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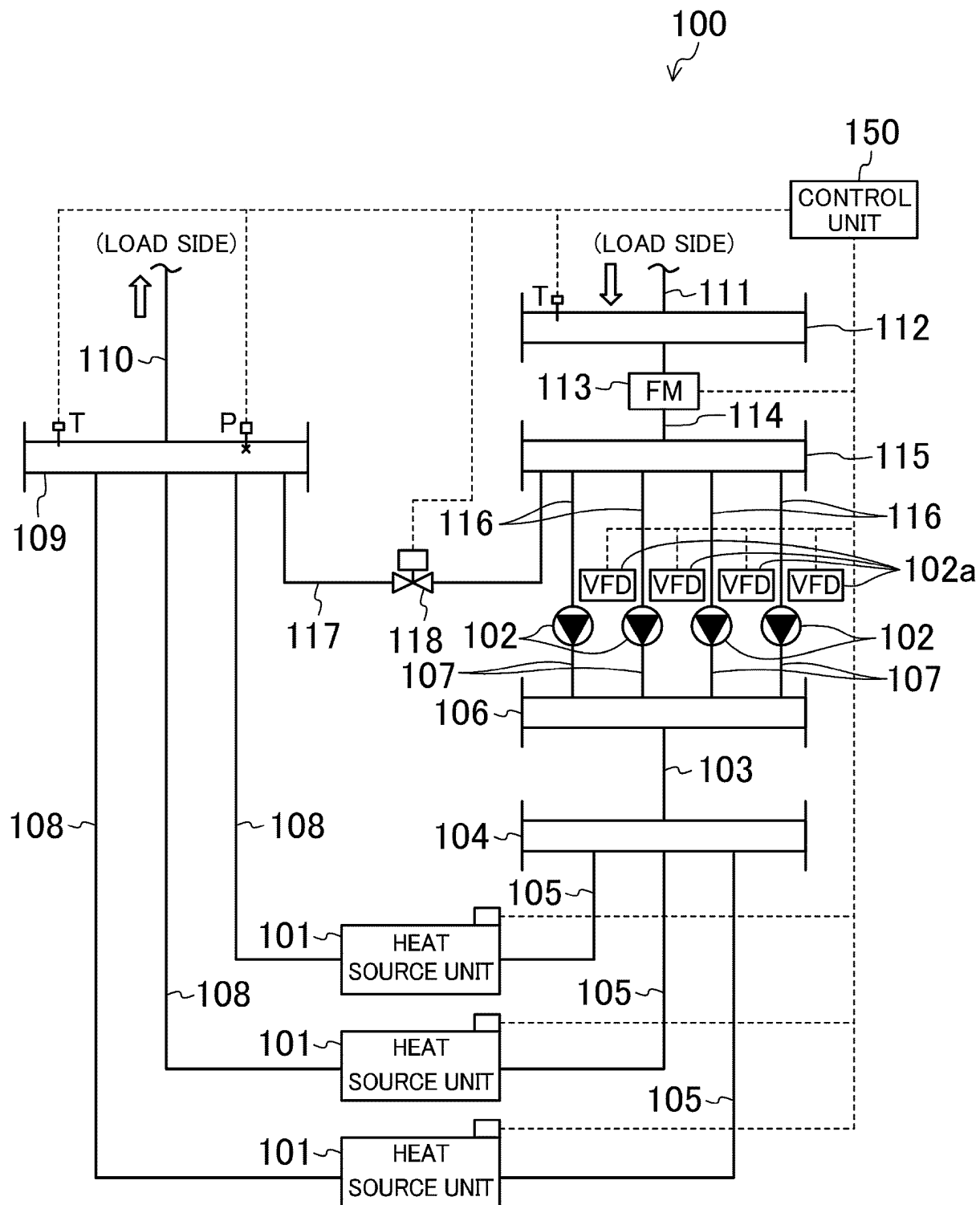
(54) **HEAT SOURCE SYSTEM**

(57) A heat source system (100) includes a plurality of heat source units (101) provided in parallel, a plurality of pumps (102) provided in parallel, a collective pipe (103) that collects flow paths between the plurality of heat source units (101) and the plurality of pumps (102) into one, and a control unit (150). The control unit (150) determines a requested flow rate, based on at least a minimum required flow rate set for each heat source unit (101) and an operation state of each heat source unit

(101), determines a current water supply amount or a maximum water supply amount, based on a flow rate set for each pump (102) and an operation state of each pump (102), makes a comparison between the requested flow rate and the current water supply amount or the maximum water supply amount, and controls operation of the plurality of heat source units (101) or the plurality of pumps (102) according to a result of the comparison.

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FIG.1



Description

Technical Field

[0001] The present disclosure relates to a heat source system.

Background Art

[0002] PTL 1 discloses a heat source system in which a plurality of heat source units connected in parallel and a plurality of pumps connected in parallel are connected in series via a manifold pipe. In a manifold-pipe-type heat source system, even if a specific pump or heat source unit fails, operation can be continued by activating another pump or heat source unit.

[0003] In a manifold-pipe-type heat source system of the related art, a minimum required flow rate of each heat source unit is ensured by fixing a minimum number of pumps to be activated and a lower limit value of a VFD (variable frequency drive) command value of a pump with a VFD function.

Citation List

Patent Literature

[0004] PTL 1: Japanese Unexamined Patent Application Publication No. 2021-17995

Summary of Invention

Technical Problem

[0005] In the manifold-pipe-type heat source system of the related art, however, if the number of heat source units is different from the number of pumps or if pumps having different capacities are present, it may be difficult to ensure the minimum required flow rates of the heat source units. In addition, if one or more pumps fail, the number of operable pumps is insufficient, which may make it difficult to ensure the minimum required flow rates of the heat source units. Furthermore, when a pump with a VFD function is used, a decrease in the VFD command value may make it difficult to ensure the minimum required flow rates of the heat source units.

[0006] In the manifold-pipe-type heat source system of the related art, accordingly, the minimum required flow rates of the heat source units may be difficult to ensure, and there is a possibility that stable control cannot be achieved.

[0007] An object of the present disclosure is to achieve stable control in a manifold-pipe-type heat source system.

Solution to Problem

[0008] A first aspect of the present disclosure provides

a manifold-pipe-type heat source system including a plurality of heat source units (101) provided in parallel with each other, a plurality of pumps (102) provided in parallel with each other, a collective pipe (103) arranged to collect flow paths between the plurality of heat source units (101) and the plurality of pumps (102) into one, and a control unit (150) configured to control operation of the plurality of heat source units (101) and the plurality of pumps (102). The control unit (150) is configured to [A] determine a requested flow rate, based on at least minimum required flow rates set for the plurality of heat source units (101) and operation states of the plurality of heat source units (101), [B] determine a current water supply amount or a maximum water supply amount, based on flow rates set for the plurality of pumps (102) and operation states of the plurality of pumps (102), and [C] make a comparison between the requested flow rate and the current water supply amount or the maximum water supply amount, and control the operation of the plurality of heat source units (101) or the plurality of pumps (102) according to a result of the comparison.

[0009] In the first aspect, the requested flow rate corresponding to the operation state or the like of each heat source unit (101) is constantly compared with the current water supply amount or the maximum water supply amount corresponding to the operation state or the like of each pump (102), and adjustment such as increasing/-decreasing the number of operating heat source units (101) or pumps (102) can be performed as necessary. This configuration can ensure the minimum required flow rate of each heat source unit (101) and achieve stable control.

[0010] According to a second aspect of the present disclosure, in the first aspect, at least either the plurality of heat source units (101) or the plurality of pumps (102) are configured to have a plurality of different capacities.

[0011] In the second aspect, unlike the manifold-pipe-type heat source system of the related art, even when heat source units (101) or pumps (102) having different capacities are present, the minimum required flow rate of each heat source unit (101) is ensured. It is possible to achieve stable control.

[0012] According to a third aspect of the present disclosure, in the first or second aspect, the control unit (150) is configured to increase or decrease the number of operating heat source units (101) among the plurality of heat source units (101) or the number of operating pumps (102) among the plurality of pumps (102).

[0013] In the third aspect, the minimum required flow rate of each heat source unit (101) can be ensured by increasing or decreasing the number of operating heat source units (101) or pumps (102), and it is possible to achieve stable control.

[0014] According to a fourth aspect of the present disclosure, in any one of the first to third aspects, the control unit (150) is configured to determine the requested flow rate, based on the operation states of the plurality of heat source units (101) and flow rates ob-

tained by multiplying the minimum required flow rates by a coefficient considering a flow rate variation in respective pipes (105) connected to the plurality of heat source units (101).

[0015] In the fourth aspect, the requested flow rate of the plurality of heat source units (101) can be determined more accurately, and thus more stable control can be achieved.

[0016] According to a fifth aspect of the present disclosure, in any one of the first to fourth aspects, the control unit (150) is configured to make a comparison between the requested flow rate and the current water supply amount, and, when the requested flow rate is larger, select a pump (102) whose operation is to be started from among the plurality of pumps (102) so that the current water supply amount satisfies the requested flow rate and a change in the current water supply amount is minimum.

[0017] In the fifth aspect, the minimum required flow rate of each heat source unit (101) can be ensured by increasing the number of operating pumps (102), and it is possible to achieve stable control. In addition, since the number of operating pumps (102) is increased so that the change in the current water supply amount is minimum, the influence on the system load due to the increase in the number of operating pumps (102) can be suppressed as small as possible.

[0018] According to a sixth aspect of the present disclosure, in any one of the first to fourth aspects, the control unit (150) is configured to calculate a post-decrease water supply amount from the current water supply amount, based on information on a pump (102) scheduled to stop operation among the plurality of pumps (102), make a comparison between the post-decrease water supply amount and the requested flow rate, and permit or prohibit stopping of operation of the pump (102) according to a result of the comparison.

[0019] In the sixth aspect, the minimum required flow rate of each heat source unit (101) can be ensured by decreasing the number of operating pumps (102), and it is possible to achieve stable control.

[0020] According to a seventh aspect of the present disclosure, in any one of the first to fourth aspects, at least one of the plurality of pumps (102) is a VFD pump (102), and the control unit (150) is configured to update a VFD command value for the VFD pump (102) that is operating, based on a difference between the requested flow rate and the current water supply amount.

[0021] In the seventh aspect, the minimum required flow rate of each heat source unit (101) can be ensured by adjusting the VFD command value of the VFD pump (102), and it is possible to achieve stable control.

[0022] According to an eighth aspect of the present disclosure, in the seventh aspect, the control unit (150) is configured to determine a VFD command value of the VFD pump (102), based on a difference between a pressure of a pipe (107, 116) connected to the VFD pump (102) and a set value of the pressure; determine the

current water supply amount by multiplying a flow rate set for the VFD pump (102) that is operating by a rotation rate; make a comparison between the requested flow rate and the current water supply amount, and calculate a lower limit value of the VFD command value so as to compensate for the difference between the requested flow rate and the current water supply amount when the requested flow rate is larger; and update the VFD command value with the lower limit value when the lower limit value is larger than the VFD command value.

[0023] In the eighth aspect, the VFD command value of the VFD pump (102) can be adjusted so that the minimum required flow rate of each heat source unit (101) can be ensured.

