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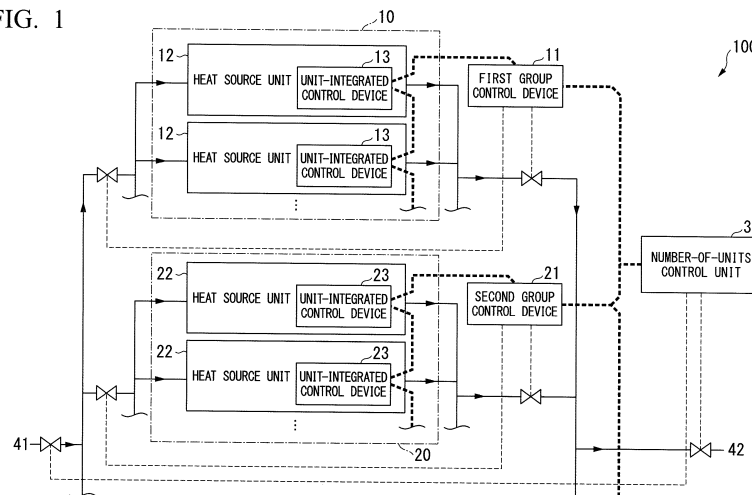
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(54) **HEAT SOURCE CONTROL DEVICE, HEAT SOURCE SYSTEM, AND HEAT SOURCE CONTROL METHOD**

(57) Abstract: In this heat source control device, heat source system, and heat source control method, provided are heat source groups (10, 20), a plurality of group control units (11, 21), and a unit-quantity control unit (30). The group control units (11, 21) have a first operational range output unit and a second operational range output

unit, and when a requested load exceeds a first appropriate operation range, the unit-quantity control unit (30) controls the group control units (11, 21) in a manner such that the startup quantity of the heat source groups (10, 20) is increased and the startup quantity of heat source units (12, 22) becomes a predetermined unit quantity.

FIG. 1



Description

[Technical Field]

[0001] The present invention relates to a heat source control device, a heat source system, and a heat source control method.

[0002] Priority is claimed on Japanese Patent Application No. 2013-228348, filed November 1, 2013, the content of which is incorporated herein by reference.

[Background Art]

[0003] In large buildings, chilled and hot water systems in which a plurality of heat sinks and heat sources are provided in parallel and secondary-side heat load sources such as air conditioners are connected to the heat sinks and heat sources are used. Each of the heat sinks and heat sources includes a chilled and hot water pump circulating chilled and hot water generated by each of the heat sinks and heat sources.

[0004] In such chilled and hot water systems, necessary flow rates of chilled and hot water are changed to handle heat loads according to secondary-side loads. Accordingly, in such chilled and hot water systems, flow rates of chilled and hot water to be supplied to secondary-side heat load sources have to be controlled.

[0005] As such chilled and hot water control methods, there are methods of controlling bypass flow rates of secondary-side heat load sources and controlling the numbers of heat sinks and heat sources. In such a method of controlling the numbers of heat sinks and heat sources, the number of operating heat sinks and heat sources is selected in accordance with schemes considering flow rates, heat amounts, and both of flow rates and heat amounts.

[0006] In this case, chilled and hot water pumps of the used heat sinks and heat sources circulate chilled and hot water by changing flow rates according to loads.

[0007] As technologies related to such a background, various technologies are known (for example, see Patent Literature 1).

[0008] For example, Patent Literature 1 discloses a heat sink and heat source output distribution control method of a chilled and hot water system that includes a plurality of heat sinks and heat sources disposed in parallel, chilled and hot water pumps included in the heat sinks and heat sources, and a secondary-side heat load source connected to the plurality of heat sinks and heat sources. More specifically, in the heat sink and heat source output distribution control method, the number of heat sinks and heat sources to be used is selected according to heat loads of secondary-side heat sources. In the heat sink and heat source output distribution control method, when a plurality of heat sinks and heat sources are used, the heat sinks and heat sources to be used are divided into two groups which each have one heat sink and one heat source or a plurality of heat sinks and heat

sources, and a ratio of a flow rate of chilled and hot water of the heat sinks and heat sources of both groups to a flow rate of chilled and hot water supplied to the secondary-side heat load source is changed so that a sum system COP of the two groups of the heat sinks and heat sources is the maximum. The flow rate is changed in a direction in which a ratio of one group increases in accordance with a predetermined period and the system COP is calculated. When the system COP increases more than the system COP before the change, the flow rate is changed in the same direction. When the system COP decreases, the flow rate is changed in the opposite direction. In this way, according to the heat sink and heat source output distribution control method, the heat sinks and heat sources work with the maximum efficiency from the viewpoint of the entire system, and thus power consumption can be reduced.

[Citation List]

[Patent Literature]

[0009] [Patent Literature 1]
Japanese Patent No. 4435651

[Summary of Invention]

[Technical Problem]

[0010] In the invention described in Patent Literature 1, when the numbers of heat sinks and heat sources increase, a control period may increase, and thus there is a possibility that a load state to be handled is changed. Therefore, in the invention described in Patent Literature 1, search results may not always be optimum.

[0011] In the invention described in Patent Literature 1, when group control is performed and the same function of a number-of-units control function mounted on a high-order control device is mounted, a load range that can be handled with one group becomes broader than a load range that can be handled with one unit. Therefore, in the invention described in Patent Literature 1, for example, when ten units are operating in an operating group and another group is newly activated in this state, sudden changes in control may be performed in such a manner that the number of operating units of the operating group is changed from 10 to 5 and the number of operating units of the newly activated group is changed from 0 to 5. Therefore, control may not be performed to prevent the number of operating units connected to the group from changing suddenly.

[Solution to Problem]

[0012] According to a first aspect of the present invention, there is provided a heat source control device including: a plurality of group control units configured to perform start/stop and load allocation of a plurality of heat

source units corresponding to heat source groups of the plurality of heat source units; and a number-of-units control unit configured to perform start/stop and load allocation of the heat source groups. The group control unit includes a first operating-range output unit configured to output a load range in which one of characteristic values of the heat source units corresponding to the number of operating heat source units is within a predetermined range as a first proper operating range to the number-of-units control unit based on the characteristic values of the heat source units, and a second operating-range output unit configured to output a load range in which another of the characteristic values is in the predetermined range as a second proper operating range to the number-of-units control unit. The number-of-units control unit increases the number of activated heat source groups when a requested load exceeds the first proper operating range.

[0013] According to a second aspect of the present invention, in the heat source control device according to the first aspect, the first operating-range output unit may use COP information indicating a relation between a coefficient of performance and a load ratio as the characteristic value and output a load range in which one of the characteristic values corresponding to the number of operating heat source units is equal to or greater than a predetermined value as the first proper operating range to the number-of-units control unit. The second operating-range output unit may output a load range in which another of the characteristic values is equal to or greater than the predetermined value as the second proper operating range to the number-of-units control unit.

