



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

(43) Date of publication:
17.09.2014 Bulletin 2014/38

(51) Int Cl.:
F24H 1/00 (2006.01)

(21) Application number: **12847838.5**

(86) International application number:
PCT/JP2012/078995

(22) Date of filing: **08.11.2012**

(87) International publication number:
WO 2013/069734 (16.05.2013 Gazette 2013/20)

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

(72) Inventors:
• **ONO Hitoi**
Tokyo 108-8215 (JP)
• **MATSUKURA Noriyuki**
Tokyo 108-8215 (JP)

(30) Priority: **11.11.2011 JP 2011248030**

(74) Representative: **Intès, Didier Gérard André et al**
Cabinet Beau de Loménie
158, rue de l'Université
75340 Paris Cedex 07 (FR)

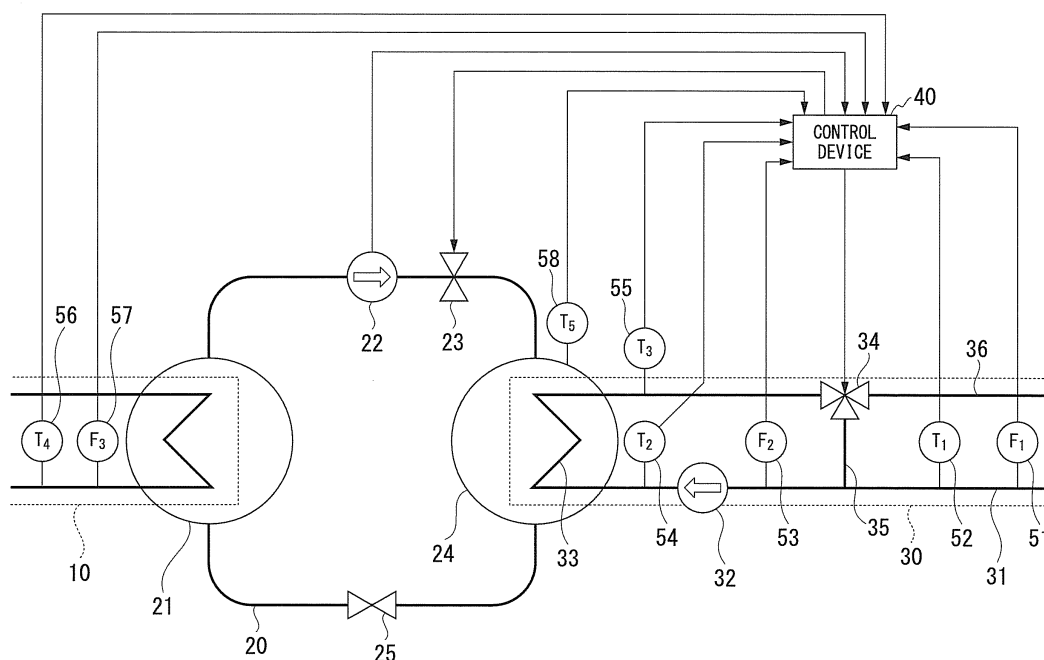
(71) Applicant: **Mitsubishi Heavy Industries, Ltd.**
Tokyo 108-8215 (JP)

(54) **WARM WATER HEATING SYSTEM, CONTROL DEVICE AND CONTROL METHOD**

(57) A control device of the present invention controls an opening degree of a three-way valve so that a temperature of water on an upstream side of a heating portion increases by a predetermined temperature until the temperature of the water on the upstream side of the heating portion reaches a target temperature after a heat pump

operates. Alternatively, the control device controls an opening degree of a vane so that a temperature of water on a downstream side of the heating portion increases by a predetermined temperature until the temperature of the water on the downstream side of the heating portion reaches a target temperature after a heat pump operates.

FIG. 9



Description

[Technical Field]

[0001] The present invention relates to a warm water heating system which heats warm water using a heat output heat exchanger provided in a heat pump, and a control device and a control method of the warm water heating system.
[0002] Priority is claimed on Japanese Patent Application No. 2011-248030, filed November 11, 2011, the content of which is incorporated herein by reference.

[Background Art]

[0003] Generally, a warm water system which supplies warm water includes a heat storage tank. In the warm water system, temperature control is performed by some water stored in this heat storage tank obtaining heat from a heat output heat exchanger provided in a main body of the warm water heat pump (e.g., see Patent Literature 1).

[0004] However, in the invention described in Patent Literature 1, there is a problem in that installation cost or an installation space increase since the heat storage tank is provided in the warm water system. Further, there is a problem in that it takes time to increase a temperature since the water stored in the heat storage tank is circulated to the heat output heat exchanger to increase the water temperature in the heat storage tank.

[0005] Therefore, a method of providing a three-way valve in a warm water system to circulate a part of output of warm water from a heat output heat exchanger to the heat output heat exchanger and perform control so that a temperature of an entrance of the heat output heat exchanger becomes a predetermined target temperature is described in Patent Literature 2. A temperature increase rate of the warm water system can be increased using this method.

[Citation List]

[Patent Literature]

[0006]

[Patent Literature 1] Japanese Patent Laid-Open Publication No. 2002-340400
 [Patent Literature 2] Japanese Patent Laid-Open Publication No. 2011-185477

[Summary of Invention]

[Problem to be Solved by the Invention]

[0007] When the method described in Patent Literature 2 is used, a three-way valve is fully opened and entire output of warm water from a heat output heat exchanger is likely to be circulated when a warm water system is in a transient state, such as at the time of start-up of the heat pump, i.e., when a water temperature of the entire warm water system is lower than a target temperature. In this case, when the water temperature of the warm water system rapidly increases and a temperature of an entrance of the heat output heat exchanger reaches a target temperature, an opening degree of the three-way valve changes for the first time. However, since opening and closing of the three-way valve is not instantly switched, an opening and closing operation of the three-way valve cannot follow a temperature change of the warm water, and the water temperature of the entrance of the heat output heat exchanger is likely to exceed the target temperature. In this case, heat capacity exchanged in the heat output heat exchanger of the heat pump may decrease and efficiency of the warm water heating system may decrease.

[0008] The present invention provides a warm water heating system, a control device and a control method which appropriately controls a temperature increase rate in a transient state of a warm water system.

[Means for Solving the Problem]

[0009] The present invention provides a control device used to control a warm water heating system, the control device including: a heat pump including a heat output heat exchanger which takes heat from a heat source system and outputs heat; a heating portion which heats water using the heat obtained from the heat output heat exchanger; an outflow portion which flows the water heated by the heating portion to a heating target; a circulation portion which circulates the water heated by the heating portion to an upstream side of the heating portion; an inflow portion which flows water from the heating target into the upstream side of the heating portion; and an adjustment unit which adjusts flow amount distribution of the water from the heating portion to the outflow portion and the circulation portion, wherein the control

device includes an upstream-side target temperature setting unit which sets a target temperature of the water on the upstream side of the heating portion; and an adjustment amount determination unit which determines an adjustment amount of the flow amount distribution by the adjustment unit so that a temperature of the water on the upstream side of the heating portion increases by a predetermined temperature until the temperature of the water on the upstream side of the heating portion reaches the target temperature.

[0010] Further, in the present invention, it is preferable for the adjustment amount determination unit to determine the adjustment amount of the flow amount distribution by the adjustment unit so that the temperature of the water on the upstream side of the heating portion increases by a predetermined temperature calculated based on states of water flowing in the heating portion, water circulated by the circulation portion, and water flowing from the inflow portion into the upstream side of the heating portion until the temperature of the water on the upstream side of the heating portion reaches the target temperature.

[0011] Further, in the present invention, it is preferable to further include an adjustment temperature calculation unit which calculates, as an adjustment temperature used for determination of the adjustment amount, a temperature difference between a temperature of water obtained by mixing water flowing from the inflow portion into the upstream side of the heating portion with water circulated by the circulation portion and a temperature of the water flowing in the heating portion based on the states of the water flowing in the heating portion, the water circulated by the circulation portion, and the water flowing from the inflow portion into the upstream side of the heating portion. It is preferable for the adjustment amount determination unit to determine the adjustment amount of the flow amount distribution by the adjustment unit so that the temperature of the water on the upstream side of the heating portion increases by the adjustment temperature calculated by the adjustment temperature calculation unit until the temperature of the water on the upstream side of the heating portion reaches the target temperature.

[0012] Further, in the present invention, it is preferable for the adjustment amount determination unit to determine the adjustment amount of the flow amount distribution by the adjustment unit so that the temperature of the water flowing into the heating portion becomes constant until the heat pump operates.

[0013] Further, in the present invention, it is preferable for the upstream-side target temperature setting unit to set a target temperature of the water on the upstream side of the heating portion based on a maximum heating amount in the heating portion, a flow amount of the water flowing into the heating portion, and a target temperature of the water on a downstream side of the heating portion.

[0014] Further, in the present invention, it is preferable to include a downstream-side target temperature setting unit which sets the target temperature of the water on the downstream side of the heating portion; and a heat pump adjustment amount determination unit which determines an adjustment amount of heat pump control so that the temperature of the water on the downstream side of the heating portion increases by a predetermined temperature until the temperature of the water on the downstream side of the heating portion reaches the target temperature.

[0015] Further, in the present invention, it is preferable for the heat pump adjustment amount determination unit to determine the adjustment amount of the heat pump control so that the temperature of the water on the downstream side of the heating portion increases by a predetermined temperature calculated based on a state of the water flowing in the heating portion and flowing from the heating portion into the adjustment unit, and a heating amount in the heating portion until the temperature of the water on the downstream side of the heating portion reaches the target temperature.

[0016] Further, in the present invention, it is preferable to include a heat pump adjustment temperature calculation unit which calculates, as a heat pump adjustment temperature used for determination of the adjustment amount of the heat pump control, the temperature difference between the temperature of the water flowing in the heating portion when the water is heated by the heating portion and the temperature of the water flowing from the heating portion into the adjustment unit, based on the state of the water flowing in the heating portion and the state of the water flowing from the heating portion into the adjustment unit, and a heating amount in the heating portion. It is preferable for the heat pump adjustment amount determination unit to determine the adjustment amount of the heat pump control so that the temperature of the water on the downstream side of the heating portion increases by the heat pump adjustment temperature calculated by the heat pump adjustment temperature calculation unit until the temperature of the water on the downstream side of the heating portion reaches the target temperature.

[0017] Further, the present invention provides a control device used to control a warm water heating system including: a heat pump including a heat output heat exchanger which takes heat from a heat source system and outputs heat; a heating portion which heats water using the heat obtained from the heat output heat exchanger; an outflow portion which flows the water heated by the heating portion to a heating target; a circulation portion which circulates the water heated by the heating portion to an upstream side of the heating portion; an inflow portion which flows water from the heating target into the upstream side of the heating portion, a downstream-side target temperature setting unit which sets a target temperature of the water on a downstream side of the heating portion; and a heat pump adjustment amount determination unit which determines an adjustment amount of heat pump control so that a temperature of the water on the downstream side of the heating portion increases by a predetermined temperature until the temperature of the water on the downstream side of the heating portion reaches the target temperature.

[0018] Further, in the present invention, it is preferable for the heat pump adjustment amount determination unit to determine the adjustment amount of the heat pump control so that the temperature of the water on the downstream side of the heating portion increases by a predetermined temperature calculated based on the state of water flowing in the heating portion and the state of water flowing from the heating portion and a heating amount in the heating portion until the temperature of the water on the downstream side of the heating portion reaches the target temperature.

