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(54) **AIR CONDITIONING SYSTEM**

(57) An air conditioning system includes an outdoor air processing unit including a heat pump and exchanging heat of an outdoor air by a heat exchanging medium of the heat pump, a heat exchanger allowing a heat exchanging water to flow therethrough, an air supply unit supplying the outdoor air supplied from the outdoor air processing unit and a return air of an air-conditioned space as an air-conditioning air by causing the outdoor air and the return air to exchange heat with the heat exchanging water of the heat exchanger, and a radiation unit inducing the return air of the air-conditioned space by using the air-conditioning air supplied from the air supply unit to generate an air mixture of the air-conditioning air and the return air, and radiating heat of the air mixture while discharging the air mixture to the air-conditioned space.

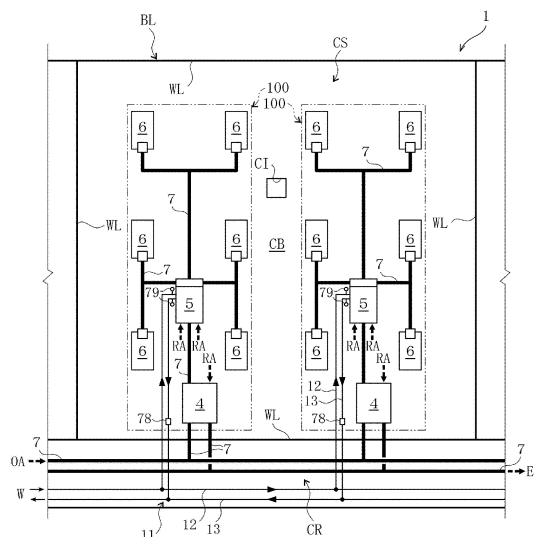


FIG.1

Description

BACKGROUND

(1) Technical Field

[0001] The present disclosure relates to an air conditioning system.

(2) Description of Related Art

[0002] In the related art, for example, in a configuration of an air conditioning system in a building such as an office building, an outdoor cold and hot water heat source device and an indoor cold and hot water air conditioner are connected by water piping, and an air-conditioning air is supplied into a room from the cold and hot water air conditioner via a duct, and an outdoor air is introduced such that a concentration of carbon dioxide within the room does not exceed a reference value. Alternatively, there is a configuration in which heat pump type outdoor unit and indoor unit are connected by refrigerant piping without using cold and hot water.

[0003] For example, Japanese Laid-Open Patent Application Publication No. 2016-217561 discloses an air conditioning system that humidifies and supplies an air-conditioning air which is an air mixture of a return air and an outdoor air to an air-conditioned space. Japanese Laid-Open Patent Application Publication No. 2000-274777 discloses a system including a plurality of sets of water-based air conditioning equipment and a set of heat source equipment. The heat source equipment converts various types of energy into air-conditioning energy such as cold water, hot water, and steam, and supplies the energy to the air conditioning equipment. Japanese Laid-Open Patent Application Publication No. 2001-280859 discloses a heat exchange coil used for a heat exchanger.

SUMMARY

[0004] For example, in order for a cold and hot water air conditioner to simultaneously perform a cooling operation and a heating operation, a water heat source facility which has a configuration called a four-pipe type, for example, and can simultaneously send a cold water and a hot water to the cold and hot water air conditioner is required. In this case, there is a problem that facility cost and operation cost are increased. Meanwhile, when a water heat source facility which has a configuration called a two-pipe type, for example, and can send a cold water and a hot water to the cold and hot water air conditioner while switching between the cold water and the hot water is used, since the cold and hot water air conditioner cannot simultaneously perform the cooling operation and the heating operation, there is a concern that comfortability is impaired. Therefore, the present disclosure provides an air conditioning system capable of per-

forming comfortable air conditioning at low cost.

[0005] An air conditioning system according to an aspect of the present disclosure includes an outdoor air processing unit that includes a heat pump capable of switching between a cooling operation and a heating operation, and exchanges heat of an outdoor air by a heat exchanging medium of the heat pump and supplies the outdoor air, a heat exchanger that selectively allows a cold water or a hot water, which is a heat exchanging water, to flow therethrough, an air supply unit that supplies the outdoor air supplied from the outdoor air processing unit and a return air of an air-conditioned space as an air-conditioning air by causing the outdoor air and the return air to exchange heat with the heat exchanging water of the heat exchanger, and a radiation unit that induces the return air of the air-conditioned space by using the air-conditioning air supplied from the air supply unit to generate an air mixture of the air-conditioning air and the return air, and radiates heat of the air mixture while discharging the air mixture to the air-conditioned space.

[0006] In the air conditioning system according to the aspect of the present disclosure, comfortable air conditioning can be performed at low cost.

[0007] The above and further objects, features and advantages of the present disclosure will more fully be apparent from the following description of preferred embodiments with accompanying the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

FIG. 1 is a plan view illustrating an example of a configuration of an air conditioning system according to Embodiment 1;

FIG. 2 is a side view illustrating an example of the configuration of the air conditioning system according to Embodiment 1;

FIG. 3 is a plan view illustrating an example of a configuration of air conditioning equipment according to Embodiment 1;

FIG. 4 is a perspective view illustrating an example of a configuration of a heat exchanger of an air conditioner according to Embodiment 1;

FIG. 5 is a cross-sectional side view illustrating an example of a cross section of the heat exchanger as viewed from arrow DA in FIG. 4;

FIG. 6 is a cross-sectional view illustrating an example of a cross section of the heat exchanger as viewed from arrow DB in FIG. 4;

FIG. 7 is a cross-sectional side view illustrating an example of a configuration of an outdoor air processing unit according to Embodiment 1;

FIG. 8 is a perspective view illustrating an example of a configuration of an induction and radiation unit according to Embodiment 1;

FIG. 9 is a cross-sectional view of the induction and

radiation unit of FIG. 8;

FIG. 10 is a flowchart illustrating an example of an air conditioning operation of the air conditioning system according to Embodiment 1;

FIG. 11 is a plan view illustrating an example of a configuration of an air conditioning system according to Embodiment 2;

FIG. 12 is a side view illustrating an example of the configuration of the air conditioning system according to Embodiment 2;

FIG. 13 is a plan view illustrating an example of a configuration of air conditioning equipment according to Embodiment 2;

FIG. 14 is a cross-sectional side view illustrating an example of a configuration of a heat exchanger of a heat exchange unit according to Embodiment 2 similarly to FIG. 5;

FIG. 15 is a cross-sectional view illustrating an example of the configuration of the heat exchanger of the heat exchange unit according to Embodiment 2 similarly to FIG. 6;

FIG. 16 is a flowchart illustrating an example of an air conditioning operation of the air conditioning system according to Embodiment 2;

FIG. 17 is a plan view illustrating an example of a configuration of an air conditioning system according to a modification example of Embodiment 2;

FIG. 18 is a plan view illustrating an example of a configuration of an air conditioning system according to Embodiment 3;

FIG. 19 is a side view illustrating an example of the configuration of the air conditioning system according to Embodiment 3;

FIG. 20 is a plan view illustrating an example of a configuration of air conditioning equipment according to Embodiment 3;

FIG. 21 is a diagram illustrating an example of a configuration of an outdoor air heat exchanger according to Embodiment 3;

FIG. 22 is a bottom perspective view illustrating an example of a configuration of a radiation air conditioner according to Embodiment 3;

FIG. 23 is a bottom view of the radiation air conditioner illustrated in FIG. 22;

FIG. 24 is a cross-sectional view of the radiation air conditioner illustrated in FIG. 23 taken along line X-X;

FIG. 25 is a cross-sectional view of the radiation air conditioner illustrated in FIG. 24 taken along line Y-Y; and

FIG. 26 is a cross-sectional view of the radiation air conditioner illustrated in FIG. 24 taken along line Z-Z.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0009] In the related art, in the case of a cold and hot water air conditioner, since the air conditioner is installed on a floor surface, a machine room dedicated to the air conditioner is required in the building such as an office

building. In this case, there is a problem that a rentable ratio is decreased. In order for the cold and hot water air conditioner to simultaneously perform the cooling operation and the heating operation, for example, the four-pipe water heat source facility is required. In this case, there is a problem that facility cost and operation cost are increased. Meanwhile, for example, when a two-pipe water heat source facility is used, since the cold and hot water air conditioner cannot simultaneously perform the cooling operation and the heating operation, there is a problem that comfortability is impaired.

[0010] Some air conditioners include a heat exchanger for exchanging heat between an air-conditioning and a heat exchanging water. For example, the heat exchanger is configured to adjust a heat exchange amount by increasing or decreasing a flow rate of the heat exchanging water and control capacity to cool or heat the air-conditioning air. For example, as disclosed in Japanese Laid-Open Patent Application Publication No. 2000-274777, a lower limit of the flow rate of the heat exchanging water is reduced by dividing a heat transfer pipe group included in the heat exchanger into two groups, and thus, a control range of a lower limit in the capacity of a heat exchange coil of the heat exchange can be widened. However, when the heat transfer pipe group is divided into two equal groups, the lower limit of the flow rate of the heat exchanging water is limited to a certain limit. For example, in a low air conditioning load region in which the heat exchange is sufficiently performed with a small amount of heat exchange (heat transmission amount), the heat exchanger overcools or overheats due to excessive capacity, and thus, there is a problem that a temperature difference of the heat exchanging water before and after the heat exchange caused by the heat exchange of the heat exchanger is not constant.

[0011] A heat source device such as a chiller is used for air conditioning of a building such as an office building in which a plurality of tenants is occupied. In this case, it is necessary to charge a fee calculated by proportionally apportioning an air conditioning fee to the tenants, for example. For example, as disclosed in Japanese Laid-Open Patent Application Publication No. 2001-280859, there is a billing system for this purpose. For example, in this billing system, the air-conditioning fee is calculated and proportionally apportioned from the product of an opening degree of a water quantity control valve of the heat exchanger provided in the air conditioner and an operating time. In the aforementioned billing system, although the quantity of water passing through the heat exchange coil can be calculated, since the energy consumption actually used for exchanging heat is not unknown, there is a problem that the calculated air-conditioning fee is not accurate.

[0012] Therefore, an air conditioning system according to an aspect of the present disclosure includes an outdoor air processing unit that includes a heat pump capable of switching between a cooling operation and a heating operation, and exchanges heat of an outdoor air by a heat

exchanging medium of the heat pump and supplies the outdoor air, a heat exchanger that selectively allows a cold water or a hot water, which is a heat exchanging water, to flow therethrough, an air supply unit that supplies the outdoor air supplied from the outdoor air processing unit and a return air of an air-conditioned space as an air-conditioning air by causing the outdoor air and the return air to exchange heat with the heat exchanging water of the heat exchanger, and a radiation unit that induces the return air of the air-conditioned space by using the air-conditioning air supplied from the air supply unit to generate an air mixture of the air-conditioning air and the return air, and radiates heat of the air mixture while discharging the air mixture to the air-conditioned space.

[0013] According to the aforementioned aspect, the air conditioning system has various effects as described below, and thus, comfortable air conditioning can be performed at low cost.

(1) Since the heat exchanger is configured to selectively allow the cold water or the hot water to flow therethrough, a two-pipe water heat source facility can be used as a water heat source facility for the heat exchanger. Therefore, the facility and operation cost can be reduced compared to a case where a four-pipe water heat source facility is used.

(2) Even in intermediate seasons in which both cooling and heating are required, the outdoor air processing unit of heat pump type can singly and freely switch between the cooling operation and the heating operation. Therefore, comfortability is improved.

(3) The outdoor air processing unit can perform the cooling operation using the outdoor air, and thus, the water heat source facility can be stopped during the cooling operation. Therefore, energy saving is improved.

(4) Since the air-conditioning air is the air which has been subjected to the processing using the outdoor air processing unit and the processing using the heat exchanger and the air supply unit, a dehumidifying effect or a humidifying effect can be improved.

(5) Since the air mixture having no draft feeling and temperature unevenness is supplied to the air-conditioned space due to the action of the heat radiation of the radiation unit, the comfortability of the air-conditioned space is improved.

(6) Since the radiation unit can cause the temperature of the air mixture to approach the temperature of the air-conditioned space by inducing and mixing the air-conditioning air and the return air, a cold draft is suppressed, and a condensation prevention effect is obtained during cooling.

[0014] The air conditioning system according to the aspect of the present disclosure may further include air conditioning equipment that is disposed on a ceiling of the air-conditioned space. The air conditioning equipment

may include the outdoor air processing unit, an air conditioner that includes the heat exchanger and the air supply unit, and the radiation unit.

[0015] According to the aforementioned aspect, since all the constitutive elements of the air conditioning equipment are disposed on the ceiling, a machine room for the elements is not required. Therefore, the labor saving of the construction of the building in which the air conditioning system is provided and the rentable ratio can be improved. Since the air-conditioning air is the air which has been subjected to the processing is performed in two stages of the outdoor air processing unit and the air conditioner, the dehumidifying effect and the humidifying effect thereof are excellent.

[0016] The air conditioning system according to the aspect of the present disclosure may further include two or more sets of the air conditioning equipment, and a control device that controls the air conditioning equipment. The control device may control air conditioning of the air-conditioned space by using a first operation pattern in which the two or more sets of the air conditioning equipment are operated or stopped for each set, and a second operation pattern in which a single operation of the outdoor air processing unit and a simultaneous operation of the outdoor air processing unit and the air conditioner are switched.

[0017] According to the aforementioned aspect, the control device can perform the air conditioning control capable of precisely coping with the fluctuation of the air conditioning load of the air-conditioned space by performing the control in which the first operation pattern and the second operation pattern are combined. Therefore, excess or deficiency of the air conditioning capacity is suppressed, unnecessary energy consumption can be reduced, and energy saving can be improved. Since a nonuniform distribution of the air-conditioned areas is suppressed by the heat radiation of the radiation unit, even though any set of the air conditioning equipment is stopped, the air conditioning that covers the entire air-conditioned space can be performed, and comfortability is not impaired.

[0018] In the air conditioning system according to the aspect of the present disclosure, the control device may control the air-conditioning of the air-conditioned space by further using a third operation pattern in which the air conditioning equipment being operated and the air conditioning equipment being stopped are switched.

[0019] According to the aforementioned aspect, since the operation time of each air conditioning equipment is averaged according to the third operation pattern, it is possible to extend the lifespan of the air conditioning equipment.

[0020] In the air conditioning system according to the aspect of the present disclosure, the outdoor air processing unit may be configured to use, as a heat source air, the return air of the air-conditioned space, and the outdoor air processing unit may include the heat pump of an integrated type that includes an outdoor air heat ex-

changer, a heat source air heat exchanger, and a compressor, a casing that accommodates the heat pump therein, and a slide mechanism that takes in or out the heat pump from a bottom of the casing by sliding the heat pump.

[0021] According to the aforementioned aspect, since the outdoor air processing unit includes the heat pump of the integrated type that does not require the piping for the heat exchange medium, the facility cost and the operation cost can be reduced compared with a separate heat pump type outdoor air processing unit. Since the outdoor air processing unit uses, as the heat source, the return air having exergy higher than exergy of the outdoor air, it is possible to improve the energy saving, and it is possible to reduce a defrost operation. Since the outdoor air processing unit has a ventilation function, it is not necessary to install a separate ventilation apparatus, and it is possible to reduce the facility cost. Since the heat pump can be taken in and out from the bottom surface of the outdoor air processing unit using the slide mechanism without taking down the whole outdoor air processing unit from the ceiling, it is easy to perform maintenance.

[0022] In the air conditioning system according to the aspect of the present disclosure, the heat exchanger of the air conditioner may include a flow dividing circuit configured such that a heat transfer pipe group of the heat exchanger through which the heat exchanging water flows is divided into a plurality of groups and grouping ratios are different from each other, and the control device may be configured to perform control such that a temperature difference of the heat exchanging water caused by the heat exchange of the heat exchanger is constant by increasing or decreasing a flow rate of the heat exchanging water in a first group having a smaller grouping ratio among the plurality of groups in a case of a low air conditioning load, and control a temperature of the air-conditioned space by increasing or decreasing a supply air volume of the air conditioner.

[0023] According to the aforementioned aspect, the control device adjusts the temperature of the air-conditioned space by both the flow rate control of the heat exchanging water and the supply air volume control. Therefore, the air conditioning system can suppress the indoor temperature overshoot by mitigating excessive fluctuation (for example, overcooling or overheating, etc.) in air conditioning capacity (compared with the temperature adjustment of only the flow rate control of the heat exchanging water or only the supply air volume control), and can perform the air conditioning with excellent stability and comfortability. The control device can control the temperature of the air-conditioned space by increasing or decreasing the supply air volume while performing the control such that the temperature difference of the heat exchanging water is constant even though the air conditioning load is fluctuated, and can also maintain the comfortability of the air-conditioned space. The control device can lower, for example, minimize, the lower limit of the flow rate of the heat exchanging water by increas-

ing or decreasing the flow rate of the heat exchanging water in the first group of the flow dividing circuit in the case of the low air conditioning load. Therefore, the control range of the capacity of the heat exchanger becomes wider toward the lower limit, and the capacity of the heat exchanger does not become excessive even in the case of the low air conditioning load. Therefore, energy waste, overcooling, and overheating are reduced, and energy saving and comfortability are improved. For example, even in the case of the low air conditioning load, the control device can perform the control such that the temperature difference of the heat exchanging water before and after the heat exchange is constant. Thus, a small water amount and large temperature difference operation of the air conditioner can be performed. It is possible to simplify the piping and the air conditioning facility due to the small water amount, and it is possible to achieve the energy saving of the heat source device due to the large temperature difference.

[0024] In the air conditioning system according to the aspect of the present disclosure, when viewed in an air flow direction of the air passing through the heat exchanger of the air conditioner, non-overlapping zones which do not overlap the first group may be formed in a second group having a grouping ratio larger than the grouping ratio of the first group among the plurality of groups, and the non-overlapping zones may be located so as to sandwich the first group.

[0025] According to the aforementioned aspect, when the control device controls to cause the heat exchanging water to flow through the first group and cause the heat exchanging water not to flow through the second group during cooling, the overcooled and dehumidified air overcooled and dehumidified by passing through the first group may pass through the non-overlapping zones, and may be reheated by a bypass air which has a higher temperature than the overcooled and dehumidified air. Accordingly, dry air without an unpleasant cooling sensation can be obtained. At this time, since the overcooled and dehumidified air is sandwiched by the bypass air so as not to escape, the overcooled and dehumidified air is promoted to be mixed with the bypass air. Therefore, the overcooled and dehumidified air can be reliably reheated. Therefore, even in the intermediate season in which the humidity is high and it is humid, the air conditioning can be performed by using a crisp air flow without a cold draft, and thus, comfortability is improved. Since a device such as a bypass damper for adjusting the flow rate of the bypass air is not required, cost reduction and compactness can be achieved.

[0026] In the air conditioning system according to the aspect of the present disclosure, the control device may be configured to calculate an energy consumption of the air-conditioned space based on a flow rate of the heat exchanging water supplied to the heat exchanger of the air conditioner and a temperature difference of the heat exchanging water caused by the heat exchange of the heat exchanger.

[0027] According to the aforementioned aspect, the control device can perform the control such that the temperature difference of the heat exchanging water before and after the heat exchange is constant, and can calculate the energy consumption of the air-conditioned space based on the temperature difference of the heat exchanging water and the flow rate of the heat exchanging water. Therefore, for example, it becomes possible to accurately calculate and proportionally apportion the air-conditioning fee for each air-conditioned space by comparing the energy consumptions of the air-conditioned spaces. The calculation of the energy consumption can be performed by simply measuring the flow rate and the temperature of the heat exchanging water. One control device can control the operation of the air conditioner, and output the energy consumption. Therefore, the simplification of the facility and the construction for the air conditioning system and the cost reduction can be achieved.

[0028] The air conditioning system according to the aspect of the present disclosure may further include a plurality of heat source devices that adjusts a water temperature by cooling or heating the heat exchanging water to be supplied to the heat exchanger of the air conditioner. The control device may be configured to increase or decrease the number of the heat source devices to be operated according to an increase or a decrease of the energy consumption of the air-conditioned space.

[0029] According to the aforementioned aspect, since the control device increases or decreases the number of the heat source devices to be operated according to the increase or decrease of the energy consumption of the air conditioner, it is possible to suppress energy waste of the heat source devices, and it is possible to save energy.

[0030] In the air conditioning system according to the aspect of the present disclosure, a heat transfer pipe group of the heat exchanger of the air conditioner may include elliptical pipes.

[0031] According to the aforementioned aspect, a dead water region of the heat transfer pipe group is reduced. Ventilation resistance of the heat transfer pipe group is reduced, and thus, energy saving can be achieved. A contact area (heat transmission amount) between the heat transfer pipe group and the air-conditioning air is increased, and thus, heat exchange efficiency is improved. Accordingly, for example, the small water amount and large temperature difference operation of the air conditioner can be performed without increasing (enlarging) the heat transfer area of the heat exchanger.

[0032] The air conditioning system according to the aspect of the present disclosure may further include a heat exchange unit that includes the heat exchanger, and a fan unit that supplies the outdoor air supplied from the outdoor air processing unit and the return air of the air-conditioned space as the air-conditioning air by introducing the outdoor air and the return air to the heat exchange unit and causing the outdoor air and the return air to exchange heat with the heat exchanging water of the heat

exchanger, and functions as the air supply unit. The outdoor air processing unit, the fan unit, and the radiation unit may be disposed on a ceiling of the air-conditioned space, and the heat exchange unit may be disposed in a machine room different from the air-conditioned space.

[0033] According to the aforementioned aspect, the heat exchange unit and the fan unit which are usually installed integrally are divided and separated. The outdoor air processing unit, the fan unit, and the induction and radiation unit are disposed on the ceiling, and the heat exchange unit is disposed in the machine room. Therefore, the size of the machine room can be reduced, and the labor saving of the construction of the building having the machine room and the improvement of the rentable ratio of the building can be achieved.

[0034] The air conditioning system according to the aspect of the present disclosure may further include two or more sets of air conditioning equipment, and a control device that controls the air conditioning equipment. The air conditioning equipment may be air conditioning equipment configured such that the outdoor air processing unit, the fan unit, and the radiation unit are one set or may be air conditioning equipment configured such that the outdoor air processing unit, the heat exchange unit, the fan unit, and the radiation unit are one set, and the control device may control air conditioning of the air-conditioned space by using a first operation pattern in which the two or more sets of air conditioning equipment are operated or stopped for each set, and a second operation pattern in which a single operation of the outdoor air processing unit and a simultaneous operation of the outdoor air processing unit and the heat exchange unit are switched.