[0014] According to a third aspect of the present invention, in the heat source control device according to the first aspect, the first operating-range output unit may use inverter input information as the characteristic value and output a load range in which one of the characteristic values corresponding to the number of operating heat source units is equal to or less than a predetermined value as the first proper operating range to the number-of-units control unit. The second operating-range output unit may output a load range in which another of the characteristic values is equal to or less than the predetermined value as the second proper operating range to the number-of-units control unit.

[0015] According to a fourth aspect of the present invention, in the heat source control device according to any one of the first to third aspects, the group control unit may set, as transmission data from the group control unit, an optimum load range corresponding to the number of operating heat source units among the connected heat source units and an operatable load range corresponding to $1 +$ the number of operating heat source units.

[0016] According to a fifth aspect of the present invention, in the heat source control device according to any one of the first to fourth aspects, when load distribution to the heat source groups from the number-of-units control unit is greater than the operatable load range for the

number of operating heat source units, the number of operating heat source units in the heat source group may be increased and the optimum load range and the operatable load range may be updated.

[0017] According to a sixth aspect of the present invention, in the heat source control device according to any one of the first to fifth aspects, when load distribution to the heat source groups from the number-of-units control unit is less than the operatable load range for the number of operating heat source units, the number of operating heat source units in the heat source group may be decreased and the optimum load range and the operatable load range may be updated.

[0018] According to a seventh aspect of the present invention, there is provided a heat source system including: the heat source control device according to any one of the first to sixth aspects; and heat source groups of the plurality of heat source units.

[0019] According to an eighth aspect of the present invention, there is provided a heat source control method including: a plurality of group control steps of performing start/stop and load allocation of a plurality of heat source units corresponding to heat source groups of the plurality of heat source units; and a number-of-units control step of performing start/stop and load allocation of the heat source groups. The group control step includes a first operating-range output step of outputting a load range in which one of characteristic values of the heat source units corresponding to the number of operating heat source units is within a predetermined range as a first proper operating range in the number-of-units control step based on the characteristic values of the heat source units, and a second operating-range output step of outputting a load range in which another of the characteristic values is in the predetermined range as a second proper operating range in the number-of-units control step. In the number-of-units control step, the number of activated heat source groups is increased when a requested load exceeds the first proper operating range.

[0020] In the overview of the first to eighth aspects of the present invention, not all of the characteristics necessary in the present invention are listed. Sub-combinations of such characteristic groups can also be aspects of the present invention.

[Advantageous Effects of Invention]

[0021] According to the heat source control device, the heat source system, and the heat source control method described above, it is possible to control the number of operating heat source units included in the plurality of heat source groups without sudden changes.

[Brief Description of Drawings]

[0022]

Fig. 1 is a diagram illustrating an example of the sys-

tem configuration of a heat source system 100 according to a first embodiment.

Fig. 2 is a block diagram illustrating the configurations of group control devices 11 and 21.

Fig. 3 is a diagram illustrating COP characteristics applied to the heat source system 100.

Fig. 4 is a diagram illustrating power consumption amount characteristics applied to the heat source system 100.

Fig. 5 is a flowchart for describing a basic control operation of the heat source system 100.

Fig. 6 is a flowchart for describing a specific control operation of the heat source system 100.

Fig. 7 is a flowchart for describing the specific control operation of the heat source system 100.

Fig. 8 is a flowchart for describing a basic control operation of a heat source system 100 according to a second embodiment.

Fig. 9 is a flowchart for describing a basic control operation of a heat source system 100 according to a third embodiment.

[Description of Embodiments]

[0023] Hereinafter, the present invention will be described according to embodiments of the invention. However, the following embodiments do not limit the invention within the scope of the claims, and not all of the combinations of the characteristics described in the embodiments are requisites for the solution of the invention.

[0024] Fig. 1 is a diagram illustrating an example of the system configuration of a heat source system 100 according to a first embodiment. Here, the heat source system 100 is a system that controls a plurality of heat sources.

[0025] The heat source system 100 includes a first heat source group 10, a first group control device 11, a second heat source group 20, a second group control device 21, and a number-of-units control device 30.

[0026] The first heat source group 10 includes a plurality of heat source units 12. Here, the heat source unit 12 is a unit that includes a heat source device and a unit-integrated control device 13. An input side of each heat source unit 12 is connected to communicate with a water inlet 41 and an output side thereof is connected to communicate with a water outlet 42. The output side of each heat source unit 12 is connected to the first group control device 11 and the number-of-units control device 30.

[0027] When the first group control device 11 controls the heat source units 12, the first group control device 11 receives necessary data from the unit-integrated control device 13 and transmits control data to the unit-integrated control device 13. Then, the first group control device 11 performs start/stop and load allocation of each heat source unit 12.

[0028] The second heat source group 20 is connected to the first heat source group 10 in parallel and includes a plurality of heat source units 22. Here, the heat source

unit 22 is a unit that includes a heat source device and a unit-integrated control device 23. An input side of each heat source unit 22 is connected to communicate with the water inlet 41 and an output side thereof is connected to communicate with the water outlet 42. The output side of each heat source unit 22 is connected to the second group control device 21 and the number-of-units control device 30. When the second group control device 21 controls the heat source units 22, the second group control device 21 receives necessary data from the unit-integrated control device 23 and transmits control data to the unit-integrated control device 23. Here, the data received from the unit-integrated control device 23 also includes COP information indicating a relation between a coefficient of performance and a load ratio of the heat source units 12 and 22.

[0029] The first group control device 11 performs start/stop and load allocation of each heat source unit 22.

[0030] The number-of-units control device 30 performs start/stop and load allocation of the first heat source group 10 and the second heat source group 20. From the viewpoint of the number-of-units control device 30, the first heat source group 10 and the second heat source group 20 are each treated like a large-capacity chiller.

[0031] Fig. 2 is a block diagram illustrating the configurations of the group control devices 11 and 21. As illustrated in Fig. 2, the group control devices 11 and 21 respectively include first operating-range output units 14 and 24 that output a load range in which a coefficient of performance corresponding to the number of operating heat source units 12 and 22 is equal to or greater than a predetermined value as a first proper operating range to the number-of-units control device 30 based on the COP information which is a characteristic value indicating the relation between the coefficient of performance and the load ratio of the heat source units 12 and 22.

[0032] The group control devices 11 and 21 respectively include second operating-range output units 15 and 25 that output a load range in which a coefficient of performance corresponding to the predetermined number of units greater than the operating heat source units 12 and 22 is equal to or greater than a predetermined value as a second proper operating range to the number-of-units control device 30 based on the COP information.

[0033] The number-of-units control device 30 increases the number of activated units of each of the heat source groups 10 and 20 when a requested load exceeds the first proper operating range.

[0034] The heat source system 100 sets an optimum load range corresponding to the number of operating units among the heat source units 12 and 22 respectively connected to the group control devices 11 and 21 and an operable load range corresponding to 1 + the number of operating units as data to be transmitted from the group control devices 11 and 21 to the number-of-units control device 30.

[0035] Specifically, for example, when ten heat source units 12 are connected to the first group control device

11 and one heat source unit is operating, an optimum load range for one unit and an operatable load range for two units are set as an optimum load range and an operatable load range of the whole group.