[0019] Further, in the present invention, it is preferable to include a heat pump adjustment temperature calculation unit which calculates, as a heat pump adjustment temperature used for determination of the adjustment amount of the heat pump control, the temperature difference between the temperature of the water flowing in the heating portion when the water is heated by the heating portion and the temperature of the water flowing from the heating portion based on the state of the water flowing in the heating portion and the state of the water flowing from the heating portion and the heating amount in the heating portion, and it is preferable for the heat pump adjustment amount determination unit to determine the adjustment amount of the heat pump control so that the temperature of the water on the downstream side of the heating portion increases by the heat pump adjustment temperature calculated by the heat pump adjustment temperature calculation unit until the temperature of the water on the downstream side of the heating portion reaches the target temperature.

[0020] Further, the present invention includes a heat pump including a heat output heat exchanger which takes heat from a heat source system and outputs heat; a heating portion which heats water using the heat obtained from the heat output heat exchanger; an outflow portion which flows the water heated by the heating portion to a heating target; a circulation portion which circulates the water heated by the heating portion to an upstream side of the heating portion; an inflow portion which flows water from the heating target into the upstream side of the heating portion; an adjustment unit which adjusts the flow amount distribution of the water from the heating portion to the circulation portion and the outflow portion; and the control device.

[0021] Further, the present invention provides a control method of controlling an adjustment amount of an adjustment unit of a warm water heating system which includes: a heat pump including a heat output heat exchanger which takes heat from a heat source system and outputs heat; a heating portion which heats water using the heat obtained from the heat output heat exchanger; an outflow portion which flows the water heated by the heating portion to a heating target; a circulation portion which circulates the water heated by the heating portion to an upstream side of the heating portion; an inflow portion which flows water from the heating target into the upstream side of the heating portion; and the adjustment unit which adjusts flow amount distribution of the water from the heating portion to the circulation portion and the outflow portion, the control method including determining a target temperature of the water on the upstream side of the heating portion; and determining an adjustment amount of the flow amount distribution by the adjustment unit so that a temperature of the water on the upstream side of the heating portion increases by a predetermined temperature until the temperature of the water on the upstream side of the heating portion reaches the target temperature.

[0022] Further, the present invention provides a control device of controlling an adjustment amount of a heat pump of a warm water heating system including: the heat pump including a heat output heat exchanger which takes heat from a heat source system and outputs heat; a heating portion which heats water using the heat obtained from the heat output heat exchanger; an outflow portion which flows the water heated by the heating portion to a heating target; a circulation portion which circulates the water heated by the heating portion to an upstream side of the heating portion; and an inflow portion which flows water from the heating target into the upstream side of the heating portion, the control method including: determining a target temperature of the water on a downstream side of the heating portion; and determining an adjustment amount of heat pump control so that a temperature of the water on the downstream side of the heating portion increases by a predetermined temperature until the temperature of the water on the downstream side of the heating portion reaches the target temperature.

[Effects of the Invention]

[0023] According to the present invention, the adjustment amount of the adjustment unit or the adjustment amount of the heat pump is determined so that the temperature of the warm water on the upstream side or the downstream side of the heating portion increases by a predetermined temperature until the temperature of the warm water on the upstream side of the heating portion reaches the target temperature. Accordingly, it is possible to appropriately control the temperature increase rate in the transient state of the warm water system.

[Brief Description of Drawings]

[0024]

Fig. 1 is a schematic configuration diagram of a warm water heating system according to a first embodiment of the present invention.

Fig. 2 is a schematic block diagram showing a configuration of a control device according to the first embodiment of the present invention.

Fig. 3 is a flowchart showing operation of the control device according to the first embodiment of the present invention.

Fig. 4 is a schematic configuration diagram of a warm water heating system according to a second embodiment of the present invention.

Fig. 5 is a schematic block diagram showing a configuration of a control device according to the second embodiment of the present invention.

Fig. 6 is a schematic configuration diagram of a warm water heating system according to a third embodiment of the present invention.

Fig. 7 is a schematic block diagram showing a configuration of a control device according to the third embodiment of the present invention.

Fig. 8 is a flowchart showing operation of the control device according to the third embodiment of the present invention.

Fig. 9 is a schematic configuration diagram of a warm water heating system according to a fourth embodiment of the present invention.

[Description of Embodiments]

[0025] Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings.

(First embodiment)

[0026] Fig. 1 is a schematic configuration diagram of a warm water heating system according to a first embodiment of the present invention.

[0027] The warm water heating system includes a heat pump 20 which takes heat from a heat source system 10 and outputs heat, a warm water system 30 which heats water using the heat output from the heat pump 20, and a control device 40 which controls the warm water system 30.

[0028] The heat pump 20 includes a pipe filled with a heat medium, and an evaporator 21, a compressor 22, a condenser 24 (a heat output heat exchanger), and an expansion valve 25 which are connected to the pipe.

[0029] The evaporator 21 increases a temperature of the heat medium using the heat output from the heat source system 10.

[0030] The compressor 22 compresses and liquefies the heat medium whose temperature is increased by the evaporator 21.

[0031] A vane 23 adjusts a flow amount of the heat medium liquefied by the compressor 22.

[0032] The condenser 24 supplies heat of the heat medium flowing from the vane 23 to the warm water system 30.

[0033] The expansion valve 25 depressurizes and vaporizes the heat medium whose temperature is decreased by the condenser 24.

[0034] The warm water system 30 is configured of an inflow portion 31, a circulation pump 32, a heating portion 33, a three-way valve 34 (adjustment portion), a circulation portion 35, and an outflow portion 36.

[0035] The inflow portion 31 flows water from a heating target into the heating portion 33 through the circulation pump 32.

[0036] The circulation pump 32 pumps the inflow water to the heating portion 33.

[0037] The heating portion 33 heats the inflow water from the circulation pump 32 using the heat supplied from the condenser 24 and supplies the heated water to the three-way valve 34.

[0038] The three-way valve 34 flows a part of the water heated by the heating portion 33 into the circulation portion 35 and flows the remainder into the outflow portion 36 according to its opening degree (flow amount distribution).

[0039] The circulation portion 35 circulates the water from the three-way valve 34 to the heating portion 33 through the circulation pump 32.

[0040] The outflow portion 36 flows the water from the three-way valve 34 to the heating target.

[0041] Further, an inflow portion flow amount detector 51, an inflow portion temperature detector 52, a heating portion flow amount detector 53, a heating portion upstream-side temperature detector 54, and a heating portion downstream-side temperature detector 55 are provided in the warm water system 30.

[0042] The inflow portion flow amount detector 51 detects a flow amount F_1 of the water flowing through the inflow portion 31.

[0043] The inflow portion temperature detector 52 detects a temperature T_1 of the water flowing through the inflow portion 31.

[0044] The heating portion flow amount detector 53 detects a flow amount F_2 of the water flowing through the heating portion 33.

[0045] The heating portion upstream-side temperature detector 54 detects a temperature of the water on an upstream

side of the heating portion 33. In other words, the heating portion upstream-side temperature detector 54 detects a temperature T_2 of the water before the water is heated in the heating portion 33.

[0046] The heating portion downstream-side temperature detector 55 detects a temperature of the water on a downstream side of the heating portion 33. In other words, the heating portion downstream-side temperature detector 55 detects a temperature T_3 of the water after the water is heated in the heating portion 33.

[0047] Fig. 2 is a schematic block diagram showing a configuration of the control device 40 according to the first embodiment of the present invention.

[0048] The control device 40 includes a sensor information acquisition unit 401, an upstream-side temperature change rate calculation unit 402 (an adjustment temperature calculation unit), an upstream-side target temperature setting unit 403, a heat pump information input unit 404, an upstream-side immediate target temperature setting unit 405, and a three-way valve control unit 406 (an adjustment amount determination unit).

[0049] The sensor information acquisition unit 401 acquires sensor information (a flow amount or a temperature) detected by each detector provided in the warm water system 30.

[0050] The upstream-side temperature change rate calculation unit 402 calculates the change rate (adjustment temperature) of the water temperature on the upstream side of the heating portion 33, i.e., an increase rate of the water temperature based on the sensor information acquired by the sensor information acquisition unit 401. The change rate of the water temperature is calculated by applying the sensor information to a heat balance model.

[0051] The upstream-side target temperature setting unit 403 sets a target temperature of the water on the upstream side of the heating portion 33 when the warm water system 30 enters a steady state if the heat pump 20 and the warm water system 30 operate.

[0052] The heat pump information input unit 404 receives input of heat pump information indicating whether the compressor 22 of the heat pump 20 has started operation.

[0053] The upstream-side immediate target temperature setting unit 405 sets the immediate target temperature of the water on the upstream-side of the heating portion 33 at a current time according to the information acquired from the sensor information acquisition unit 401, the upstream-side temperature change rate calculation unit 402, the upstream-side target temperature setting unit 403 and the heat pump information input unit 404. Specifically, the upstream-side immediate target temperature setting unit 405 sets the current water temperature on the upstream side of the heating portion 33 as the immediate target temperature in a state in which the compressor 22 of the heat pump 20 does not operate. In other words, the upstream-side immediate target temperature setting unit 405 sets the immediate target temperature to preserve the current water temperature. Further, the upstream-side immediate target temperature setting unit 405 sets the immediate target temperature based on the temperature change rate calculated by the upstream-side temperature change rate calculation unit 402 until the current water temperature on the upstream side of the heating portion 33 reaches the upstream-side target temperature after the compressor 22 operates. Also, the upstream-side immediate target temperature setting unit 405 sets the target temperature set by the upstream-side target temperature setting unit 403 as the immediate target temperature after the current water temperature on the upstream side of the heating portion 33 has reached the upstream-side target temperature.

[0054] The three-way valve control unit 406 performs control of an opening degree of the three-way valve 34 under PID (Proportional/Integral/Differential) control based on the immediate target temperature set by the upstream-side immediate target temperature setting unit 405 and the current water temperature on the upstream side of the current heating portion 33.

[0055] Next, operation of the control device 40 at the time of operation start of the warm water heating system according to the present embodiment will be described.

[0056] Fig. 3 is a flowchart showing operation of the control device 40 according to the first embodiment of the present invention.

[0057] First, the upstream-side target temperature setting unit 403 of the control device 40 receives input of a target temperature T_{2d} on the upstream side of the heating portion 33 from a manager before operation start of the warm water heating system (step S1).

[0058] The manager of the warm water heating system operates the warm water system 30 after the setting of the target temperature. When the warm water system 30 operates, the upstream-side immediate target temperature setting unit 405 determines whether the heat pump information received as input by the heat pump information input unit 404 indicates operation start of the compressor 22 (step S2). The heat pump information indicates the operation start of the compressor 22 when the manager of the warm water heating system operates the compressor 22.

[0059] When the upstream-side immediate target temperature setting unit 405 determines that the heat pump information indicates that the compressor 22 has not yet operated (step S2: NO), the upstream-side immediate target temperature setting unit 405 acquires a temperature T_2 detected by the heating portion upstream-side temperature detector 54 from the sensor information acquisition unit 401 and sets the temperature T_2 , i.e., the water temperature on the upstream-side of the heating portion 33, as the immediate target temperature T_{2a} (step S3). Then, the three-way valve control unit 406 determines the opening degree so that the water temperature on the upstream side of the heating portion

33 becomes constant as the immediate target temperature T_{2a} , i.e., the current temperature T_2 , and controls the three-way valve 34 based on the opening degree (step S4). In other words, the three-way valve control unit 406 controls the opening degree of the three-way valve 34 so that the water for dissipating generated heat by the circulation pump 32 flows from the inflow portion 31.

[0060] Accordingly, the three-way valve 34 is adjusted with a small closing degree from full opening with respect to the circulation portion 35, i.e., a small opening degree with respect to the outflow portion 36, until the compressor 22 operates.

[0061] Thereafter, the process returns to step S2 and the operation of steps S2 to S4 is repeatedly executed until the compressor 22 operates.