[0035] According to the aforementioned aspect, the control device can perform the air conditioning control capable of precisely coping with the fluctuation of the air conditioning load of the air-conditioned space by performing the control in which the first operation pattern and the second operation pattern are combined. Therefore, excess or deficiency of the air conditioning capacity is suppressed, unnecessary energy consumption can be reduced, and energy saving can be improved. Since a nonuniform distribution of the air conditioned areas is suppressed by the heat radiation of the radiation unit, even though any set of the air conditioning equipment is stopped, the air conditioning that covers the entire air-conditioned space can be performed, and comfortability is not impaired.

[0036] In the air conditioning system according to the aspect of the present disclosure, the control device may control the air-conditioning of the air-conditioned space by further using a third operation pattern with which the air conditioning equipment being operated and the air conditioning equipment being stopped are switched.

[0037] According to the aforementioned aspect, since the operation time of each air conditioning equipment is averaged according to the third operation pattern, it is possible to extend the lifespan of the air conditioning equipment.

[0038] In the air conditioning system according to the aspect of the present disclosure, the outdoor air processing unit may be configured to use, as a heat source air, the return air of the air-conditioned space, and the outdoor air processing unit may include the heat pump of an integrated type that includes an outdoor air heat exchanger, a heat source air heat exchanger, and a compressor, a casing that accommodates the heat pump therein, and a slide mechanism that takes in or out the heat pump from a bottom of the casing by sliding the heat pump.

[0039] According to the aforementioned aspect, since the outdoor air processing unit includes the heat pump of the integrated type that does not require the piping for the heat exchange medium, the facility cost and the operation cost can be reduced compared with a separate heat pump type outdoor air processing unit. Since the outdoor air processing unit uses, as the heat source, the return air having exergy higher than exergy of the outdoor air, it is possible to improve the energy saving, and it is possible to reduce a defrost operation. Since the outdoor air processing unit has a ventilation function, it is not necessary to install a separate ventilation apparatus, and it is possible to reduce the facility cost. Since the heat pump can be taken in and out from the bottom surface of the outdoor air processing unit using the slide mechanism without taking down the whole outdoor air processing unit from the ceiling, it is easy to perform maintenance.

[0040] In the air conditioning system according to the aspect of the present disclosure, the heat exchanger of the heat exchange unit may include a flow dividing circuit configured such that a heat transfer pipe group of the heat exchanger through which the heat exchanging water flows is divided into a plurality of groups and grouping ratios are different from each other, and the control device may be configured to perform control such that a temperature difference of the heat exchanging water caused by the heat exchange of the heat exchanger is constant by increasing or decreasing a flow rate of the heat exchanging water in a first group having a smaller grouping ratio among the plurality of groups in a case of a low air conditioning load, and control a temperature of the air-conditioned space by increasing or decreasing a supply air volume of the fan unit.

[0041] According to the aforementioned aspect, the control device adjusts the temperature of the air-conditioned space by both the flow rate control of the heat exchanging water and the supply air volume control. Therefore, the air conditioning system can suppress the indoor temperature overshoot by mitigating excessive fluctuation (for example, overcooling or overheating, etc.) in air conditioning capacity (compared with the temperature adjustment of only the flow rate control of the heat exchanging water or only the supply air volume control), and can perform the air conditioning with excellent stability and comfortability. The control device can control the temperature of the air-conditioned space by increasing or decreasing the supply air volume while performing

the control such that the temperature difference of the heat exchanging water is constant even though the air conditioning load is fluctuated, and can also maintain the comfortability of the air-conditioned space. The control device can lower, for example, minimize, the lower limit of the flow rate of the heat exchanging water by increasing or decreasing the flow rate of the heat exchanging water in the first group of the flow dividing circuit in the case of the low air conditioning load. Therefore, the control range of the capacity of the heat exchanger becomes wider toward the lower limit, and the capacity of the heat exchanger does not become excessive even in the case of the low air conditioning load. Therefore, energy waste, overcooling, and overheating are reduced, and energy saving and comfortability are improved. For example, even in the case of the low air conditioning load, the control device can perform the control such that the temperature difference of the heat exchanging water before and after the heat exchange is constant. Thus, the small water amount and large temperature difference operation of the heat exchange unit can be performed. It is possible to simplify the piping and the air conditioning facility due to the small water amount, and it is possible to achieve the energy saving of the heat source device due to the large temperature difference.

[0042] In the air conditioning system according to the aspect of the present disclosure, when viewed in an air flow direction of the air passing through the heat exchanger of the heat exchange unit, non-overlapping zones which do not overlap the first group may be formed in a second group having a grouping ratio larger than the grouping ratio of the first group among the plurality of groups, and the non-overlapping zones may be located so as to sandwich the first group.

[0043] According to the aforementioned aspect, when the control device controls to cause the heat exchanging water to flow through the first group and cause the heat exchanging water not to flow through the second group during cooling, the overcooled and dehumidified air overcooled and dehumidified by passing through the first group may pass through the non-overlapping zones, and may be reheated by a bypass air which has a higher temperature than the overcooled and dehumidified air. Accordingly, dry air without an unpleasant cooling sensation can be obtained. At this time, since the overcooled and dehumidified air is sandwiched by the bypass air so as not to escape, the overcooled and dehumidified air is promoted to be mixed with the bypass air. Therefore, the overcooled and dehumidified air can be reliably reheated. Therefore, even in the intermediate season in which the humidity is high and it is humid, the air conditioning can be performed by using a crisp air flow without a cold draft, and thus, comfortability is improved. Since a device such as a bypass damper for adjusting the flow rate of the bypass air is not required, cost reduction and compactness can be achieved.

[0044] In the air conditioning system according to the aspect of the present disclosure, the control device may

be configured to calculate an energy consumption of the air-conditioned space based on a flow rate of the heat exchanging water supplied to the heat exchanger of the heat exchange unit and a temperature difference of the heat exchanging water caused by the heat exchange of the heat exchanger.

[0045] According to the aforementioned aspect, the control device can perform the control such that the temperature difference of the heat exchanging water before and after the heat exchange is constant, and can calculate the energy consumption of the air-conditioned space based on the temperature difference of the heat exchanging water and the flow rate of the heat exchanging water. Therefore, for example, it becomes possible to accurately calculate and proportionally apportion the air-conditioning fee for each air-conditioned space by comparing the energy consumptions of the air-conditioned spaces. The calculation of the energy consumption can be performed by simply measuring the flow rate and the temperature of the heat exchanging water. One control device can control the operation of the heat exchange unit and output the energy consumption. Therefore, the simplification of the facility and the construction for the air conditioning system and the cost reduction can be achieved.

[0046] The air conditioning system according to the aspect of the present disclosure may further include a plurality of heat source devices that adjusts a water temperature by cooling or heating the heat exchanging water to be supplied to the heat exchanger of the heat exchange unit. The control device may be configured to increase or decrease the number of the heat source devices to be operated according to an increase or a decrease of the energy consumption of the air-conditioned space.

[0047] According to the aforementioned aspect, since the control device increases or decreases the number of the heat source devices to be operated according to the increase or decrease of the energy consumption of the heat exchange unit, it is possible to suppress energy waste of the heat source devices, and it is possible to save energy.

[0048] In the air conditioning system according to the aspect of the present disclosure, a heat transfer pipe group of the heat exchanger of the heat exchange unit may include elliptical pipes.

[0049] According to the aforementioned aspect, a dead water region of the heat transfer pipe group is reduced. Ventilation resistance of the heat transfer pipe group is reduced, and thus, energy saving can be achieved. A contact area (heat transmission amount) between the heat transfer pipe group and the air-conditioning air is increased, and thus, heat exchange efficiency is improved. Accordingly, for example, the small water amount and large temperature difference operation of the air conditioning equipment can be performed without increasing (enlarging) the heat transfer area of the heat exchanger.

[0050] The air conditioning system according to the aspect of the present disclosure may further include two or

more sets of air conditioning equipment that are disposed on a ceiling of the air-conditioned space, and a control device that controls the air conditioning equipment. The air conditioning equipment may include a radiation air conditioner that is configured to function as the air supply unit and the radiation unit, cools and heats the air-conditioning air through the heat exchange using the heat exchanging water, discharges the cooled or heated air-conditioning air to the air-conditioned space, and radiates heat of the air-conditioned air, and the outdoor air processing unit that includes the heat pump which cools or heats the outdoor air by performing the heat exchange using the heat exchanging medium, and supplies the outdoor air after the heat exchange to the air-conditioned space through the radiation air conditioner. The control device may control air conditioning of the air-conditioned space by using a first operation pattern in which the two or more sets of air conditioning equipment are operated or stopped for each set and a second operation pattern in which a single operation of the outdoor air processing unit and a simultaneous operation of the outdoor air processing unit and the radiation air conditioner are switched.

[0051] According to the aforementioned aspect, since all the constitutive elements of the air conditioning equipment are disposed on the ceiling, a machine room for the elements is not required. Therefore, the labor saving of the construction of the building in which the air conditioning system is provided and the rentable ratio can be improved. The control device can suppress excess or deficiency of the air conditioning capacity even during the low air conditioning load such as the intermediate seasons, can reduce unnecessary energy consumption, and can improve comfortability and energy saving by using the first operation pattern. The control device can cause the outdoor air processing unit of heat pump type to switch singly and freely between the cooling operation and the heating operation by performing the control using the second operation pattern in the intermediate seasons, etc., in which both cooling and heating are required. Therefore, comfortability is improved. The control device can cause the outdoor air processing unit to perform the cooling operation using the outdoor air, and can cause the heat source facility of the radiation air conditioner to stop. Therefore, energy saving is improved. Since the air-conditioning air is adjusted by two-stage processing of the processing using the outdoor air processing unit and the processing using the radiation air conditioner, the dehumidifying effect and the humidifying effect of the air-conditioning air can be improved as compared with a case where the processing using the outdoor air processing unit singly is performed.

[0052] In the air conditioning system according to the aspect of the present disclosure, the air conditioning equipment may include an air conditioner group including a plurality of the radiation air conditioners, and the control device may control the air conditioning of the air-conditioned space by further using a fifth operation pattern in

which the radiation air conditioners are operated or stopped for each air conditioner group.

[0053] According to the aforementioned aspect, the control ranges of the temperature and the humidity of the air-conditioned space are expanded by adding the fifth operation pattern, and more precise air-conditioning can be performed.

[0054] In the air conditioning system according to the aspect of the present disclosure, the control device may control the air-conditioning of the air-conditioned space by further using a third operation pattern in which the air conditioning equipment being operated and the air conditioning equipment being stopped are switched.

[0055] According to the aforementioned aspect, since the operation time of each air conditioning equipment is averaged according to the third operation pattern, it is possible to extend the lifespan of the air conditioning equipment.

[0056] In the air conditioning system according to the aspect of the present disclosure, the outdoor air processing unit may be configured to use, as a heat source air, the return air of the air-conditioned space, and the outdoor air processing unit may include the heat pump of an integrated type that includes an outdoor air heat exchanger, a heat source air heat exchanger, and a compressor, a casing that accommodates the heat pump therein, and a slide mechanism that takes in or out the heat pump from a bottom of the casing by sliding the heat pump.

[0057] According to the aforementioned aspect, since the outdoor air processing unit includes the heat pump of the integrated type that does not require the piping for the heat exchange medium, the facility cost and the operation cost can be reduced compared with a separate heat pump type outdoor air processing unit. Since the outdoor air processing unit uses, as the heat source, the return air having exergy higher than exergy of the outdoor air, it is possible to improve the energy saving, and it is possible to reduce a defrost operation. Since the outdoor air processing unit has a ventilation function, it is not necessary to install a separate ventilation apparatus, and it is possible to reduce the facility cost. Since the heat pump can be taken in and out from the bottom surface of the outdoor air processing unit using the slide mechanism without taking down the whole outdoor air processing unit from the ceiling, it is easy to perform maintenance.

[0058] In the air conditioning system according to the aspect of the present disclosure, the radiation air conditioner may include an air-conditioning heat exchanger that exchanges heat of the air-conditioning air, a radiation part, and an air-conditioning air supply fan that sends the air-conditioning air to the radiation part. The radiation part may include a first chamber through which the air-conditioning air flows, a second chamber that radiates heat of the air-conditioning air introduced from the first chamber while discharging the air-conditioning air introduced from the first chamber to the air-conditioned space, and an air flow adjustment part that adjusts a wind speed and

a distribution of the air-conditioning air to be discharged to the second chamber from the first chamber.

[0059] According to the aforementioned aspect, the structure of the radiation part is a simple structure including two chambers and an air flow adjustment part. Therefore, cost reduction, weight reduction, easy construction, and easy maintenance can be achieved by the radiation part. The radiation part can equalize the air volume distribution of the air-conditioning air in the second chamber and can equalize the discharge and the heat radiation of the air-conditioning air to the air-conditioned space by adjusting the wind speed and distribution of the air-conditioning air by the air flow adjustment part.

[0060] In the air conditioning system according to the aspect of the present disclosure, the air flow adjustment part may include a group of first through-holes that allows the air-conditioning air to be discharged therethrough from the first chamber to the second chamber, the second chamber may include a group of second through-holes that allows the air-conditioning air to be discharged therethrough to the air-conditioned space from the second chamber, and an opening area of the group of the second through-holes may be larger than an opening area of the group of the first through-holes.

[0061] According to the aforementioned aspect, the opening area of the group of the second through-holes is larger than the opening area of the group of the first through-holes, and thus, the air-conditioning air can spread over the entire space of the first chamber and the second chamber while increasing a static pressure thereof and gradually lowering the wind speed thereof in two stages of the group of the first through-holes and the group of the second through-holes. Therefore, the discharge and heat radiation of the air-conditioning air to the air-conditioned space are equalized, and comfortable air conditioning with no draft feeling and temperature unevenness can be achieved. Since the structure of the air flow adjustment part is a simple structure in which groups of through-holes are formed in two chambers, it is possible to achieve cost reduction, weight reduction, easy construction, and easy maintenance.

[0062] In the air conditioning system according to the aspect of the present disclosure, the first chamber may be configured such that a cross-sectional area of the first chamber through which the air-conditioning air passes becomes narrower toward a leeward side from a windward side.

[0063] According to the above aspect, since the cross-sectional area of the first chamber becomes narrower from the windward side to the leeward side, the wind speed of the air-conditioning air becomes higher from the windward side to the leeward side, and the air-conditioning air can spread over the entire space of the first chamber and the second chamber. Therefore, the discharge and heat radiation of the air-conditioning air to the air-conditioned space are equalized, and comfortable air conditioning with no draft feeling and temperature unevenness can be achieved.

[0064] Hereinafter, embodiments of the present disclosure will be described with reference to the drawings. All the embodiments described below illustrate comprehensive or specific examples. Components not described in the independent claims indicating the most generic concept among component elements in the following embodiments are described as optional component elements. Each drawing in the accompanying drawings is a schematic diagram, and is not necessarily illustrated exactly. In each drawing, substantially the same component elements are denoted by the same reference numerals, and redundant description may be omitted or simplified. In the present specification and the claims, "apparatus" and "device" can mean not only one apparatus and one device, but also a system including a plurality of apparatuses and a plurality of devices.

Embodiment 1

[0065] An air conditioning system 1 according to Embodiment 1 will be described. FIG. 1 is a plan view illustrating an example of a configuration of the air conditioning system 1 according to Embodiment 1. FIG. 2 is a side view illustrating an example of the configuration of the air conditioning system 1 according to Embodiment 1. FIG. 3 is a plan view illustrating an example of a configuration of air conditioning equipment 100 according to Embodiment 1.

[0066] As illustrated in FIGS. 1 and 2, the air conditioning system 1 includes air conditioning equipment 100, a water heat source facility 200, and a control device 300. The air conditioning system 1 is configured such that the air conditioning equipment 100 is disposed on a ceiling of an air-conditioned space S within a building BL such as an office building, and is a ceiling-installed air conditioning system. For example, an indoor space of each story of the building BL is partitioned by a ceiling board CB into a ceiling plenum space CS and the air-conditioned space S. Such an air-conditioned space S is a space formed by dividing each story of the building BL with the ceiling board CB, a floor FL, a wall WL and so on. For example, ducts 7 communicating with the outdoor and water piping 11 for circulating a heat exchanging water W are disposed in a corridor CR outside the air-conditioned space S.

[0067] The air conditioning equipment 100 includes a set of outdoor air processing unit 4, an air conditioner 5, and induction and radiation units 6. The induction and radiation unit 6 is an example of a radiation unit. A thick dashed arrow in each diagram indicates a direction of a flow of an air in the air conditioning system 1, that is, an air flow direction. In the present embodiment, two or more sets of air conditioning equipment 100 are disposed on the ceiling of one or a plurality of air-conditioned spaces S within building BL.

[0068] The outdoor air processing unit 4 includes a heat pump 50 that can switch between a cooling operation and a heating operation. The outdoor air processing

unit 4 is configured to use, as a heat source air, a return air RA which is an air returned from the air-conditioned space S. The heat pump 50 cools or heats an outdoor air OA by exchanging heat between the outdoor air OA with a heat exchanging refrigerant which is an example of a heat exchanging medium. The outdoor air processing unit 4 supplies, as a supply air SA, the outdoor air OA after the heat exchange.

[0069] The air conditioner 5 includes a heat exchanger 20 for water that selectively allows a cold water or a hot water, which is the heat exchanging water W, to flow therethrough. The heat exchanger 20 cools or heats the outdoor air OA and the return air RA by exchanging heat between the heat exchanging water W and the outdoor air OA supplied from the outdoor air processing unit 4 and the return air RA of the air-conditioned space S. The air conditioner 5 supplies, as the supply air SA, an air-conditioning air which includes an air mixture of the outdoor air OA and return air RA after the heat exchange. Instead of the air mixture, the air conditioner 5 may supply, as the air-conditioning air, any one of only the outdoor air OA after the heat exchange, only the return air RA after the heat exchange, only the outdoor air OA of which heat is not exchanged by using the heat exchanging water W, only the return air RA of which heat is not exchanged by using the heat exchanging water W, and an air mixture of the outdoor air OA and the return air RA of which heat is not exchanged by using the heat exchanging water W.

[0070] The induction and radiation unit 6 induces the return air RA of the air-conditioned space S by using the air-conditioning air supplied from the air conditioner 5 to generate an air mixture of the air-conditioning air and the return air RA. The induction and radiation unit 6 radiates heat of the air mixture while discharging the air mixture to the air-conditioned space S.

[0071] The induction and radiation unit 6, the air conditioner 5, the outdoor air processing unit 4, and an outdoor space are connected to each other via the ducts 7 such that the air flows therebetween. Each duct 7 is depicted by a thick solid line in FIGS. 1 and 2 in a simplified manner. In the illustrated example, the air conditioning equipment 100 is disposed in the ceiling plenum space CS formed by partitioning the air-conditioned space S by the ceiling board CB. The ceiling plenum space CS is used as a ceiling chamber, and is configured such that the return air RA of the air-conditioned space S can be introduced into the ceiling plenum space CS from an air inlet CI formed on the ceiling board CB.

[0072] The water heat source facility 200 supplies the heat exchanging water W to the heat exchanger 20 of the air conditioner 5. In the present embodiment, the water heat source facility 200 is a two-pipe water heat source facility, but is not limited thereto. The water heat source facility 200 includes heat source devices 210 and circulation equipment 220. The heat source device 210 adjusts a water temperature of the heat exchanging water W so as to be a cold water or a hot water suitable for

heat exchange by cooling or heating the heat exchanging water W to be supplied to the heat exchanger 20 of the air conditioner 5. The water heat source facility 200 includes a plurality of heat source devices 210. The plurality of heat source devices 210 are respectively configured to be individually operated and stopped, and are further configured to be capable to supply the heat exchanging water W which is the cold water or the hot water by switching between the cooling and the heating of the heat exchanging water W.

The circulation equipment 220 circulates the heat exchanging water W between the heat source devices 210 and the air conditioner 5. The circulation equipment 220 includes water piping 11 for circulating the heat exchanging water W, and a pump 14 for feeding the heat exchanging water W. The water piping 11 includes outgoing piping 12 for sending the heat exchanging water W from the heat source devices 210 to the air conditioner 5, and return piping 13 for returning the heat exchanging water W from the air conditioner 5 to the heat source devices 210.

[0073] As illustrated in FIGS. 2 and 3, the air conditioner 5 includes valves 33, a humidifier 21, an air supply fan 22, a rotation controller 23, a casing 24, and a branching chamber 25 in addition to the heat exchanger 20. The valve 33 adjusts a flow rate of the heat exchanging water W flowing into the heat exchanger 20. The humidifier 21 humidifies the air passed through the heat exchanger 20. The rotation controller 23 adjusts the supply air volume by steplessly and stepwisely controlling a rotational speed of the air supply fan 22. The casing 24 accommodates, for example, houses the heat exchanger 20, the humidifier 21, and the air supply fan 22 therein. The branching chamber 25 divides the air flow. The air supply fan 22 is an example of an air supply unit.

[0074] The branching chamber 25 is connected to the plurality of induction and radiation units 6 via the ducts 7. A return air port 26 is formed on the casing 24. The air supply fan 22 sends the outdoor air OA supplied from the outdoor air processing unit 4 and the return air RA introduced from the air-conditioned space S via the air inlet CI and the return air port 26 to cause the outdoor air OA and the return air RA to pass through the heat exchanger 20 and the humidifier 21 and then discharge to the ducts 7 from the branching chamber 25 and further flow into the induction and radiation units 6 via the ducts 7.

[0075] FIG. 4 is a perspective view illustrating an example of a configuration of the heat exchanger 20 of the air conditioner 5 according to Embodiment 1. FIG. 5 is a cross-sectional side view illustrating an example of a cross section of the heat exchanger 20 as viewed from arrow DA in FIG. 4. FIG. 6 is a cross-sectional view illustrating an example of a cross section of the heat exchanger 20 as viewed from arrow DB in FIG. 4. As illustrated in FIGS. 4 to 6, the heat exchanger 20 includes a fin group 27 and a flow dividing circuit 28. The fin group 27 includes multiple plate fins 29. The multiple plate fins 29 are disposed with gaps such that a heat-unexchanged

air BA such as the outdoor air OA and the return air RA, which is an air before being subjected to the heat exchange, passes the gaps. For example, the gaps between the plate fins 29 may extend in the air flow direction of the heat-unexchanged air BA. The flow dividing circuit 28 is configured to divide a heat transfer pipe group 30, which is a group of a plurality of heat transfer pipes through which the heat exchanging water W flows, into a plurality of groups G, and is further configured such that grouping ratios between the plurality of groups G is different from each other. Accordingly, heat transfer areas (the amount of heat exchanged) can be different between some or all of the groups G.