[0036] When all of the units stop among the heat source units 12 and 22 respectively connected to the group control devices 11 and 21, the heat source system 100 sets an optimum load range and an operatable load range for one unit as data to be transmitted from the group control devices 11 and 21 to the number-of-units control device 30.

[0037] When the operating heat source units are in the heat source groups 10 and 20, the number-of-units control device 30 sets optimum load ranges and operatable load ranges of both of the heat source groups 10 and 20 using the following Expressions (1) to (12).

[0038] In Expressions (1) to (6), L_{oh_gi} and L_{ol_gi} are a Hi-side and a Lo-side of the optimum load range of each of the heat source groups 10 and 20, L_{h_gi} and L_{l_gi} are a Hi-side and a Lo-side of the operatable load range, and L_{oph_gi} and L_{opl_gi} are a Hi-side and a Lo-side of the operatable load range of the operating unit (where $i = 1$ to 20). Further, L_{oh_gkui} and L_{ol_gkui} are a Hi-side and a Lo-side of the optimum load range of each of the heat source units 12 and 22, L_{h_gkui} and L_{l_gkui} are a Hi-side and a Lo-side of the operatable load range (where $k = 1$ to 6 and $i = 1$ to 20), and m is the number of operating units.

[Expression 1]

$$L_{oh_gi} = \sum_{k=1}^m L_{oh_gkui}$$

[Expression 2]

$$L_{ol_gi} = \sum_{k=1}^m L_{ol_gkui}$$

[Expression 3]

$$L_{h_gi} = \sum_{k=1}^{m+1} L_{h_gkui}$$

[Expression 4]

$$L_{l_gi} = \sum_{k=1}^m L_{l_gkui}$$

[Expression 5]

$$L_{oph_gi} = \sum_{k=1}^m L_{h_gkui}$$

[Expression 6]

$$L_{opl_gi} = \sum_{k=1}^m L_{l_gkui}$$

[0039] In Expressions (7) to (12), L_{oh_gi} and L_{ol_gi} are a Hi-side and a Lo-side of the optimum load range of each of the heat source groups 10 and 20, and L_{h_gi} and L_{l_gi} are a Hi-side and a Lo-side of the operatable load range (where $i = 1$ to 20). Further, L_{oh_gkui} and L_{ol_gkui} are a Hi-side and a Lo-side of the optimum load range of each of the heat source units 12 and 22, L_{h_gkui} and L_{l_gkui} are a Hi-side and a Lo-side of the operatable load range (where $k = 1$ to 6 and $i = 1$ to 20), and the number of operating units is 0.

[Expression 7]

$$L_{oh_gi} = \sum_{k=1}^m L_{oh_gkui}$$

[Expression 8]

$$L_{ol_gi} = \sum_{k=1}^m L_{ol_gkui}$$

[Expression 9]

$$L_{h_gi} = \sum_{k=1}^{m+1} L_{h_giuk}$$

[Expression 10]

$$L_{l_gi} = \sum_{k=1}^m L_{l_giuk}$$

[Expression 11]

$$L_{oph_gi} = \sum_{k=1}^m L_{h_giuk}$$

[Expression 12]

$$L_{opl_gi} = \sum_{k=1}^m L_{l_giuk}$$

[0040] Fig. 3 is a diagram illustrating COP characteristics applied to the heat source system 100. Information regarding the COP characteristics indicates a relation between the coefficient of performance and a load ratio of each of the heat source units 12 and 22 and includes data received from the unit-integrated control device 23. In Fig. 3, the horizontal axis represents a chiller output capacity and the vertical axis represents a COP value. As illustrated in Fig. 3, in the COP characteristics, the COP has a parabolic shape according to an increase in the chiller output capacity when outside air temperature is, for example, 15°C, 25°C, and 32°C. At this time, the proper operating range is a load range equal to or greater than a predetermined value.

[0041] Fig. 4 is a diagram illustrating power consumption amount characteristics applied to the heat source system 100. In Fig. 4, the horizontal axis represents a chiller output capacity and the vertical axis represents an inverter input. As illustrated in Fig. 4, in power consumption amount characteristics, power consumption increases directly proportionally with an increase in the chiller output capacity when an outside air temperature is, for example, 15°C, 25°C, and 32°C. At this time, the proper operating range is a load range equal to or less than a predetermined value.

[0042] Fig. 5 is a flowchart for describing a basic control operation of the heat source system 100. As illustrated in Fig. 5, when the control starts, the number-of-units control device 30 first determines whether the operating heat source unit is in either of the heat source groups 10 and 20 (S101).

[0043] When the operating unit is in either of the heat source groups 10 and 20, the number-of-units control device 30 decides the optimum load range and the operable load range of both of the heat source groups 10 and 20 according to the above-described Expressions (1) to (6) (S102).

[0044] When the operating unit is not present in either of the heat source groups 10 and 20, the number-of-units control device 30 decides the optimum load range and the operable load range of both of the heat source groups 10 and 20 according to the above-described Expressions (7) to (12) (S103).

[0045] Figs. 6 and 7 are flowchart for describing a specific control operation of the heat source system 100. Fig. 6 illustrates a case in which the first heat source group 10 works first. As illustrated in Fig. 6, when the control starts, the number-of-units control device 30 first starts operating and issues a group operating instruction (S111). The group operating instruction is transmitted to the first group control device 11, and thus the first group control device 11 starts operating (S112).

[0046] The first group control device 11 transmits the optimum load range and the operable load range calculated from Expressions (1) to (6) to the number-of-units control device 30 (S113). The optimum load range and the operable load range are periodically transmitted to the number-of-units control device 30.

[0047] At this time, the second group control device 21 transmits the optimum load range and the operable load range calculated according to Expressions (7) to (12) to the number-of-units control device 30 (S114). The optimum load range and the operable load range are periodically transmitted to the number-of-units control device 30.

[0048] The number-of-units control device 30 determines whether a request load is greater than the optimum load range during the operating (S115). The second group control device 21 starts operating when the number-of-units control device 30 determines that the request load is greater than the optimum load range during the operating (S116).

[0049] Thereafter, the first group control device 11 periodically transmits the optimum load range and the operable load range calculated according to Expressions (1) to (6) to the number-of-units control device 30 (S117).

[0050] The second group control device 21 periodically transmits the optimum load range and the operable load range calculated according to Expressions (1) to (6) (S118).

[0051] Next, the number-of-units control device 30 transmits load allocation to the first group control device 11 and the second group control device 21. The first

group control device 11 determines whether the allocated load is greater than a load range that can be handled with the number of operating units (S119). When the first group control device 11 determines that the load allocated by the number-of-units control device 30 is greater than the load range that can be handled with the number of operating units, the first group control device 11 increases the number of operating units in the heat source group (S120). Conversely, when the first group control device 11 determines that the load allocated by the number-of-units control device 30 is not greater than the load range that can be handled with the number of operating units, the first group control device 11 does not change the number of operating units.