[0062] On the other hand, when the upstream-side immediate target temperature setting unit 405 determines that the heat pump information indicates the operation start of the compressor 22 (step S2: YES), the upstream-side immediate target temperature setting unit 405 acquires the temperature T_2 detected by the heating portion upstream-side temperature detector 54 from the sensor information acquisition unit 401. The upstream-side immediate target temperature setting unit 405 then determines whether the temperature T_2 reaches the target temperature T_{2d} set by the upstream-side target temperature setting unit 403 (step S5).

[0063] When the upstream-side immediate target temperature setting unit 405 determines that the temperature T_2 is lower than the target temperature T_{2d} (step S5: NO), the upstream-side immediate target temperature setting unit 405 calculates a temperature change rate dT_2/dt on the upstream side of the heating portion 33 using the temperatures T_1 , T_2 , and T_3 and the heat medium flow amounts F_1 and F_2 acquired by the sensor information acquisition unit 401 (step S6). The temperature T_1 is a temperature of the water flowing through the inflow portion 31. Further, the temperature T_2 is the temperature of the water on the upstream side of the heating portion 33. Further, the temperature T_3 is the temperature of the water on the downstream side of the heating portion 33. Further, the flow amount F_1 is the flow amount of the water flowing through the inflow portion 31. Further, the flow amount F_2 is the flow amount of the water flowing through the heating portion 33.

[0064] Here, the upstream-side temperature change rate calculation unit 402 calculates the temperature change rate dT_2/dt by substituting each piece of sensor information into Equation (1) shown below indicating a heat balance model.

[0065] [Equation 1]

$$\frac{dT_2}{dt} = \frac{1}{M \cdot cp_2} \{ cp_1 \cdot F_1 \cdot T_1 + cp_3 (F_2 - F_1) \cdot T_3 - cp_2 \cdot F_2 \cdot T_2 + Q_{pump} \} \quad \dots (1)$$

[0066] Here, M denotes an amount of the water held in the heating portion 33. Further, cp_n (n is a natural number) denotes a specific heat of the water at a temperature T_n . Since the specific heat is determined by a water temperature, the upstream-side temperature change rate calculation unit 402 calculates the specific heat cp_n according to the temperature T_n . Further, Q_{pump} denotes an amount of heat input to the water in the circulation pump 32. Since the amount of heat from the circulation pump 32 to the water is determined based on the flow amount F_2 of the water passing through the circulation pump 32, and the number of rotations, power consumption and characteristics of the circulation pump 32, the upstream-side temperature change rate calculation unit 402 calculates the input heat amount Q_{pump} according to these values. Since detection delay is included in the sensor information detected by each detection unit, the upstream-side temperature change rate calculation unit 402 may identify the water amount M , the specific heat cp_n and the input heat amount Q_{pump} based on data of a transient state during actual operation, such that estimation precision is improved.

[0067] Here, referring to Equation (1), a denominator of a right side of Equation (1) indicates a heat capacity of the water held in the heating portion 33. Further, a numerator of the right side of Equation (2) indicates a heat amount of a difference between a heat amount of water obtained by mixing the water flowing from the inflow portion 31 into the upstream side of the heating portion 33 with the water circulated by the circulation portion 35 and a heat amount of the water flowing in the heating portion 33. In other words, the temperature change rate dT_2/dt is calculated based on a difference between a temperature of the water obtained by mixing the water flowing from the inflow portion 31 into the upstream side of the heating portion 33 with the water circulated by the circulation portion 35 and the temperature of the water flowing in the heating portion 33.

[0068] Then, the upstream-side immediate target temperature setting unit 405 sets a value obtained by adding the temperature change rate calculated by the upstream-side temperature change rate calculation unit 402 to the temperature T_2 acquired by the sensor information acquisition unit 401 as the immediate target temperature T_{2a} (step S7). The three-way valve control unit 406 then determines the opening degree so that the water temperature on the upstream side of the heating portion 33 is the target temperature T_{2a} , and controls the three-way valve 34 based on the opening degree

(step S8). Accordingly, the three-way valve control unit 406 can control the opening degree of the three-way valve 34 at an appropriate temperature change rate according to characteristics (each portion temperature, a flow amount and a water amount held in the heating portion 33) of the warm water system 30 until the water temperature T_2 on the upstream side of the heating portion 33 reaches the target temperature T_{2d} . Thereafter, the operation of steps S5 to S8 is repeatedly executed until the temperature T_2 reaches the target temperature T_{2d} in step S5.

[0069] When the upstream-side immediate target temperature setting unit 405 determines that the temperature T_2 reaches the target temperature T_{2d} in step S5 (step S5: YES), the upstream-side immediate target temperature setting unit 405 sets the target temperature T_{2d} as the immediate target temperature T_{2a} (step S9). The three-way valve control unit 406 then determines the opening degree so that the water temperature on the upstream side of the heating portion 33 is the immediate target temperature T_{2a} , i.e., the target temperature T_{2d} , and controls the three-way valve 34 based on the opening degree (step S10). Thereafter, the control device 40 ends the control of the three-way valve 34 in the transient state, and starts steady-state control to control the opening degree of the three-way valve 34 based on the target temperature T_{2d} . The control of the three-way valve 34 in the steady state is the same as the process of repeatedly executing steps S9 and S10.

[0070] Thus, according to the present embodiment, the three-way valve control unit 406 controls the opening degree of the three-way valve 34 so that the temperature of the water on the upstream side of the heating portion 33 increases by a predetermined temperature until the temperature of the water on the upstream side of the heating portion 33 reaches the target temperature T_{2d} after the heat pump 20 operates. Accordingly, when the warm water system 30 is in a transient state, the opening degree of the three-way valve 34 can be controlled such that an opening and closing operation of the three-way valve 34 can follow the temperature change of the warm water. Particularly, in the present embodiment, the predetermined temperature is calculated based on states of the water flowing in the heating portion 33, the water circulated by the circulation portion 35, and the water flowing from the inflow portion 31 into the upstream side of the heating portion 33. Accordingly, the control of the opening degree of the three-way valve 34 can be performed according to the characteristics of the warm water heating system, and the water temperature on the upstream side of the heating portion 33 can be increased to the target temperature T_{2a} at an appropriate temperature increase rate. Particularly, appropriate control of the opening degree can be performed using the temperature change rate dT_2/dt , which is the temperature difference between the temperature of the water obtained by mixing the water from the inflow portion 31 into the upstream side of the heating portion 33 with the water circulated by the circulation portion 35 and the temperature of the water flowing in the heating portion 33, as in the present embodiment.

[0071] While the case in which the three-way valve control unit 406 in the present embodiment performs the control of the opening degree using the temperature change rate dT_2/dt calculated by the upstream-side temperature change rate calculation unit 402 has been described, the present invention is not limited thereto and the three-way valve control unit 406 may control the opening degree of the three-way valve 34 so that the water temperature on the upstream side of the heating portion 33 increases by another predetermined temperature. However, when the predetermined temperature is set to be too low, the opening degree to the outflow portion 36 is controlled to be large such that temperature increase of the water temperature on the upstream side of the heating portion 33 becomes slow and it takes time for the warm water system 30 to transition to the steady state. On the other hand, when the predetermined temperature is set to be excessively high, the opening degree to the circulation portion 35 is controlled to be large such that the temperature increase of the water temperature on the upstream side of the heating portion 33 becomes fast and the opening and closing operation of the three-way valve 34 may not follow the temperature change of the warm water. In this case, the amount of heat exchanged in the condenser 24 of the heat pump 20 may decrease and the efficiency of the warm water heating system may become low.

(Second embodiment)

[0072] Next, a second embodiment of the present invention will be described. A warm water heating system according to the second embodiment sets the target temperature on the upstream side of the heating portion 33 of the warm water system 30 based on the characteristics of the heat source system 10 and the warm water system 30.

[0073] Fig. 4 is a schematic configuration diagram of the warm water heating system according to the second embodiment of the present invention.

[0074] The warm water heating system according to the second embodiment includes a heat source upstream-side temperature detector 56 and a heat source flow amount detector 57, in addition to the warm water system 30 of the warm water heating system according to the first embodiment, and operation of the control device 40 is different.

[0075] The heat source upstream-side temperature detector 56 detects a temperature T_4 of hot water on the upstream side of the heat source system 10.

[0076] The heat source flow amount detector 57 detects a flow amount F_3 of the hot water flowing through the heat source system 10.

[0077] Fig. 5 is a schematic block diagram showing a configuration of a control device 40 according to the second

embodiment of the present invention.

[0078] The control device 40 according to the second embodiment includes a downstream-side target temperature setting unit 407, in addition to the configuration of the control device 40 according to the first embodiment, and operation of the upstream-side target temperature setting unit 403 is different.

[0079] The downstream-side target temperature setting unit 407 sets a target temperature of the water on the downstream side of the heating portion 33 when the warm water system 30 enters a steady state if the heat pump 20 and the warm water system 30 operate.

[0080] The upstream-side target temperature setting unit 403 sets a target temperature of the water on the upstream side of the heating portion 33 when the warm water system 30 enters the steady state, based on the target temperature on the downstream side, and the sensor information acquired by the sensor information acquisition unit 401.

[0081] Next, operation of the control device 40 at the time of operation start of the warm water heating system according to the present embodiment will be described.

[0082] The operation of the control device 40 according to the second embodiment differs in operation of step S1 from the operation of the control device 40 in the first embodiment, and operation after step S1 is the same as that in the first embodiment.

[0083] Therefore, the operation of step S1 in the second embodiment will be described herein.

[0084] First, the downstream-side target temperature setting unit 407 of the control device 40 receives input of a target temperature T_{3d} on a downstream side of the heating portion 33 from a manager before operation start of the warm water heating system. Then, the upstream-side target temperature setting unit 403 acquires a temperature T_4 and a flow amount F_3 detected by the heat source upstream-side temperature detector 56 and the heat source flow amount detector 57 from the sensor information acquisition unit 401. Also, the upstream-side target temperature setting unit 403 calculates a maximum heating amount of the condenser 24 at the time of maximum output of the heat pump 20 based on the acquired temperature T_4 and flow amount F_3 . Then, the upstream-side target temperature setting unit 403 calculates a target temperature T_{2d} on the upstream side of the heating portion 33 based on the calculated maximum heating amount, the flow amount F_2 of the water flowing in the heating portion 33, and the target temperature T_{3d} on the downstream side. Specifically, the upstream-side target temperature setting unit 403 sets, as the target temperature T_{2d} , the water temperature on the upstream side of the heating portion 33 required for setting the water temperature on the downstream side of the heating portion 33 as a target temperature T_{3d} based on the maximum output of the heat pump 20.

[0085] Thereafter, a process after step S2 is executed as in the first embodiment, such that the temperature of the warm water system 30 can be controlled to utilize maximum capacity of the heat pump 20 according to a condition of the heat source system 10.

(Third embodiment)

[0086] Next, a third embodiment of the present invention will be described. A warm water heating system according to the third embodiment controls an opening degree (an adjustment amount of heat pump control) of a vane 23 of a heat pump 20 based on the temperature on a downstream side of a heating portion 33 of a warm water system 30.

[0087] Fig. 6 is a schematic configuration diagram of the warm water heating system according to the third embodiment of the present invention.

[0088] The warm water heating system according to the third embodiment includes a condenser temperature detector 58, in addition to the warm water system 30 of the warm water heating system according to the first embodiment, and operation of the control device 40 is different. Further, the warm water heating system according to the third embodiment may not include the inflow portion temperature detector 52 and the inflow portion flow amount detector 51.

[0089] The condenser temperature detector 58 detects a temperature T_5 of the condenser 24 of the heat pump 20.

