub, the hot water device for bathtub mixing high-temperature water supplied from the hot water storage tank (30) and low-temperature water supplied from the water supplying means (40) and then supplying water for bathtub of a preset temperature to the bathtub (51), wherein the hot water device for bathtub includes outdoor air temperature information acquiring

means (70) for acquiring prescribed information on outdoor air temperature; and
control means (80) for varying the temperature of water for bathtub to a temperature lower than the preset temperature when the outside air temperature acquired by the outdoor air temperature information acquiring means (70) is higher than a prescribed reference temperature, or varying the temperature of water for bathtub to a temperature higher than the preset temperature when the outside air temperature acquired by the outdoor air temperature information acquiring means (70) is lower than the prescribed reference temperature.

2. The hot water device for bathtub according to claim 1, further comprising a mixing valve (50) which mixes high-temperature water supplied from the hot water storage tank (30) and low-temperature water supplied from the water supplying means (40) to produce water for bathtub,
wherein the control means (80) controls the opening of the mixing valve (50) and thereby varies the preset temperature of water for bathtub to be supplied to the bathtub (51).
3. The hot water device for bathtub according to claim 1 or 2,
wherein an outdoor air temperature sensor (70) constitutes the outdoor air temperature information acquiring means (70).
4. The hot water device for bathtub according to claim 1 or 2,
wherein the outdoor air temperature information acquiring means (70) acquires an outdoor air temperature from predetermined meteorological data.