[0024] According to a ninth aspect of the present disclosure, in any one of the first to fourth aspects, the control unit (150) is configured to make a comparison between the requested flow rate and the maximum water supply amount, and, when the requested flow rate is larger, select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate.

[0025] In the ninth aspect, the minimum required flow rate of another operating heat source unit (101) can be ensured by decreasing the number of operating heat source units (101), and it is possible to achieve stable control.

[0026] According to a tenth aspect of the present disclosure, in the ninth aspect, the control unit (150) is configured to make a comparison between the requested flow rate and the maximum water supply amount, and selectively perform first control and second control when the requested flow rate is larger; in the first control, select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units

[0027] (101) so that the maximum water supply amount satisfies the requested flow rate; and in the second control, select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate and a change in the requested flow rate is minimum.

[0028] In the tenth aspect, the minimum required flow rate of another operating heat source unit (101) can be ensured by decreasing the number of operating heat source units (101), and it is possible to achieve stable control. In addition, in the second control, since the number of operating heat source units (101) is decreased so that the change in the requested flow rate is minimum, the influence on the system load due to the decrease in the number of operating heat source units (101) can be suppressed as small as possible.

[0029] According to an eleventh aspect of the present disclosure, in any one of the first to fourth aspects, the control unit (150) is configured to calculate a post-increase requested flow rate from the requested flow rate, based on information on a heat source unit (101) sched-

uled to start operation among the plurality of heat source units (101), make a comparison between the post-increase requested flow rate and the maximum water supply amount, and permit or prohibit a start of operation of the heat source unit (101) according to a result of the comparison.

[0030] In the eleventh aspect, the number of operating heat source units (101) is increased while the minimum required flow rate of each operating heat source unit (101) is ensured, and thus it is possible to achieve stable control.

[0031] According to a twelfth aspect of the present disclosure, in any one of the first to fourth aspects, the control unit (150) is configured to make a comparison between the requested flow rate and the maximum water supply amount, and, when the requested flow rate is larger, limit a capacity of an operating heat source unit (101) among the plurality of heat source units (101).

[0032] In the twelfth aspect, the minimum required flow rate of each operating heat source unit (101) can be ensured by limiting the capacity of the operating heat source unit (101), and it is possible to achieve stable control.

[0033] According to a thirteenth aspect of the present disclosure, in any one of the first to fourth aspects, the control unit (150) is configured to make a comparison between the requested flow rate and the maximum water supply amount, and selectively perform third control and fourth control when the requested flow rate is larger; in the third control, select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate; and in the fourth control, limit a capacity of an operating heat source unit (101) among the plurality of heat source units (101).

[0034] In the thirteenth aspect, the minimum required flow rate of each heat source unit (101) can be ensured by selectively decreasing the number of operating heat source units (101) or limiting the capacity of the operating heat source unit (101), and it is possible to achieve stable control.

[0035] According to a fourteenth aspect of the present disclosure, in the thirteenth aspect, the control unit (150) is configured to perform the fourth control when the requested flow rate is larger than the maximum water supply amount.

[0036] In the fourteenth aspect, it is possible to avoid the influence on the system load due to the decrease in the number of operating heat source units (101).

[0037] According to a fifteenth aspect of the present disclosure, in the thirteenth or fourteenth aspect, the control unit (150) is configured to perform the third control when the requested flow rate is larger than the maximum water supply amount and the capacity of the operating heat source unit (101) among the plurality of heat source units (101) is lower than a predetermined lower limit value.

[0038] In the fifteenth aspect, when it is difficult to limit the capacity of the operating heat source unit (101), the minimum required flow rate of another operating heat source unit (101) can be ensured by decreasing the number of operating heat source units (101), and it is possible to achieve stable control.

[0039] According to a sixteenth aspect of the present disclosure, in any one of the thirteenth to fifteenth aspects, the control unit (150) is configured to selectively perform fifth control and sixth control as the third control when the requested flow rate is larger than the maximum water supply amount and the capacity of the operating heat source unit (101) among the plurality of heat source units (101) is lower than a predetermined lower limit value; in the fifth control, select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate; and in the sixth control, select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate and a change in the requested flow rate is minimum.

[0040] In the sixteenth aspect, when it is difficult to limit the capacity of the operating heat source unit (101), the minimum required flow rate of another operating heat source unit (101) can be ensured by decreasing the number of operating heat source units (101), and it is possible to achieve stable control. In addition, in the sixth control, since the number of operating heat source units (101) is decreased so that the change in the requested flow rate is minimum, the influence on the system load due to the decrease in the number of operating heat source units (101) can be suppressed as small as possible.

Brief Description of Drawings

[0041]

[Fig. 1] Fig. 1 is a configuration diagram illustrating an overview of a heat source system according to an embodiment.

[Fig. 2] Fig. 2 is a flowchart illustrating pump quantity control in the heat source system illustrated in Fig. 1.

[Fig. 3] Fig. 3 is a schematic diagram illustrating the content of a pump increase process in the heat source system illustrated in Fig. 1.

[Fig. 4] Fig. 4 is a schematic diagram illustrating the content of a pump decrease process in the heat source system illustrated in Fig. 1.

[Fig. 5] Fig. 5 is a flowchart illustrating pump VFD control in the heat source system illustrated in Fig. 1.

[Fig. 6] Fig. 6 is a flowchart illustrating heat source unit quantity control in the heat source system illustrated in Fig. 1.

[Fig. 7] Fig. 7 is a schematic diagram illustrating the content of a heat source unit capacity limiting pro-

cess in the heat source system illustrated in Fig. 1.
[Fig. 8] Fig. 8 is a schematic diagram illustrating the content of a heat source unit decrease process in the heat source system illustrated in Fig. 1.

[Fig. 9] Fig. 9 is a schematic diagram illustrating the content of a heat source unit increase process in the heat source system illustrated in Fig. 1.

Description of Embodiments

(Embodiment)

[0042] An embodiment of the present disclosure will be described hereinafter with reference to the drawings. It should be noted that the following embodiment is an essentially preferred example and is not intended to limit the scope of the present invention, applications thereof, or uses thereof. In addition, since the drawings are intended to conceptually describe the present disclosure, dimensions, ratios, or numbers may be exaggerated or simplified as necessary for easy understanding.

<Heat Source System>

[0043] As illustrated in Fig. 1, a heat source system (100) according to the present embodiment mainly includes a plurality of (in this example, three) heat source units (101), a plurality of (in this example, four) pumps (102), and a control unit (150). In the heat source system (100) illustrated in Fig. 1, a heat medium such as cold water or hot water circulates between each heat source unit (101) and a system load in a direction indicated by an arrow. The system load is a load such as an air conditioner. The plurality of heat source units (101) are, for example, chillers, heat pumps, or the like. In the following description, the plurality of heat source units (101) are chillers, by way of example. In this example, the plurality of pumps (102) are primary pumps having VFDs (102a). The control unit (150) mainly controls the operation of the heat source units (101) and the pumps (102).

[0044] The plurality of heat source units (101) are arranged in parallel with each other. The plurality of pumps (102) are arranged in parallel with each other. The number of heat source units (101) and the number of pumps (102) are not limited. In addition, the number of heat source units (101) and the number of pumps (102) may be different from each other as in this example, or may be the same. Furthermore, at least either the plurality of heat source units (101) or the plurality of pumps (102) may be configured to have a plurality of different capacities.

[0045] In the heat source system (100), a collective pipe (103) is arranged to collect flow paths between the plurality of heat source units (101) and the plurality of pumps (102) into one. That is, the heat source system (100) is of a manifold pipe type. The collective pipe (103) is connected to a plurality of pipes (105) communicating with the respective heat source units (101) via a first

header (104). The collective pipe (103) is connected to a plurality of pipes (107) communicating with the respective pumps (102) via a second header (106).

[0046] Cold water cooled by the plurality of heat source units (101) is supplied to the system load via a plurality of pipes (108) communicating with the respective heat source units (101). The plurality of pipes (108) are connected to a water supply pipe (110) via a third header (109). The third header (109) may be provided with sensors (T and P in Fig. 1) for measuring the temperature and pressure of the cold water to be supplied to the system load. A secondary pump may be arranged between the water supply pipe (110) and the system load.

[0047] The heat medium (in this example, water) used in the system load is fed to the heat source units (101) via a return pipe (111). The return pipe (111) is connected to a measurement pipe (114) provided with a flowmeter (113) via a fourth header (112). The fourth header (112) may be provided with a sensor (T in Fig. 1) for measuring the temperature of the heat medium to be fed to the heat source units (101). The measurement pipe (114) is connected to a plurality of pipes (116) communicating with the respective pumps (102) via a fifth header (115).

[0048] A bypass pipe (117) is provided between the third header (109) and the fifth header (115) to bypass the plurality of heat source units (101) and the plurality of pumps (102). The bypass pipe (117) is provided with a valve (118).

<Control Unit>

[0049] The control unit (150) includes, for example, a computer and its peripheral devices. The control unit (150) executes functions described below by hardware such as a computer and a program executed by the computer.

[0050] The control unit (150) outputs a command signal for activating or stopping the heat source units (101) or the pumps (102). The control unit (150) outputs a command signal for controlling the VFDs (102a) of the pumps (102). The control unit (150) receives input of measurement signals (temperature and pressure) of the sensors provided in the third header (109) and the fourth header (112) and a measurement signal of the flowmeter (113). The control unit (150) controls the opening degree of the valve (118) provided in the bypass pipe (117).

[0051] The control unit (150) determines a requested flow rate, based on at least minimum required flow rates set for the plurality of heat source units (101) and operation states of the plurality of heat source units (101). The control unit (150) determines a current water supply amount or a maximum water supply amount, based on flow rates set for the plurality of pumps (102) and operation states of the plurality of pumps (102). The control unit (150) compares the requested flow rate with the current water supply amount or the maximum water supply amount and controls the operation of the plurality of heat

source units (101) or the plurality of pumps (102) according to the result. For example, the control unit (150) may increase or decrease the number of operating heat source units (101) or the number of operating pumps (102). Here, the "operation state" includes not only the ON/OFF states of the heat source units (101) and the pumps (102) but also the VFD command values of the heat source units (101) and the pumps (102). The "control of operation" includes not only the control of the ON/OFF states of the heat source units (101) and the pumps (102) but also the VFD control of the heat source units (101) and the pumps (102).

[0052] When the pipes (105), each of which is connected to one of the plurality of heat source units (101), have a difference in pipe length, the control unit (150) may determine the requested flow rate, based on, for example, the operation states of the plurality of heat source units (101) and flow rates obtained by multiplying the minimum required flow rates by a coefficient considering the flow rate variation in the pipes (105) connected to the respective heat source units (101). Specifically, in a case where a pipe length L1 of the pipe (105) from the first header (104) to one heat source unit (101) is different from a pipe length L2 of the pipe (105) from the first header (104) to another heat source unit (101), the one heat source unit (101) is used as a reference. In this case, the minimum required flow rate of the other heat source unit (101) is desirably set to a flow rate obtained by multiplying a predetermined minimum required flow rate by a coefficient L2/L1.