[0076] For example, as illustrated in FIGS. 5 and 6, the flow dividing circuit 28 divides the heat transfer pipe group 30 into a first group G (G1) indicated by a thicker dashed-dotted line and a second group G (G2) which is obtained by excluding the first group G1 from the heat transfer pipe group 30 and is indicated by a thinner dashed-dotted line. The first group G1 is a group having a smaller grouping ratio. The group having a smaller grouping ratio may be a group having a smaller grouping ratio than a certain group among the plurality of groups. For example, the first group G1 may be a group having the smallest grouping ratio, which is a single group. The second group G2 is a group having a larger grouping ratio, for example, a group having a larger grouping ratio than the first group G1. For example, the heat transfer pipe group 30 meanders in a zigzag manner so as to traverse the air flow direction of the heat-unexchanged air BA, and is connected to the plate fins 29 of the fin group 27. A straight pipe portion of the heat transfer pipe constituting the heat transfer pipe group 30 is preferably formed as an elliptical pipe, but may be formed as a circular pipe.

[0077] The grouping ratio may be a ratio of the heat transfer pipes. The ratio of the heat transfer pipes may be a ratio such as a ratio of the total amount of a critical flow rate of the heat transfer pipes of each group to the total amount of a critical flow rate of all the heat transfer pipes, a ratio of the total number of the heat transfer pipes of each group to the total number of all the heat transfer pipes, a ratio of the total amount of a flow passage cross-sectional area of the heat transfer pipes of each group to the total amount of a flow passage cross-sectional area of all the heat transfer pipes, a ratio of the total length of the heat transfer pipes of each group to the total length of all the heat transfer pipes, a ratio of the total amount of a heat transfer area as a surface area of the heat transfer pipes of each group to the total amount of a heat transfer area of all the heat transfer pipes, and a ratio of the total volume of a heat-exchangeable region of the heat transfer pipes of each group to the total volume of a heat-exchangeable region of all the heat transfer pipes. The critical flow rate of the heat transfer pipe may be an upper limit of the flow rate of the heat exchanging water W that can flow through the heat transfer pipe.

[0078] An inlet of the heat exchanging water W of the first group G1 is connected to a first branching header

31a of branching headers 31. An inlet of the heat exchanging water W of the second group G2 is connected to a second branching header 31b. An outlet of the heat exchanging water W of the first group G1 and an outlet of the heat exchanging water W of the second group G2 are both connected to a confluence header 32. The branching headers 31a and 31b are respectively connected to the outgoing piping 12 of the water piping 11 via valves 33a and 33b of the valves 33. The confluence header 32 is connected to the return piping 13 of the water piping 11. The temperature-adjusted heat exchanging water W to be sent from the water heat source facility 200 flows through the outgoing piping 12, and the heat exchanging water W after the heat exchange to be sent from the heat exchanger 20 to the water heat source facility 200 flows through the return piping 13.

[0079] The valves 33a and 33b may be proportional control valves capable of steplessly adjusting the flow rate (for example, a valve opening degree), and are provided in each group G of the flow dividing circuit 28. An increase and a decrease in cooling capacity and heating capacity of the air conditioner 5 are adjusted by combining flow rate control of the heat exchanging water W flowing through the flow dividing circuit 28 and air flow control of the air supply of the air supply fan 22. The flow dividing circuit 28 forms, in the second group G2, a plurality of non-overlapping zones F which are zones that do not overlap with the first group G1 when viewed in the air flow direction (a direction of a dashed arrow in FIG. 5) of the air passing through the heat exchanger 20. The plurality of non-overlapping zones F are located such that the first group G1 is sandwiched between the non-overlapping zones F.

[0080] FIG. 7 is a cross-sectional side view illustrating an example of a configuration of the outdoor air processing unit 4 according to Embodiment 1. As illustrated in FIGS. 3 and 7, the outdoor air processing unit 4 includes the heat pump 50, a humidifier 40, an outdoor air supply fan 41, a heat source air exhaust fan 42, a rotation controller 43, and a casing 45, and a slide mechanism 46. The humidifier 40 humidifies the outdoor air OA. The outdoor air supply fan 41 supplies the outdoor air OA to the air conditioner 5 from the outdoor air processing unit 4. The heat source air exhaust fan 42 exhausts, as an exhaust air EA, the return air RA to the outdoor. The rotation controller 43 adjusts the supply air volume and the exhaust air volume by steplessly or stepwisely controlling rotational speeds of the outdoor air supply fan 41 and the heat source air exhaust fan 42. The casing 45 accommodates the heat pump 50, the humidifier 40, the outdoor air supply fan 41, the heat source air exhaust fan 42, the rotation controller 43, and the slide mechanism 46. The slide mechanism 46 is a mechanism for taking the heat pump 50 in and out of a bottom of the casing 45. A return air port 54 for introducing the return air RA is formed on the casing 45.

[0081] The slide mechanism 46 includes a frame 47 to which the heat pump 50 is attached, and a damper 48

for moving the frame 47 up and down. The damper 48 is provided across the casing 45 and the frame 47. For example, in maintenance and inspection of the outdoor air processing unit 4, an inspection door 44 provided on the ceiling board CB is opened, an exterior plate 49 that closes an opening on a bottom surface of the casing 45 is removed, and the heat pump 50 is moved down together with the frame 47 by using the slide mechanism 46. The damper 48 expands and contracts with a pressure of gas or oil, and reduces a physical burden on a worker.

[0082] As illustrated in FIG. 3, in the present embodiment, the heat pump 50 includes an outdoor air heat exchanger 51, a heat source air heat exchanger 52, and a compressor 53. The heat pump 50 is an integrated type heat pump in which the outdoor air heat exchanger 51, the heat source air heat exchanger 52, and the compressor 53 are integrated, but is not limited thereto. The integrated type heat pump 50 does not require a refrigerant piping work. The outdoor air supply fan 41 is configured to introduce the outdoor air OA from the outdoor via the duct 7 and send the outdoor air OA to cause the outdoor air OA to pass through the outdoor air heat exchanger 51 and cause the passed outdoor air OA to discharge from the outdoor air processing unit 4 to the duct 7 and further flow into the air conditioner 5 via the duct 7. The heat source air exhaust fan 42 is configured to introduce the return air RA from the air-conditioned space S via the air inlet CI and the return air port 54 and send the return air RA to cause the return air RA to pass through the heat source air heat exchanger 52 and cause the passed return air RA to discharge to the duct 7 from the outdoor air processing unit 4 and be exhausted to the outdoor via the duct 7.

[0083] The heat pump 50 repeatedly performs compression, condensation, expansion, and evaporation processes on the heat exchanging refrigerant in this order. The heat pump 50 absorbs heat from the air that exchanges the heat with the refrigerant in a refrigerant evaporation process, and radiates heat to the air in a refrigerant condensation process. Such a heat pump 50 includes at least component elements of the outdoor air heat exchanger 51 and the heat source air heat exchanger 52 that perform different processes from each other which are the refrigerant evaporation process and the refrigerant condensation processes, the compressor 53 that compresses and feeds the refrigerant, a pressure reduction mechanism 55 such as an expansion valve that expands the refrigerant, and a switching mechanism 56 such as a valve for alternating the evaporation process and the condensation process between the outdoor air heat exchanger 51 and the heat source air heat exchanger 52. This heat pump 50 is configured to connect these component elements via piping such that the refrigerant is circulated.

[0084] Similar to the heat exchanger 20 of the air conditioner 5, the outdoor air heat exchanger 51 and the heat source air heat exchanger 52 each have a structure in which the heat transfer pipe group through which the heat

exchanging refrigerant flows is connected to the fin group through which the air passes. In the outdoor air heat exchanger 51 and the heat source air heat exchanger 52, the heat is exchanged between the heat exchanging refrigerant and the flowing air via the heat transfer pipe group and the fin group (not illustrated). The heat transfer pipes constituting the heat transfer pipe group are preferably formed as elliptical pipes, but may be formed as circular pipes or the like. An increase or a decrease in cooling capacity and heating capacity of the outdoor air processing unit 4 are adjusted by combining the control of the cooling capacity or the heating capacity of the outdoor air heat exchanger 51 for the outdoor air OA and the control of the supply air volume of the outdoor air supply fan 41.

[0085] FIG. 8 is a perspective view illustrating an example of a configuration of the induction and radiation unit 6 according to Embodiment 1. FIG. 9 is a cross-sectional view of the induction and radiation unit 6 of FIG. 8, and the cross-sectional view illustrates a cross section perpendicular to the air flow direction (a direction of dashed arrow in FIG. 8) of the supply air SA. As illustrated in FIGS. 8 and 9, the induction and radiation unit 6 includes an air supply part 60, an air induction part 61, and an air mixing part 62. In the present embodiment, the induction and radiation unit 6 is disposed in a state in which a bottom surface of the air mixing part 62 is exposed from the opening of the ceiling board CB and faces the air-conditioned space S.

[0086] The air supply part 60, the air induction part 61, and the air mixing part 62 are configured such that the supply air SA which is the air supplied from the air conditioner 5 to the air supply part 60 is ejected into the air mixing part 62 through the air induction part 61. In the air supply part 60, an air jet is generated from the supply air SA. The air induction part 61 is configured to communicate with the air-conditioned space S and to introduce the return air RA of the air-conditioned space S. In the air induction part 61, a supply air jet SA draws the return air RA of the air-conditioned space S into the air induction part 61 by the induction action, and is mixed with the return air RA. The air mixing part 62 includes plates 63 that absorb and store heat of an air mixture of the supply air jet SA and the return air RA, and a group of through-holes 64 opened to the air-conditioned space S. In the air mixing part 62, the air mixture is discharged to the air-conditioned space S via the through-holes 64 while radiating heat to the air-conditioned space S via the plates 63.

[0087] As illustrated in FIGS. 2 and 5, the control device 300 includes, as component elements, a setting part 70, an air condition detection part 71, a water condition detection part 72, an air conditioning control part 73, a temperature compensation part 74, an energy consumption monitoring part 75, and a heat source control part 76. The aforementioned elements include a microprocessor, various sensors, switches, other control devices and so on. For example, some or all of functions of the afore-

mentioned elements may be realized by a computer system (not shown) that includes a processor such as a Central Processing Unit (CPU), a volatile memory such as a Random Access Memory (RAM), a nonvolatile memory such as a Read-Only Memory (ROM) and so on. Such functions may be realized by the CPU executing a program recorded in the ROM by using the RAM as a work area. Alternatively, some or all of the functions of the aforementioned elements may be realized by a dedicated hardware circuit such as an electronic circuit or an integrated circuit or the like, or may be realized by a combination of the computer system and the hardware circuit.

[0088] The setting part 70 sets a temperature and a humidity of the air-conditioned space S and a temperature difference of the heat exchanging water W before and after the heat exchange. The air condition detection part 71 includes a return air sensor 77 that detects the temperature and the humidity of the air (return air RA) of the air-conditioned space S. The water condition detection part 72 includes a flow meter 78 that detects a flow rate of the heat exchanging water W in each air-conditioned space S, and water temperature meters 79 that detect temperatures of the heat exchanging water W at the inlet and the outlet of the heat exchanger 20. The flow meter 78 is provided at the outgoing piping 12 or the return piping 13 of each air-conditioned space S, and the water temperature meters 79 are provided at the outgoing piping 12 and the return piping 13 connected to the heat exchanger 20 of each air conditioner 5. The water condition detection part 72 may include a calorimeter in which the flow meter 78 and the water temperature meters 79 are integrated.

[0089] The air conditioning control part 73 controls the temperature and the humidity of the air-conditioned space S. Specifically, the air conditioning control part 73 controls the cooling capacity and the heating capacity of the air conditioning equipment 100 and the humidification amounts of the humidifiers 21 and 40 of the air conditioning equipment 100 such that the temperature and the humidity of the air of the air-conditioned space S detected by the air condition detection part 71 become the temperature and the humidity of the air-conditioned space S set by the setting part 70. The air conditioning control part 73 is configured to perform control in first to fourth operation patterns, and controls the air conditioning of the air-conditioned space S by switching or combining the first to fourth operation patterns. The first operation pattern is an operation pattern in which the operation and the stop of the air conditioning equipment 100 are performed for each set of the air conditioning equipment 100. The second operation pattern is an operation pattern in which a single operation of the outdoor air processing unit 4 and a simultaneous operation of the outdoor air processing unit 4 and the air conditioner 5 are switched. The third operation pattern is an operation pattern in which the air conditioning equipment 100 being operated and the air conditioning equipment 100 being stopped are alternately operated. The fourth operation pattern is

an operation pattern in which the air conditioning capacity of one or both of the outdoor air processing unit 4 and the air conditioner 5 is increased or decreased.

[0090] For example, as differences (that is, air conditioning loads) between the temperature and the humidity of the air of the air-conditioned space S and the predetermined temperature and humidity are decreased, the air conditioning control part 73 reduces the air conditioning capacity while switching the operation pattern of the air conditioning equipment 100 in the order of the first operation pattern to the second operation pattern. For example, when the first operation pattern, the second operation pattern, and the fourth operation pattern are combined, control ranges of the temperature and the humidity of the air-conditioned space S are expanded, and more precise air conditioning is executable. When the third operation pattern is additionally combined with these operation patterns, the operation is not biased only to the specific air conditioning equipment 100.

[0091] In the aforementioned operation patterns, the outdoor air processing unit 4 operates while operating the compressor 53 of the heat pump 50, the outdoor air supply fan 41, and the heat source air exhaust fan 42. The air conditioner 5 operates while causing the heat exchanging water W to flow through the heat exchanger 20 by opening the valves 33a and 33b and operating the air supply fan 22. The outdoor air processing unit 4 is stopped by stopping the compressor 53 of the heat pump 50. The air conditioner 5 is stopped by completely closing the valves 33a and 33b and stopping the flow of the heat exchanging water W thorough the heat exchanger 20.

[0092] The temperature compensation part 74 controls the temperature difference of the heat exchanging water W before and after the heat exchange in the heat exchanger 20 of the air conditioner 5 and the supply air volume of the air conditioner 5. Specifically, in the case of a low air conditioning load, the temperature compensation part 74 performs control such that the temperature difference of the heat exchanging water W before and after the heat exchange caused by the heat exchange of the heat exchanger 20 is constant by increasing or decreasing the flow rate of the heat exchanging water W in the first group G1 of the flow dividing circuit 28. The temperature compensation part 74 controls the temperature of the air-conditioned space S by increasing or decreasing the supply air volume to the air conditioner 5. In the case of a high air conditioning load, the temperature compensation part 74 performs control such that the temperature difference of the heat exchanging water W is constant by increasing or decreasing the flow rate of the heat exchanging water W in all the groups G. In the case of a normal air conditioning load between the high air conditioning load and the low air conditioning load, the temperature compensation part 74 performs control such that the temperature difference of the heat exchanging water W is constant by increasing or decreasing the flow rate of the heat exchanging water W in the second group G2. Accordingly, the temperature compensation part 74

can widely cope with a small water amount and large temperature difference operation of the air conditioner 5 from the case of the high air conditioning load requiring a maximum heat exchange amount such as midsummer and midwinter to the case of the low air conditioning load requiring a small heat exchange amount such as intermediate seasons.

[0093] The energy consumption monitoring part 75 calculates the energy consumption for each air-conditioned space S and outputs it as data based on the flow rate of the heat exchanging water W supplied to the heat exchanger 20 of the air conditioner 5 and the temperature difference of the heat exchanging water W before and after the heat exchange caused by the heat exchange of the heat exchanger 20. The heat source control part 76 outputs a command such as a signal for increasing or decreasing the number of the heat source devices 210 to be operated according to the increase or decrease of the energy consumptions of all the air-conditioned spaces S output by the energy consumption monitoring part 75.

[0094] FIG. 10 is a flowchart illustrating an example of an air conditioning operation of the air conditioning system 1 according to Embodiment 1. In step S101, the control device 300 of the air conditioning system 1 starts the air conditioning operation of the air conditioning system 1. Subsequently, in step S102, first, the control device 300 starts a warm-up operation of the air conditioning system 1. At this time, the control device 300 operates only the air conditioner 5 without operating the outdoor air processing unit 4 and maximizes the flow rate of the heat exchanging water W of the heat exchanger 20 and the supply air volume of the air supply fan 22. When the temperature (that is, the return air temperature) of the air-conditioned space S falls within a predetermined allowable range of the return air temperature, the control device 300 starts the operation of the outdoor air processing unit 4. That is, the control device 300 starts the main operation of the air conditioning system 1.

[0095] Subsequently, in step S103, the control device 300 determines whether or not the temperature difference (water temperature difference) of the heat exchanging water W before and after the heat exchange caused by the heat exchange of the heat exchanger 20 of the air conditioner 5 falls within a predetermined allowable range of the water temperature difference. The control device 300 proceeds to step S104 when the water temperature difference falls within the allowable range (YES in step S 103), and proceeds to step S105 when the water temperature difference is out of the allowable range (NO in step S103).

[0096] In step S105, the control device 300 controls the flow rate of the heat exchanging water W of the heat exchanger 20 such that the water temperature difference approaches the aforementioned allowable range. In step S104, the control device 300 determines whether or not the return air temperature falls within the predetermined allowable range of the return air temperature. When the

return air temperature falls within the allowable range (YES in step S 104), the control device 300 returns to step S103, and repeats the processing of step S103 and the subsequent steps. The control device 300 proceeds to step S106 when the return air temperature is out of the allowable range (NO in step S104).

[0097] In step S106, the control device 300 controls the supply air volume from the air supply fan 22 such that the return air temperature approaches the aforementioned allowable range. The control device 300 repeats the processing of steps S103 to S106 until the air conditioning operation of the air conditioning system 1 is stopped, that is, until the air conditioning operation of the air conditioner 5 is stopped.

Embodiment 2

[0098] An air conditioning system 1A according to Embodiment 2 will be described. Hereinafter, the present embodiment will be described focusing on points different from those of Embodiment 1, and the description of the same points as those of Embodiment 1 will be appropriately omitted. FIG. 11 is a plan view illustrating an example of a configuration of the air conditioning system 1A according to Embodiment 2. FIG. 12 is a side view illustrating an example of the configuration of the air conditioning system 1A according to Embodiment 2. FIG. 13 is a plan view illustrating an example of the configuration of the air conditioning equipment 100A according to Embodiment 2.

[0099] As illustrated in FIGS. 11 and 12, the air conditioning system 1A includes air conditioning equipment 100A, a heat exchange unit 500, the water heat source facility 200, and a control device 300A. Two or more sets of air conditioning equipment 100A are disposed on the ceiling of one or a plurality of air-conditioned spaces S in the building BL. The heat exchange unit 500 is disposed in a machine room R of the building BL. The air conditioning system 1A is configured such that the air conditioning equipment 100A and the heat exchange unit 500 are disposed at different places, and constitutes a separately installed air conditioning system.

[0100] The air conditioning equipment 100A includes a set of an outdoor air processing unit 4, a fan unit 8, and induction and radiation units 6. The heat exchange unit 500 includes a heat exchanger 20A for the heat exchanging water W. The heat exchanger 20A has the same configuration as that of the heat exchanger 20 according to Embodiment 1, and cools or heats the outdoor air OA supplied from the outdoor air processing unit 4 and the return air RA of the air-conditioned space S by exchanging heat between the heat exchanging water W and the outdoor air OA and the return air RA. The heat exchange unit 500 discharges, as the air-conditioning air, the air mixture of the outdoor air OA and the return air RA after the heat exchange. Instead of the air mixture, the heat exchange unit 500 may discharge, as the air-conditioning air, any one of only the outdoor air OA after the heat

exchange, only the return air RA after the heat exchange, only the outdoor air OA of which heat is not exchanged by using the heat exchanging water W, only the return air RA of which heat is not exchanged by using the heat exchanging water W, and an air mixture of the outdoor air OA and the return air RA of which heat is not exchanged by using the heat exchanging water W.

[0101] The fan unit 8 sends, as the supply air SA, the air-conditioning air discharged from the heat exchange unit 500 to the induction and radiation units 6. The configurations of the outdoor air processing unit 4 and the induction and radiation unit 6 are the same as those of Embodiment 1.

[0102] The induction and radiation units 6, the fan unit 8, the machine room R, the heat exchange unit 500, the outdoor air processing unit 4, and the outdoor space are connected to each other via the ducts 7 such that the air flows therebetween.

[0103] The water heat source facility 200 supplies the heat exchanging water W to the heat exchanger 20A of the heat exchange unit 500, and has the same configuration as that of the water heat source facility 200 according to Embodiment 1. The heat source devices 210 of the water heat source facility 200 adjust the temperature of the heat exchanging water W by cooling or heating the heat exchanging water W to be supplied to the heat exchanger 20A. The circulation equipment 220 circulates the heat exchanging water W between the heat source devices 210 and the heat exchange unit 500.

[0104] As illustrated in FIG. 13, the heat exchange unit 500 includes the heat exchanger 20A, valves 33A, a humidifier 21A, and a casing 24A. The valves 33A adjust the flow rate of the heat exchanging water W flowing into the heat exchanger 20A. The humidifier 21A humidifies the air passed through the heat exchanger 20A. The casing 24A accommodates the heat exchanger 20A and the humidifier 21A therein. An outdoor air port 16A and a return air port 26A are formed on the casing 24A. The machine room R is used as an air mixing chamber, and the return air RA of the air-conditioned space S can be introduced into the machine room R from an air inlet 17A formed at the machine room R.

[0105] The fan unit 8 includes an air supply fan 22A, a rotation controller 23A, and a branching chamber 25A. The rotation controller 23A adjusts the supply air volume by steplessly and stepwisely controlling a rotational speed of the air supply fan 22A. The branching chamber 25A divides the air flow. The branching chamber 25A is connected to the plurality of induction and radiation units 6 via the ducts 7. The air supply fan 22A sends the outdoor air OA supplied from the outdoor air processing unit 4 and the return air RA introduced from the air-conditioned space S via the air inlet 17 and the return air port 26A to cause the outdoor air OA and the return air RA to pass through the heat exchanger 20A and the humidifier 21A of the heat exchange unit 500 and then discharge to the ducts 7 from the branching chamber 25A and further flow into the induction and radiation units 6 via the

ducts 7.

[0106] FIG. 14 is a cross-sectional side view illustrating an example of a configuration of the heat exchanger 20A of the heat exchange unit 500 according to Embodiment 2 similarly to FIG. 5. FIG. 15 is a cross-sectional view illustrating an example of the configuration of the heat exchanger 20A of the heat exchange unit 500 according to Embodiment 2 similarly to FIG. 6. As illustrated in FIGS. 14 and 15, the heat exchanger 20A has the same configuration as that of the heat exchanger 20 according to Embodiment 1.