[0052] The second group control device 21 determines whether the allocated load is greater than the load range that can be handled with the number of operating units (S121). When the second group control device 21 determines that the load allocated by the number-of-units control device 30 is greater than the load range that can be handled with the number of operating units, the second group control device 21 increases the number of operating units in the heat source group (S122). Conversely, when the load allocated by the number-of-units control device 30 is not greater than the load range that can be handled with the number of operating units, the second group control device 21 does not change the number of operating units.

[0053] Subsequently, the first group control device 11 determines whether the allocated load is less than the load range that can be handled with the number of operating units (S123). When the first group control device 11 determines that the load allocated by the number-of-units control device 30 is less than the load range that can be handled with the number of operating units, the first group control device 11 decreases the number of operating units in the heat source group (S124). Conversely, when the load allocated by the number-of-units control device 30 is not less than the load range that can be handled with the number of operating units, the first group control device 11 does not change the number of operating units.

[0054] The second group control device 21 determines whether the allocated load is less than the load range that can be handled with the number of operating units (S125). When the second group control device 21 determines that the load allocated by the number-of-units control device 30 is less than the load range that can be handled with the number of operating units, the second group control device 21 decreases the number of operating units in the heat source group (S126). When the second group control device 21 determines that the load allocated by the number-of-units control device 30 is not less than the load range that can be handled with the number of operating units, the second group control device 21 does not change the number of operating units.

[0055] The number-of-units control device 30 determines whether the requested load is less than the opti-

mum load range during the operating (S127). When the number-of-units control device 30 determines that the requested load is less than the optimum load range during the operating, a stop instruction is issued to the first group control device 11, and thus the operating of the first group control device 11 ends (S128). At this time, when the operating group is only one first heat source group 10, the stop instruction is not issued.

[0056] When the number-of-units control device 30 determines that the requested load is not less than the optimum load range during the operating, the number-of-units control device 30 determines whether only the second heat source group 20 is operating (S129). When the number-of-units control device 30 determines that only the second heat source group 20 is operating, the process proceeds to (S 145) illustrated in Fig. 7. When the number-of-units control device 30 determines that only the second heat source group 20 is not operating, the number-of-units control device 30 determines whether only the first heat source group 10 is operating (S130). When the number-of-units control device 30 determines that only the first heat source group 10 is operating, the process proceeds to (S 115). When the number-of-units control device 30 determines that only the first heat source group 10 is not operating, the process proceeds to (S117) to repeat the routine.

[0057] Fig. 7 illustrates a case in which the second heat source group 20 works first. As illustrated in Fig. 7, when the control starts, the number-of-units control device 30 first starts operating and issues a group operating instruction (S141). The group operating instruction is transmitted to the second group control device 21, and thus the second group control device 21 starts operating (S142).

[0058] The second group control device 21 transmits the optimum load range and the operatable load range calculated from Expressions (1) to (6) to the number-of-units control device 30 (S143). The optimum load range and the operatable load range are periodically transmitted to the number-of-units control device 30.

[0059] At this time, the first group control device 11 transmits the optimum load range and the operatable load range calculated according to Expressions (7) to (12) to the number-of-units control device 30 (S144). The optimum load range and the operatable load range are periodically transmitted to the number-of-units control device 30.

[0060] The number-of-units control device 30 determines whether a request load is greater than the optimum load range during the operating (S145). The first group control device 11 starts operating when the number-of-units control device 30 determines that the request load is greater than the optimum load range during the operating (S146).

[0061] Thereafter, the first group control device 11 periodically transmits the optimum load range and the operatable load range calculated according to Expressions (1) to (6) to the number-of-units control device 30 (S147).

[0062] The second group control device 21 periodically

transmits the optimum load range and the operatable load range calculated according to Expressions (1) to (6) (S148).

[0063] Next, the number-of-units control device 30 transmits load allocation to the first group control device 11 and the second group control device 21. The first group control device 11 determines whether the allocated load is greater than a load range that can be handled with the number of operating units (S149). When the first group control device 11 determines that the load allocated by the number-of-units control device 30 is greater than the load range that can be handled with the number of operating units, the first group control device 11 increases the number of operating units in the heat source group (S150). Conversely, when the first group control device 11 determines that the load allocated by the number-of-units control device 30 is not greater than the load range that can be handled with the number of operating units, the first group control device 11 does not change the number of operating units.

[0064] The second group control device 21 determines whether the allocated load is greater than the load range that can be handled with the number of operating units (S151). When the second group control device 21 determines that the load allocated by the number-of-units control device 30 is greater than the load range that can be handled with the number of operating units, the second group control device 21 increases the number of operating units in the heat source group (S152). Conversely, when the second group control device 21 determines that the load allocated by the number-of-units control device 30 is not greater than the load range that can be handled with the number of operating units, the second group control device 21 does not change the number of operating units.

[0065] Subsequently, the first group control device 11 determines whether the allocated load is less than the load range that can be handled with the number of operating units (S153). When the first group control device 11 determines that the load allocated by the number-of-units control device 30 is less than the load range that can be handled with the number of operating units, the first group control device 11 decreases the number of operating units in the heat source group (S154). Conversely, when the first group control device 11 determines that the load allocated by the number-of-units control device 30 is not less than the load range that can be handled with the number of operating units, the first group control device 11 does not change the number of operating units.

[0066] The second group control device 21 determines whether the allocated load is less than the load range that can be handled with the number of operating units (S155). When the second group control device 21 determines that the load allocated by the number-of-units control device 30 is less than the load range that can be handled with the number of operating units, the second group control device 21 decreases the number of oper-

ating units in the heat source group (S156). When the second group control device 21 determines that the load allocated by the number-of-units control device 30 is not less than the load range that can be handled with the number of operating units, the second group control device 21 does not change the number of operating units.

[0067] The number-of-units control device 30 determines whether the requested load is less than the optimum load range during the operating (S157). When the number-of-units control device 30 determines that the requested load is less than the optimum load range during the operating, a stop instruction is issued to the second group control device 21, and thus the operating of the second group control device 21 ends (S158). At this time, when the number-of-units control device 30 determines that the operating group is only one second heat source group 20, the stop instruction is not issued.

[0068] When the number-of-units control device 30 determines that the requested load is not less than the optimum load range during the operating, the number-of-units control device 30 determines whether only the first heat source group 10 is operating (S159). When the number-of-units control device 30 determines that only the first heat source group 10 is operating, the process proceeds to (S115) illustrated in Fig. 6. When the number-of-units control device 30 determines that only the first heat source group 10 is not operating, the number-of-units control device 30 determines whether only the second heat source group 20 is operating (S160). When the number-of-units control device 30 determines that only the second heat source group 20 is operating, the process proceeds to (S145). When the number-of-units control device 30 determines that only the second heat source group 20 is not operating, the process proceeds to (S147) to repeat the routine.

[0069] As described above, the heat source system 100 according to the embodiment first performs the process of increasing the number of heat source groups when the load departs from the optimum load range. Accordingly, in the heat source system 100, when only one heat source unit is operating between the heat source units 12 and 22 connected to the heat source groups 10 and 20, the number of operating target heat source groups can first be increased. Therefore, even when the load can be equally distributed to the heat source groups 10 and 20, control can be performed such that the number of operating heat source units 12 and 22 connected to the heat source groups 10 and 20 is not changed suddenly.