[0053] The details of the control of the operation of the heat source units (101) or the pumps (102) by the control unit (150) will be described hereinafter with reference to Figs. 2 to 9.

<Pump Quantity Control>

[0054] Fig. 2 is a flowchart illustrating pump quantity control by the control unit (150).

[0055] First, in step S101, the control unit (150) determines whether the flow rate at the system load (hereinafter referred to as a load-side flow rate) exceeds the capacity of all the operating pumps (102). If the load-side flow rate is larger, the control unit (150) increases the number of operating pumps

[0056] (102) by normal quantity control. Specifically, in step S102, the control unit (150) enables activation of, for example, a pump (102) having the shortest cumulative operating time among pumps (102) that can be activated. In step S103, the control unit (150) operates the pump (102) to increase the number of operating pumps (102).

[0057] On the other hand, if it is determined in step S101 that the load-side flow rate is not larger, in step S104, the control unit (150) determines whether the load-side flow rate is smaller than the capacity of the operating pumps (102), the number of which is equal to the number of operating pumps (102) decreased by one. If the load-side flow rate is not smaller, in step S105, the control unit

(150) determines whether the sum of the minimum required flow rates set for the respective operating heat source units (101), that is, the requested flow rate, is larger than the sum of the flow rates (rated flow rates) set for the respective operating pumps (102), that is, the current water supply amount. If the requested flow rate is larger, in step S106, the control unit (150) forcibly increases the number of operating pumps (102). If the requested flow rate is not larger, in step S107, the control unit (150) determines to maintain the current number of operating pumps (102). When the requested flow rate is determined in step S105, as described above, the flow rate variation in the pipes (105) connected to the respective heat source units (101) may be considered.

[0058] Hereinafter, the content of the pump increase process (processing in step S106 and the like) by the control unit (150) will be described with reference to Fig. 3. When there are standby pumps (102) for which the current water supply amount after the increase in the number of operating pumps (102) satisfies the requested flow rate (Standby Pump Case 1 (corresponding to pump 2 and pump 3) in Fig. 3), the control unit (150) enables activation of the pump (102) having the smallest change in the current water supply amount after the increase in the number of operating pumps (102) (i.e., the smallest capacity) (corresponding to the pump 2 in the Standby Pump Case 1 in Fig. 3) among the standby pumps (102). On the other hand, in step S106, when there is no standby pump (102) for which the current water supply amount after the increase in the number of operating pumps (102) satisfies the requested flow rate (Standby Pump Case 2 (no corresponding pump) in Fig. 3), the control unit (150) enables activation of the pump (102) having the largest capacity (corresponding to pump 1 in the Standby Pump Case 2 in Fig. 3) among standby pumps (102). In this case, the control unit (150) sequentially enables activation of the pumps (102) in descending order of the capacity until a standby pump (102) for which the current water supply amount after the increase in the number of operating pumps (102) satisfies the requested flow rate is found. When there is a plurality of pumps (102) satisfying the condition in step S106, in step S102, the control unit (150) enables activation of, for example, the pump (102) having the shortest cumulative operating time among the plurality of pumps (102). Thereafter, in step S103, the control unit (150) increases the number of operating pumps (102) by operating the pump (102) that can be activated.

[0059] If the control unit (150) determines in step S104 that the load-side flow rate is smaller, the control unit (150) decreases the number of operating pumps (102) by normal quantity control. Specifically, in step S108, the control unit (150) determines whether "the sum of the minimum required flow rates set for the respective operating heat source units (101)", that is, the requested flow rate, is smaller than "the flow rate obtained by subtracting the rated flow rate of the pump (102) scheduled to stop operation next from the sum of the rated flow rates of the

operating pumps (102) (the current water supply amount)", that is, the post-decrease water supply amount. If the requested flow rate is smaller, in step S109, the control unit (150) enables stopping of a pump (102) scheduled to stop operation, for example, the pump (102) having the longest cumulative operating time. In step S110, the control unit (150) stops the operation of the pump (102) to decrease the number of operating pumps (102). When the requested flow rate is determined in step S108, as described above, the flow rate variation in the pipes (105) connected to the respective heat source units (101) may be considered.

[0060] If the control unit (150) determines in step S108 that the requested flow rate is not smaller than the post-decrease water supply amount, in step S111, the control unit (150) determines whether there is an operating pump (102) for which the current water supply amount after the decrease in the number of operating pumps (102) is larger than the requested flow rate, in addition to the pump (102) scheduled to stop operation. Hereinafter, the content of the pump decrease process by the control unit (150) will be described with reference to Fig. 4. In Fig. 4, it is assumed that the pump 2 is a pump (102) originally scheduled to stop operation (to be turned off). If there is no operating pump (102) for which the current water supply amount after the decrease in the number of operating pumps (102) satisfies the requested flow rate (Operating Pump Case 1 (no corresponding pump including the pump 2) in Fig. 4), in step S107, the control unit (150) prohibits the decrease in the number of all operating pumps (102) and determines to maintain the current number of operating pumps (102). On the other hand, if there is an operating pump (102) for which the current water supply amount after the decrease in the number of operating pumps (102) is larger than the requested flow rate (Operating Pump Case 2 (corresponding to the pump 1) in Fig. 4), in step S109, the control unit (150) enables stopping of, for example, the pump (102) having the longest cumulative operating time (corresponding to the pump 1 in Operating Pump Case 2 in Fig. 4) among the pumps (102) that can stop operation. In step S110, the control unit (150) stops the operation of the pump (102) to decrease the number of operating pumps (102).

[0061] In the pump quantity control illustrated in Fig. 2, the processing of steps S101 to S111 described above may be repeatedly performed at predetermined time intervals.

<Pump VFD Control>

[0062] When at least one of the plurality of pumps (102) has the VFD function, the control unit (150) may update the VFD command value for an operating pump (102) with the VFD function (hereinafter referred to as a VFD pump (102)), based on the difference between the requested flow rate described above and the current water supply amount described above, instead of or in addition

to the pump quantity control illustrated in Fig. 2.

[0063] Fig. 5 is a flowchart illustrating the pump VFD control by the control unit (150).

[0064] First, in step S151, the control unit (150) determines a VFD command value for the VFD pump (102), based on a difference between a pressure of the pipes (107 and 116) connected to the VFD pump (102) and a set value of the pressure.

[0065] Then, in step S152, the control unit (150) determines the lower limit value of the VFD command value from information on each operating heat source unit (101) and each operating pump

[0066] (102). Specifically, for the VFD pump (102) that is operating, the flow rate set for the VFD pump (102) is multiplied by a rotation rate to calculate an estimated value of the current flow rate, and the estimated value is used to determine the current water supply amount described above. If the requested flow rate described above is larger than the current water supply amount, the lower limit value of the VFD command value is calculated so that the difference between the requested flow rate and the current water supply amount can be compensated for.

[0067] Then, in step S153, the control unit (150) determines whether the lower limit value of the VFD command value determined in step S152 is larger than the VFD command value determined based on the pressure in step S151. If the lower limit value of the VFD command value is larger, in step S154, the control unit (150) increases the VFD command value to the lower limit value. That is, the VFD command value is updated with the lower limit value, and thereafter, in step S155, the control unit (150) outputs the updated VFD command value as the VFD command value for the VFD pump (102).

[0068] If the control unit (150) determines in step S153 that the lower limit value of the VFD command value determined in step S152 is not larger than the VFD command value determined based on the pressure in step S151, in step S155, the control unit (150) outputs the VFD command value determined based on the pressure as it is as the VFD command value for the VFD pump (102).

[0069] In the pump VFD control illustrated in Fig. 5, the processing of steps S151 to S155 described above may be repeatedly performed at predetermined time intervals. In a case where a plurality of VFD pumps (102) are provided, in the pump VFD control illustrated in Fig. 5, the same VFD command value may be output to the VFD pumps (102).

<Heat Source Unit Quantity Control>

[0070] Instead of or in addition to the pump quantity control illustrated in Fig. 2 and/or the pump VFD control illustrated in Fig. 5, the control unit (150) may perform heat source unit quantity control described below.

[0071] Fig. 6 is a flowchart illustrating heat source unit quantity control by the control unit (150).

[0072] First, in step S301, the control unit (150) determines whether the amount of heat in the system load (hereinafter referred to as a load-side heat amount) exceeds the capacity of all the operating heat source units (101). If the load-side heat amount is not larger, in step S302, the control unit (150) determines whether the load-side heat amount is smaller than the capacity of the operating heat source units (101), the number of which is equal to the number of operating heat source units (101) decreased by one. If the load-side heat amount is smaller, the control unit (150) decreases the number of operating heat source units (101) by normal quantity control. Specifically, in step S303, the control unit (150) enables stopping of, for example, the heat source unit (101) having the longest cumulative operating time among the heat source units (101) that can be stopped. In step S304, the control unit (150) stops the operation of the heat source unit (101) to decrease the number of operating pumps (102).

[0073] On the other hand, if it is determined in step S302 that the load-side heat amount is not smaller, in step S305, the control unit (150) determines whether "the sum of the minimum required flow rates set for the respective operating heat source units (101)", that is, the requested flow rate, is larger than "the sum of the flow rates (rated flow rates) set for all the non-failed pumps (102)", that is, the maximum water supply amount. If the requested flow rate is not larger, in step S306, the control unit (150) determines to maintain the current number of operating heat source units (101). When the requested flow rate is determined in step S305, as described above, the flow rate variation in the pipes (105) connected to the respective heat source units (101) may be considered.

[0074] If it is determined in step S305 that the requested flow rate is larger, when at least one of the plurality of heat source units (101) has, for example, the VFD function or the like and is capable of capacity adjustment, the control unit (150) performs a heat source unit capacity limiting process of steps S307 and S308 described below.

[0075] Hereinafter, the content of the heat source unit capacity limiting process by the control unit (150) will be described with reference to Fig. 7. As illustrated in Fig. 7, in a case where a compressor of a heat source unit (101) has the VFD function, even if the flow rate does not satisfy the minimum required flow rate of the heat source unit (101), limiting the maximum value of the VFD command value of the compressor of the heat source unit (101) enables the operation to continue while keeping the flow rate low. For example, [1] it is assumed that when the compressor of the heat source unit (101) is operating at a capacity of 100%, a flow rate that is half the rated flow rate is the minimum required flow rate. Thereafter, [2] it is assumed that the flow rate corresponding to the maximum water supply amount described above becomes 40% of the rated flow rate and cannot satisfy the minimum required flow rate as it is. In this case, [3] limiting the upper limit of the VFD command value (i.e., the capacity limit

value) of the compressor of the heat source unit (101) to 80% enables the operation to continue even when the flow rate is 40% of the original rated flow rate. The capacity limit value of the heat source unit (101) has a lower limit set by specifications or the like.

[0076] Accordingly, in step S307, the control unit (150) first calculates the capacity limit value of a heat source unit (101) that can continue operation. Then, in step S308, the control unit (150) determines whether the calculated capacity limit value is larger than a predetermined lower limit value. If the calculated capacity limit value is larger than the predetermined lower limit value, in step S309, the control unit (150) limits the capacity of the heat source unit (101) to the capacity limit value while keeping the number of operating heat source units (101) constant. On the other hand, if the capacity limit value of the heat source unit (101) is not larger than the predetermined lower limit value, the control unit (150) forcibly decreases the number of operating heat source units (101) in step S310 and subsequent processing described below.