[0107] As illustrated in FIG. 13, the configuration of the outdoor air processing unit 4 is the same as that of Embodiment 1. The configuration of the heat pump 50 is also the same as that of Embodiment 1. The outdoor air supply fan 41 of the outdoor air processing unit 4 is configured to supply the outdoor air OA to the heat exchange unit 500 from the outdoor air processing unit 4. Specifically, the outdoor air supply fan 41 sends the outdoor air OA introduced from the outdoor via the ducts 7 to cause the outdoor air OA to pass through the outdoor air heat exchanger 51 and cause the passed outdoor air OA to discharge to the duct 7 from the outdoor air processing unit 4 and further flow into the heat exchange unit 500 via the duct 7 and the machine room R. Although it has been described in the illustrated example that the machine room R and the outdoor air processing unit 4 are connected via the duct 7, the outdoor air processing unit 4 and the heat exchange unit 500 may be connected via the duct 7.

[0108] The configuration of the induction and radiation unit 6 is the same as that of Embodiment 1. The air supply part 60, the air induction part 61, and the air mixing part 62 of the induction and radiation unit 6 are configured such that the supply air SA which is the air to be supplied from the heat exchange unit 500 to the air supply part 60 is ejected into the air mixing part 62 through the air induction part 61. An air jet is generated from the supply air SA by the air supply part 60.

[0109] As illustrated in FIGS. 12 and 14, the control device 300A includes the setting part 70, the air condition detection part 71, the water condition detection part 72, the air conditioning control part 73, the temperature compensation part 74, the energy consumption monitoring part 75, and the heat source control part 76, as in Embodiment 1. The flow meter 78 of the water condition detection part 72 is provided at the outgoing piping 12 or the return piping 13 of each air-conditioned space S. The water temperature meters 79 are provided at the outgoing piping 12 and the return piping 13 connected to the heat exchanger 20A of each heat exchange unit 500, and detects the inlet water temperature and the outlet water temperature of the heat exchanging water W of the heat exchanger 20A.

[0110] The air conditioning control part 73 controls the cooling capacity and the heating capacity of the heat exchange unit 500 and the outdoor air processing unit 4 and the humidification amounts of the humidifiers 21A

and 40 of the heat exchange unit 500 and the outdoor air processing unit 4 such that the temperature and the humidity of the air of the air-conditioned space S detected by the air condition detection part 71 become the temperature and the humidity of the air-conditioned space S set by the setting part 70. The air conditioning control part 73 controls the air conditioning of the air-conditioned space S by switching or combining the first to fourth operation patterns. The first operation pattern is an operation pattern in which the operation and the stop of the air conditioning equipment 100A are performed for each set of the air conditioning equipment 100A. The second operation pattern is an operation pattern in which a single operation of the outdoor air processing unit 4 and a simultaneous operation of the outdoor air processing unit 4 and the heat exchange unit 500 are switched. The third operation pattern is an operation pattern in which the air conditioning equipment 100A being operated and the air conditioning equipment 100A being stopped are alternately operated. The fourth operation pattern is an operation pattern in which the air conditioning capacity of one or both of the outdoor air processing unit 4 and the heat exchange unit 500 is increased or decreased.

[0111] In the aforementioned operation patterns, the outdoor air processing unit 4 operates while operating the compressor 53 of the heat pump 50, the outdoor air supply fan 41, and the heat source air exhaust fan 42. The heat exchange unit 500 operates while causing the heat exchanging water W to flow through the heat exchanger 20A by opening the valves 33a and 33b of the valves 33A and operating the air supply fan 22A of the fan unit 8. The outdoor air processing unit 4 is stopped by stopping the compressor 53 of the heat pump 50. The heat exchange unit 500 is stopped by completely closing the valves 33a and 33b and stopping the flow of the heat exchanging water W through the heat exchanger 20A.

[0112] The temperature compensation part 74 controls the temperature difference of the heat exchanging water W before and after the heat exchange in the heat exchanger 20A of the heat exchange unit 500 and the supply air volume of the heat exchange unit 500. Specifically, in the case of the low air conditioning load, the temperature compensation part 74 performs control such that the temperature difference of the heat exchanging water W before and after the heat exchange caused by the heat exchange of the heat exchanger 20A is constant by increasing or decreasing the flow rate of the heat exchanging water W in the first group G1 of the flow dividing circuit 28 of the heat exchanger 20A. The temperature compensation part 74 controls the temperature of the air-conditioned space S by controlling the fan unit 8 to increase or decrease the supply air volume from the heat exchange unit 500. In the case of a high air conditioning load, the temperature compensation part 74 performs control such that the temperature difference of the heat exchanging water W is constant by increasing or decreasing the flow rate of the heat exchanging water W in all the groups G. In the case of a normal air conditioning

load, the temperature compensation part 74 performs control such that the temperature difference of the heat exchanging water W is constant by increasing or decreasing the flow rate of the heat exchanging water W in the second group G2. Accordingly, the temperature compensation part 74 can widely cope with a small water amount and large temperature difference operation of the heat exchange unit 500 from the case of the high air conditioning load to the case of the low air conditioning load.

[0113] The energy consumption monitoring part 75 calculates the energy consumption for each air-conditioned space S based on the flow rate of the heat exchanging water W supplied to the heat exchanger 20A of the heat exchange unit 500 and the temperature difference of the heat exchanging water W before and after the heat exchange caused by the heat exchange of the heat exchanger 20A, and outputs it as data. The function of the heat source control part 76 is the same as that of Embodiment 1.

[0114] FIG. 16 is a flowchart illustrating an example of an air conditioning operation of the air conditioning system 1A according to Embodiment 2. In step S201, the control device 300A of the air conditioning system 1A starts the air conditioning operation of the air conditioning system 1A. Subsequently, in step S202, first, the control device 300A starts a warm-up operation of the air conditioning system 1A by operating only the heat exchange unit 500 without operating the outdoor air processing unit 4. At this time, the control device 300A performs control such that the flow rate of the heat exchanging water W of the heat exchanger 20A and the supply air volume of the air supply fan 22A are maximized. When the return air temperature of the air-conditioned space S falls within the predetermined allowable range of the return air temperature, the control device 300A starts the operation of the outdoor air processing unit 4 and starts the main operation of the air conditioning system 1A.

[0115] Subsequently, in step S203, the control device 300A determines whether or not the water temperature difference of the heat exchanging water W before and after the heat exchange caused by the heat exchange of the heat exchanger 20A of the heat exchange unit 500 falls within a predetermined allowable range. The control device 300A proceeds to step S204 when the water temperature difference falls within the allowable range (YES in step S203), and proceeds to step S205 when the water temperature difference is out of the allowable range (NO in step S203).

[0116] In step S205, the control device 300A controls the flow rate of the heat exchanging water W of the heat exchanger 20A such that the water temperature difference approaches the aforementioned allowable range. In step S204, the control device 300A determines whether or not the return air temperature falls within a predetermined allowable range. The control device 300A returns to step S203 when the return air temperature falls within the allowable range (YES in step S204), and pro-

ceeds to step S206 when the return air temperature is out of the allowable range (NO in step S204). When the control device 300A returns to step S203, the control device 300A repeats the processing of step S203 and the subsequent steps.

[0117] In step S206, the control device 300A controls the supply air volume of the air supply fan 22A of the fan unit 8 such that the return air temperature approaches the allowable range. The control device 300A repeats the processing of steps S203 to S206 until the air conditioning operation of the heat exchange unit 500 is stopped.

[0118] In Embodiment 2, the air conditioning equipment 100A is constituted by a set of the outdoor air processing unit 4, the fan unit 8, and the induction and radiation unit 6, but is not limited thereto. For example, as illustrated in FIG. 17, the air conditioning equipment 100A may be constituted by a set of the outdoor air processing unit 4, the heat exchange unit 500, the fan unit 8, and the induction and radiation unit 6. FIG. 17 is a plan view illustrating an example of a configuration of an air conditioning system 1A according to a modification example of Embodiment 2.

Embodiment 3

[0119] An air conditioning system 1B according to Embodiment 3 will be described. Hereinafter, the present embodiment will be described focusing on points different from those of Embodiments 1 and 2, and the description of the same points as those of Embodiments 1 and 2 will be appropriately omitted. FIG. 18 is a plan view illustrating an example of a configuration of the air conditioning system 1B according to Embodiment 3. FIG. 19 is a side view illustrating an example of the configuration of the air conditioning system 1B according to Embodiment 3. FIG. 20 is a plan view illustrating an example of a configuration of air conditioning equipment 100B according to Embodiment 3. FIG. 21 is a diagram illustrating an example of a configuration of the outdoor air heat exchanger 51 according to Embodiment 3.

[0120] As illustrated in FIGS. 18 to 20, the air conditioning system 1B includes air conditioning equipment 100B, the water heat source facility 200, and a control device 300B. Two or more sets of air conditioning equipment 100B are disposed on the ceiling of one or a plurality of air-conditioned spaces S in the building BL. Specifically, the air conditioning equipment 100B is disposed in the ceiling plenum space CS. Although not illustrated in FIGS. 18 to 20, the water heat source facility 200 has the same configuration as that of the water heat source facility 200 according to Embodiment 1, and supplies the heat exchanging water W to radiation air conditioners 9 of the air conditioning equipment 100B.

[0121] The air conditioning equipment 100B includes the radiation air conditioners 9 and the outdoor air processing unit 4. In the present embodiment, the air conditioning equipment 100B includes a plurality of radi-

ation air conditioners 9, and the plurality of radiation air conditioners 9 included in one set of air conditioning equipment 100B constitute an air conditioner group B. The radiation air conditioners 9, the outdoor air processing unit 4, and the outdoor space are connected to each other via the ducts 7 such that the air flows therebetween.

[0122] The radiation air conditioner 9 cools or heats the air-conditioning air such as the outdoor air OA and the return air RA by using the heat exchanging water W, and radiates the heat of the air-conditioning air after the heat exchange while discharging the said air-conditioning air to the air-conditioned space S. The outdoor air processing unit 4 includes the heat pump 50 that cools or heats the outdoor air OA and the return air RA by using the heat exchanging refrigerant, and supplies the outdoor air OA and the return air RA after the heat exchange in the heat pump 50 to the air-conditioned space S through the radiation air conditioners 9. At this time, the outdoor air processing unit 4 may supply, to the air-conditioned space S, any one of only the outdoor air OA after the heat exchange in the heat pump 50, only the return air RA after the aforementioned heat exchange, the air mixture of the outdoor air OA and the return air RA after the aforementioned heat exchange, only the outdoor air OA which is not subjected to the aforementioned heat exchange, only the return air RA which is not subjected to the aforementioned heat exchange, and the air mixture of the outdoor air OA and the return air RA which is not subjected to the aforementioned heat exchange. The air inlet CI through which the return air RA is introduced from the air-conditioned space S to the ceiling plenum space CS, and inspection doors (not illustrated) for maintaining the radiation air conditioners 9 and the outdoor air processing unit 4 are disposed on the ceiling board CB above the air-conditioned space S.

[0123] As illustrated in FIG. 20, the outdoor air processing unit 4 includes the humidifier 40, the outdoor air supply fan 41, the heat source air exhaust fan 42, the casing 45, and the slide mechanism 46 in addition to the heat pump 50, as in Embodiment 1. The outdoor air supply fan 41 supplies the outdoor air OA from the outdoor air processing unit 4 to the radiation air conditioner 9. The heat pump 50 includes the outdoor air heat exchanger 51, the heat source air heat exchanger 52, and the compressor 53, as in Embodiment 1. The outdoor air supply fan 41 sends the outdoor air OA introduced from the outdoor via the duct 7 to cause the outdoor air OA to pass through the outdoor air heat exchanger 51 and cause the passed outdoor air OA to discharge to the duct 7 from the outdoor air processing unit 4 and further flow into the radiation air conditioners 9 via the ducts 7. The heat source air exhaust fan 42 sends the return air RA introduced from the air-conditioned space S via the air inlet CI and the ceiling chamber, etc., to cause the return air RA to pass through the heat source air heat exchanger 52 and cause the passed return air RA to discharge to the duct 7 from the outdoor air processing unit and be exhausted to the outdoor via the duct 7.

[0124] As illustrated in FIGS. 20 and 21, the outdoor air heat exchanger 51 includes a group of multiple-plate-like heat transfer plates 22B through which the air, and a group of multiple heat transfer pipes 23B connected to the heat transfer plates 22B, similarly to a known plate fin coil. The refrigerant flowing within the heat transfer pipes 23B and the air passing within the outdoor air heat exchanger 51 exchange heat via the pipe walls of the heat transfer pipes 23B and the heat transfer plates 22B. An outer peripheral shape of the heat transfer pipe 23B is preferably elliptical, but may be circular and so on. The increase or the decrease in capacity to cool or heat the air in the outdoor air heat exchanger 51 are adjusted by changing a rotational speed of the compressor 53 by using an inverter (not illustrated). The heat source air heat exchanger 52 may have the same configuration as that of the outdoor air heat exchanger 51.

[0125] FIG. 22 is a bottom perspective view illustrating an example of a configuration of the radiation air conditioner 9 according to Embodiment 3. FIG. 23 is a bottom view of the radiation air conditioner 9 illustrated in FIG. 22. FIG. 24 is a cross-sectional view of the radiation air conditioner 9 illustrated in FIG. 23 taken along line X-X. FIG. 25 is a cross-sectional view of the radiation air conditioner 9 illustrated in FIG. 24 taken along line Y-Y. FIG. 26 is a cross-sectional view of the radiation air conditioner 9 illustrated in FIG. 24 taken along line Z-Z.

[0126] As illustrated in FIGS. 19, 20, and 22 to 26, the radiation air conditioner 9 includes an air conditioning heat exchanger 24B, a radiation part 25B, an air-conditioning air supply fan 26B, a drain pan 27B, and a casing 28B. The casing 28B accommodates the air-conditioning heat exchanger 24B, the radiation part 25B, the air-conditioning air supply fan 26B, and the drain pan 27B.

[0127] The air-conditioning air supply fan 26B supplies the outdoor air OA and the return air RA via the radiation part 25B. Specifically, the air-conditioning air supply fan 26B sends the outdoor air OA supplied from the outdoor air processing unit 4 and the return air RA introduced from the air-conditioned space S via the air inlet CI and the ceiling chamber to cause the outdoor air OA and the return air RA to pass through the air-conditioning heat exchanger 24B and cause the passed outdoor air OA and return air RA to flow into the radiation part 25B.

[0128] The air-conditioning heat exchanger 24B cools or heats the outdoor air OA supplied from the outdoor air processing unit 4 and the return air RA of the air-conditioned space S by using the heat exchanging water W. For example, the air-conditioning heat exchanger 24B may have the same structure as that of the outdoor air heat exchanger 51 illustrated in FIG. 21, and may include heat transfer plates 29B and heat transfer pipes 30B. The heat transfer plates 29B correspond to the heat transfer plates 22B of FIG. 21, and the heat transfer pipes 30B correspond to the heat transfer pipes 23B of FIG. 21. Therefore, the illustration of the configuration of the air-conditioning heat exchanger 24B is omitted. Such an air-conditioning heat exchanger 24B exchanges heat be-

tween the heat exchanging water W flowing within the heat transfer pipes 30B and the air passing through the air-conditioning heat exchanger 24B via the pipe walls of the heat transfer pipes 30B and the heat transfer plates 29B. The increase or the decrease in capacity to cool or heat the air in each air-conditioning heat exchanger 24B are adjusted by operating an electric valve 31B (see FIG. 20) provided at the water piping 11 and changing the flow rate of the heat exchanging water W flowing within the heat transfer pipes 30B. The electric valve 31B is provided so as to correspond to each radiation air conditioner 9.

[0129] As illustrated in FIG. 24, the radiation part 25B includes a first chamber 32B, a second chamber 33B, and an air flow adjustment part 34B. The first chamber 32B is a chamber through which the air-conditioning air flows, and is a chamber into which the air-conditioning air flows from the air-conditioning heat exchanger 24B. The second chamber 33B is a chamber into which the air-conditioning air flows from the first chamber 32B, and radiates the heat of the air-conditioning air introduced from the first chamber 32B while discharging the said air-conditioning air to the air-conditioned space S. The air flow adjustment part 34B is configured to adjust a wind speed and distribution of the air-conditioning air flowing out into the second chamber 33B from the first chamber 32B. For example, the radiation air conditioner 9 is installed in a state in which the bottom surface of the second chamber 33B is exposed from the opening of the ceiling board CB toward the air-conditioned space S.

[0130] The air flow adjustment part 34B includes a group of first through-holes 35B that allows the air-conditioning air to be discharged therethrough to the second chamber 33B. The second chamber 33B includes a group of second through-holes 36B that allows the air-conditioning air to be discharged therethrough into the air-conditioned space S. The first chamber 32B includes a flat plate-shaped first ventilation part 37B that is disposed in contact with the second chamber 33B and discharges the air-conditioning air to the second chamber 33B. The group of the first through-holes 35B is formed in the first ventilation part 37B. The first chamber 32B is configured such that a cross-sectional area of the first chamber 32B (for example, an area in a direction parallel to a cut surface of the Y-Y cross section in FIG. 24) through which the air-conditioning air passes becomes narrower, that is, becomes smaller from a windward side (upstream side) to a leeward side (downstream side).

[0131] The second chamber 33B includes a second ventilation part 38B, a heat storage 39B, and a frame body 40B. The second ventilation part 38B has, for example, a flat plate shape, is disposed in contact with the air-conditioned space S, and is configured to discharge the air-conditioning air to the air-conditioned space S. The frame body 40B has a flanged configuration for attaching the second ventilation part 38B and the heat storage 39B to the ceiling board CB and so on. The group of the second through-holes 36B is formed in the second ventilation part 38B. An opening area of the group of the

second through-holes 36B is set to be larger than an opening area of the group of the first through-holes 35B. For example, the opening area of the group of the second through-holes 36B may be the sum of the opening areas of all the second through-holes 36B, and the opening area of the group of the first through-holes 35B may be the sum of the opening areas of all the first through-holes 35B. The opening area of each second through-hole 36B may be larger than the opening area of each first through-hole 35B, and the opening areas of some of the second through-holes 36B may be smaller than the opening area of the first through-hole 35B. The cross-sectional shapes of the first through-hole 35B and the second through-hole 36B can be freely changed to various shapes such as a true circle, an ellipse, an elongate hole, and a slot.

[0132] The heat storage 39B includes a group of plates 41B that can store and radiate the heat of the contact air-conditioning air. The plates 41B in the group of the plates 41B are disposed with gaps through which the air-conditioning air passes. The plates 41B and the second ventilation part 38B are made of a material such as aluminum having high heat transfer and thermal emissivity. The air-conditioning air passes through the group of the plates 41B in a straightened flow manner while being divided and diffused by the group of the plates 41B, and is discharged into the air-conditioned space S through the second through-holes 36B of the second ventilation part 38B. The heat of the air-conditioning air is transferred to the group of the plates 41B and the second ventilation part 38B, and the transferred heat is radiated from the group of the plates 41B and the second ventilation part 38B through the group of the second through-holes 36B to the air-conditioned space S.

[0133] Although not limited thereto, in the present embodiment, the first chamber 32B and the second chamber 33B are formed in a thin box shape, and the first chamber 32B and the second chamber 33B are disposed adjacent to each other in a thickness direction. In the illustrated example, the first chamber 32B and the second chamber 33B have a rectangular flat shape, but may be freely changed to various flat shapes such as an elongated shape, a square shape, and a round shape.

[0134] As illustrated in FIG. 20, the control device 300B includes a setting part 70B, an air condition detection part 71B, an air conditioning control part 73B, an air volume control part 77B, a humidification control part 78B, and a capacity control part 79B. The setting part 70B sets the temperature and the humidity of the air-conditioned space S. The air condition detection part 71B detects the temperature and the humidity of the air (return air RA) in the air-conditioned space S and the air blown out from the air conditioning equipment 100B. The air volume control part 77B controls the air volume of the fans 41, 42, and 26B of the air conditioning equipment 100B. The humidification control part 78B controls the humidification amount of the humidifier 40 of the air conditioning equipment 100B. The capacity control part 79B controls the capacity to cool or heat the outdoor air OA and the

return air RA using the air conditioning equipment 100B. The air-conditioning control part 73B sends a command to the air volume control part 77B, the humidification control part 78B, and the capacity control part 79B such that the temperature and the humidity of the air of the air-conditioned space S detected by the air condition detection part 71B reach the temperature and the humidity of the air-conditioned space S set by the setting part 70B.

[0135] The air-conditioning control part 73B is configured to perform control in the first to fifth operation patterns, and controls the air conditioning of the air-conditioned space S by switching or combining the first to fifth operation patterns. The first operation pattern is an operation pattern in which the operation and the stop of the air conditioning equipment 100B are performed for each set of the air conditioning equipment 100B. The second operation pattern is an operation pattern in which a single operation of the outdoor air processing unit 4 and a simultaneous operation of the outdoor air processing unit 4 and the radiation air conditioner 9 are switched. The third operation pattern is an operation pattern in which the air conditioning equipment 100B being operated and the air conditioning equipment 100B being stopped are alternately operated. The fourth operation pattern is an operation pattern in which the air conditioning capacity of one or both of the outdoor air processing unit 4 and the radiation air conditioner 9 is increased or decreased. The fifth operation pattern is an operation pattern in which the operation and the stop of the radiation air conditioner 9 are performed for each air conditioner group B.

[0136] For example, as the differences (that is, air conditioning loads) between the temperature and the humidity of the air of the air-conditioned space S and the predetermined temperature and humidity are decreased, the air conditioning control part 73B reduces the air conditioning capacity while switching the operation pattern of the air conditioning equipment 100B in the order of the first operation pattern, the second operation pattern, the third operation pattern, and the fourth operation pattern. For example, when the first operation pattern, the second operation pattern, the third operation pattern, and the fourth operation pattern are combined, the control ranges of the temperature and the humidity of the air-conditioned space S are expanded, and more precise air conditioning is executable. The third operation pattern is combined, and thus, the operation is not biased only to the specific air conditioning equipment 100B. The fifth operation pattern is realized by operating an electric two-way valve 42B (see FIG. 20) provided for each branch pipe of the water piping 11 that circulates the heat exchanging water W to the air conditioner group B.

Other embodiments

[0137] Although the embodiments of the present disclosure have been described, the present disclosure is not limited to the aforementioned embodiments and modification examples. That is, various modifications and im-

provements are possible within the scope of the present disclosure. For example, embodiments in which various modifications are implemented on the embodiments and the modification examples, and embodiments in which component elements in different embodiments and modification examples are combined are also included in the scope of the present disclosure.

[0138] For example, in Embodiments 1-3, the number of sets of air conditioning equipment may be increased or decreased according to the air conditioning capacity designed for the air conditioning system, or the outdoor air processing unit 4 may be appropriately omitted in any set of air conditioning equipment when the air conditioning capacity of the air conditioning system exceeds required air conditioning capacity. The air conditioning equipment may be disposed in the ceiling plenum space CS in a state in which the ceiling board CB is omitted.