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Fig. 1

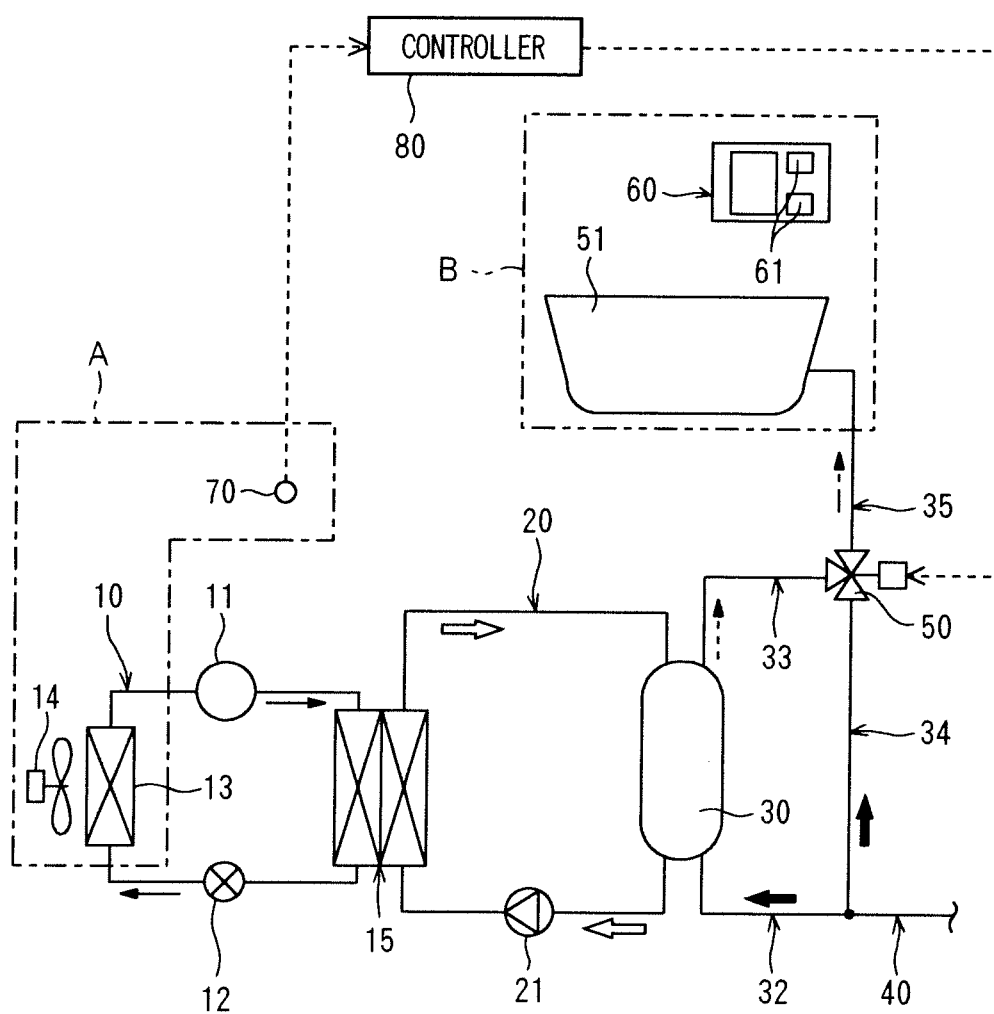
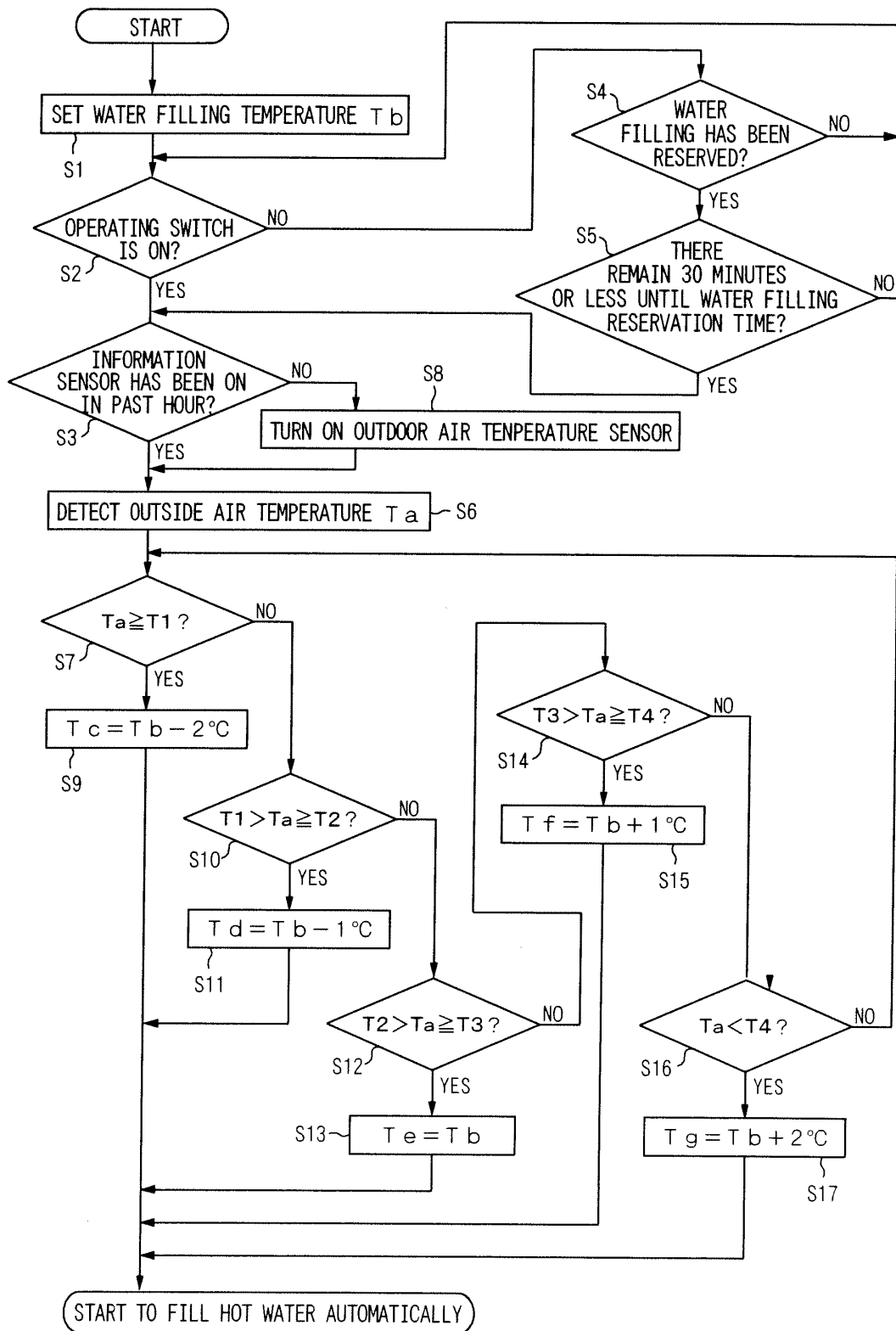


Fig. 2



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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