[0077] The heat source unit capacity limiting process of steps S307 and S308 described above may be selectable by the user, for example, and if it is determined in step S305 that the requested flow rate is larger, the control unit (150) may omit the heat source unit capacity limiting process of steps S307 and S308 and forcibly decrease the number of operating heat source units (101) in step S310 and subsequent processing described below.

[0078] Hereinafter, the content of the heat source unit decrease process (processing in step S310 and the like) by the control unit (150) will be described with reference to Fig. 8. In step S310, when there are operating heat source units (101) for which the requested flow rate after the decrease in the number of operating heat source units (101) is smaller than the maximum water supply amount (Operating Heat Source Unit Case 1 (corresponding to heat source unit 2 and heat source unit 3) in Fig. 8), the control unit (150) enables stopping of the heat source unit (101) having the smallest change in the requested flow rate after the decrease in the number of operating heat source units (101) (i.e., the smallest minimum required flow rate) (corresponding to the heat source unit 2 in the Operating Heat Source Unit Case 1 in Fig. 8) among the operating heat source units (101). On the other hand, in step S310, when there is no operating heat source unit (101) for which the requested flow rate after the decrease in the number of operating heat source units (101) is smaller than the maximum water supply amount (Operating Heat Source Unit Case 2 (no corresponding heat source unit) in Fig. 8), the control unit (150) enables stopping of the heat source unit (101) having the largest minimum required flow rate (corresponding to heat source unit 1 in the Operating Heat Source Unit Case 2 in Fig. 8) among the operating heat source units (101). In this case, the control unit (150) sequentially enables stopping of the heat source units (101) in descending

order of the minimum required flow rate until the operating heat source unit (101) for which the requested flow rate after the decrease in the number of operating heat source units (101) is smaller than the maximum water supply amount is found. When there is a plurality of heat source units (101) satisfying the condition in step S310, in step S303, the control unit (150) enables stopping of, for example, the heat source unit (101) having the longest cumulative operating time among the plurality of heat source units (101). Thereafter, in step S304, the control unit (150) decreases the number of operating heat source units (101) by stopping the operation of the heat source unit (101) that can be stopped. When the requested flow rate is determined in step S310, as described above, the flow rate variation in the pipes (105) connected to the respective heat source units (101) may be considered.

[0079] The heat source unit decrease process performed when it is determined in step S301 that the load-side heat amount does not exceed the capacity of all the operating heat source units (101) has been described above. On the other hand, if it is determined in step S301 that the load-side heat amount exceeds the capacity of all the operating heat source units (101), the control unit (150) performs a process of increasing the number of operating heat source units (101) by normal quantity control. Specifically, first, in step S311, the control unit (150) determines whether "the flow rate obtained by adding the minimum required flow rate of the heat source unit (101) scheduled to start operation next to the sum of the minimum required flow rates set for the respective operating heat source units (101) (requested flow rate)", that is, the post-increase requested flow rate, is smaller than "the sum of the rated flow rates of all the non-failed pumps (102)", that is, the maximum water supply amount. If the post-increase requested flow rate is smaller, in step S312, the control unit (150) enables activation of a heat source unit (101) scheduled to start operation, for example, the heat source unit (101) having the shortest cumulative operating time. In step S313, the control unit (150) operates the heat source unit (101) to increase the number of operating heat source units (101). When the requested flow rate is determined in step S311, as described above, the flow rate variation in the pipes (105) connected to the respective heat source units (101) may be considered.

[0080] On the other hand, if it is determined in step S311 that the post-increase requested flow rate is not smaller than the maximum water supply amount, in step S314, the control unit (150) determines whether there is a standby heat source unit (101) for which the requested flow rate after the increase in the number of operating heat source units (101) is smaller than the maximum water supply amount, in addition to the heat source unit (101) scheduled to start operation.

[0081] Hereinafter, the content of the heat source unit increase process by the control unit (150) will be described with reference to Fig. 9. In Fig. 9, it is assumed

that the heat source unit 2 is a heat source unit (101) originally scheduled to start operation (to be turned on). If there is no standby heat source unit (101) for which the requested flow rate after the increase in the number of operating heat source units (101) is smaller than the maximum water supply amount (Standby Heat Source Unit Case 1 (no corresponding heat source unit including the heat source unit 2) in Fig. 9), in step S306, the control unit (150) prohibits the increase in the number of operating heat source units (101) and determines to maintain the current number of operating heat source units (101). On the other hand, if there is a standby heat source unit (101) for which the requested flow rate after the increase in the number of operating heat source units (101) is smaller than the maximum water supply amount (Standby Heat Source Unit Case 2 (corresponding to the heat source unit 1) in Fig. 9), in step S312, the control unit (150) enables activation of, for example, the heat source unit (101) having the shortest cumulative operating time (corresponding to the heat source unit 1 in the Standby Heat Source Unit Case 2 in Fig. 9) among the heat source units (101) that can start operation. In step S313, the control unit (150) operates the heat source unit (101) to increase the number of operating heat source units (101).

[0082] In the heat source unit quantity control illustrated in Fig. 6, the processing of steps S301 to S313 described above may be repeatedly performed at predetermined time intervals.

<Features of Embodiment>

[0083] A heat source system (100) of the present embodiment includes a plurality of heat source units (101) provided in parallel with each other, a plurality of pumps (102) provided in parallel with each other, a collective pipe (103) arranged to collect flow paths between the plurality of heat source units (101) and the plurality of pumps (102) into one, and a control unit (150) configured to control operation of the plurality of heat source units (101) and the plurality of pumps (102).

[0084] According to the heat source system (100) of the present embodiment, the requested flow rate corresponding to the number of activated heat source units (101) is always compared with the current water supply amount (the water supply amount at the current point in time) or the maximum water supply amount (the maximum water supply amount allowed) corresponding to the number of activated pumps (102), and the number of operating heat source units (101) or pumps (102) can be increased or decreased or a VFD setting value of a pump (102) having the VFD function can be adjusted as necessary. This configuration can ensure the minimum required flow rate of each heat source unit (101) and achieve stable control.

[0085] Further, according to the heat source system (100) of the present embodiment, even when the number of heat source units (101) is different from the number of pumps (102) or a plurality of pumps (102) having different

capacities are present, it is possible to always ensure the minimum required flow rate of each heat source unit (101). Thus, the heat source system (100) can support various system configurations.

[0086] In addition, according to the heat source system (100) of the present embodiment, the number of heat source units (101) to be activated can be limited in accordance with the number of operable pumps (102). For example, when one or more pumps (102) fail, even if a start/stop command is output to the heat source units (101) under a high load, the number of operable pumps (102) may be insufficient, and some heat source units (101) cannot ensure the minimum required flow rates, which may make it impossible to achieve stable control. In contrast, the heat source system (100) of the present embodiment can limit the number of heat source units (101) to be activated, based on the water supply amount of operable pumps (102).

[0087] According to the heat source system (100) of the present embodiment, furthermore, for the pump (102) with the VFD function, an estimated value of the current flow rate is calculated according to the various kinds of operation information described above, and when the requested flow rate is larger than the estimated value of the flow rate, the requested flow rate can be met by increasing the VFD command value of the pump (102). When the VFD command value decreases, the flow rates of the heat source units (101) may be insufficient, and it may be impossible to achieve stable control. Accordingly, for example, the lower limit of the VFD command value may be determined according to the number of activated heat source units (101) and the number of activated pumps (102).

[0088] According to the heat source system (100) of the present embodiment, furthermore, it is possible to decrease the number of man-hours taken for test operation adjustment for ensuring the minimum required flow rates of the heat source units (101), and it is also possible even for an unskilled person to provide stable quality. Thus, it is possible to contribute to the reduction of labor shortages and the reduction of adjustment cost.

[0089] In the heat source system (100) of the present embodiment, at least either the plurality of heat source units (101) or the plurality of pumps (102) may be configured to have a plurality of different capacities. For example, in a case where a plurality of pumps (102) having different capacities are present, since the current water supply amount changes depending on the capacity of activated pumps (102), the flow rates of the heat source units (101) may be insufficient. In contrast, the heat source system (100) of the present embodiment can increase or decrease, for example, the number of operating pumps (102) in accordance with the number of activated heat source units (101) or the rated flow rates of the activated pumps (102). Accordingly, unlike the manifold-pipe-type heat source system of the related art, even when heat source units (101) or pumps (102) having different capacities are present, the minimum

required flow rate of each heat source unit (101) is ensured. It is possible to achieve stable control.

[0090] In the heat source system (100) of the present embodiment, the control unit (150) may increase or decrease the number of operating heat source units (101) among the plurality of heat source units (101) or the number of operating pumps (102) among the plurality of pumps (102). In this way, the minimum required flow rate of each heat source unit (101) can be ensured by increasing or decreasing the number of operating heat source units (101) or pumps (102), and it is possible to achieve stable control.

[0091] In the heat source system (100) of the present embodiment, the control unit (150) may determine the requested flow rate, based on the operation states of the plurality of heat source units (101) and flow rates obtained by multiplying the minimum required flow rates by a coefficient considering a flow rate variation in respective pipes (105) connected to the plurality of heat source units (101). In this way, the requested flow rate of the plurality of heat source units (101) can be determined more accurately, and thus more stable control can be achieved.

[0092] In the heat source system (100) of the present embodiment, the control unit (150) may make a comparison between the requested flow rate and the current water supply amount, and, when the requested flow rate is larger, select a pump (102) whose operation is to be started from among the plurality of pumps (102) so that the current water supply amount satisfies the requested flow rate and a change in the current water supply amount is minimum. In this way, the minimum required flow rate of each heat source unit (101) can be ensured by increasing the number of operating pumps (102), and it is possible to achieve stable control. In addition, since the number of operating pumps (102) is increased so that the change in the current water supply amount is minimum, the influence on the system load due to the increase in the number of operating pumps (102) can be suppressed as small as possible.

[0093] In the heat source system (100) of the present embodiment, the control unit (150) may calculate a post-decrease water supply amount from the current water supply amount, based on information on a pump (102) scheduled to stop operation among the plurality of pumps (102), make a comparison between the post-decrease water supply amount and the requested flow rate, and permit or prohibit stopping of operation of the pump (102) according to a result of the comparison. In this way, the minimum required flow rate of each heat source unit (101) can be ensured by decreasing the number of operating pumps (102), and it is possible to achieve stable control.

[0094] In the heat source system (100) of the present embodiment, at least one of the plurality of pumps (102) may be a VFD pump (102), and the control unit (150) may update a VFD command value for the VFD pump (102) that is operating, based on a difference between the requested flow rate and the current water supply amount.