[0090] Fig. 7 is a schematic block diagram showing a configuration of the control device 40 according to the third embodiment of the present invention.

[0091] The control device 40 according to the third embodiment includes a sensor information acquisition unit 401, a downstream-side temperature change rate calculation unit 408 (heat pump adjustment temperature calculation unit), a downstream-side target temperature setting unit 407, a downstream-side immediate target temperature setting unit 409, and a vane control unit 410 (heat pump adjustment amount determination unit).

[0092] The sensor information acquisition unit 401 acquires sensor information (a flow amount or a temperature) detected by each detector provided in the warm water system 30 and the condenser 24.

[0093] The downstream-side temperature change rate calculation unit 408 calculates a change rate (a heat pump adjustment temperature) of the water temperature on the downstream side of the heating portion 33, i.e., an increase rate of the water temperature, based on the sensor information acquired by the sensor information acquisition unit 401. The change rate of the water temperature is calculated by applying the sensor information to a heat balance model.

[0094] The downstream-side target temperature setting unit 407 sets a target temperature of the water on the down-

stream side of the heating portion 33 when the warm water system 30 enters a steady state if the heat pump 20 operates.

[0095] The downstream-side immediate target temperature setting unit 409 sets an immediate target temperature of the water on the downstream side of the heating portion 33 at a current time according to the information acquired from the sensor information acquisition unit 401, the downstream-side temperature change rate calculation unit 408 and the downstream-side target temperature setting unit 407. Specifically, the downstream-side immediate target temperature setting unit 409 sets the immediate target temperature based on the temperature change rate calculated by the downstream-side temperature change rate calculation unit 408 until a current water temperature on the downstream side of the heating portion 33 reaches the downstream-side target temperature. Also, the downstream-side immediate target temperature setting unit 409 sets the target temperature set by the downstream-side target temperature setting unit 407 as the immediate target temperature after the current water temperature on the downstream side of the heating portion 33 reaches the downstream-side target temperature.

[0096] The vane control unit 410 performs control of the opening degree of the vane 23 through PID control based on the immediate target temperature set by the downstream-side immediate target temperature setting unit 409 and the current water temperature on the downstream side of the current heating portion 33.

[0097] Next, operation of the control device 40 at the time of operation start of the warm water heating system according to the present embodiment will be described.

[0098] Fig. 8 is a flowchart showing operation of the control device 40 according to the third embodiment of the present invention.

[0099] First, the downstream-side target temperature setting unit 407 of the control device 40 receives input of a target temperature T_{3d} on the downstream side of the heating portion 33 from a manager before operation start of the warm water heating system (step S11).

[0100] The manager of the warm water heating system operates the warm water system 30 and then operates the compressor 22 after the setting of the target temperature.

[0101] The downstream-side immediate target temperature setting unit 409 acquires a temperature T_3 detected by the heating portion downstream-side temperature detector 55 from the sensor information acquisition unit 401. The downstream-side immediate target temperature setting unit 409 then determines whether the temperature T_3 reaches the target temperature T_{3d} set by the downstream-side target temperature setting unit 407

[0102] (step S12).

[0103] When the downstream-side immediate target temperature setting unit 409 determines that the temperature T_3 is lower than the target temperature T_{3d} (step S12: NO), the downstream-side immediate target temperature setting unit 409 calculates a temperature change rate dT_3/dt on the downstream side of the heating portion 33 using temperatures T_2 , T_3 , and T_5 and a heat medium flow amount F_2 acquired by the sensor information acquisition unit 401 (step S13). The temperature T_2 is a temperature of the water on the upstream side of the heating portion 33. Further, the temperature T_3 is a temperature of the water on the downstream side of the heating portion 33. Further, the temperature T_5 is a temperature of the heat medium in the condenser 24. Further, the flow amount F_2 is a flow amount of the water flowing through the heating portion 33.

[0104] Here, the downstream-side temperature change rate calculation unit 408 calculates the temperature change rate dT_3/dt by substituting each piece of sensor information into Equation (2) shown below indicating a heat balance model.

[0105] [Equation 2]

$$\frac{dT_3}{dt} = \frac{1}{M \cdot cp_3} \left\{ cp_2 \cdot F_2 \cdot T_2 - cp_3 \cdot F_2 \cdot T_3 + U \cdot A \left(T_5 - \frac{T_2 + T_3}{2} \right) \right\} \quad \dots (2)$$

[0106] Here, U and A denote a general heat transfer coefficient and a heat transfer area of the condenser 24, respectively. While values of U and A may be calculated as design values of the heat pump 20 in advance, the present invention is not limited thereto and the values may be identified from the data in a steady state during an actual operation. U and A can be calculated through calculation of Equation (3) shown below.

[0107] [Equation 3]

$$U \cdot A = (cp_3 \cdot T_3 - cp_2 \cdot T_2) \cdot \frac{F_2}{T_5 - \frac{T_2 + T_3}{2}} \quad \dots (3)$$

[0108] Here, referring to Equation (2), a denominator of a right side of Equation (2) indicates a heat capacity of the water held in the heating portion 33. Further, a numerator of the right side of Equation (2) indicates a heat amount of a difference between a sum of a heat amount of water flowing in the heating portion 33 and a heat amount heated in the heating portion 33 and a heat amount of the water flowing from the heating portion 33 into the three-way valve 34. In other words, the temperature change rate dT_3/dt is calculated based on a difference between a temperature of the water when the water flowing in the heating portion 33 is heated by the heating portion 33 and the temperature of the water flowing from the heating portion 33 into the three-way valve 34.

[0109] The downstream-side immediate target temperature setting unit 409 then sets, as an immediate target temperature T_{3a} , a value obtained by adding the temperature change rate calculated by the downstream-side temperature change rate calculation unit 408 to the temperature T_3 acquired by the sensor information acquisition unit 401 (step S14). The vane control unit 410 then determines the opening degree of the vane 23 so that the water temperature on a downstream side of the heating portion 33 becomes the immediate target temperature T_{3a} , and controls the vane 23 to the opening degree (step S15). Accordingly, the vane control unit 410 can control the opening degree of the vane 23 at an appropriate temperature change rate according to characteristics of the heating portion 33 until the water temperature T_3 on the downstream side of the heating portion 33 reaches the target temperature T_{3d} . Thereafter, the operation of steps S12 to S15 is repeatedly performed until the temperature T_3 reaches the target temperature T_{3d} in step S12.

[0110] When the downstream-side immediate target temperature setting unit 409 determines that the temperature T_3 reaches the target temperature T_{3d} in step S12 (step S12: YES), the downstream-side immediate target temperature setting unit 409 sets the target temperature T_{3d} to the immediate target temperature T_{3a} (step S16). The vane control unit 410 then determines the opening degree so that the water temperature on the downstream side of the heating portion 33 is the immediate target temperature T_{3a} , i.e., the target temperature T_{3d} , and controls the vane 23 with the opening degree (step S17). Thereafter, the control device 40 ends the control of the compressor 22 in the transient state, and starts steady-state control to control the opening degree of the vane 23 based on target temperature T_{3d} . The control of the vane 23 in the steady state is the same as the process of repeatedly executing steps S16 and S17.

[0111] Thus, according to the present embodiment, the vane control unit 410 controls the opening degree of the vane 23 so that the temperature of the water on the downstream side of the heating portion 33 increases by a predetermined temperature until the temperature of the water on the downstream side of the heating portion 33 reaches the target temperature T_{3d} after the heat pump 20 operates. Accordingly, when the warm water system 30 is in a transient state, the opening degree of the vane 23 can be controlled so that the opening degree control of the vane 23 can follow the temperature change of the warm water. Particularly, in the present embodiment, the predetermined temperature is calculated based on the state of the water flowing in the heating portion 33 and the state of the water flowing from the heating portion 33 into the three-way valve 34, and the heating amount in the heating portion 33. Accordingly, the control of the opening degree of the vane 23 can be performed according to the characteristics of the warm water heating system, and the water temperature on the downstream side of the heating portion 33 can increase to the target temperature T_{3a} at an appropriate temperature increase rate. Particularly, as shown in the present embodiment, appropriate control of the opening degree can be performed using the temperature change rate dT_3/dt , which is the temperature difference between the temperature of the water when the water flowing in the heating portion 33 is heated by the heating portion 33 and the temperature of the water flowing from the heating portion 33 into the three-way valve 34.

[0112] While the case in which the vane control unit 410 in the present embodiment performs control of the opening degree using the temperature change rate dT_3/dt calculated by the downstream-side temperature change rate calculation unit 408 has been described, the present invention is not limited thereto and the opening degree of the vane 23 may be controlled so that the water temperature on the downstream side of the heating portion 33 increases by another predetermined temperature. However, when the predetermined temperature is set to be too low, the increase rate of the opening degree is controlled to be suppressed, a speed of a temperature increase of the water temperature on the downstream side of the heating portion 33 decreases, and it takes time for the warm water system 30 to transition to the steady state. On the other hand, when the predetermined temperature is set to be excessively high, the increase rate of the opening degree is controlled to be high, the speed of the temperature increase of the water temperature on the downstream side of the heating portion 33 increases, and the opening degree control of the vane 23 may not follow the temperature change of the warm water. In this case, the amount of heat exchanged in the condenser 24 of the heat

pump 20 may become small, and efficiency of the warm water heating system may become low.

(Fourth embodiment)

[0113] Next, a fourth embodiment of the present invention will be described. A warm water heating system according to the fourth embodiment controls the opening degree of the vane 23 of the heat pump 20 based on a state of the heating portion 33 of the warm water system 30 as in the third embodiment while controlling the opening degree of the three-way valve 34 based on the state of the warm water system 30 as in the second embodiment.

[0114] Fig. 9 is a schematic configuration diagram of the warm water heating system according to the fourth embodiment of the present invention.

[0115] The warm water heating system according to the fourth embodiment has both the configuration of the warm water heating system according to the second embodiment and the configuration of the warm water heating system according to the third embodiment. The configuration of the control device 40 according to the fourth embodiment may also have both the configuration of the control device 40 according to the second embodiment and the configuration of the control device 40 according to the third embodiment.

[0116] Operation of the warm water heating system according to the fourth embodiment includes the operation of the second embodiment and the operation of the third embodiment.

[0117] Specifically, when the setting of the downstream-side target temperature in step S11 of the third embodiment is performed, calculation of the upstream-side target temperature in step S1 of the second embodiment is performed using the downstream-side target temperature.

[0118] Further, in steps S2 to S4 according to the second embodiment, the control device 40 performs only opening degree control of the three-way valve 34. On the other hand, the control device 40 executes the process of steps S12 to S15 according to the third embodiment in parallel while executing the process of steps S5 to S8. Also, the control device 40 performs the process of steps S16 and S17 according to the third embodiment when executing the process of steps S9 and S10 according to the second embodiment.

[0119] Accordingly, the control device 40 can appropriately control the opening degree of the three-way valve 34 and the opening degree of the vane 23.

[0120] While the embodiments of the present invention have been described above in detail with reference to the drawings, a specific configuration is not limited to the foregoing, and various design changes or the like can be made without departing from the gist of the present invention.

[0121] The control device 40 described above includes a computer system therein. Also, the above process is performed by storing the operation of each processing unit described above in a computer-readable recording medium in the form of a program and by a computer reading and executing this program. Here, the computer-readable recording medium refers to a magnetic disk, a magneto-optical disc, a CD-ROM, a DVD-ROM, a semiconductor memory, or the like. Further, this computer program may be distributed to a computer by a communication line, and the computer receiving this distribution may execute the program.

[0122] Further, the above program may be intended to realize some of the functions described above.

[0123] Further, the program may be a program capable of realizing the above-described functions through a combination with a program previously recorded in a computer system, i.e., a differential file (a differential program).