[0070] In the heat source system 100 according to the embodiment, the control of the number of units and the load distribution in the plurality of heat source groups 10 and 20 can be performed without considerable change in the number of operating heat source units 12 and 22 connected to the heat source groups 10 and 20. Further, the optimum operating state in which the power consumption is small can be kept as the operating state of the heat source units 12 and 22.

[0071] Next, a second embodiment will be described with reference to Fig. 8. The same reference numerals are given to the same portions as those of the first embodiment. The description thereof will be omitted and only differences will be described. Fig. 8 is a flowchart for describing a basic control operation of a heat source system 100 according to a second embodiment.

[0072] When the load distribution to the heat source groups 10 and 20 from the number-of-units control device 30 is greater than an operatable load range of the number of operating heat source units, the heat source system 100 increases the number of operating heat source units in the heat source groups 10 and 20 and updates the optimum load range and the operatable load range. Specifically, in the heat source system 100, for example, when ten heat source units 12 are connected to the first group control device 11 (the load range that can be handled with the whole heat source group is assumed to be 100%) and the load distribution from the number-of-units control device 30 is greater than 10% in the case of an operating state of one unit (the operatable load range corresponding to the operating state is 10%), the number of operating units is updated from one to two and the optimum load range for two heat source units and the operatable load range for three heat source units are assumed to be the optimum load range and the operatable load range of the whole heat source group.

[0073] As illustrated in Fig. 8, when control starts, the first group control device 11 and the second group control device 21 determine whether the load distribution is greater than a Hi-side of an operatable load range of the operating heat source units (S201).

[0074] When the load distribution is greater than the Hi-side of the operatable load range of the operating heat source units, the first group control device 11 and the second group control device 21 increase the number of operating heat source units and update the optimum load range and the operatable load range of both of the heat source groups 10 and 20.

[0075] At this time, when the load distribution is not greater than the Hi-side of the operatable load range of the operating heat source units, the first group control device 11 and the second group control device 21 end the process.

[0076] The heat source system 100 according to the embodiment can automatically increase the number of operating heat source units of the heat source groups 10 and 20 by increasing the load allocation once all the subordinate heat source groups 10 and 20 are in an operating state of one heat source unit from the viewpoint of the number-of-units control device 30.

[0077] Next, a third embodiment will be described with reference to Fig. 9. The same reference numerals are given to the same portions as those of the first embodiment. The description thereof will be omitted and only differences will be described. Fig. 9 is a flowchart for describing a basic control operation of a heat source system 100 according to a third embodiment.

[0078] When the load distribution to the heat source groups from the number-of-units control device 30 is less than an operatable load range of the number of operating heat source units, the heat source system 100 decreases the number of operating heat source units in the heat source groups 10 and 20 and updates the optimum load range and the operatable load range. Specifically, for example, when ten heat source units are connected to the group control devices 11 and 21 (the load range that can be handled with both of the heat source groups is assumed to be 100%) and the load distribution from the number-of-units control device 30 is less than 20% in the case of an operating state of two units (the operatable load range corresponding to the operating state is 20%), the number of operating units is updated from two to one and the optimum load range for one heat source unit and the operatable load range for two heat source units are assumed to be the optimum load range and the operatable load range of both of the heat source groups.

[0079] As illustrated in Fig. 9, when control starts, the first group control device 11 and the second group control device 21 determine whether the load distribution is less than a Lo-side of an operatable load range of the operating heat source units (S301).

[0080] When the load distribution is less than the Lo-side of the operatable load range of the operating heat source units, the first group control device 11 and the second group control device 21 decrease the number of operating heat source units and update the optimum load range and the operatable load range of both of the heat source groups 10 and 20.

[0081] At this time, when the load distribution is not less than the Lo-side of the operatable load range of the operating heat source units, the first group control device 11 and the second group control device 21 end the process.

[0082] The heat source system 100 according to the embodiment can automatically decrease the number of operating heat source units of the heat source groups 10 and 20 by decreasing the load allocation once all the subordinate heat source groups are in an operating state of the plurality of heat source units from the viewpoint of the number-of-units control device 30.

[0083] The heat source system and the heat source control method are not limited to the above-described embodiments, but can be appropriately modified or improved.

[Industrial Applicability]

[0084] It is possible to control the number of operating heat source units included in the plurality of heat source groups without sudden changes.

[Reference Signs List]

[0085]

100	Heat source system
10	First heat source group
11	First group control device
12, 22	Heat source unit
13, 23	Unit-integrated control device
14, 24	First operating-range output unit
15, 25	Second operating-range output unit
20	Second heat source group
21	Second group control device
30	Number-of-units control device
41	Water inlet
42	Water outlet

Claims

1. A heat source control device comprising:

a plurality of group control units configured to perform start/stop and load allocation of a plurality of heat source units corresponding to heat source groups of the plurality of heat source units; and

a number-of-units control unit configured to perform start/stop and load allocation of the heat source groups,

wherein the group control unit includes

a first operating-range output unit configured to output a load range in which one of characteristic values of the heat source units corresponding to the number of operating heat source units is within a predetermined range as a first proper operating range to the number-of-units control unit based on the characteristic values of the heat source units, and

a second operating-range output unit configured to output a load range in which another of the characteristic values is in the predetermined range as a second proper operating range to the number-of-units control unit, and

wherein the number-of-units control unit increases the number of activated heat source groups when a requested load exceeds the first proper operating range.

2. The heat source control device according to claim 1, wherein the first operating-range output unit uses COP information indicating a relation between a coefficient of performance and a load ratio as the characteristic value and outputs a load range in which one of the characteristic values corresponding to the number of operating heat source units is equal to or greater than a predetermined value as the first proper operating range to the number-of-units control unit, and

wherein the second operating-range output unit outputs a load range in which another of the characteristic values is equal to or greater than the predeter-

mined value as the second proper operating range to the number-of-units control unit.

3. The heat source control device according to claim 1, wherein the first operating-range output unit uses inverter input information as the characteristic value and outputs a load range in which one of the characteristic values corresponding to the number of operating heat source units is equal to or less than a predetermined value as the first proper operating range to the number-of-units control unit, and wherein the second operating-range output unit outputs a load range in which another of the characteristic values is equal to or less than the predetermined value as the second proper operating range to the number-of-units control unit.

4. The heat source control device according to any one of claims 1 to 3, wherein the group control unit sets, as transmission data from the group control unit, an optimum load range corresponding to the number of operating heat source units among the connected heat source units and an operable load range corresponding to 1 + the number of operating heat source units.

5. The heat source control device according to any one of claims 1 to 4, wherein, when load distribution to the heat source groups from the number-of-units control unit is greater than the operable load range for the number of operating heat source units, the number of operating heat source units in the heat source group is increased and the optimum load range and the operable load range are updated.