In this way, the minimum required flow rate of each heat source unit (101) can be ensured by adjusting the VFD command value of the VFD pump (102), and it is possible to achieve stable control. In this case, the control unit (150) may determine a VFD command value of the VFD pump (102), based on a difference between a pressure of a pipe (107, 116) connected to the VFD pump (102) and a set value of the pressure, determine the current water supply amount by multiplying a flow rate set for the VFD pump (102) that is operating by a rotation rate, make a comparison between the requested flow rate and the current water supply amount, calculate a lower limit value of the VFD command value so as to compensate for the difference between the requested flow rate and the current water supply amount when the requested flow rate is larger, and update the VFD command value with the lower limit value when the lower limit value is larger than the VFD command value. In this way, the VFD command value of the VFD pump (102) can be adjusted so that the minimum required flow rate of each heat source unit (101) can be ensured.

[0095] In the heat source system (100) of the present embodiment, the control unit (150) may make a comparison between the requested flow rate and the maximum water supply amount, and, when the requested flow rate is larger, select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate. In this way, the minimum required flow rate of another operating heat source unit (101) can be ensured by decreasing the number of operating heat source units (101), and it is possible to achieve stable control. In this case, the control unit (150) may make a comparison between the requested flow rate and the maximum water supply amount, and selectively perform first control and second control when the requested flow rate is larger. In the first control, the control unit (150) may select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate. In the second control, the control unit (150) may select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate and a change in the requested flow rate is minimum. In this way, the minimum required flow rate of another operating heat source unit (101) can be ensured by decreasing the number of operating heat source units (101), and it is possible to achieve stable control. In addition, in the second control, since the number of operating heat source units (101) is decreased so that the change in the requested flow rate is minimum, the influence on the system load due to the decrease in the number of operating heat source units (101) can be suppressed as small as possible.

[0096] In the heat source system (100) of the present embodiment, the control unit (150) may calculate a post-

increase requested flow rate from the requested flow rate, based on information on a heat source unit (101) scheduled to start operation among the plurality of heat source units (101), make a comparison between the post-increase requested flow rate and the maximum water supply amount, and permit or prohibit a start of operation of the heat source unit (101) according to a result of the comparison. In this way, the number of operating heat source units (101) is increased while the minimum required flow rate of each operating heat source unit (101) is ensured, and thus it is possible to achieve stable control.

[0097] In the heat source system (100) of the present embodiment, the control unit (150) may make a comparison between the requested flow rate and the maximum water supply amount, and, when the requested flow rate is larger, limit a capacity of an operating heat source unit (101) among the plurality of heat source units (101). In this way, the minimum required flow rate of each operating heat source unit (101) can be ensured by limiting the capacity of the operating heat source unit (101), and it is possible to achieve stable control.

[0098] In the heat source system (100) of the present embodiment, the control unit (150) may make a comparison between the requested flow rate and the maximum water supply amount, and selectively perform third control and fourth control when the requested flow rate is larger. In the third control, the control unit (150) may select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate. In the fourth control, the control unit (150) may limit a capacity of an operating heat source unit (101) among the plurality of heat source units (101). In this way, the minimum required flow rate of each operating heat source unit (101) can be ensured by selectively decreasing the number of operating heat source units (101) or limiting the capacity of the operating heat source unit (101), and it is possible to achieve stable control. In this case, the control unit (150) performs the fourth control when the requested flow rate is larger than the maximum water supply amount. Accordingly, it is possible to avoid the influence on the system load due to the decrease in the number of operating heat source units (101). Further, the control unit (150) performs the third control when the requested flow rate is larger than the maximum water supply amount and the capacity of the operating heat source unit (101) among the plurality of heat source units (101) is lower than a predetermined lower limit value. Accordingly, even if it is difficult to limit the capacity of the operating heat source unit (101), the minimum required flow rate of another operating heat source unit (101) can be ensured by decreasing the number of operating heat source units (101), and it is possible to achieve stable control. Further, the control unit (150) may selectively perform fifth control and sixth control as the third control when the requested flow rate is larger than the maximum water supply amount and the

capacity of the operating heat source unit (101) among the plurality of heat source units (101) is lower than a predetermined lower limit value. In the fifth control, the control unit (150) may select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate. In the sixth control, the control unit (150) may select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate and a change in the requested flow rate is minimum. In this way, when it is difficult to limit the capacity of the operating heat source unit (101), the minimum required flow rate of another operating heat source unit (101) can be ensured by decreasing the number of operating heat source units (101), and it is possible to achieve stable control. In addition, in the sixth control, since the number of operating heat source units (101) is decreased so that the change in the requested flow rate is minimum, the influence on the system load due to the decrease in the number of operating heat source units (101) can be suppressed as small as possible.

(Other Embodiments)

[0099] While an embodiment and modifications have been described, it will be understood that various changes in the form or in the details may be made without departing from the spirit and scope of the claims. In addition, the embodiment and modifications described above may be appropriately combined or replaced. Furthermore, the terms "first", "second", etc. are used to distinguish between elements to which such terms are added, and are not intended to limit the number or order of the elements.

Industrial Applicability

[0100] As described above, the present disclosure is useful for a heat source system.

Reference Signs List

[0101]

100 heat source system
101 heat source unit
102 pump
103 collective pipe
105, 107, 116 pipe
150 control unit

Claims

1. A heat source system comprising:

a plurality of heat source units (101) provided in parallel with each other;
a plurality of pumps (102) provided in parallel with each other;
a collective pipe (103) arranged to collect flow paths between the plurality of heat source units (101) and the plurality of pumps (102) into one; and
a control unit (150) configured to control operation of the plurality of heat source units (101) and the plurality of pumps (102), wherein the control unit (150) is configured to:
determine a requested flow rate, based on at least minimum required flow rates set for the plurality of heat source units (101) and operation states of the plurality of heat source units (101);
determine a current water supply amount or a maximum water supply amount, based on flow rates set for the plurality of pumps (102) and operation states of the plurality of pumps (102); and
make a comparison between the requested flow rate and the current water supply amount or the maximum water supply amount, and control the operation of the plurality of heat source units (101) or the plurality of pumps (102) according to a result of the comparison.

2. The heat source system according to claim 1, wherein at least either the plurality of heat source units (101) or the plurality of pumps (102) are configured to have a plurality of different capacities.
3. The heat source system according to claim 1 or 2, wherein the control unit (150) is configured to increase or decrease the number of operating heat source units (101) among the plurality of heat source units (101) or the number of operating pumps (102) among the plurality of pumps (102).
4. The heat source system according to any one of claims 1 to 3, wherein the control unit (150) is configured to determine the requested flow rate, based on the operation states of the plurality of heat source units (101) and flow rates obtained by multiplying the minimum required flow rates by a coefficient considering a flow rate variation in respective pipes (105) connected to the plurality of heat source units (101).
5. The heat source system according to any one of claims 1 to 4, wherein the control unit (150) is configured to make a comparison between the requested flow rate and the current water supply amount, and, when the requested flow rate is larger, select a pump (102)

whose operation is to be started from among the plurality of pumps (102) so that the current water supply amount satisfies the requested flow rate and a change in the current water supply amount is minimum.

6. The heat source system according to any one of claims 1 to 4, wherein
the control unit (150) is configured to calculate a post-decrease water supply amount from the current water supply amount, based on information on a pump (102) scheduled to stop operation among the plurality of pumps (102), make a comparison between the post-decrease water supply amount and the requested flow rate, and permit or prohibit stopping of operation of the pump (102) according to a result of the comparison.

7. The heat source system according to any one of claims 1 to 4, wherein

at least one of the plurality of pumps (102) is a VFD pump (102), and
the control unit (150) is configured to update a VFD command value for the VFD pump (102) that is operating, based on a difference between the requested flow rate and the current water supply amount.

8. The heat source system according to claim 7, wherein
the control unit (150) is configured to:

determine a VFD command value of the VFD pump (102), based on a difference between a pressure of a pipe (107, 116) connected to the VFD pump (102) and a set value of the pressure;
determine the current water supply amount by multiplying a flow rate set for the VFD pump (102) that is operating by a rotation rate;
make a comparison between the requested flow rate and the current water supply amount, and calculate a lower limit value of the VFD command value so as to compensate for the difference between the requested flow rate and the current water supply amount when the requested flow rate is larger; and
update the VFD command value with the lower limit value when the lower limit value is larger than the VFD command value.

9. The heat source system according to any one of claims 1 to 4, wherein
the control unit (150) is configured to make a comparison between the requested flow rate and the maximum water supply amount, and, when the requested flow rate is larger, select a heat source unit (101) whose operation is to be stopped from among

the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate.

10. The heat source system according to claim 9, wherein
the control unit (150) is configured to:

make a comparison between the requested flow rate and the maximum water supply amount, and selectively perform first control and second control when the requested flow rate is larger; in the first control, select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate; and
in the second control, select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate and a change in the requested flow rate is minimum.

11. The heat source system according to any one of claims 1 to 4, wherein
the control unit (150) is configured to calculate a post-increase requested flow rate from the requested flow rate, based on information on a heat source unit (101) scheduled to start operation among the plurality of heat source units (101), make a comparison between the post-increase requested flow rate and the maximum water supply amount, and permit or prohibit a start of operation of the heat source unit (101) according to a result of the comparison.

12. The heat source system according to any one of claims 1 to 4, wherein
the control unit (150) is configured to make a comparison between the requested flow rate and the maximum water supply amount, and, when the requested flow rate is larger, limit a capacity of an operating heat source unit (101) among the plurality of heat source units (101).

13. The heat source system according to any one of claims 1 to 4, wherein
the control unit (150) is configured to:

make a comparison between the requested flow rate and the maximum water supply amount, and selectively perform third control and fourth control when the requested flow rate is larger; in the third control, select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount sa-

tisfies the requested flow rate; and
 in the fourth control, limit a capacity of an operating heat source unit (101) among the plurality of heat source units (101).

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14. The heat source system according to claim 13, wherein
 the control unit (150) is configured to perform the fourth control when the requested flow rate is larger than the maximum water supply amount.

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15. The heat source system according to claim 13 or 14, wherein
 the control unit (150) is configured to perform the third control when the requested flow rate is larger than the maximum water supply amount and the capacity of the operating heat source unit (101) among the plurality of heat source units (101) is lower than a predetermined lower limit value.

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16. The heat source system according to any one of claims 13 to 15, wherein
 the control unit (150) is configured to:

selectively perform fifth control and sixth control as the third control when the requested flow rate is larger than the maximum water supply amount and the capacity of the operating heat source unit (101) among the plurality of heat source units (101) is lower than a predetermined lower limit value;
 in the fifth control, select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate; and
 in the sixth control, select a heat source unit (101) whose operation is to be stopped from among the plurality of heat source units (101) so that the maximum water supply amount satisfies the requested flow rate and a change in the requested flow rate is minimum.