[Industrial Applicability]

[0124] The present invention provides a control device for controlling a warm water heating system including a heat pump including a heat output heat exchanger which takes heat from a heat source system and outputs heat, a heating portion which heats water using the heat obtained from the heat output heat exchanger, an outflow portion which flows the water heated by the heating portion to a heating target, a circulation portion which circulates the water heated by the heating portion to an upstream side of the heating portion, an inflow portion which flows water from the heating target into the upstream side of the heating portion, and an adjustment unit which adjusts flow amount distribution of the water from the heating portion to the outflow portion and the circulation portion, wherein the control device includes an upstream-side target temperature setting unit which sets a target temperature of the water on the upstream side of the heating portion, and an adjustment amount determination unit which determines an adjustment amount of the flow amount distribution by the adjustment unit so that the temperature of the water on the upstream side of the heating portion increases by a predetermined temperature until a temperature of the water on the upstream side of the heating portion reaches the target temperature. According to the present invention, the adjustment amount in the adjustment unit or the adjustment amount of the heat pump is determined so that the temperature of the warm water on the upstream side or the downstream side of the heating portion increases by a predetermined temperature until a temperature of the warm water on the upstream side of the heating portion reaches the target temperature. Accordingly, it is possible to appropriately control the temperature increase rate in the transient state of the warm water system.

[Reference Signs List]

[0125]

5	10 ... Heat source system
	20 ... Heat pump
	21 ... Evaporator
	22 ... Compressor
	23 ... Condenser
10	24 ... Expansion valve
	30 ... Warm water system
	31 ... Inflow portion
	32 ... Circulation pump
	33 ... Heating portion
15	34 ... Three-way valve
	35 ... Circulation portion
	36 ... Outflow portion
	40 ... Control device
	51 ... Inflow portion flow amount detector
20	52 ... Inflow portion temperature detector
	53 ... Heating portion flow amount detector
	54 ... Heating portion upstream-side temperature detector
	55 ... Heating portion downstream-side temperature detector
	56 ... Heat source upstream-side temperature detector
25	57 ... Heat source flow amount detector
	58 ... Condenser temperature detector
	401 ... Sensor information acquisition unit
	402 ... Upstream-side temperature change rate calculation unit
	403 ... Upstream-side target temperature setting unit
30	404 ... Heat pump information input unit
	405 ... Upstream-side immediate target temperature setting unit
	406 ... Three-way valve control unit
	407 ... Downstream-side target temperature setting unit
	408 ... Downstream-side temperature change rate calculation unit
35	409 ... Downstream-side immediate target temperature setting unit
	410 ... Vane control unit

Claims

- 40
1. A control device for controlling a warm water heating system, the control device comprising:
- 45
- a heat pump including a heat output heat exchanger which takes heat from a heat source system and outputs heat;
a heating portion which heats water using the heat obtained from the heat output heat exchanger;
an outflow portion which flows the water heated by the heating portion to a heating target;
a circulation portion which circulates the water heated by the heating portion to an upstream side of the heating
portion;
an inflow portion which flows water from the heating target into the upstream side of the heating portion; and
an adjustment unit which adjusts flow amount distribution of the water from the heating portion to the outflow
50 portion and the circulation portion,
wherein the control device includes
an upstream-side target temperature setting unit which sets a target temperature of the water on the upstream
side of the heating portion; and
an adjustment amount determination unit which determines an adjustment amount of the flow amount distribution
55 by the adjustment unit so that a temperature of the water on the upstream side of the heating portion increases
by a predetermined temperature until the temperature of the water on the upstream side of the heating portion
reaches the target temperature.

2. The control device according to claim 1, wherein the adjustment amount determination unit determines the adjustment amount of the flow amount distribution by the adjustment unit so that the temperature of the water on the upstream side of the heating portion increases by a predetermined temperature calculated based on states of water flowing in the heating portion, water circulated by the circulation portion, and water flowing from the inflow portion into the upstream side of the heating portion until the temperature of the water on the upstream side of the heating portion reaches the target temperature.
3. The control device according to claim 2, further comprising an adjustment temperature calculation unit which calculates, as an adjustment temperature used for determination of the adjustment amount, a temperature difference between a temperature of water obtained by mixing water flowing from the inflow portion into the upstream side of the heating portion with water circulated by the circulation portion and the temperature of the water flowing in the heating portion based on the states of the water flowing in the heating portion, the water circulated by the circulation portion, and the water flowing from the inflow portion into the upstream side of the heating portion, wherein the adjustment amount determination unit determines the adjustment amount of the flow amount distribution by the adjustment unit so that the temperature of the water on the upstream side of the heating portion increases by the adjustment temperature calculated by the adjustment temperature calculation unit until the temperature of the water on the upstream side of the heating portion reaches the target temperature.
4. The control device according to any one of claims 1 to 3, wherein the adjustment amount determination unit determines the adjustment amount of the flow amount distribution by the adjustment unit so that the temperature of the water flowing into the heating portion becomes constant until the heat pump operates.
5. The control device according to any one of claims 1 to 4, wherein the upstream-side target temperature setting unit sets a target temperature of the water on the upstream side of the heating portion based on a maximum heating amount in the heating portion, a flow amount of the water flowing into the heating portion, and a target temperature of the water on a downstream side of the heating portion.
6. The control device according to any one of claims 1 to 5, further comprising:
 - a downstream-side target temperature setting unit which sets a target temperature of the water on the downstream side of the heating portion; and
 - a heat pump adjustment amount determination unit which determines an adjustment amount of heat pump control so that the temperature of the water on the downstream side of the heating portion increases by a predetermined temperature until the temperature of the water on the downstream side of the heating portion reaches the target temperature.
7. The control device according to claim 6, wherein the heat pump adjustment amount determination unit determines the adjustment amount of the heat pump control so that the temperature of the water on the downstream side of the heating portion increases by a predetermined temperature calculated based on a state of the water flowing in the heating portion and flowing from the heating portion into the adjustment unit, and a heating amount in the heating portion until the temperature of the water on the downstream side of the heating portion reaches the target temperature.
8. The control device according to claim 7, further comprising a heat pump adjustment temperature calculation unit which calculates, as a heat pump adjustment temperature used for determination of the adjustment amount of the heat pump control, a temperature difference between the temperature of the water flowing in the heating portion when the water is heated by the heating portion and the temperature of the water flowing from the heating portion into the adjustment unit, based on the state of the water flowing in the heating portion and the state of the water flowing from the heating portion into the adjustment unit, and a heating amount in the heating portion, wherein the heat pump adjustment amount determination unit determines the adjustment amount of the heat pump control so that the temperature of the water on the downstream side of the heating portion increases by the heat pump adjustment temperature calculated by the heat pump adjustment temperature calculation unit until the temperature of the water on the downstream side of the heating portion reaches the target temperature.
9. A control device for controlling a warm water heating system, the control device comprising:
 - a heat pump including a heat output heat exchanger which takes heat from a heat source system and outputs heat;
 - a heating portion which heats water using the heat obtained from the heat output heat exchanger;

an outflow portion which flows the water heated by the heating portion to a heating target;
 a circulation portion which circulates the water heated by the heating portion to an upstream side of the heating portion;
 an inflow portion which flows water from the heating target into the upstream side of the heating portion,
 a downstream-side target temperature setting unit which sets a target temperature of the water on a downstream side of the heating portion; and
 a heat pump adjustment amount determination unit which determines an adjustment amount of heat pump control so that a temperature of the water on the downstream side of the heating portion increases by a predetermined temperature until the temperature of the water on the downstream side of the heating portion reaches the target temperature.

10. The control device according to claim 9, wherein the heat pump adjustment amount determination unit determines the adjustment amount of the heat pump control so that the temperature of the water on the downstream side of the heating portion increases by a predetermined temperature calculated based on a state of water flowing in the heating portion and a state of water flowing from the heating portion and a heating amount in the heating portion until the temperature of the water on the downstream side of the heating portion reaches the target temperature.

11. The control device according to claim 10, further comprising a heat pump adjustment temperature calculation unit which calculates, as a heat pump adjustment temperature used for determination of the adjustment amount of the heat pump control, a temperature difference between the temperature of the water in the heating portion when the water is heated by the heating portion and the temperature of the water flowing from the heating portion based on the state of the water flowing in the heating portion and the state of the water flowing from the heating portion and the heating amount in the heating portion,
 wherein the heat pump adjustment amount determination unit determines the adjustment amount of the heat pump control so that the temperature of the water on the downstream side of the heating portion increases by the heat pump adjustment temperature calculated by the heat pump adjustment temperature calculation unit until the temperature of the water on the downstream side of the heating portion reaches the target temperature.

12. A warm water heating system comprising:

a heat pump including a heat output heat exchanger which takes heat from a heat source system and outputs heat;
 a heating portion which heats water using the heat obtained from the heat output heat exchanger;
 an outflow portion which flows the water heated by the heating portion to a heating target;
 a circulation portion which circulates the water heated by the heating portion to an upstream side of the heating portion;
 an inflow portion which flows water from the heating target into the upstream side of the heating portion;
 an adjustment unit which adjusts flow amount distribution of the water from the heating portion to the circulation portion and the outflow portion; and
 the control device according to any one of claims 1 to 11.

13. A control method of controlling an adjustment amount of an adjustment unit of a warm water heating system which comprises:

a heat pump including a heat output heat exchanger which takes heat from a heat source system and outputs heat;
 a heating portion which heats water using the heat obtained from the heat output heat exchanger;
 an outflow portion which flows the water heated by the heating portion to a heating target;
 a circulation portion which circulates the water heated by the heating portion to an upstream side of the heating portion;
 an inflow portion which flows water from the heating target into the upstream side of the heating portion; and
 the adjustment unit which adjusts flow amount distribution of the water from the heating portion to the circulation portion and the outflow portion,
 the control method comprising:

determining a target temperature of the water on the upstream side of the heating portion; and
 determining an adjustment amount of the flow amount distribution by the adjustment unit so that a temperature of the water on the upstream side of the heating portion increases by a predetermined temperature until the temperature of the water on the upstream side of the heating portion reaches the target temperature.

14. A control device of controlling an adjustment amount of a heat pump of a warm water heating system comprising:

the heat pump including a heat output heat exchanger which takes heat from a heat source system and outputs heat;

a heating portion which heats water using the heat obtained from the heat output heat exchanger;

an outflow portion which flows the water heated by the heating portion to a heating target;

a circulation portion which circulates the water heated by the heating portion to an upstream side of the heating portion; and

an inflow portion which flows water from the heating target into the upstream side of the heating portion,

wherein the control method includes

determining a target temperature of the water on a downstream side of the heating portion; and

determining an adjustment amount of heat pump control so that a temperature of the water on the downstream side of the heating portion increases by a predetermined temperature until the temperature of the water on the downstream side of the heating portion reaches the target temperature.