[0139] Although it has been described in Embodiments 1 and 2 that the flow dividing circuits 28 of the heat exchangers 20 and 20A divide the heat transfer pipe group 30 into two groups G1 and G2 as the plurality of groups G, the heat transfer pipe group may be divided into three or more groups G. The grouping ratio of one of the groups G may be minimized.

[0140] Although it has been described in Embodiments 1-3 that the induction and radiation unit 6 and the radiation air conditioner 9 are disposed on the ceiling board CB, these component elements may be disposed on the wall surface of the wall WL constituting the air-conditioned space S.

[0141] As the present disclosure may be embodied in several forms without departing from the spirit of essential characteristics thereof, the present embodiments are therefore illustrative and not restrictive, since the scope of the disclosure is defined by the appended claims rather than by the description preceding them, and all changes that fall within metes and bounds of the claims, or equivalence of such metes and bounds thereof are therefore intended to be embraced by the claims.

Claims

1. An air conditioning system comprising:

an outdoor air processing unit that includes a heat pump capable of switching between a cooling operation and a heating operation, and exchanges heat of an outdoor air by a heat exchanging medium of the heat pump and supplies the outdoor air;

a heat exchanger that selectively allows a cold water or a hot water, which is a heat exchanging water, to flow therethrough;

an air supply unit that supplies the outdoor air supplied from the outdoor air processing unit and a return air of an air-conditioned space as an air-conditioning air by causing the outdoor air

- and the return air to exchange heat with the heat exchanging water of the heat exchanger; and a radiation unit that induces the return air of the air-conditioned space by using the air-conditioning air supplied from the air supply unit to generate an air mixture of the air-conditioning air and the return air, and radiates heat of the air mixture while discharging the air mixture to the air-conditioned space.
2. The air conditioning system according to claim 1, further comprising:

air conditioning equipment that is disposed on a ceiling of the air-conditioned space, wherein the air conditioning equipment includes the outdoor air processing unit, an air conditioner that includes the heat exchanger and the air supply unit, and the radiation unit.
 3. The air conditioning system according to claim 2, wherein

the outdoor air processing unit is configured to use, as a heat source air, the return air of the air-conditioned space, and

the outdoor air processing unit includes the heat pump of an integrated type that includes an outdoor air heat exchanger, a heat source air heat exchanger, and a compressor, a casing that accommodates the heat pump therein, and a slide mechanism that takes in or out the heat pump from a bottom of the casing by sliding the heat pump.
 4. The air conditioning system according to claim 2 or 3, further comprising:

two or more sets of the air conditioning equipment; and

a control device that controls the air conditioning equipment, wherein the control device controls air conditioning of the air-conditioned space by using a first operation pattern in which the two or more sets of the air conditioning equipment are operated or stopped for each set, and a second operation pattern in which a single operation of the outdoor air processing unit and a simultaneous operation of the outdoor air processing unit and the air conditioner are switched.
 5. The air conditioning system according to claim 4, wherein

the control device controls the air-conditioning of the air-conditioned space by further using a third operation pattern in which the air conditioning equipment being operated and the air conditioning equipment being stopped are switched.
 6. The air conditioning system according to claim 4 or 5, wherein

the heat exchanger of the air conditioner includes a flow dividing circuit configured such that a heat transfer pipe group of the heat exchanger through which the heat exchanging water flows is divided into a plurality of groups and grouping ratios are different from each other, and

the control device is configured to perform control such that a temperature difference of the heat exchanging water caused by the heat exchange of the heat exchanger is constant by increasing or decreasing a flow rate of the heat exchanging water in a first group having a smaller grouping ratio among the plurality of groups in a case of a low air conditioning load, and control a temperature of the air-conditioned space by increasing or decreasing a supply air volume of the air conditioner.
 7. The air conditioning system according to claim 6, wherein

when viewed in an air flow direction of the air passing through the heat exchanger of the air conditioner, non-overlapping zones which do not overlap the first group are formed in a second group having a grouping ratio larger than the grouping ratio of the first group among the plurality of groups, and the non-overlapping zones are located so as to sandwich the first group.
 8. The air conditioning system according to any one of claims 4 to 7, wherein

the control device is configured to calculate an energy consumption of the air-conditioned space based on a flow rate of the heat exchanging water supplied to the heat exchanger of the air conditioner and a temperature difference of the heat exchanging water caused by the heat exchange of the heat exchanger.
 9. The air conditioning system according to claim 8, further comprising:

a plurality of heat source devices that adjusts a water temperature by cooling or heating the heat exchanging water to be supplied to the heat exchanger of the air conditioner, wherein the control device is configured to increase or decrease the number of the heat source devices to be operated according to an increase or a decrease of the energy consumption of the air-conditioned space.
 10. The air conditioning system according to any one of claims 2 to 9, wherein

a heat transfer pipe group of the heat exchanger of the air conditioner includes elliptical pipes.

11. The air conditioning system according to claim 1, further comprising:

a heat exchange unit that includes the heat exchanger; and
 a fan unit that supplies the outdoor air supplied from the outdoor air processing unit and the return air of the air-conditioned space as the air-conditioning air by introducing the outdoor air and the return air to the heat exchange unit and causing the outdoor air and the return air to exchange heat with the heat exchanging water of the heat exchanger, and functions as the air supply unit,
 wherein the outdoor air processing unit, the fan unit, and the radiation unit are disposed on a ceiling of the air-conditioned space, and the heat exchange unit is disposed in a machine room different from the air-conditioned space.

12. The air conditioning system according to claim 11, wherein
 the outdoor air processing unit is configured to use, as a heat source air, the return air of the air-conditioned space, and
 the outdoor air processing unit includes the heat pump of an integrated type that includes an outdoor air heat exchanger, a heat source air heat exchanger, and a compressor,
 a casing that accommodates the heat pump therein, and
 a slide mechanism that takes in and out the heat pump from a bottom of the casing by sliding the heat pump.

13. The air conditioning system according to claim 11 or 12, further comprising:

two or more sets of air conditioning equipment; and
 a control device that controls the air conditioning equipment,
 wherein the air conditioning equipment is an air conditioning equipment configured such that the outdoor air processing unit, the fan unit, and the radiation unit are one set or is an air conditioning equipment configured such that the outdoor air processing unit, the heat exchange unit, the fan unit, and the radiation unit are one set, and the control device controls air conditioning of the air-conditioned space by using a first operation pattern in which the two or more sets of air conditioning equipment are operated or stopped for each set, and a second operation pattern in which a single operation of the outdoor air processing unit and a simultaneous operation of the outdoor air processing unit and the heat exchange unit are switched.

14. The air conditioning system according to claim 13, wherein

the control device controls the air-conditioning of the air-conditioned space by further using a third operation pattern in which the air conditioning equipment being operated and the air conditioning equipment being stopped are switched.

15. The air conditioning system according to claim 13 or 14, wherein

the heat exchanger of the heat exchange unit includes a flow dividing circuit configured such that a heat transfer pipe group of the heat exchanger through which the heat exchanging water flows is divided into a plurality of groups and grouping ratios are different from each other, and the control device is configured to perform control such that a temperature difference of the heat exchanging water caused by the heat exchange of the heat exchanger is constant by increasing or decreasing a flow rate of the heat exchanging water in a first group having a smaller grouping ratio among the plurality of groups in a case of a low air conditioning load, and control a temperature of the air-conditioned space by increasing or decreasing a supply air volume of the fan unit.

16. The air conditioning system according to claim 15, wherein

when viewed in an air flow direction of the air passing through the heat exchanger of the heat exchange unit, non-overlapping zones which do not overlap the first group are formed in a second group having a grouping ratio larger than the grouping ratio of the first group among the plurality of groups, and the non-overlapping zones are located so as to sandwich the first group.

17. The air conditioning system according to any one of claims 13 to 16, wherein

the control device is configured to calculate an energy consumption of the air-conditioned space based on a flow rate of the heat exchanging water supplied to the heat exchanger of the heat exchange unit and a temperature difference of the heat exchanging water caused by the heat exchange of the heat exchanger.

18. The air conditioning system according to claim 17, further comprising:

a plurality of heat source devices that adjusts a water temperature by cooling or heating the heat exchanging water to be supplied to the heat exchanger of the heat exchange unit,
 wherein the control device is configured to increase or decrease the number of the heat source devices to be operated according to an

increase or a decrease of the energy consumption of the air-conditioned space.

19. The air conditioning system according to any one of claims 11 to 18, wherein
a heat transfer pipe group of the heat exchanger of the heat exchange unit includes elliptical pipes.

20. The air conditioning system according to claim 1, further comprising:

two or more sets of air conditioning equipment that are disposed on a ceiling of the air-conditioned space; and
a control device that controls the air conditioning equipment,

wherein the air conditioning equipment includes a radiation air conditioner that is configured to function as the air supply unit and the radiation unit, cools and heats the air-conditioning air through the heat exchange using the heat exchanging water, discharges the cooled or heated air-conditioning air to the air-conditioned space, and radiates heat of the air-conditioned air, and

the outdoor air processing unit that includes the heat pump which cools or heats the outdoor air by performing the heat exchange using the heat exchanging medium, and supplies the outdoor air after the heat exchange to the air-conditioned space through the radiation air conditioner, and the control device controls air conditioning of the air-conditioned space by using a first operation pattern in which the two or more sets of air conditioning equipment are operated or stopped for each set and a second operation pattern in which a single operation of the outdoor air processing unit and a simultaneous operation of the outdoor air processing unit and the radiation air conditioner are switched.

21. The air conditioning system according to claim 20, wherein
the air conditioning equipment includes an air conditioner group including a plurality of the radiation air conditioners, and
the control device controls the air conditioning of the air-conditioned space by further using a fifth operation pattern in which the radiation air conditioners are operated or stopped for each air conditioner group.

22. The air conditioning system according to claim 20 or 21, wherein
the control device controls the air conditioning of the air-conditioned space by further using a third operation pattern in which the air conditioning equipment being operated and the air conditioning equipment

being stopped are switched.

23. The air conditioning system according to any one of claims 20 to 22, wherein

the outdoor air processing unit is configured to use, as a heat source air, the return air of the air-conditioned space, and

the outdoor air processing unit includes

the heat pump of an integrated type that includes an outdoor air heat exchanger, a heat source air heat exchanger, and a compressor,

a casing that accommodates the heat pump therein, and

a slide mechanism that takes in or out the heat pump from a bottom of the casing by sliding the heat pump.

24. The air conditioning system according to any one of claims 20 to 23, wherein

the radiation air conditioner includes

an air-conditioning heat exchanger that exchanges heat of the air-conditioning air,

a radiation part, and

an air-conditioning air supply fan that sends the air-conditioning air to the radiation part, and

the radiation part includes

a first chamber through which the air-conditioning air flows,

a second chamber that radiates heat of the air-conditioning air introduced from the first chamber while discharging the air-conditioning air introduced from the first chamber to the air-conditioned space, and
an air flow adjustment part that adjusts a wind speed and a distribution of the air-conditioning air to be discharged to the second chamber from the first chamber.

25. The air conditioning system according to claim 24, wherein

the air flow adjustment part includes a group of first through-holes that allows the air-conditioning air to be discharged therethrough from the first chamber to the second chamber,

the second chamber includes a group of second through-holes that allows the air-conditioning air to be discharged therethrough to the air-conditioned space from the second chamber, and

an opening area of the group of the second through-holes is larger than an opening area of the group of the first through-holes.

26. The air conditioning system according to claim 24 or 25, wherein

the first chamber is configured such that a cross-sectional area of the first chamber through which the air-conditioning air passes becomes narrower toward a leeward side from a windward side.