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FIG. 1

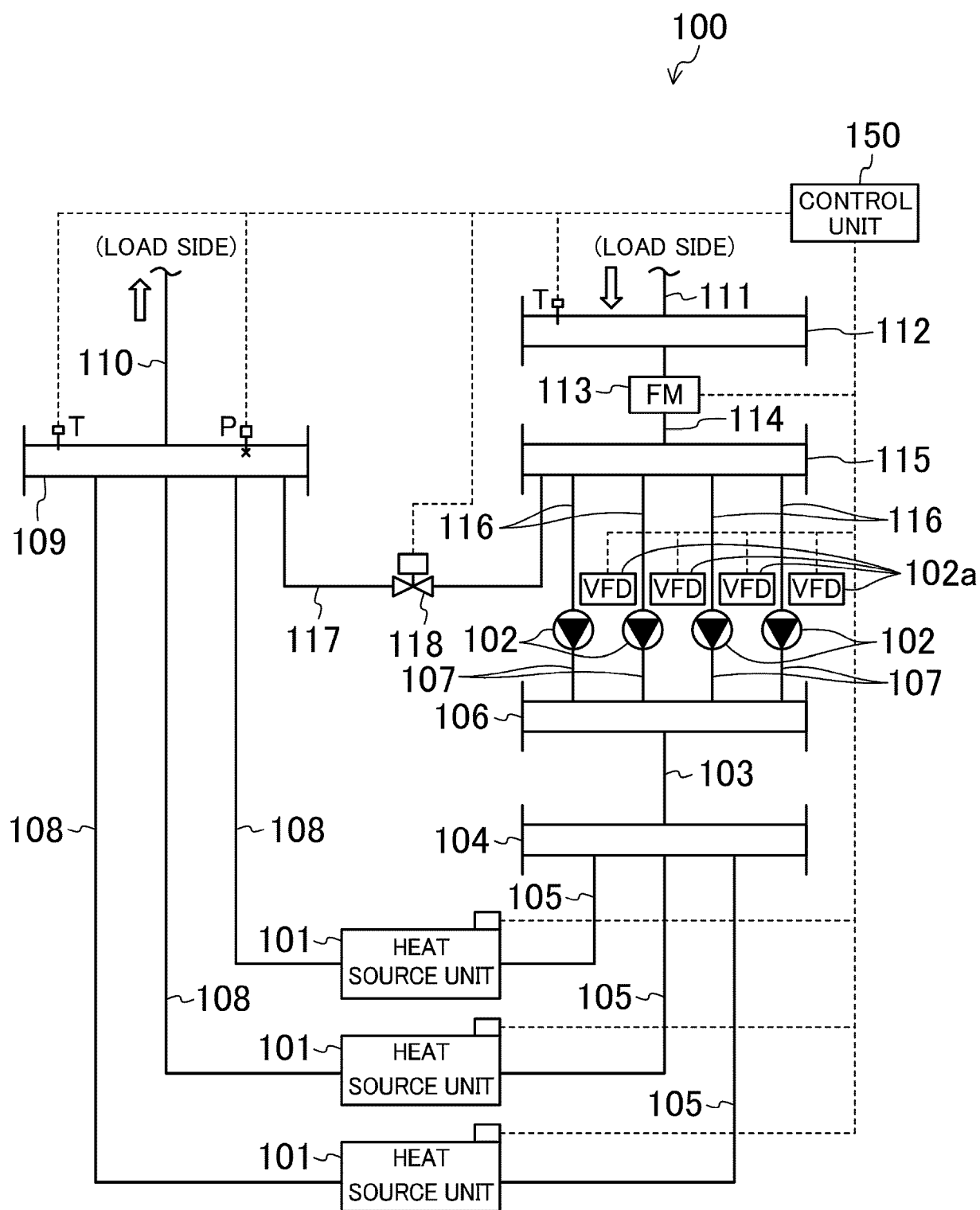


FIG.2

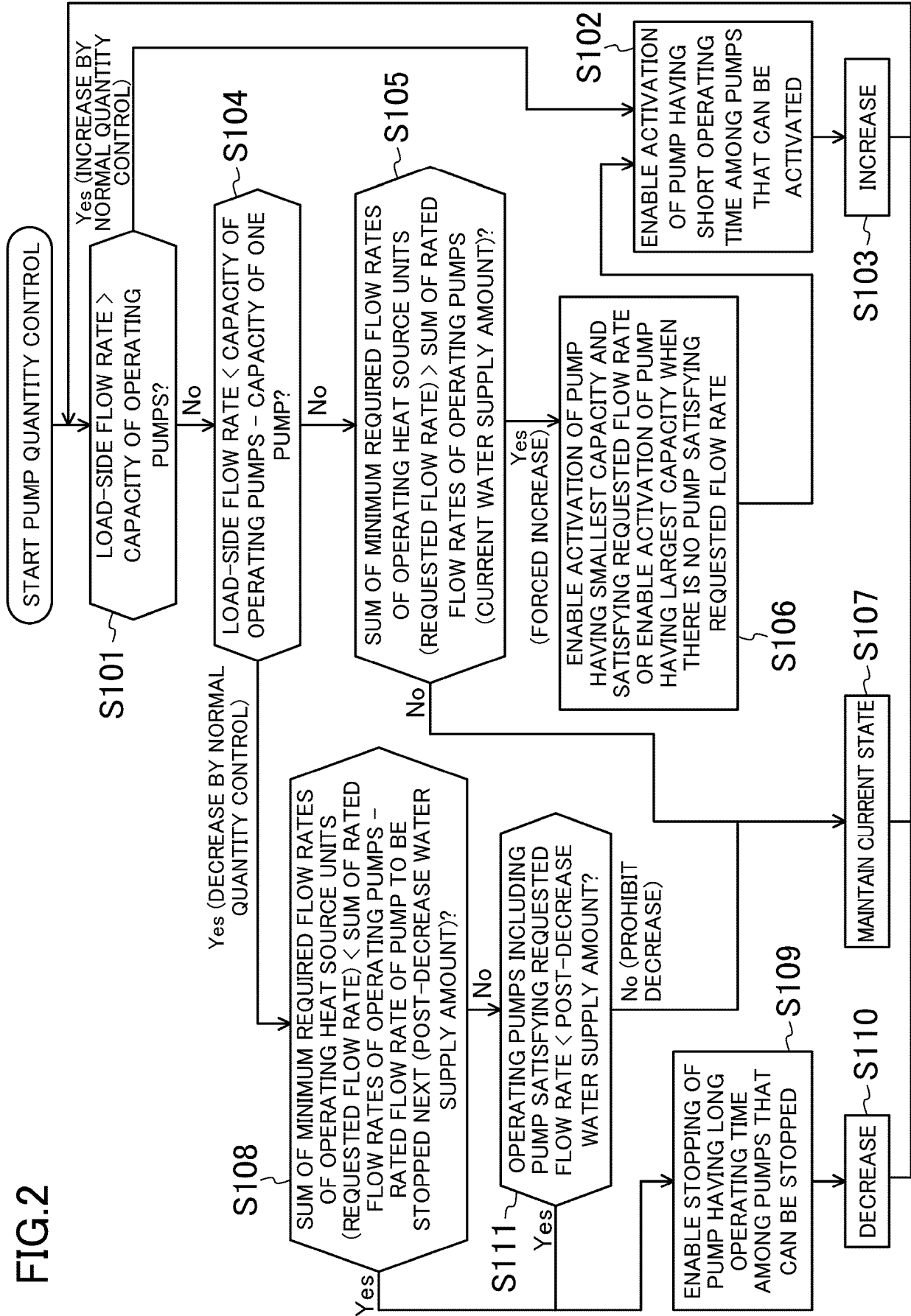


FIG.3

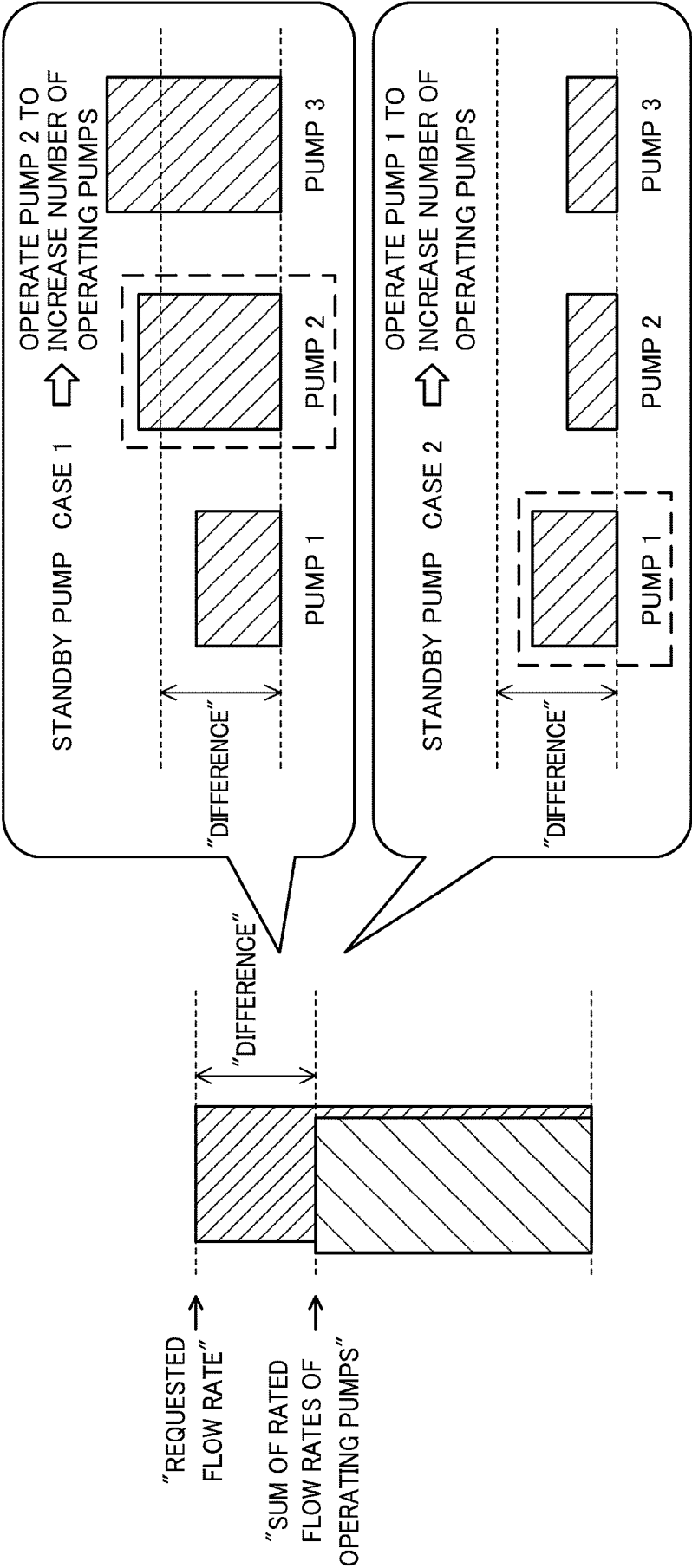


FIG.4

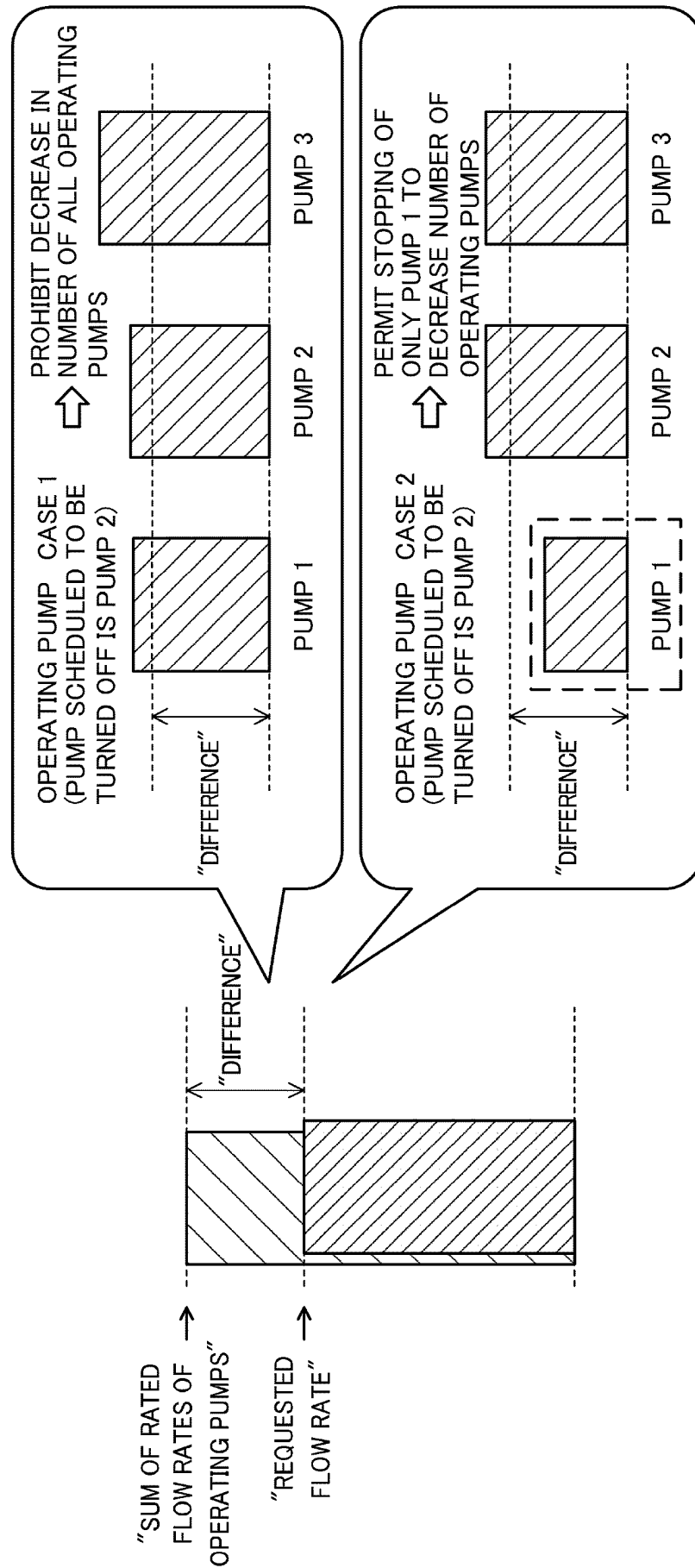


FIG.5

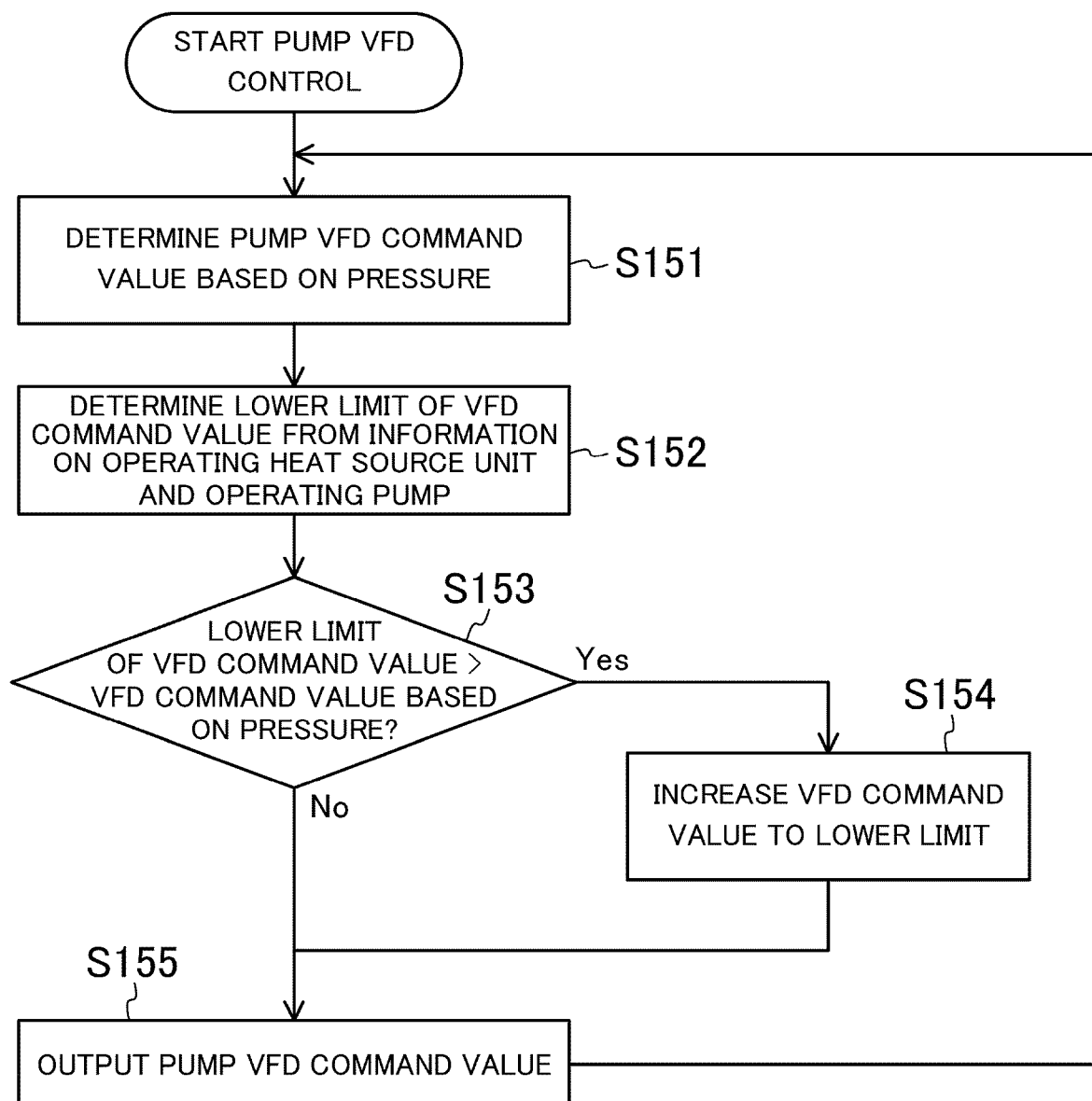


FIG.6

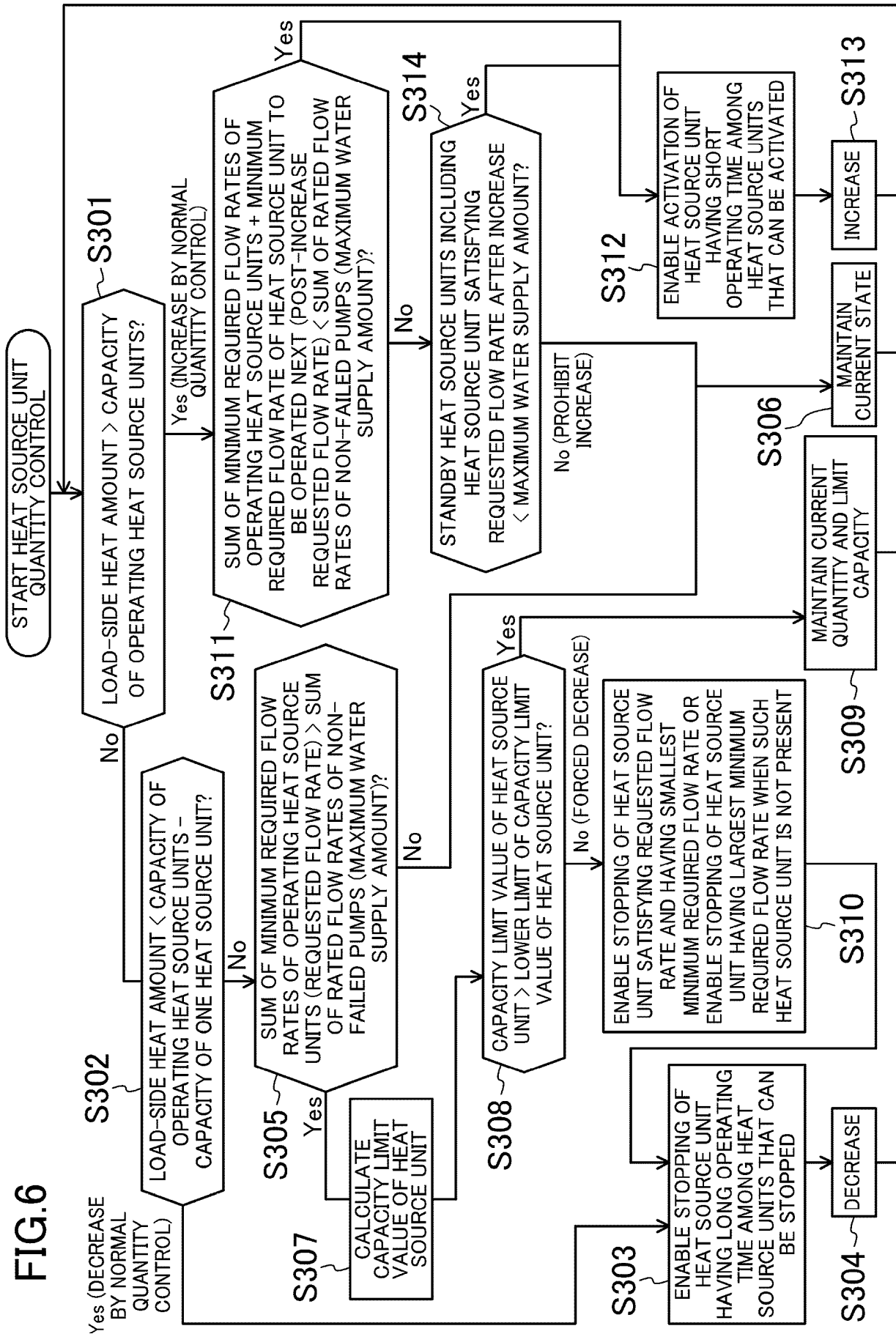


FIG.7

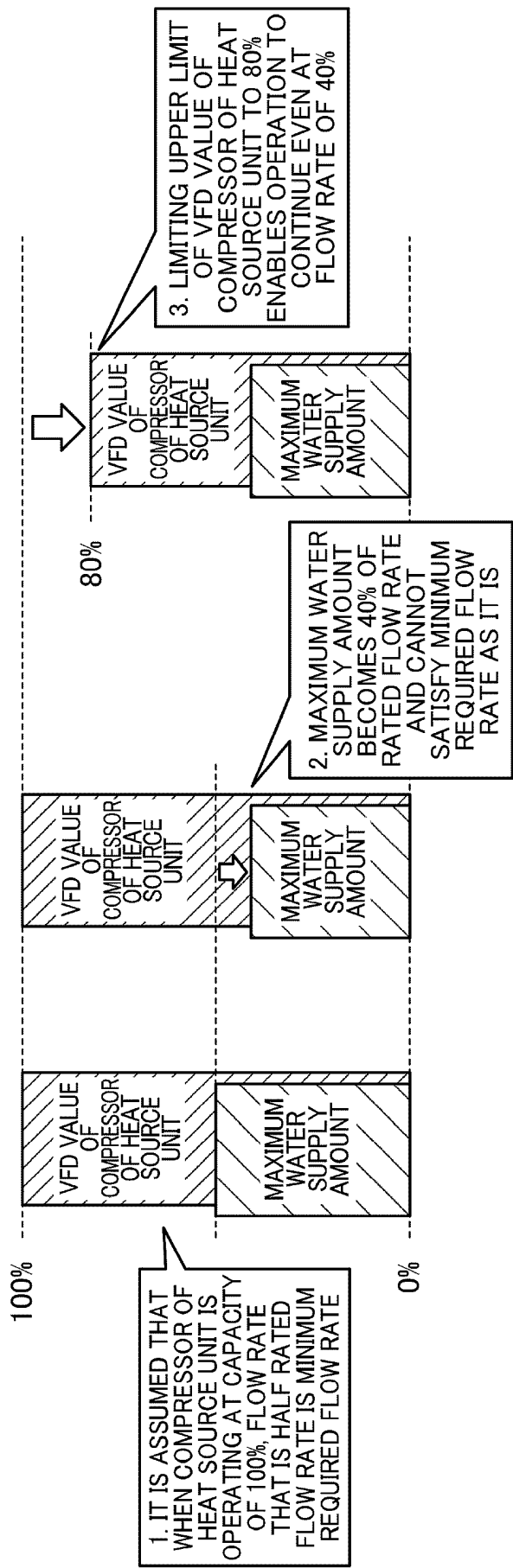


FIG.8

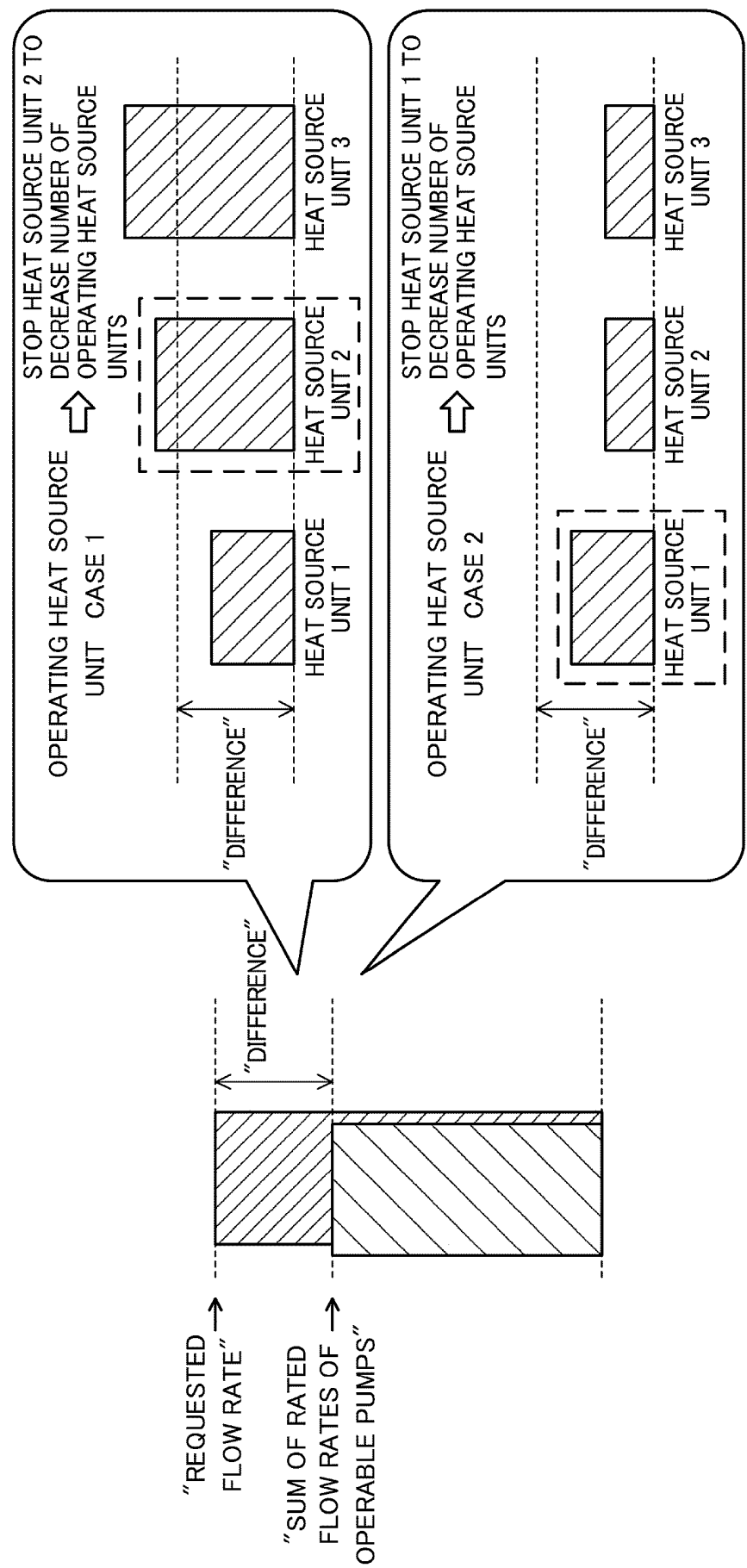
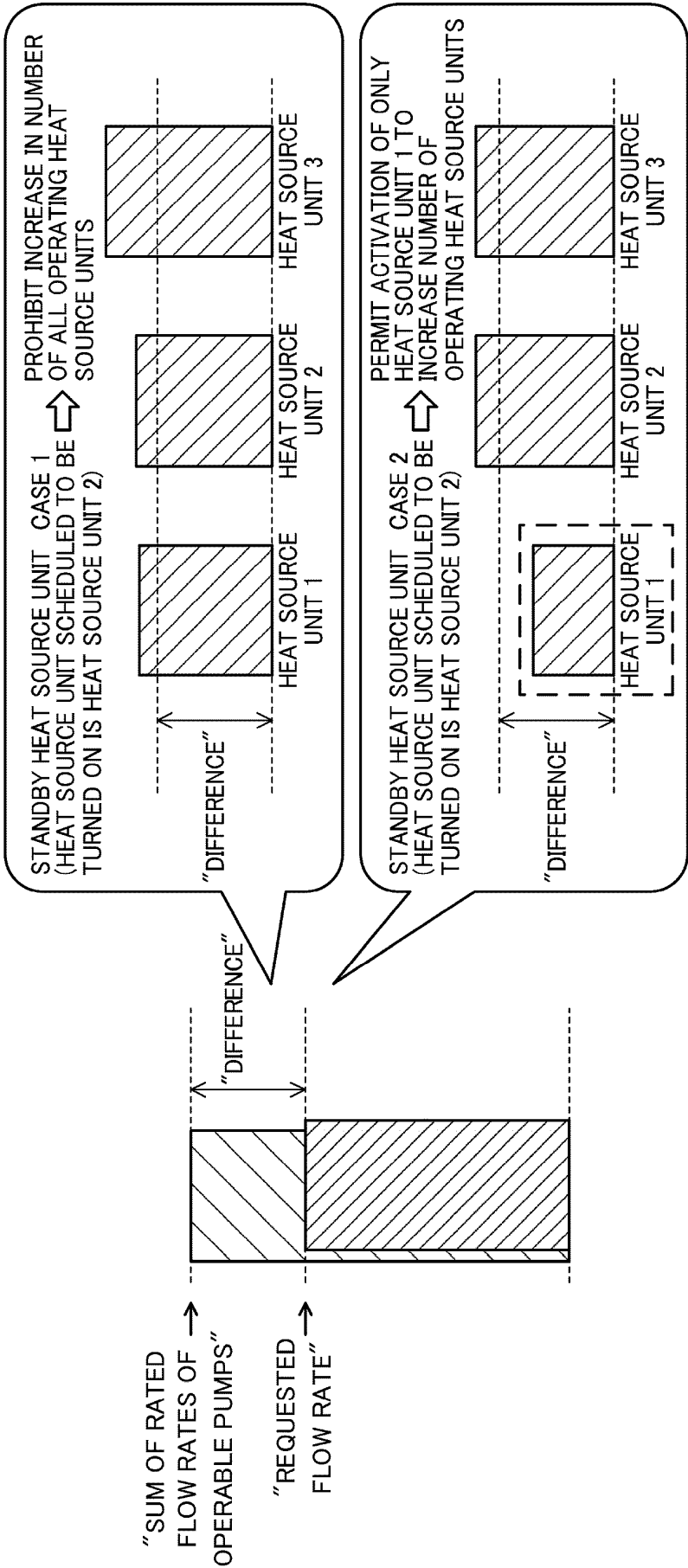


FIG.9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/004129

A. CLASSIFICATION OF SUBJECT MATTER

F24F 5/00(2006.01)i; **F24F 11/49**(2018.01)i; **F24F 11/64**(2018.01)i; **F24F 11/83**(2018.01)i; **F24F 11/85**(2018.01)i;
F24F 140/00(2018.01)n; **F24F 140/12**(2018.01)n
 FI: F24F5/00 101Z; F24F11/83; F24F11/85; F24F11/64; F24F11/49; F24F140/00; F24F140/12