6. The heat source control device according to any one of claims 1 to 5, wherein, when load distribution to the heat source groups from the number-of-units control unit is less than the operable load range for the number of operating heat source units, the number of operating heat source units in the heat source group is decreased and the optimum load range and the operable load range are updated.

7. A heat source system comprising:

the heat source control device according to any one of claims 1 to 6; and
heat source groups of the plurality of heat source units.

8. A heat source control method comprising:

a plurality of group control steps of performing start/stop and load allocation of a plurality of heat source units corresponding to heat source

groups of the plurality of heat source units; and
a number-of-units control step of performing
start/stop and load allocation of the heat source
groups,

wherein the group control step includes

a first operating-range output step of outputting
a load range in which one of characteristic val-
ues of the heat source units corresponding to
the number of operating heat source units is
within a predetermined range as a first proper
operating range in the number-of-units control
step based on the characteristic values of the
heat source units, and

a second operating-range output step of output-
ting a load range in which another of the char-
acteristic values is in the predetermined range
as a second proper operating range in the
number-of-units control step, and

wherein, in the number-of-units control step, the
number of activated heat source groups is in-
creased when a requested load exceeds the first
proper operating range.

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FIG. 1

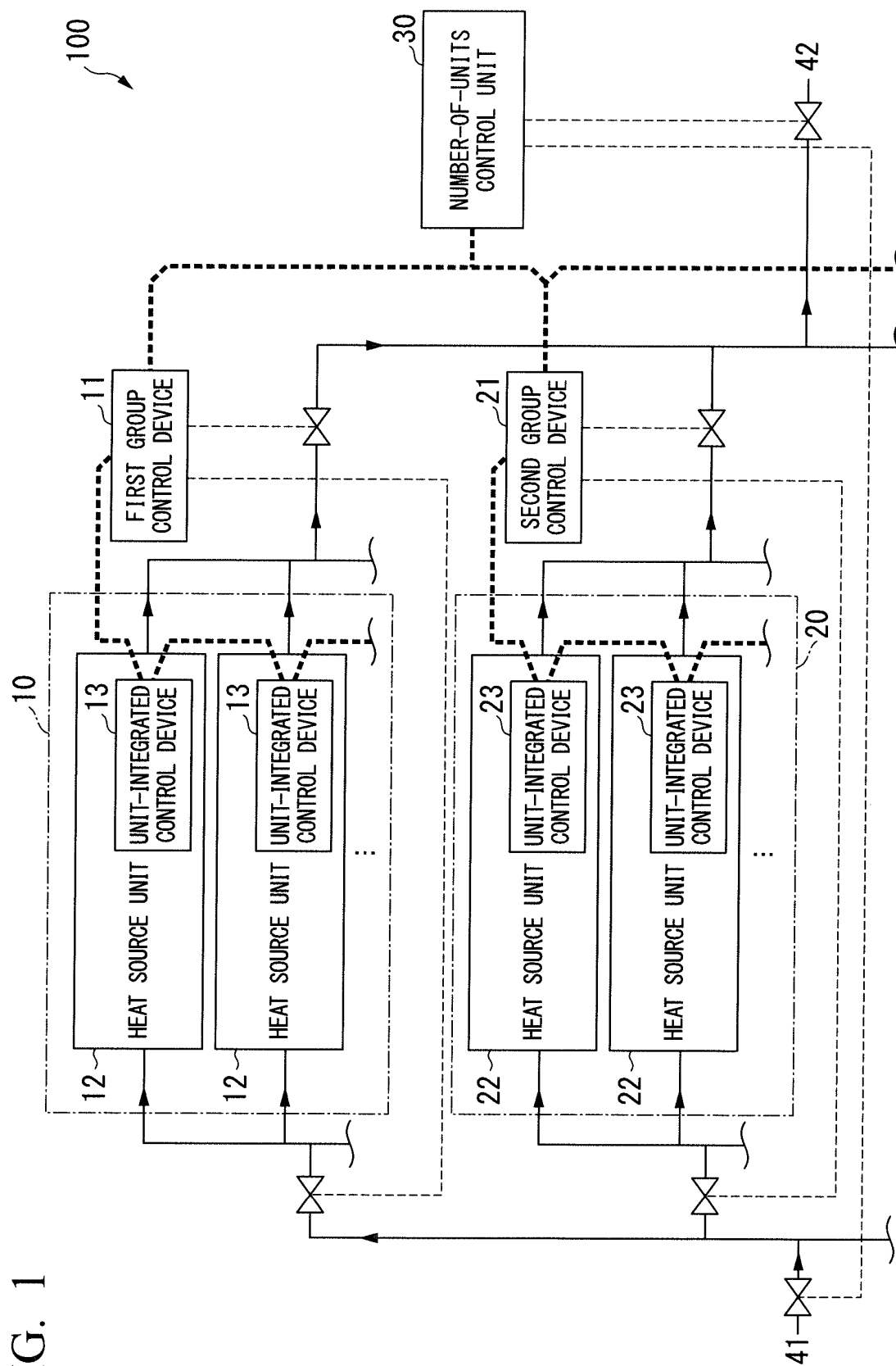


FIG. 2

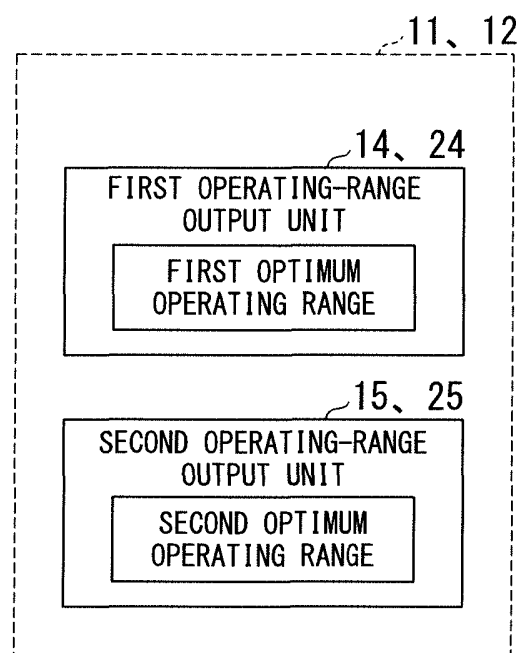


FIG. 3

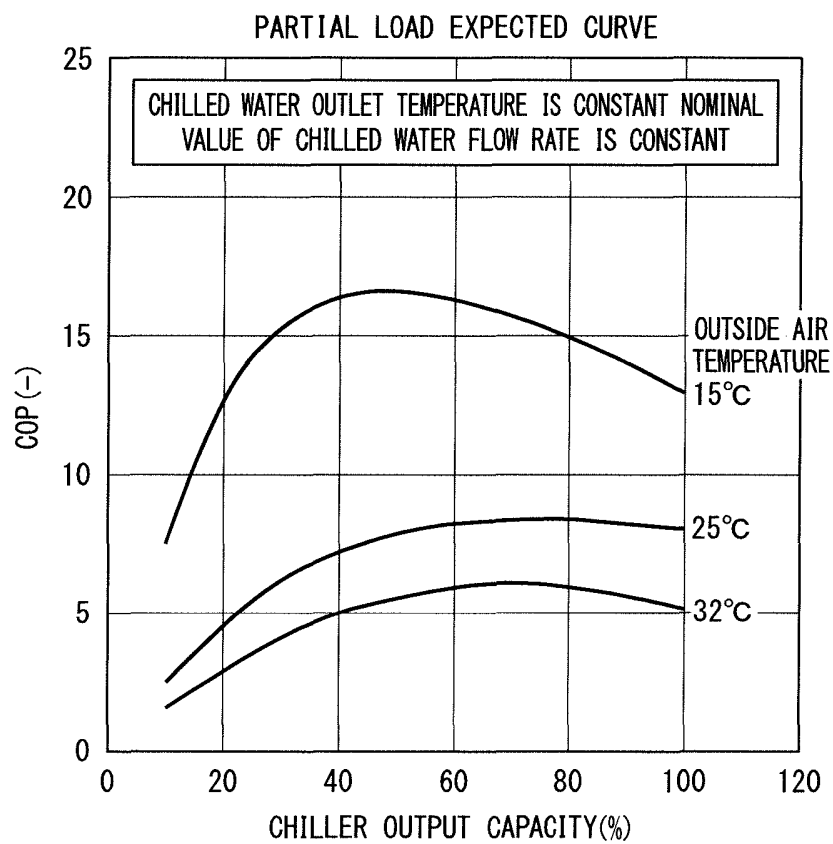


FIG. 4

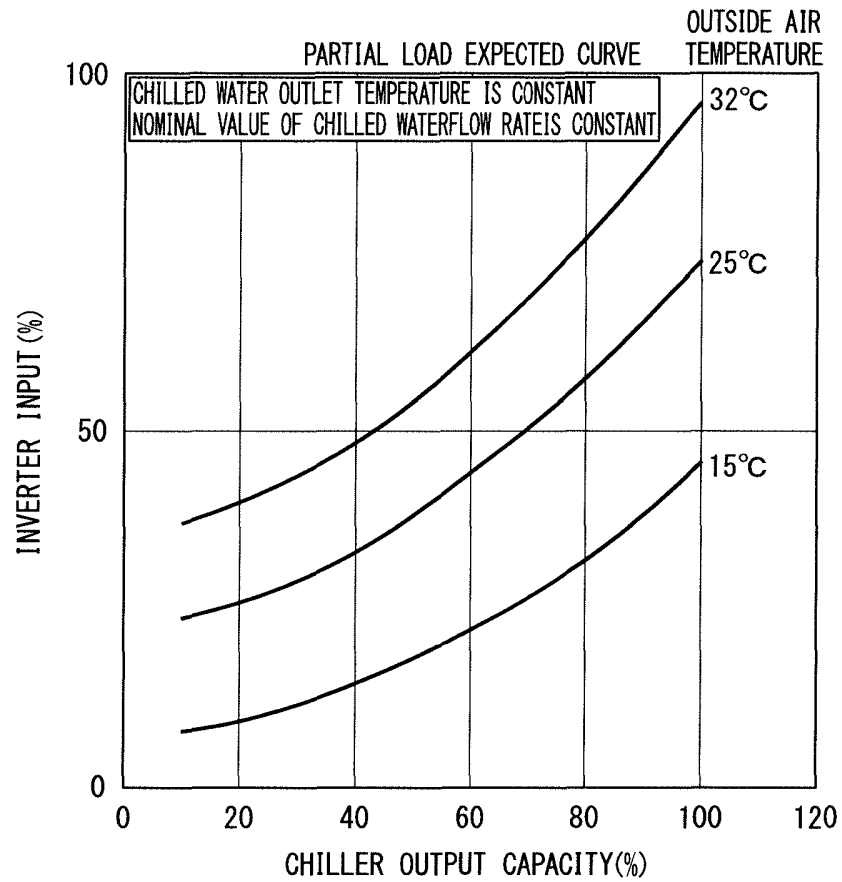


FIG. 5

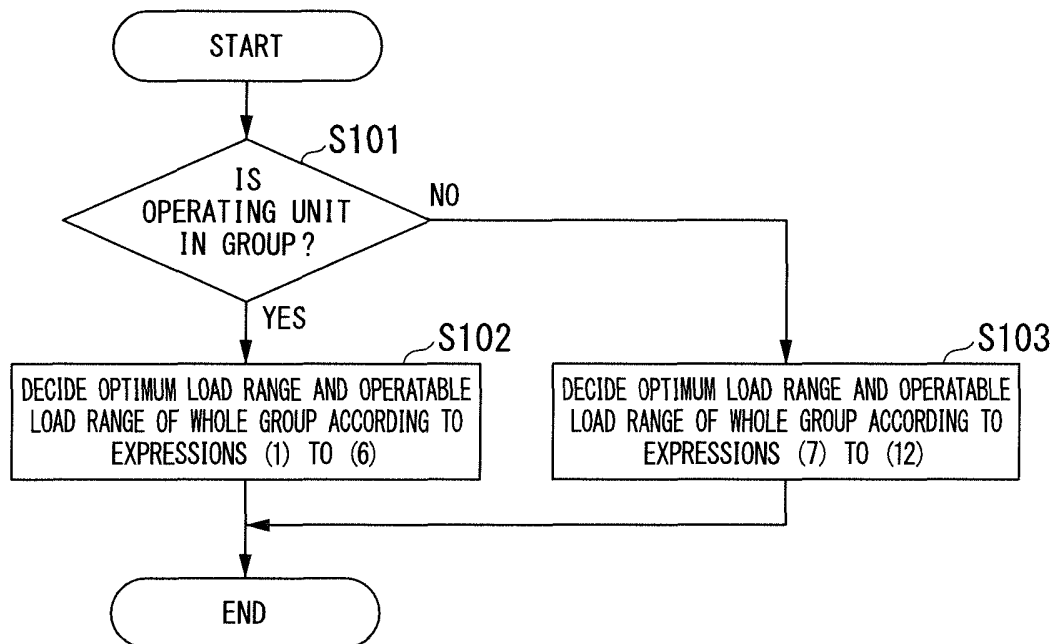
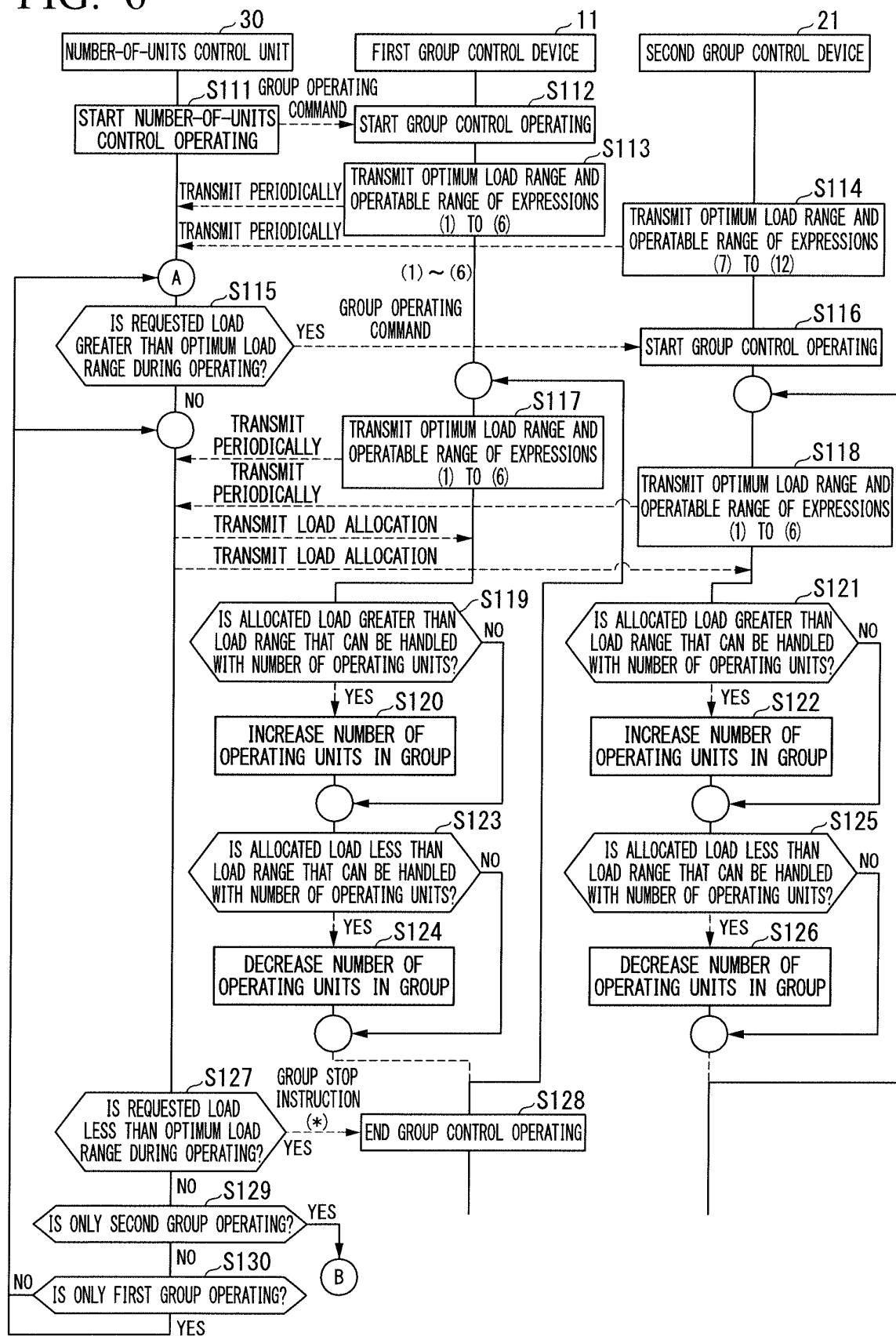