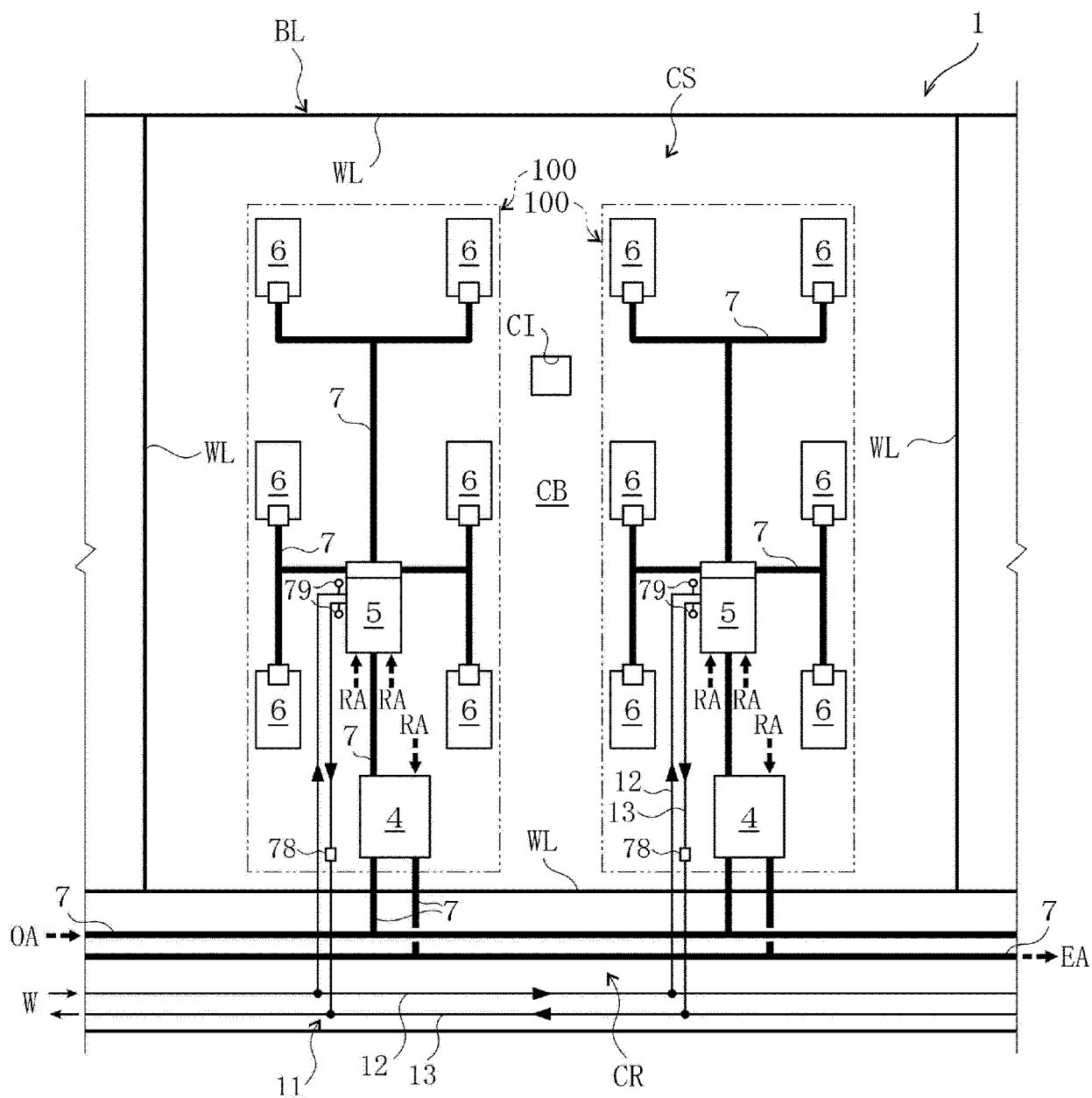


FIG.1

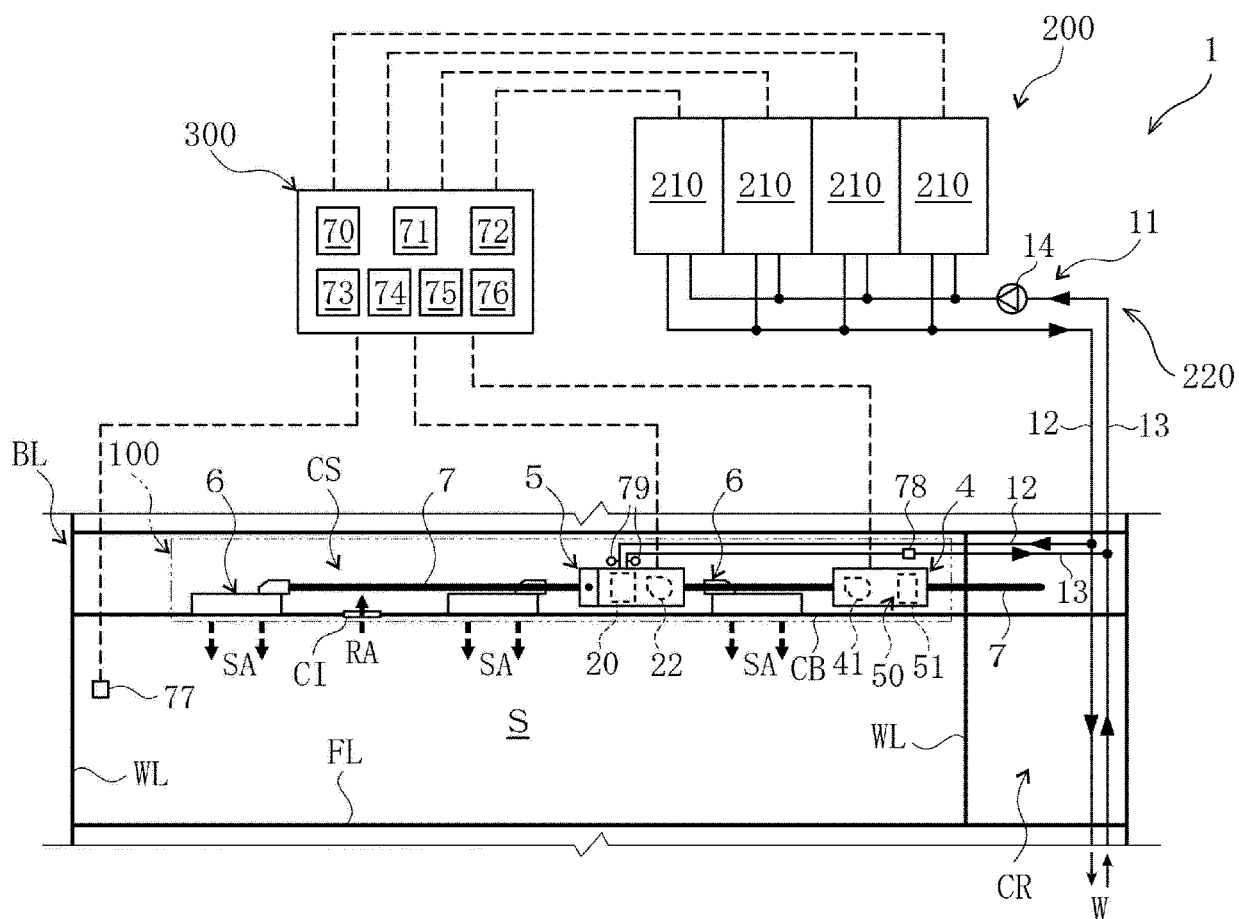


FIG.2

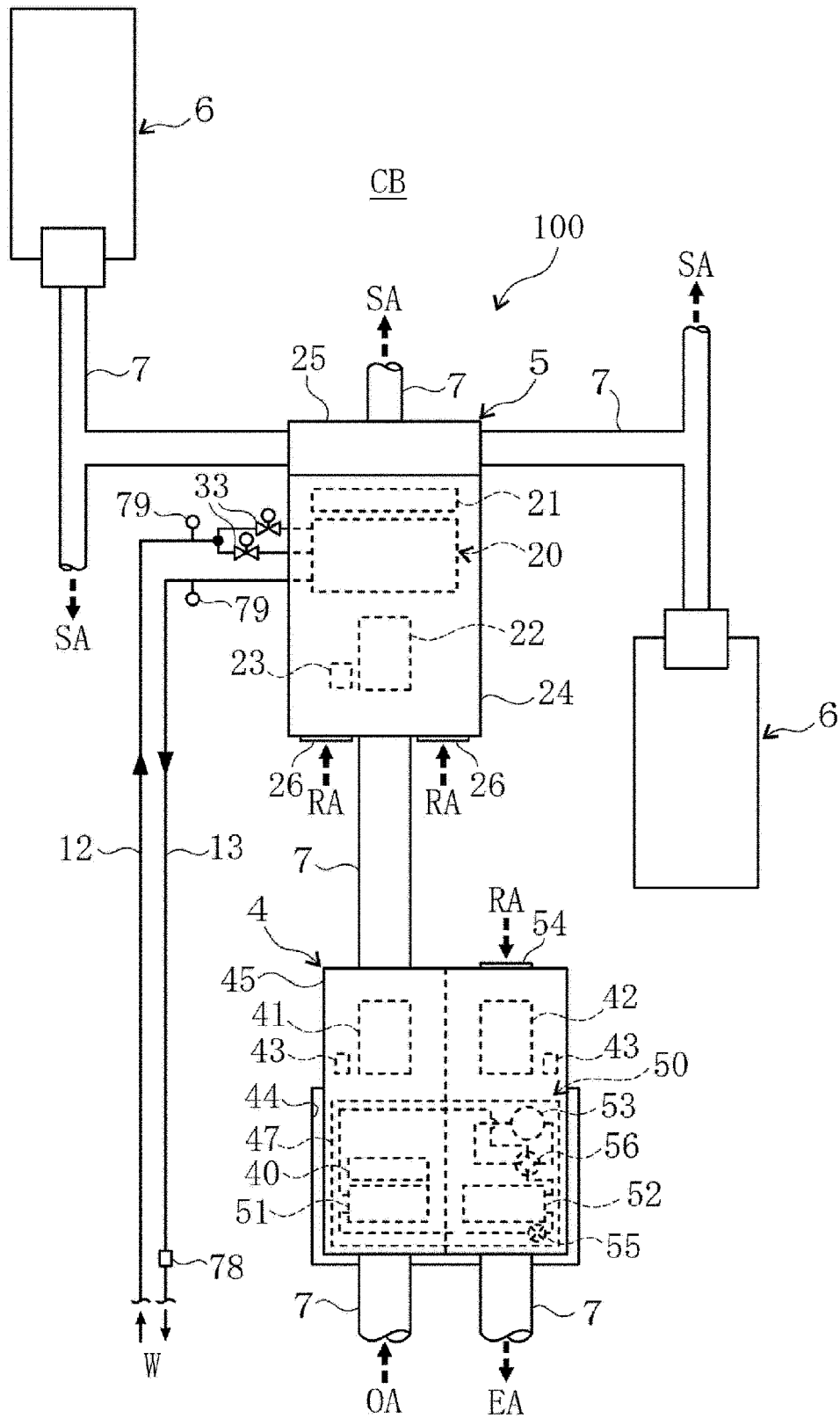


FIG.3

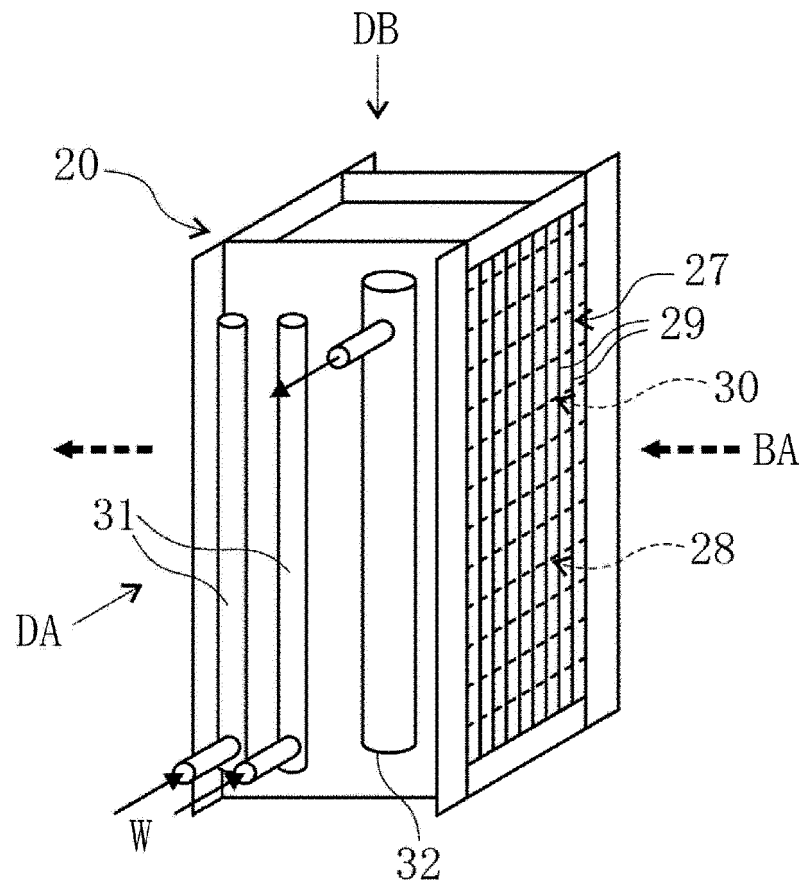


FIG.4

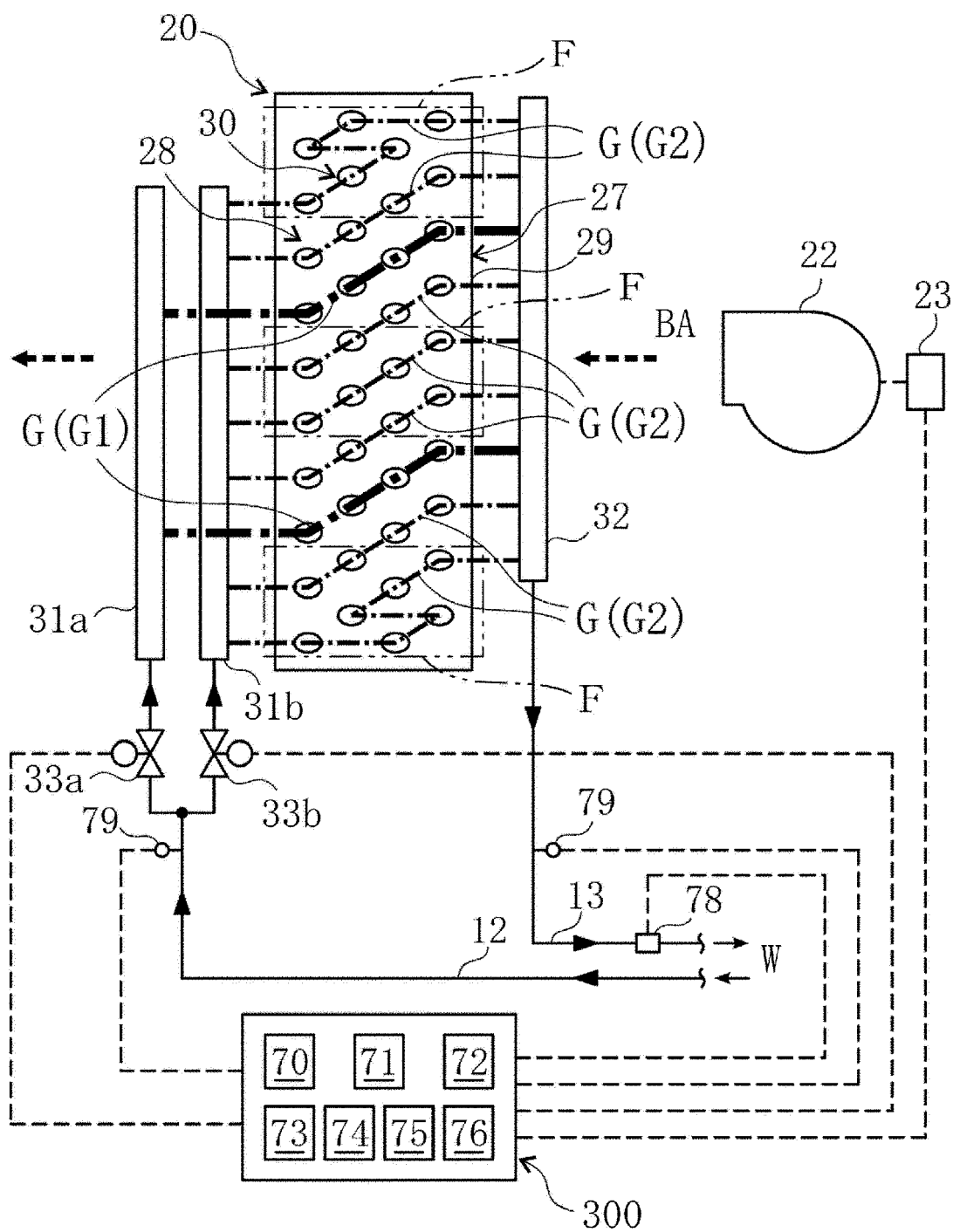


FIG.5

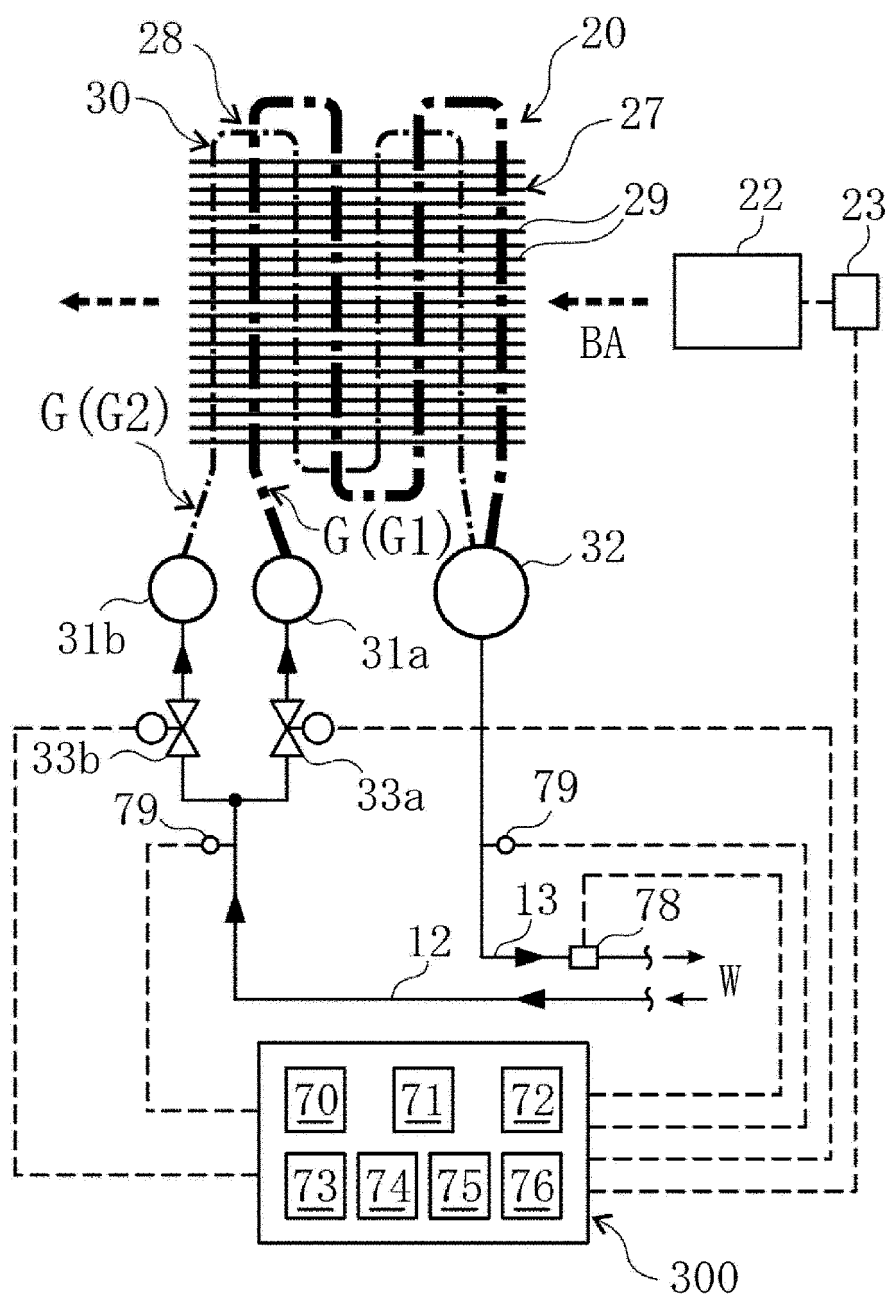


FIG.6

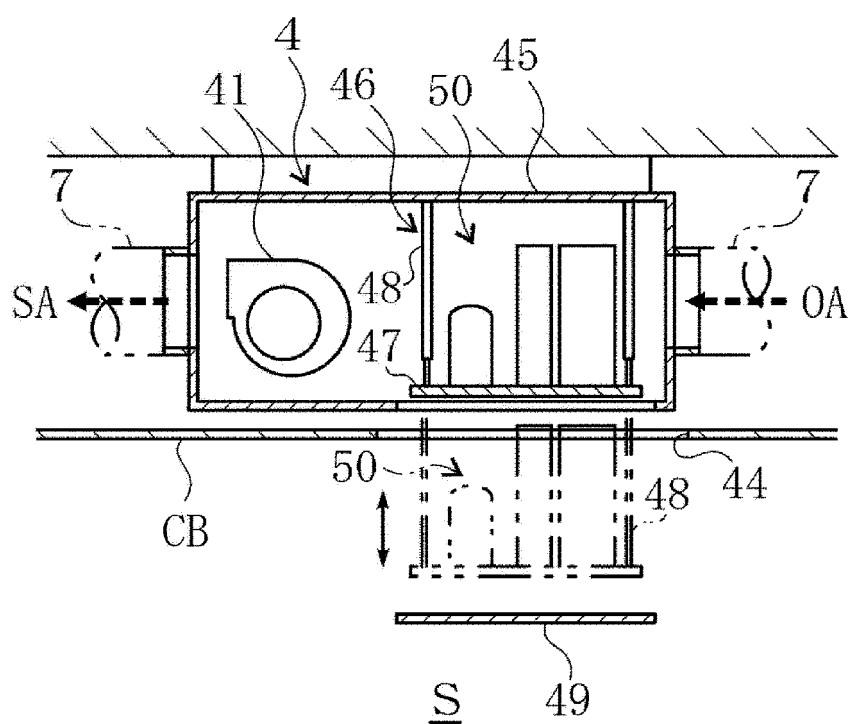


FIG.7

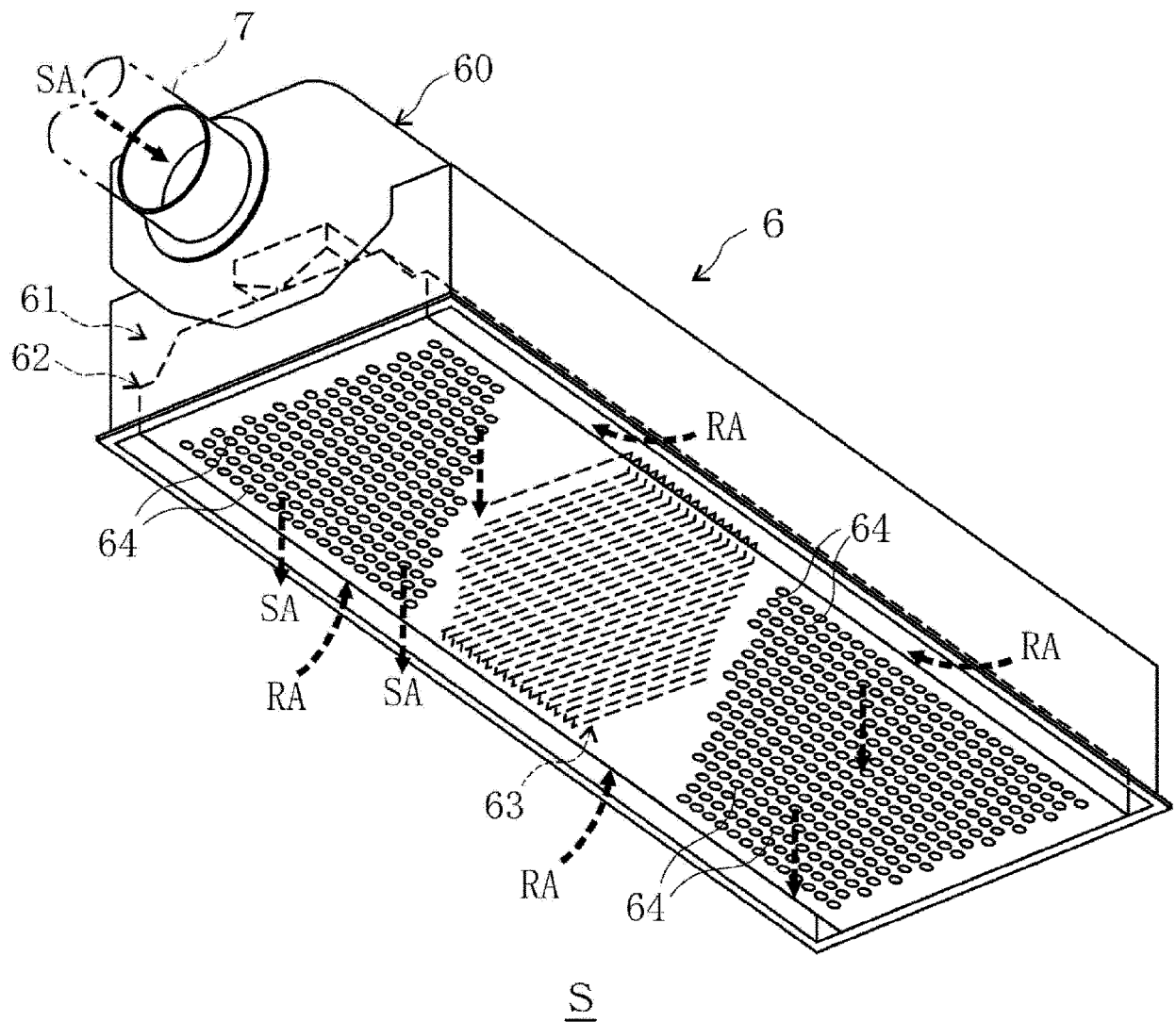


FIG.8