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)

F24F5/00; F24F11/49; F24F11/64; F24F11/83; F24F11/85; F24F140/00; F24F140/12

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

Published examined utility model applications of Japan 1922-1996
 Published unexamined utility model applications of Japan 1971-2023
 Registered utility model specifications of Japan 1996-2023
 Published registered utility model applications of Japan 1994-2023

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	JP 2020-197345 A (DAIKIN IND LTD) 10 December 2020 (2020-12-10) paragraphs [0021]-[0074], fig. 1-8	1-16
Y	JP 2021-017995 A (MITSUBISHI HEAVY IND THERMAL SYSTEMS LTD) 15 February 2021 (2021-02-15) paragraphs [0012]-[0075], fig. 1-6	1-16
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Y	JP 2014-066453 A (DAIKIN IND LTD) 17 April 2014 (2014-04-17) paragraphs [0029]-[0085]	2-16
Y	JP 2014-035090 A (DAIKIN IND LTD) 24 February 2014 (2014-02-24) paragraphs [0088]-[0099]	4-16
Y	JP 2018-036028 A (TOKYO GAS CO LTD) 08 March 2018 (2018-03-08) paragraphs [0014]-[0135]	9-16

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 ☒ See patent family annex.

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Date of the actual completion of the international search

14 April 2023

Date of mailing of the international search report

09 May 2023

Name and mailing address of the ISA/JP

Japan Patent Office (ISA/JP)
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Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2023/004129

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JP 2018-036028 A	08 March 2018	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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