FIG. 6



[illegible]

FIG. 8

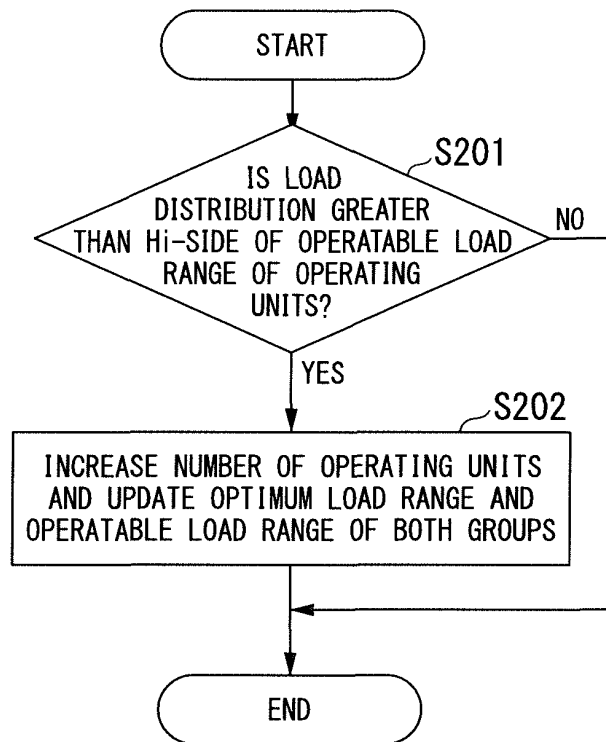
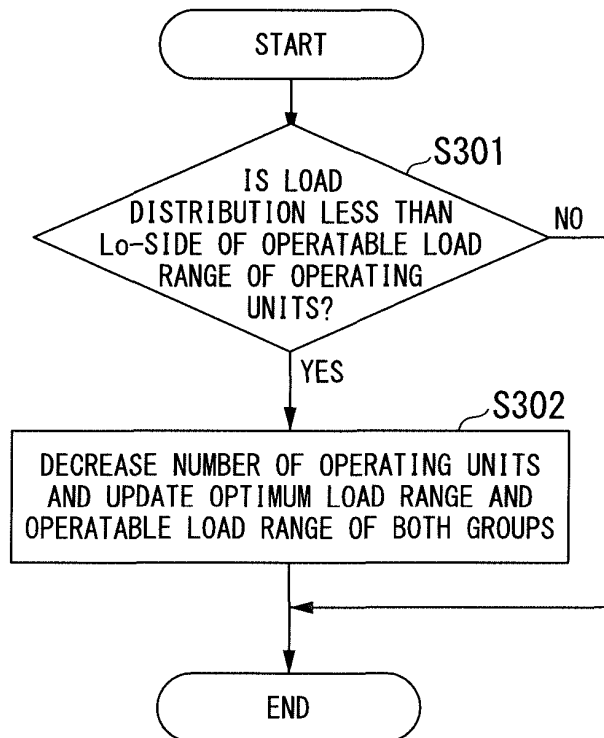


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/066373

A. CLASSIFICATION OF SUBJECT MATTER

F24F11/02(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)

F24F11/02

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 1996-2014

Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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 2012-37141 A (Mitsubishi Heavy Industries, Ltd.), 23 February 2012 (23.02.2012), paragraphs [0015] to [0064]; fig. 1 to 6 & US 2013/0098084 A1 & EP 2602565 A1 & WO 2012/017912 A1 & CN 102971589 A & KR 10-2013-0020683 A	1-8
Y	JP 2013-221623 A (Mitsubishi Electric Corp.), 28 October 2013 (28.10.2013), paragraphs [0014] to [0019]; fig. 2 (Family: none)	1-8

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

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Date of the actual completion of the international search
12 September, 2014 (12.09.14)Date of mailing of the international search report
22 September, 2014 (22.09.14)Name and mailing address of the ISA/
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/066373

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	JP 2006-71127 A (Tonets Corp.), 16 March 2006 (16.03.2006), paragraphs [0021] to [0035]; fig. 1 to 7 (Family: none)	7

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REFERENCES CITED IN THE DESCRIPTION

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