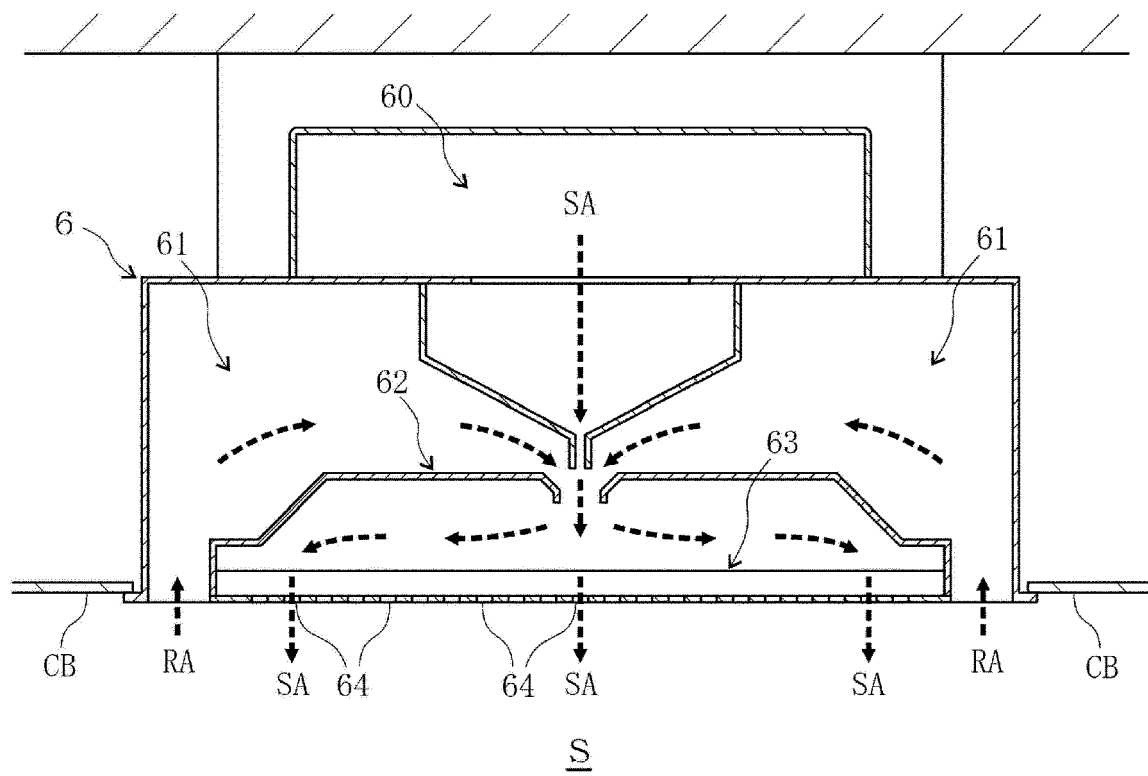


FIG.9

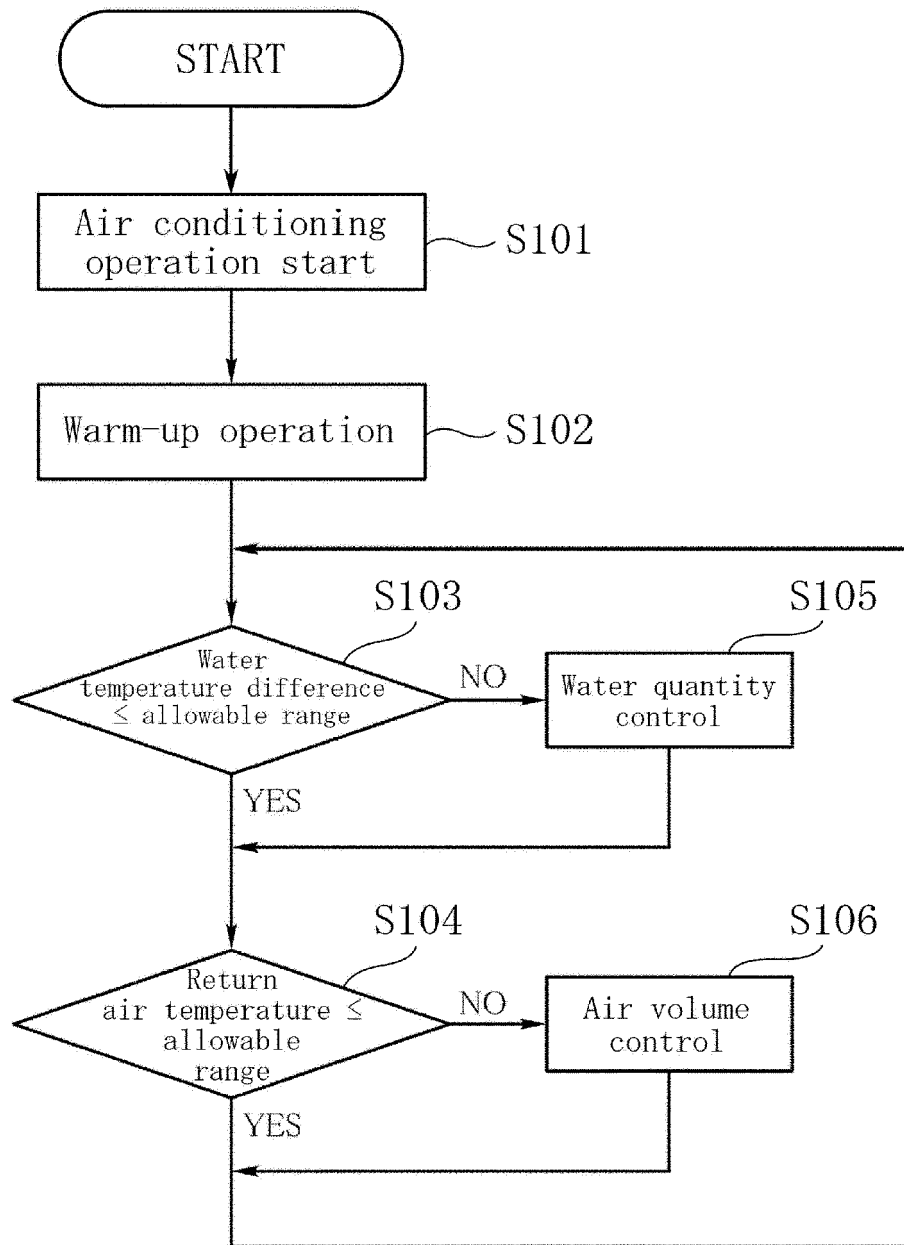


FIG.10

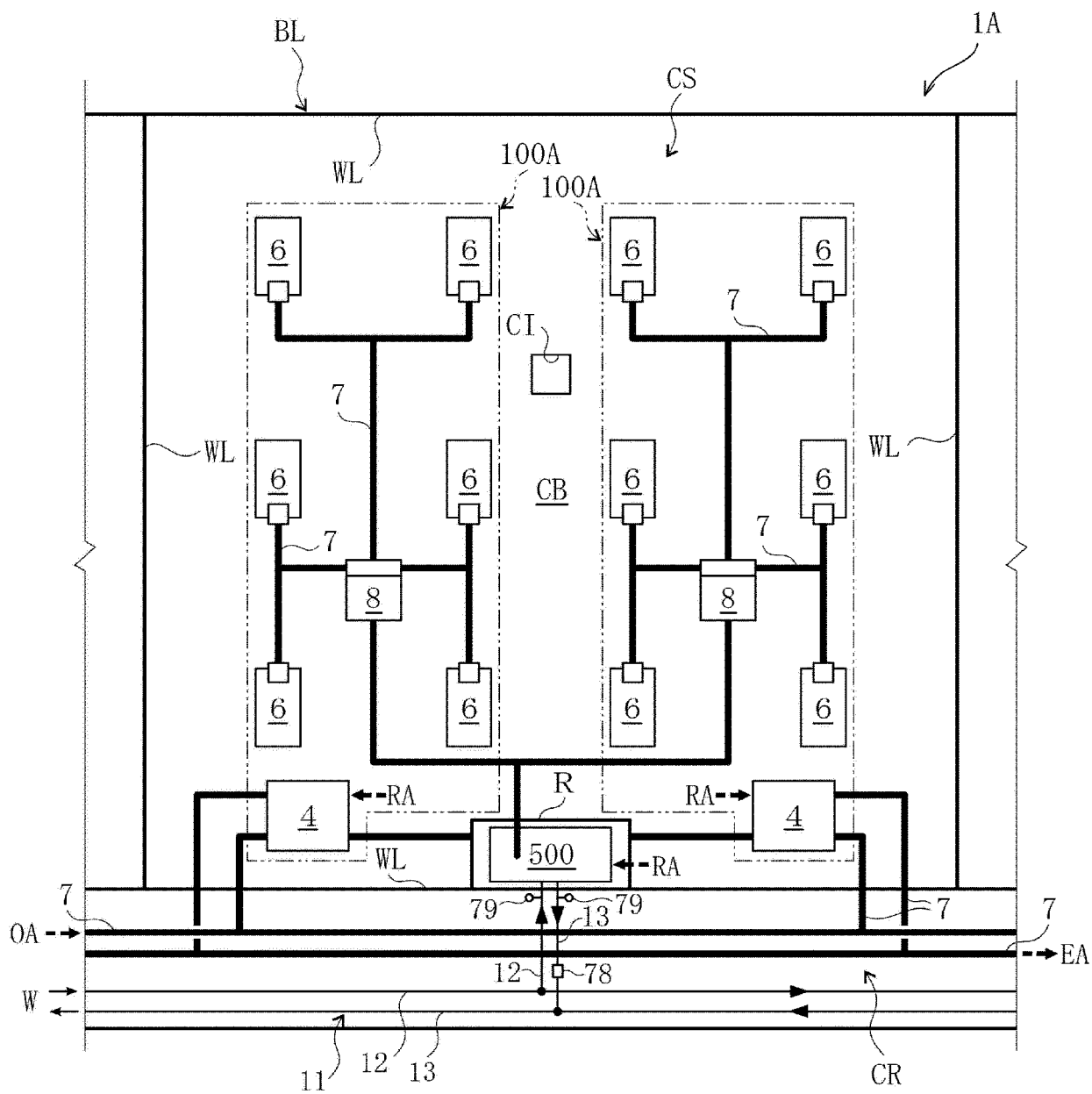


FIG.11

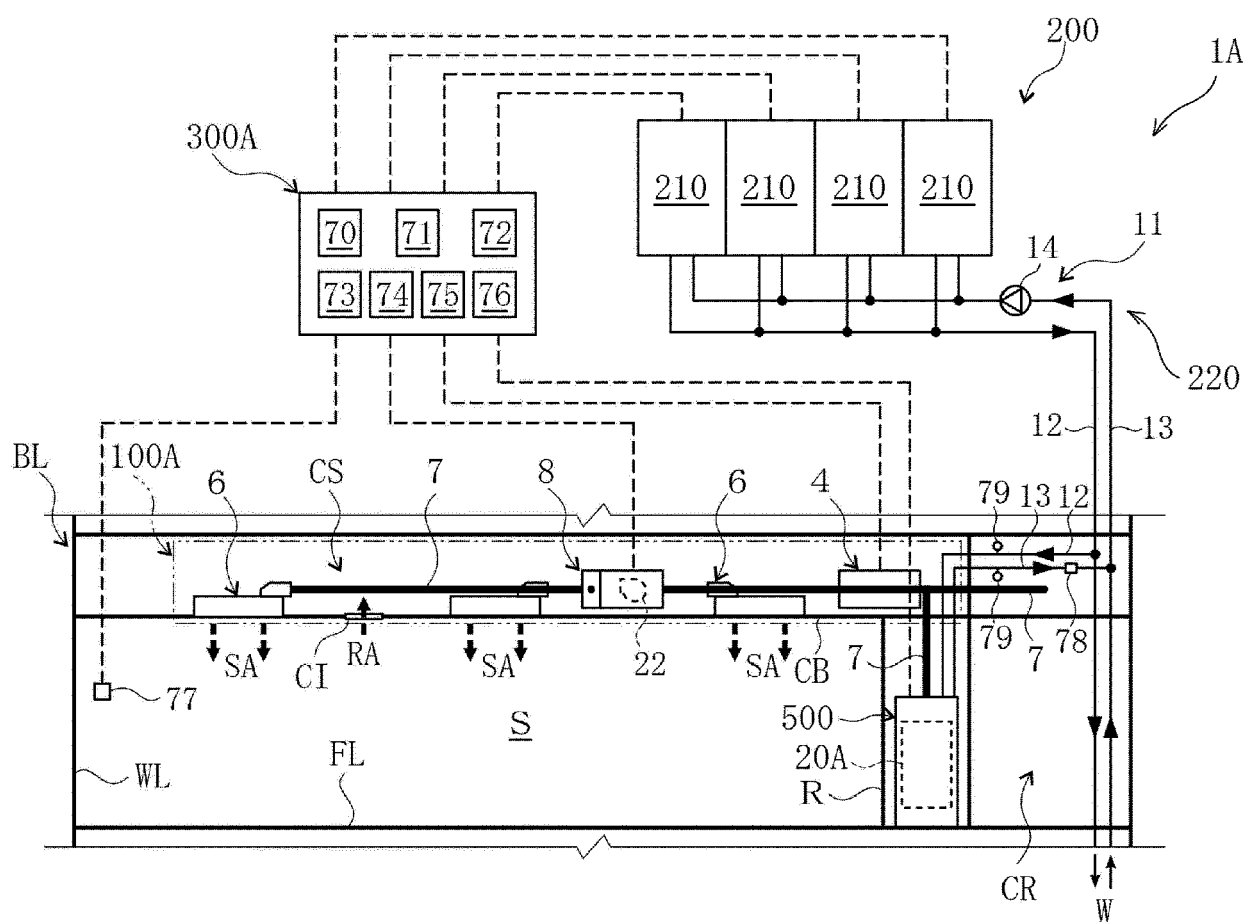


FIG.12

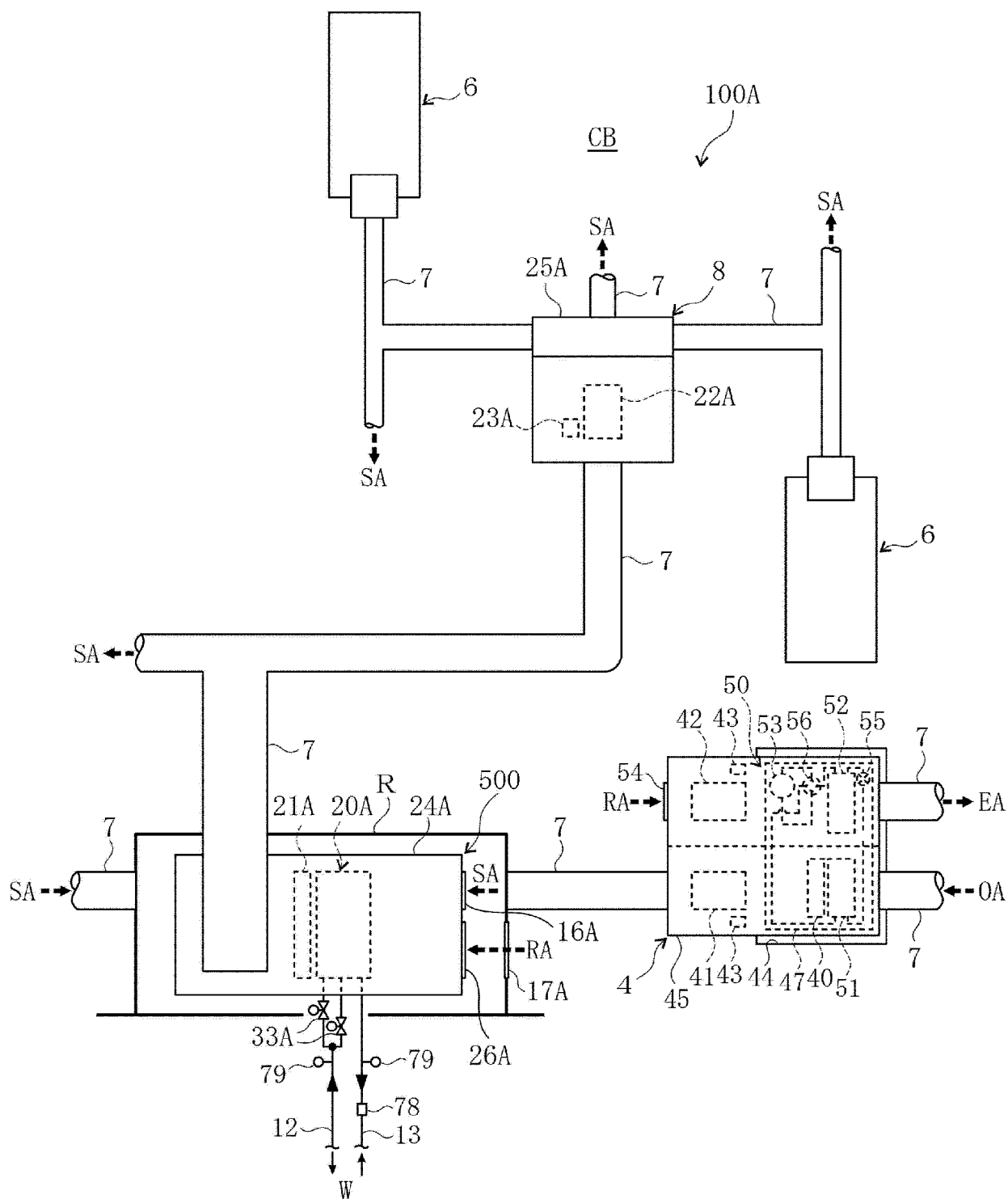


FIG.13

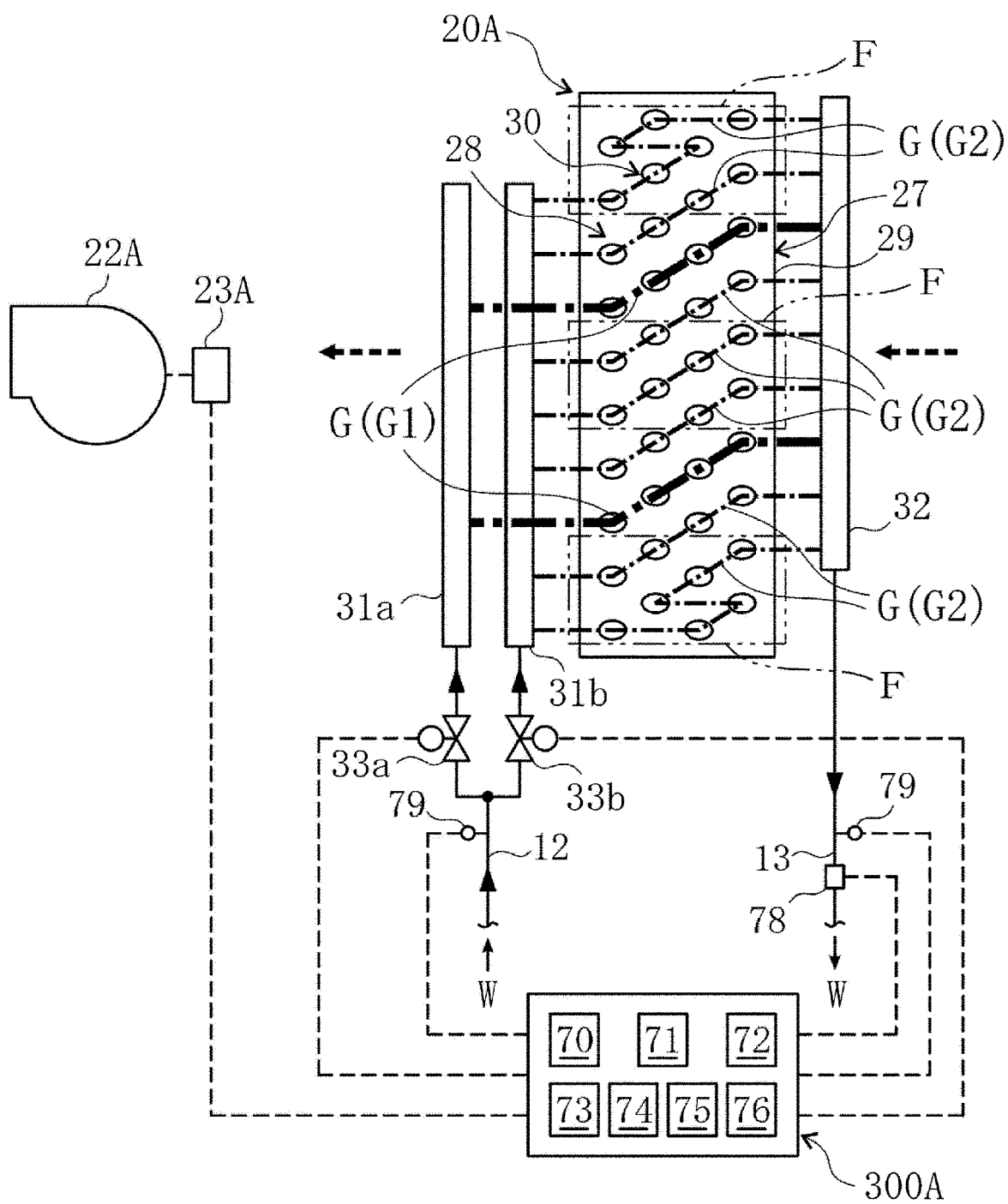


FIG.14

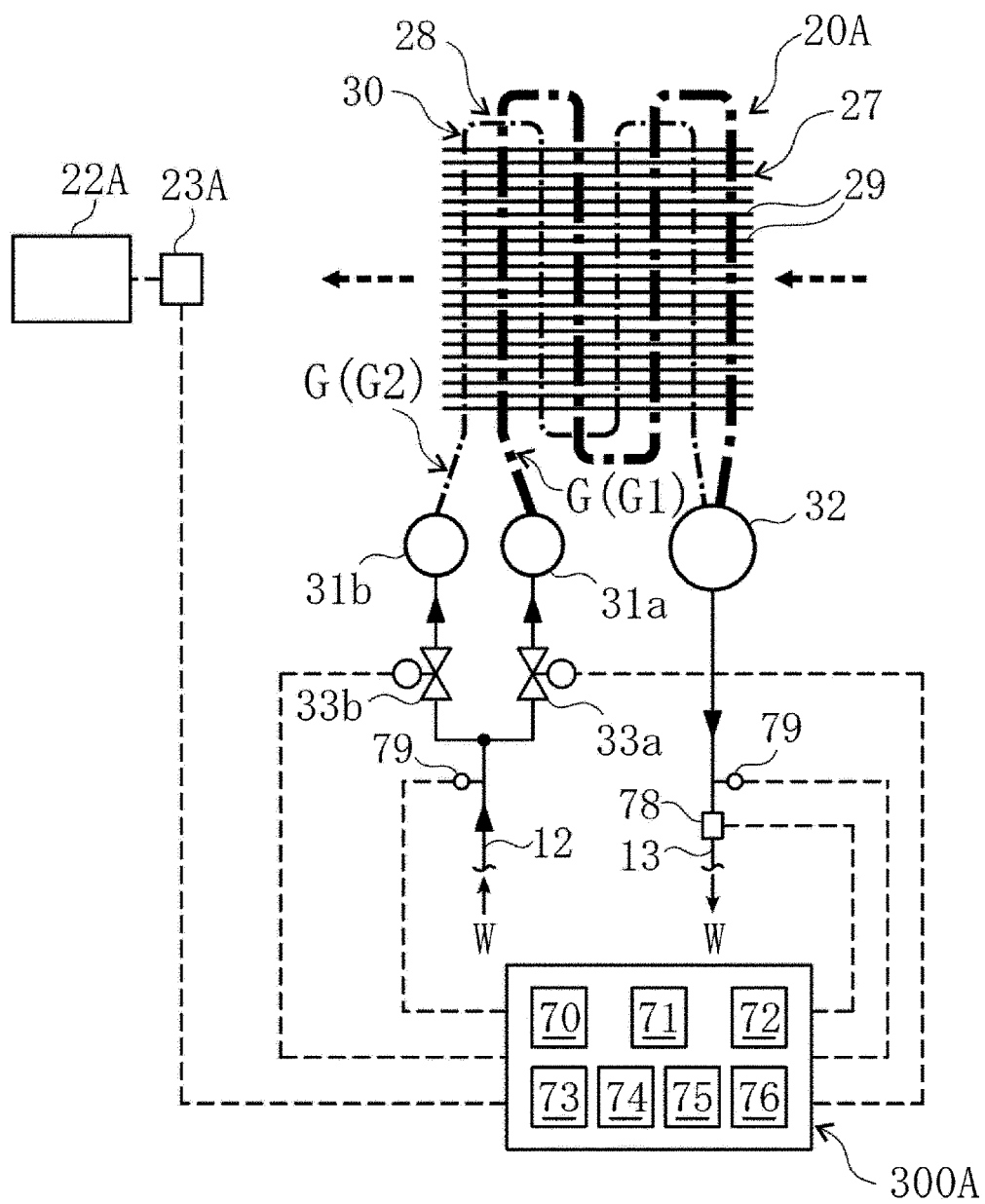


FIG.15

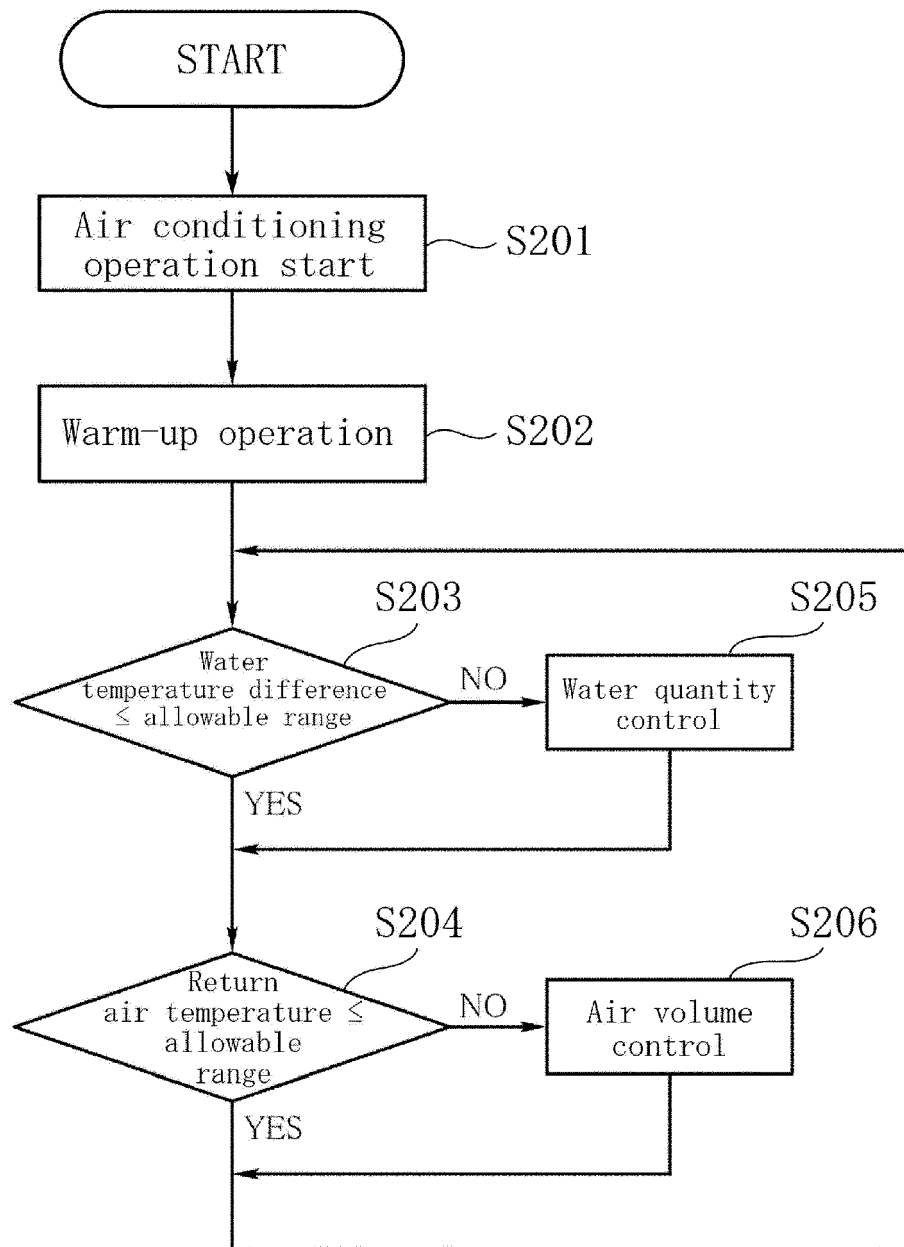


FIG.16

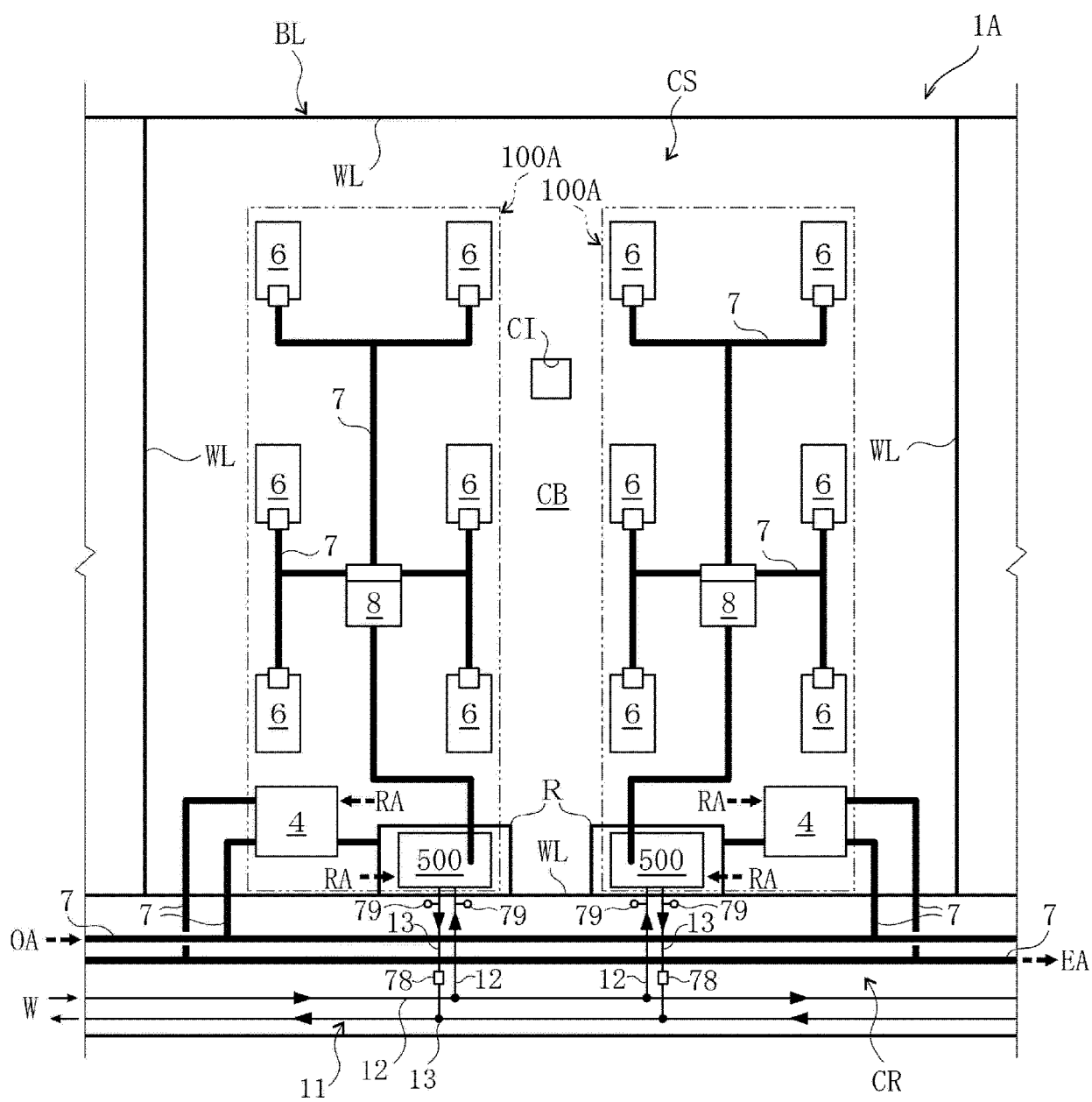