FIG. 1

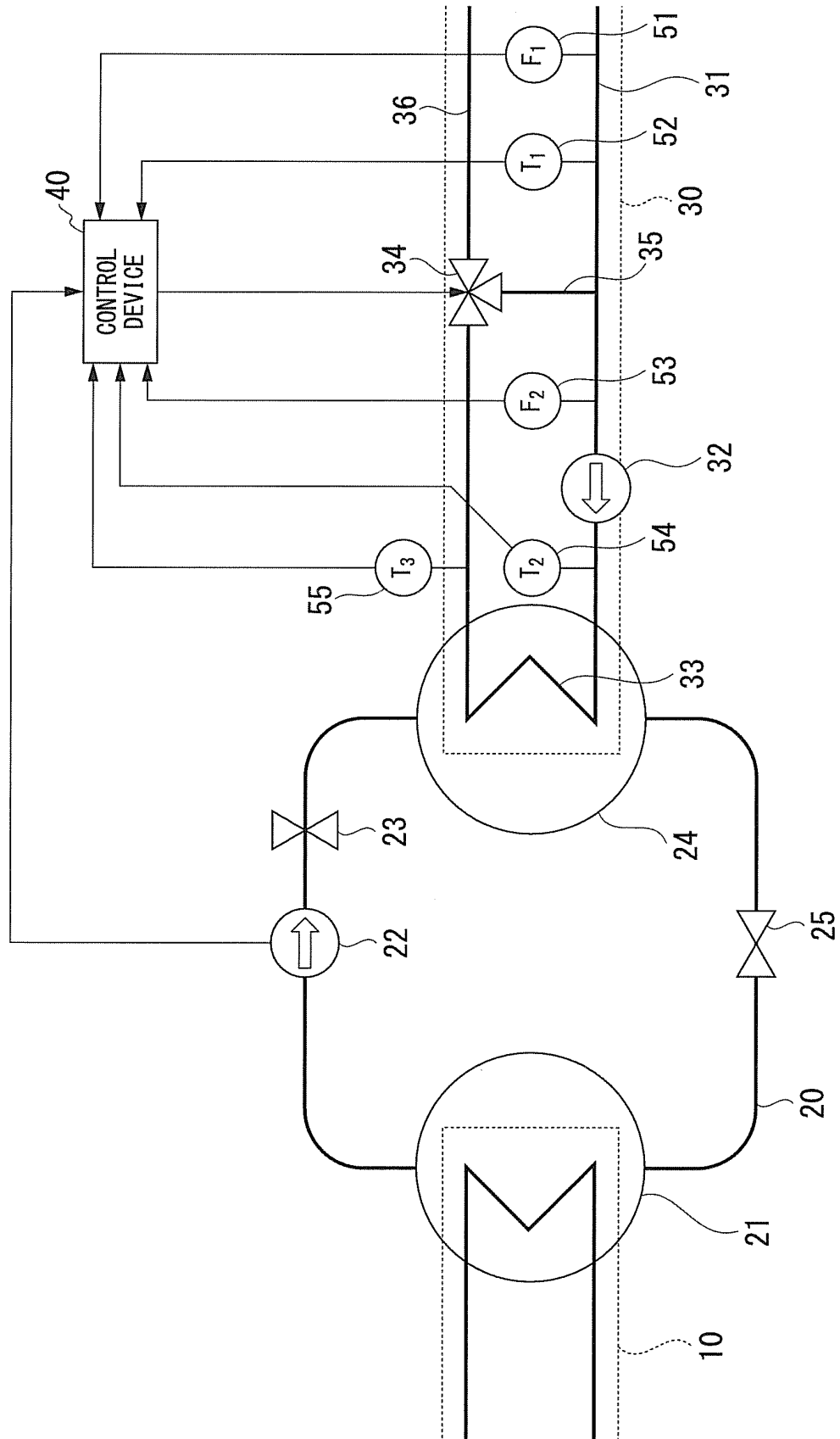


FIG. 2

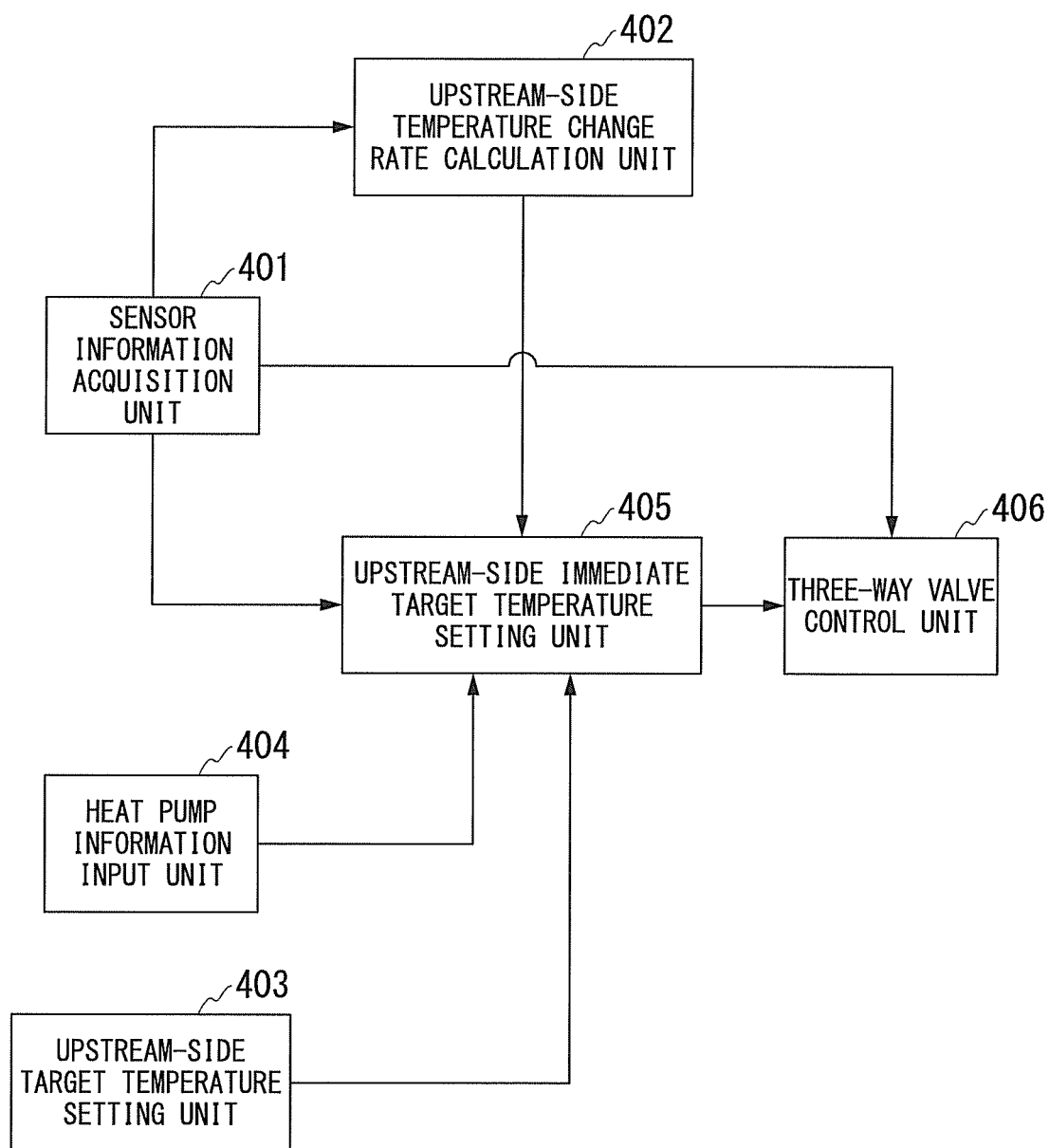


FIG. 3

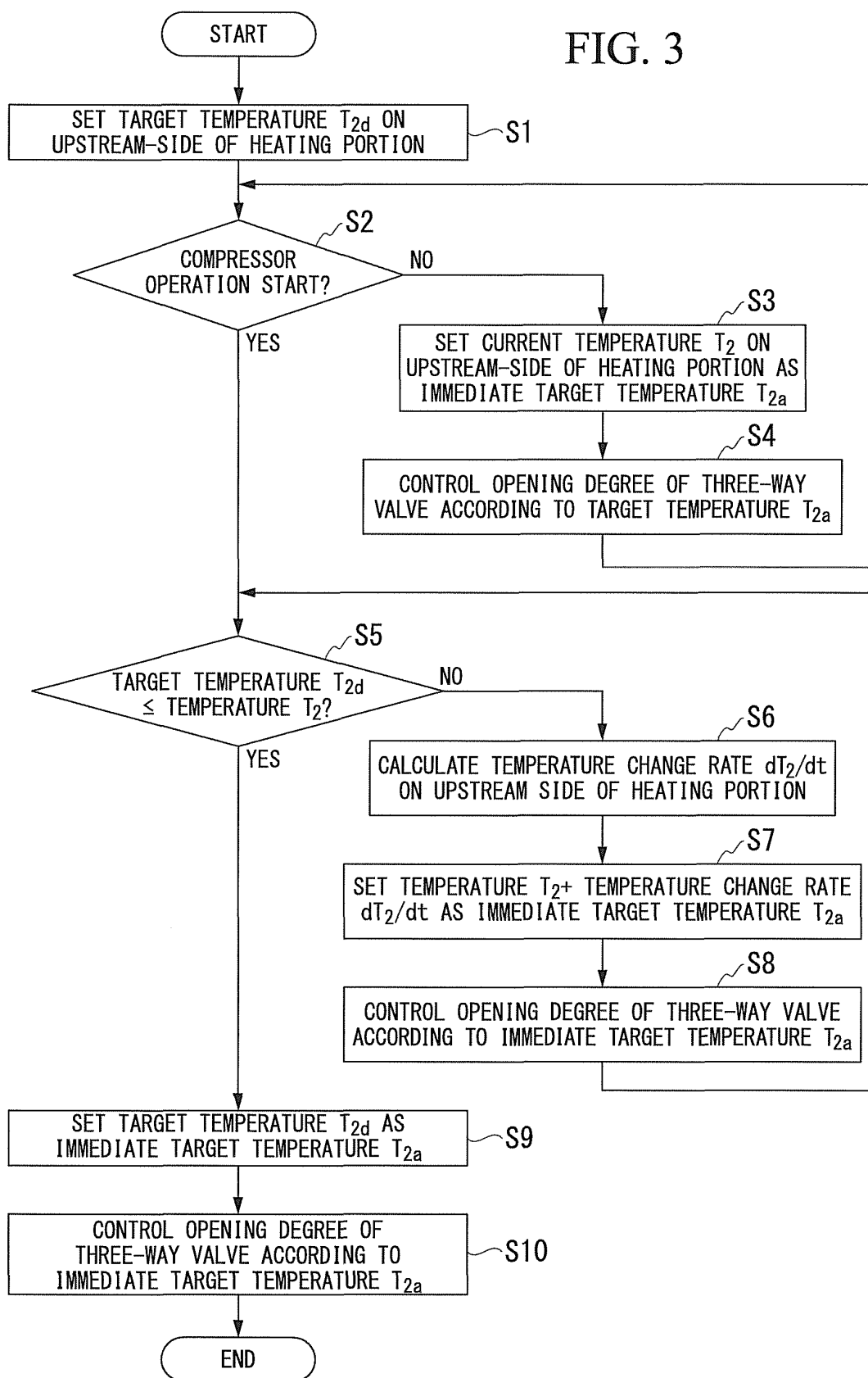


FIG. 4

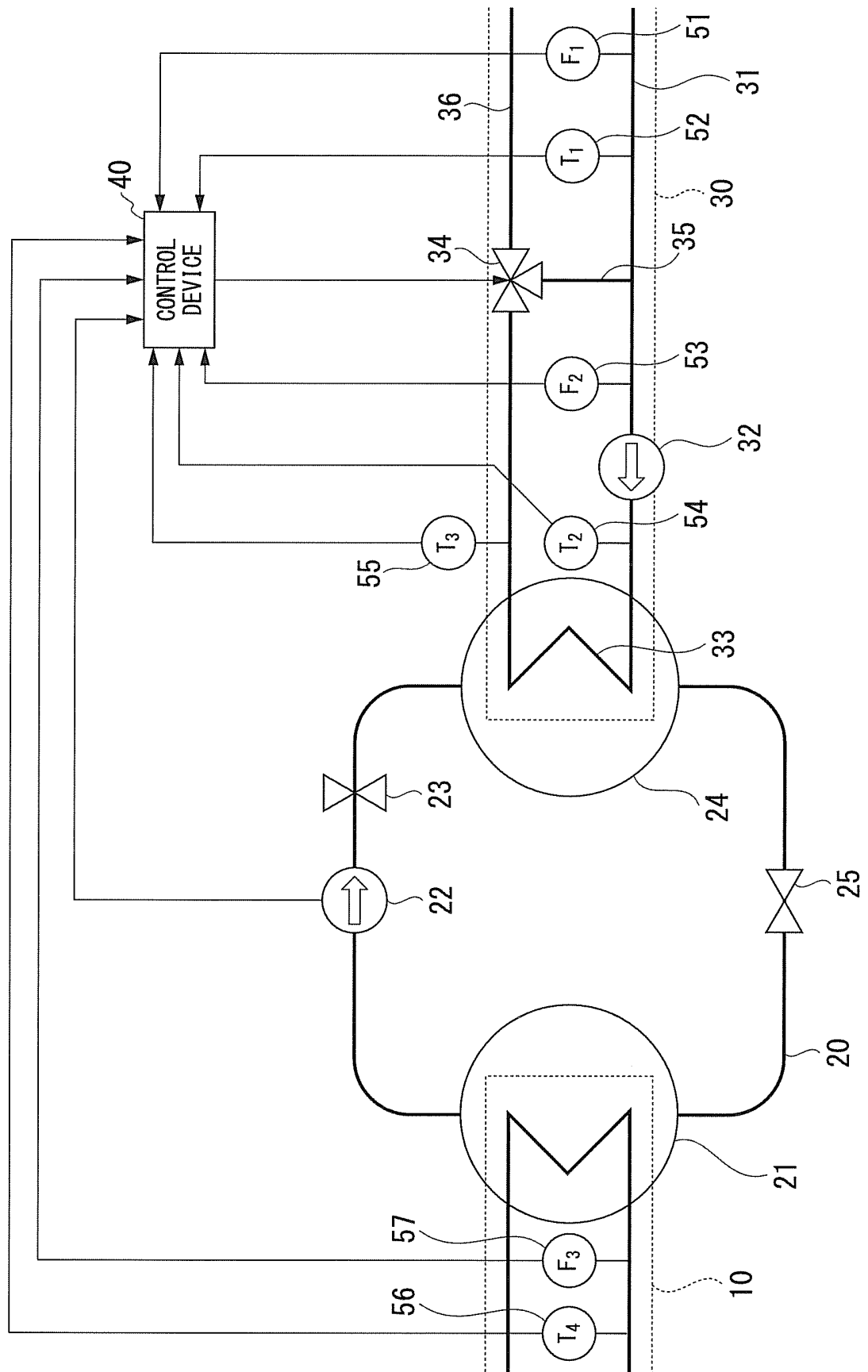


FIG. 5

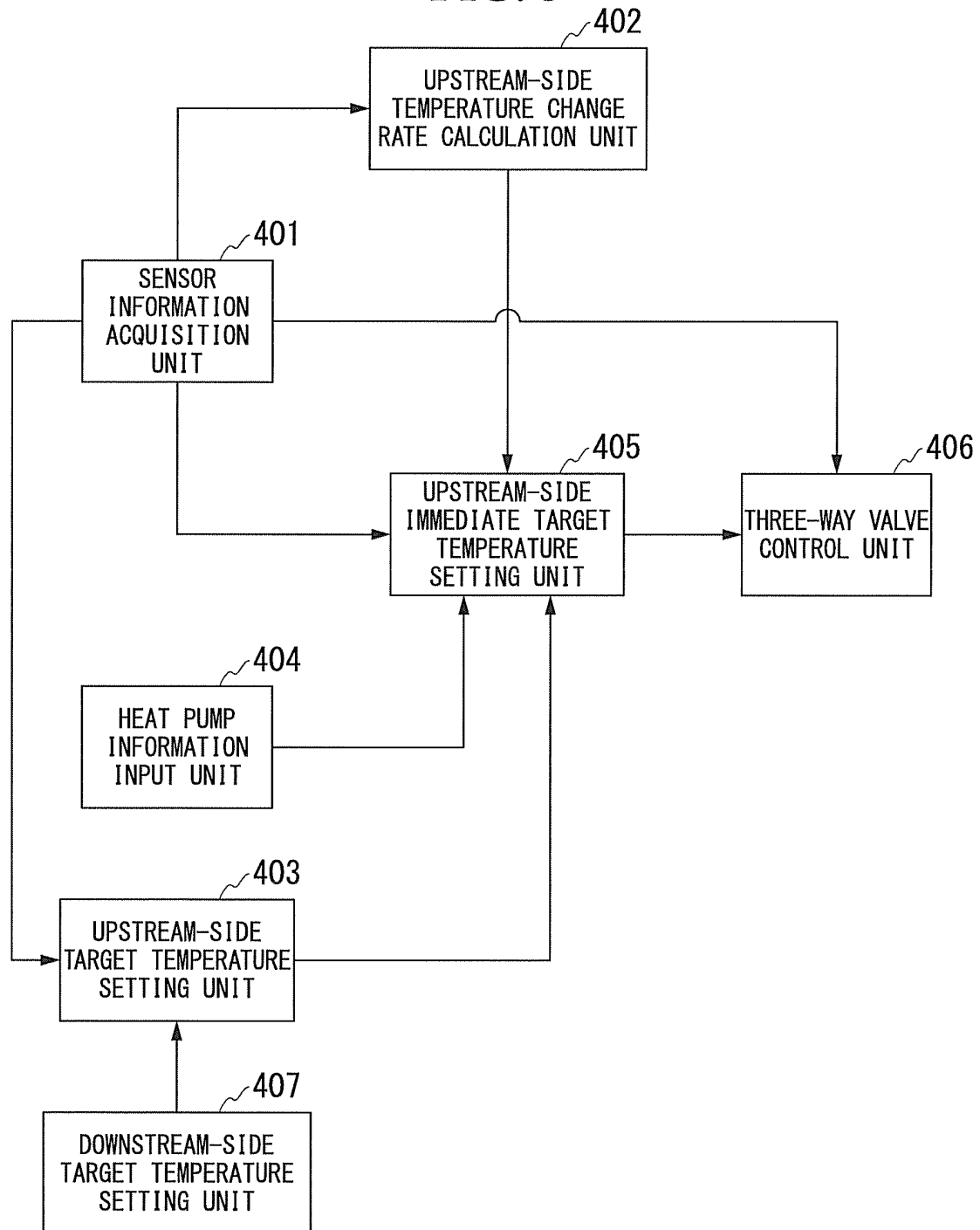


FIG. 6

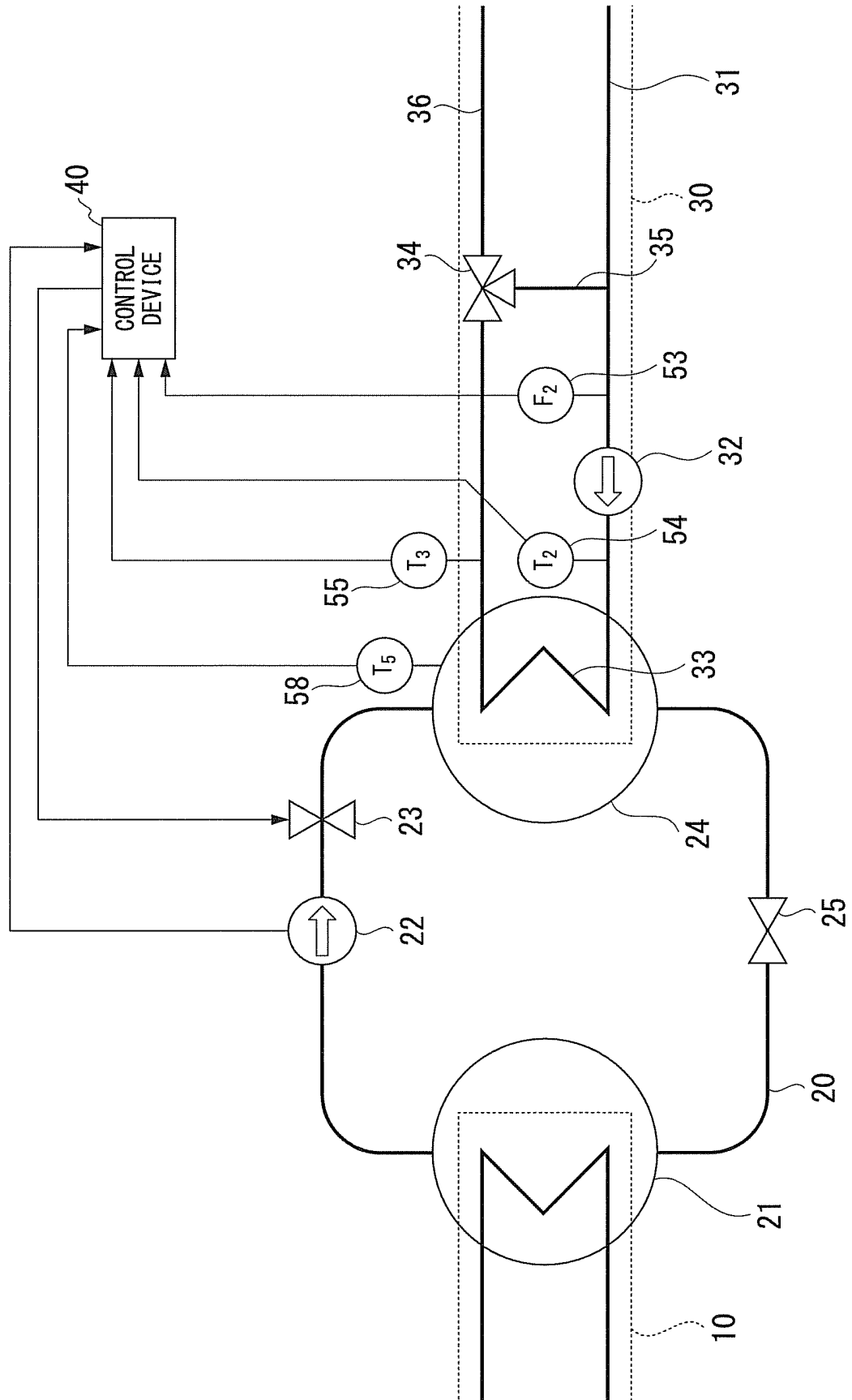


FIG. 7

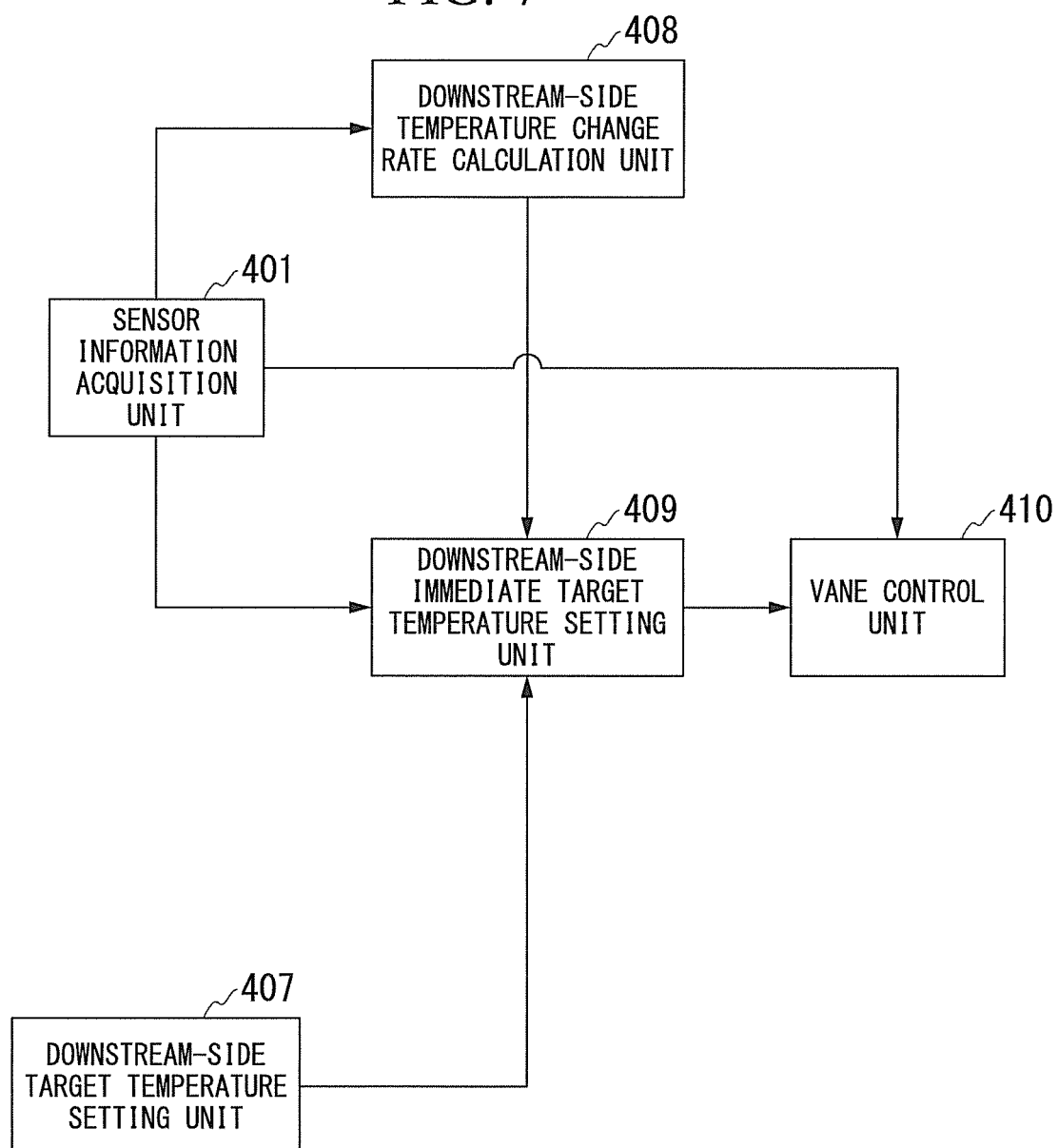


FIG. 8

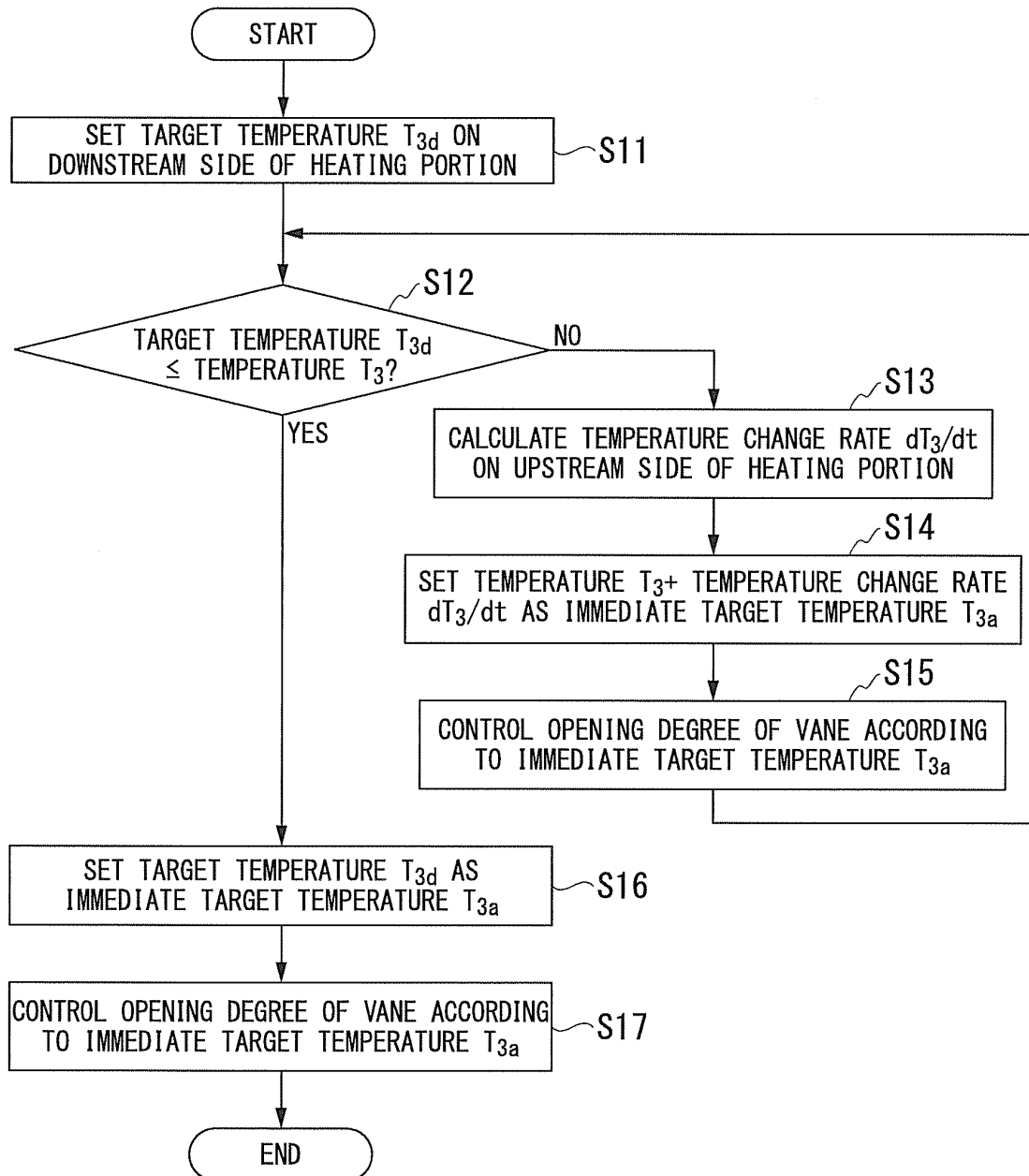
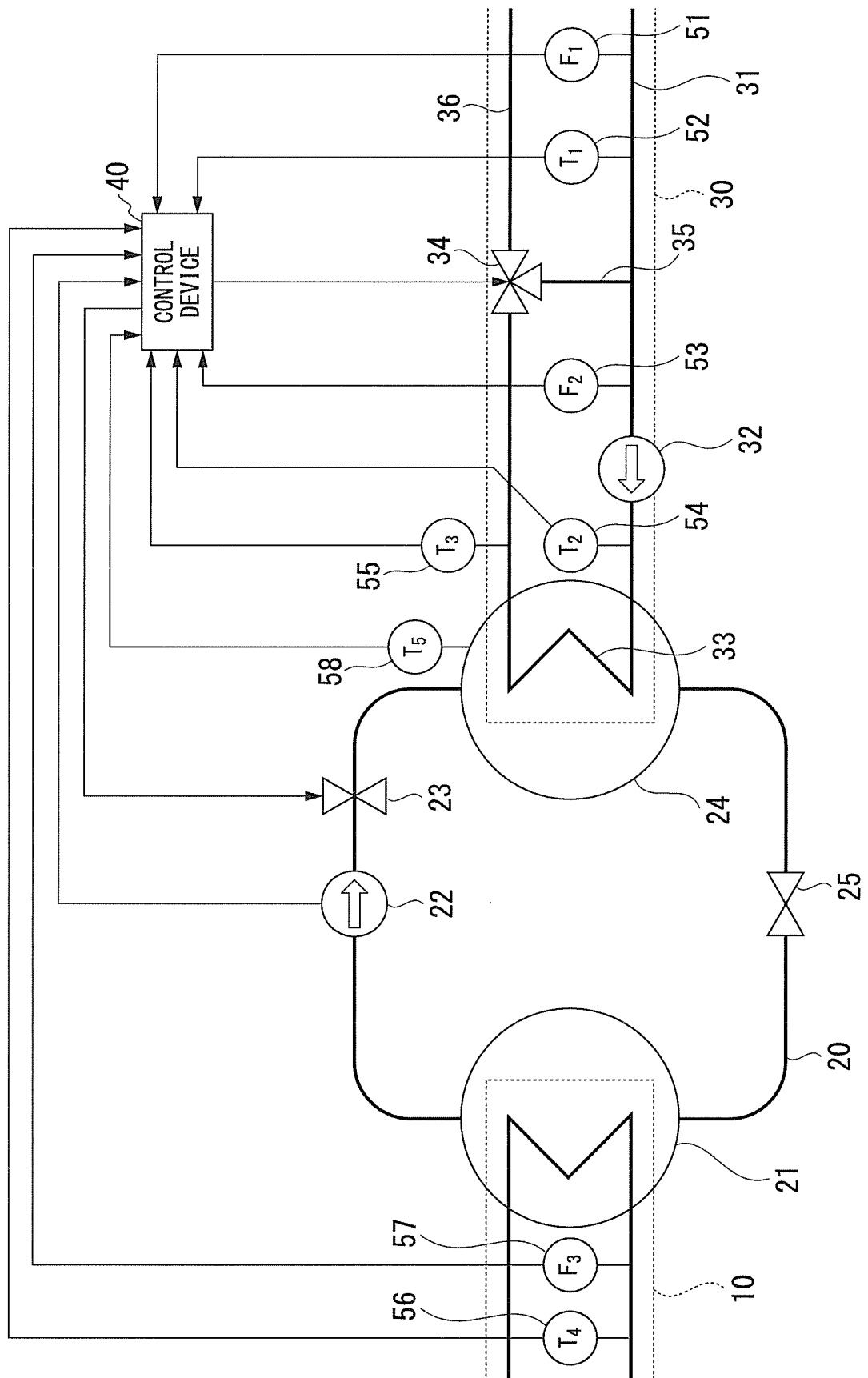


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/078995

A. CLASSIFICATION OF SUBJECT MATTER

F24H1/00 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24H1/00

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012

Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 63-148046 A (Mitsubishi Electric Corp.), 20 June 1988 (20.06.1988), page 3, lower right column, line 6 to page 4, upper left column, line 3; fig. 1 (Family: none)	1, 6, 9, 12-14 2-5, 7, 8, 10, 11
Y A	JP 2011-185477 A (Mitsubishi Heavy Industries, Ltd.), 22 September 2011 (22.09.2011), claims 1 to 3 & WO 2011/108392 A1	1, 6, 9, 12-14 2-5, 7, 8, 10, 11
Y	JP 1-179835 A (Toto Ltd.), 17 July 1989 (17.07.1989), page 1, lower right column, line 17 to page 2, upper left column, line 9 (Family: none)	1, 6, 9, 12-14

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

* Special categories of cited documents:

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Date of the actual completion of the international search

22 November, 2012 (22.11.12)

Date of mailing of the international search report

04 December, 2012 (04.12.12)

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2003-240344 A (Matsushita Electric Industrial Co., Ltd.), 27 August 2003 (27.08.2003), paragraphs [0005], [0041] & US 2004/0144528 A1 & EP 1475576 A1 & WO 2003/069236 A1 & KR 10-2005-0105521 A & CN 1509396 A	1, 6, 9, 12-14

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REFERENCES CITED IN THE DESCRIPTION

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