FIG.17

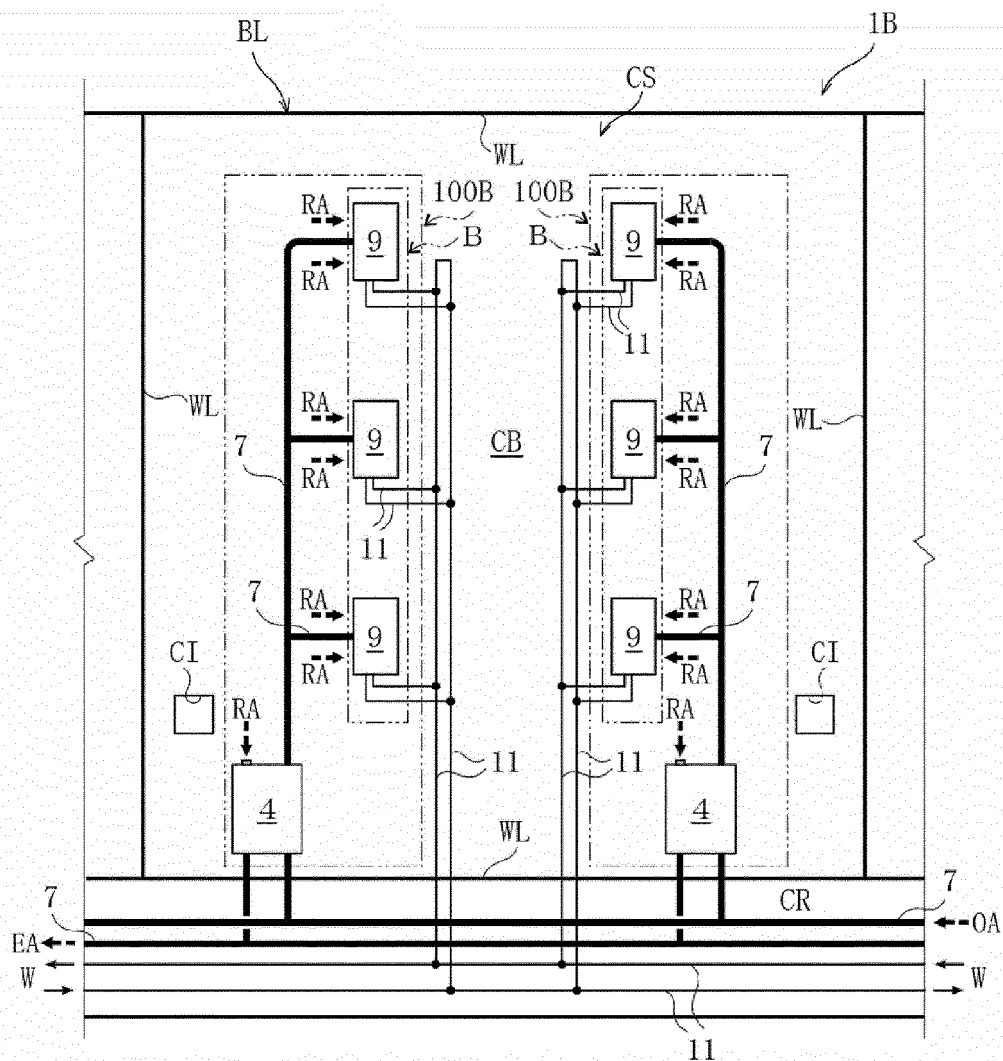


FIG.18

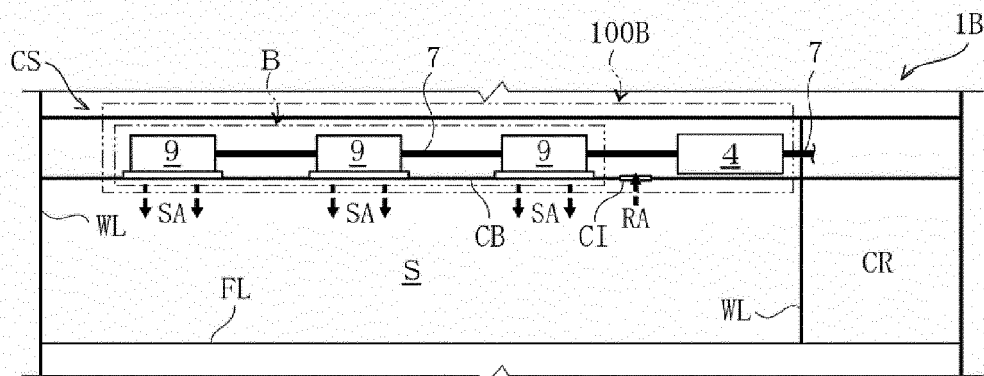


FIG.19

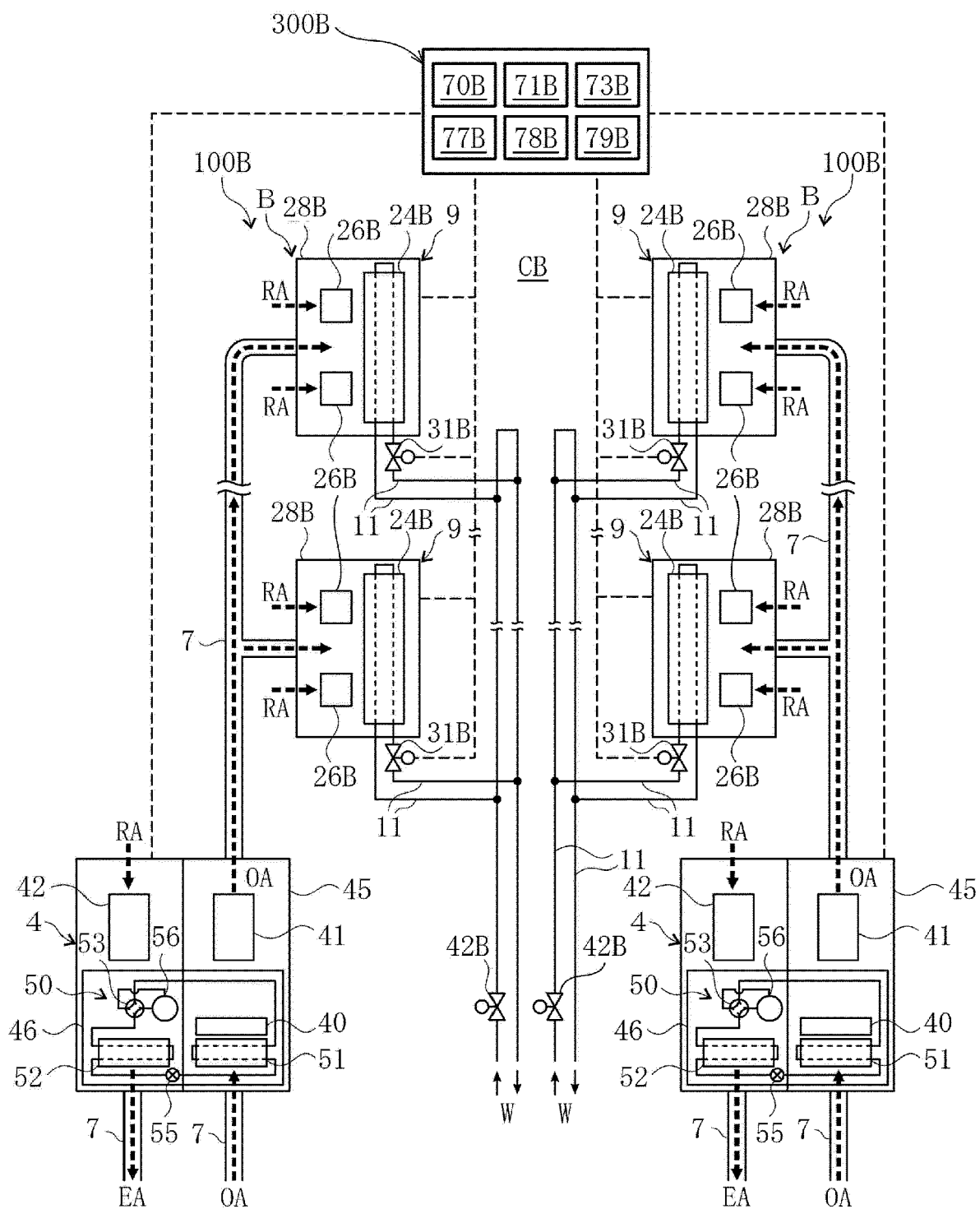


FIG.20

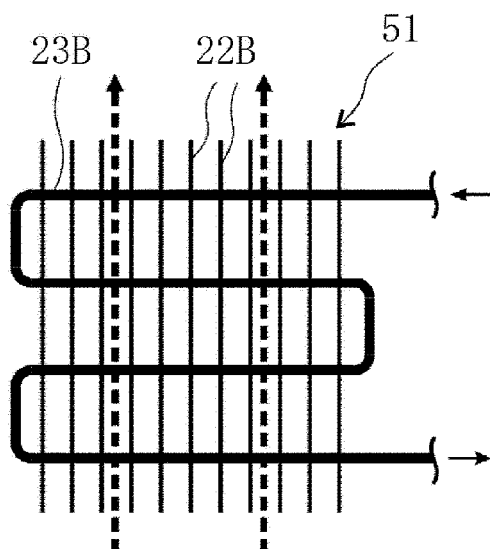
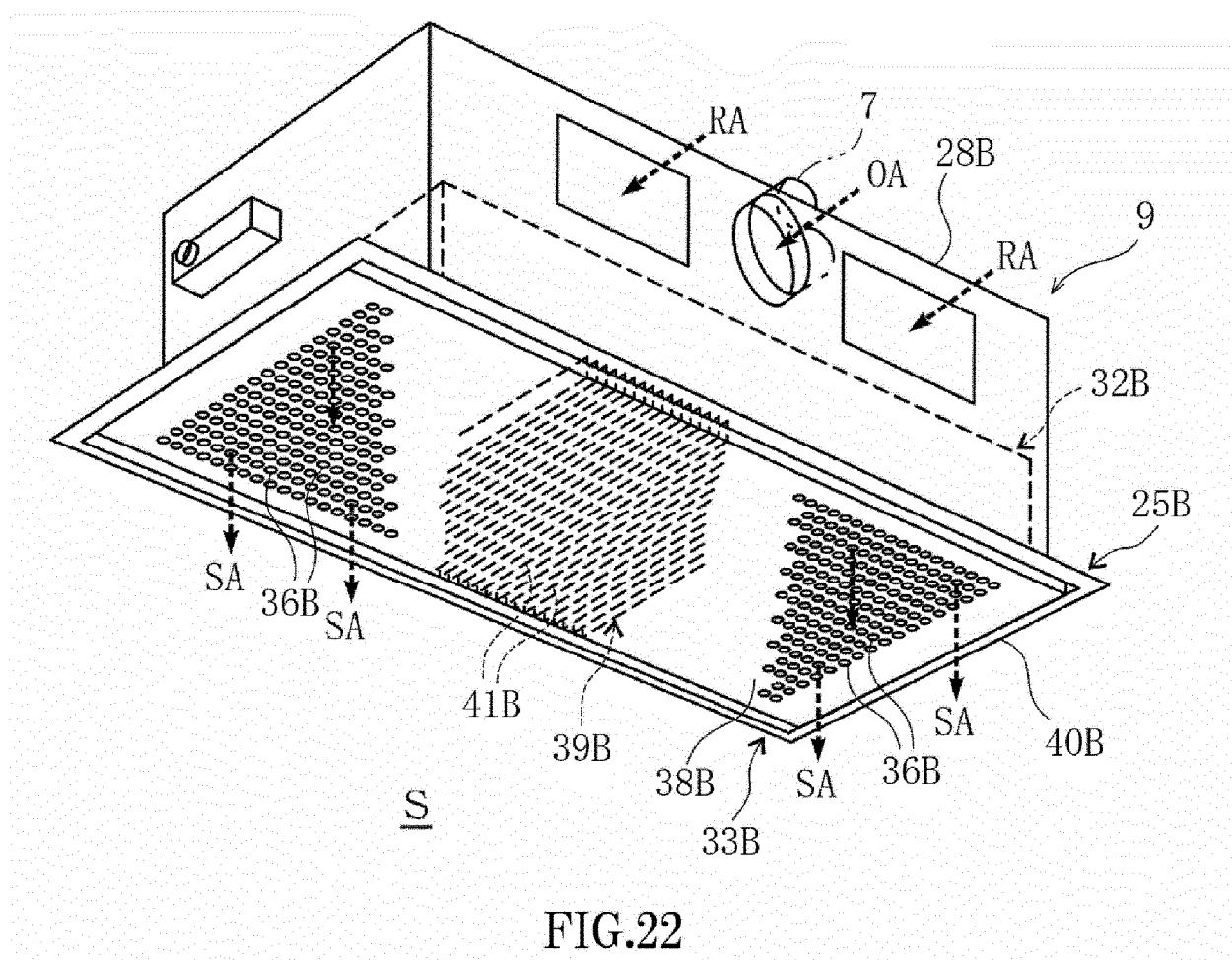


FIG.21



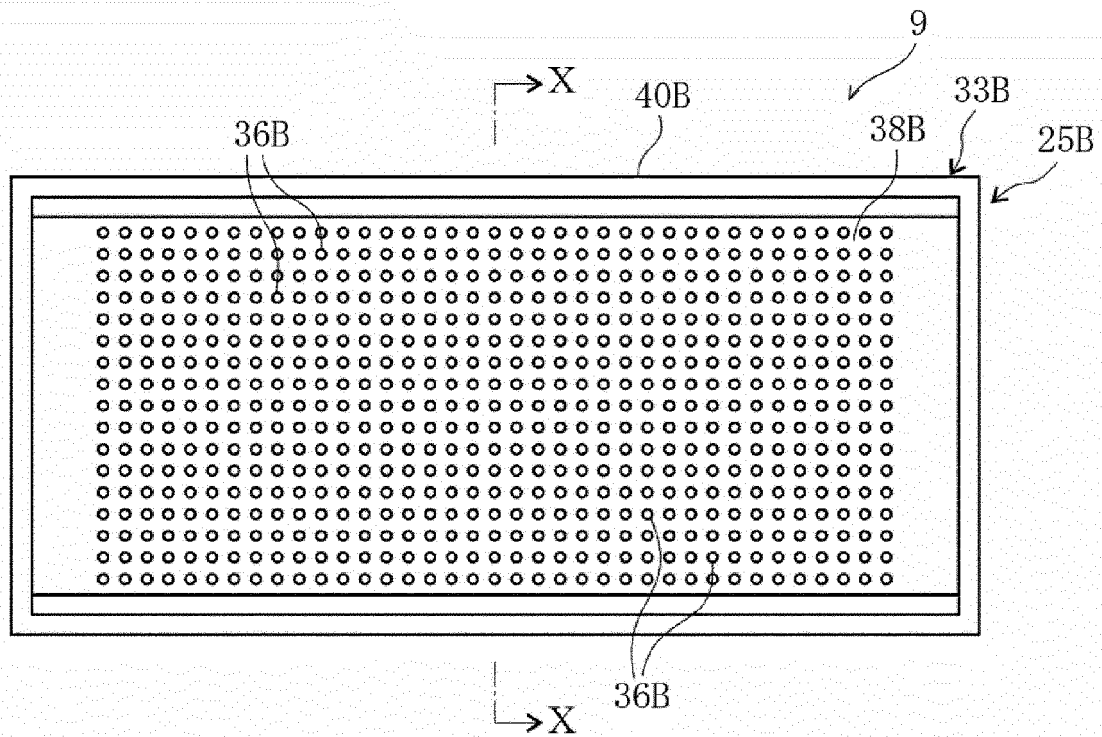


FIG. 23

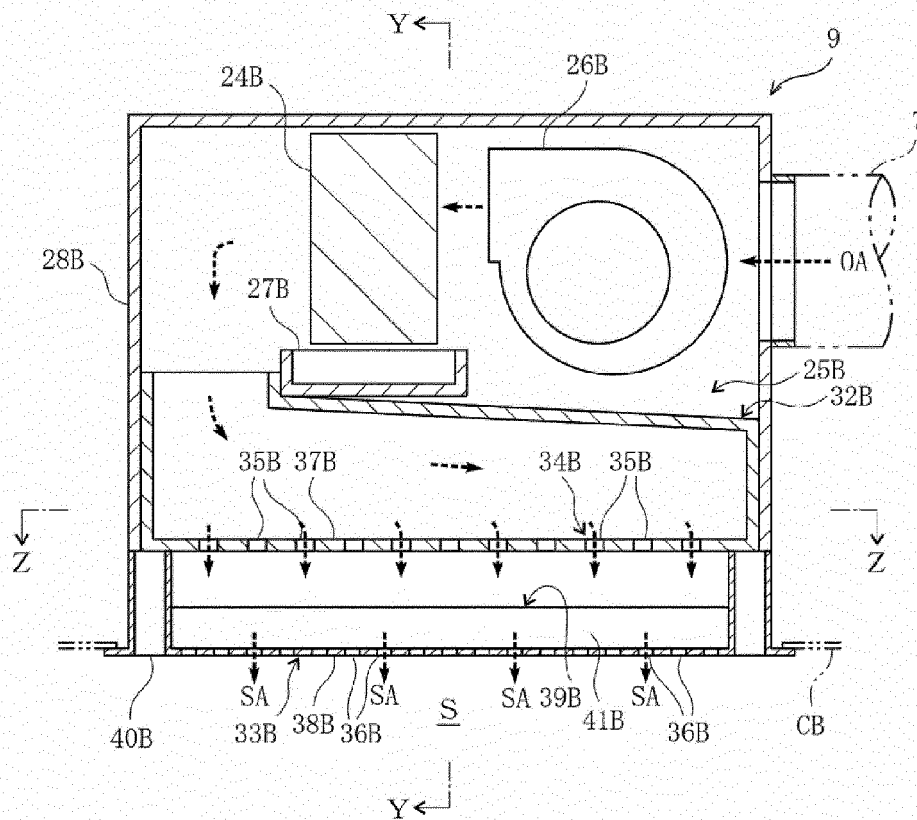


FIG. 24

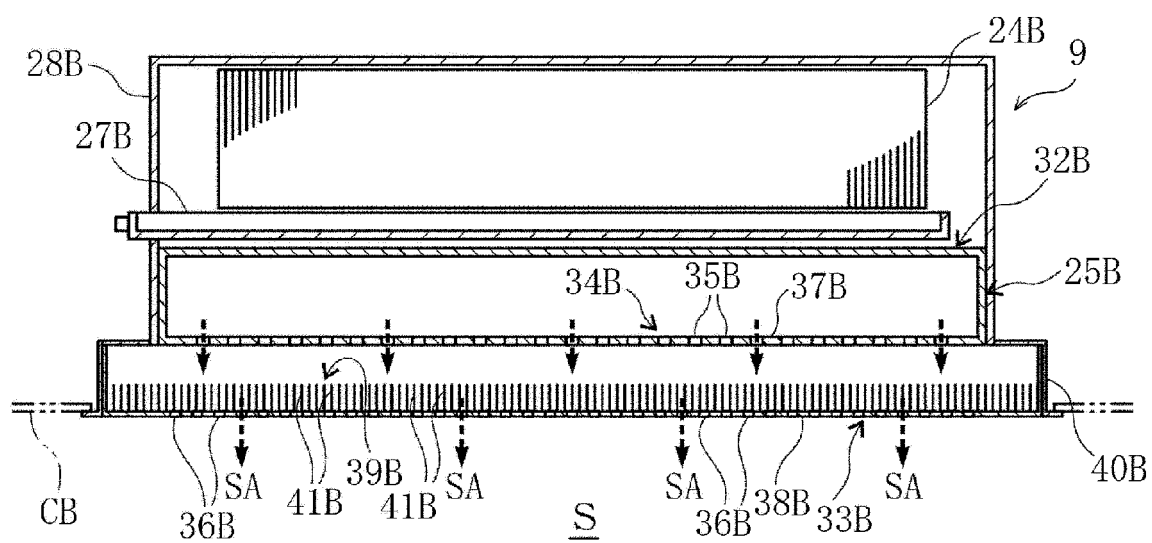


FIG.25

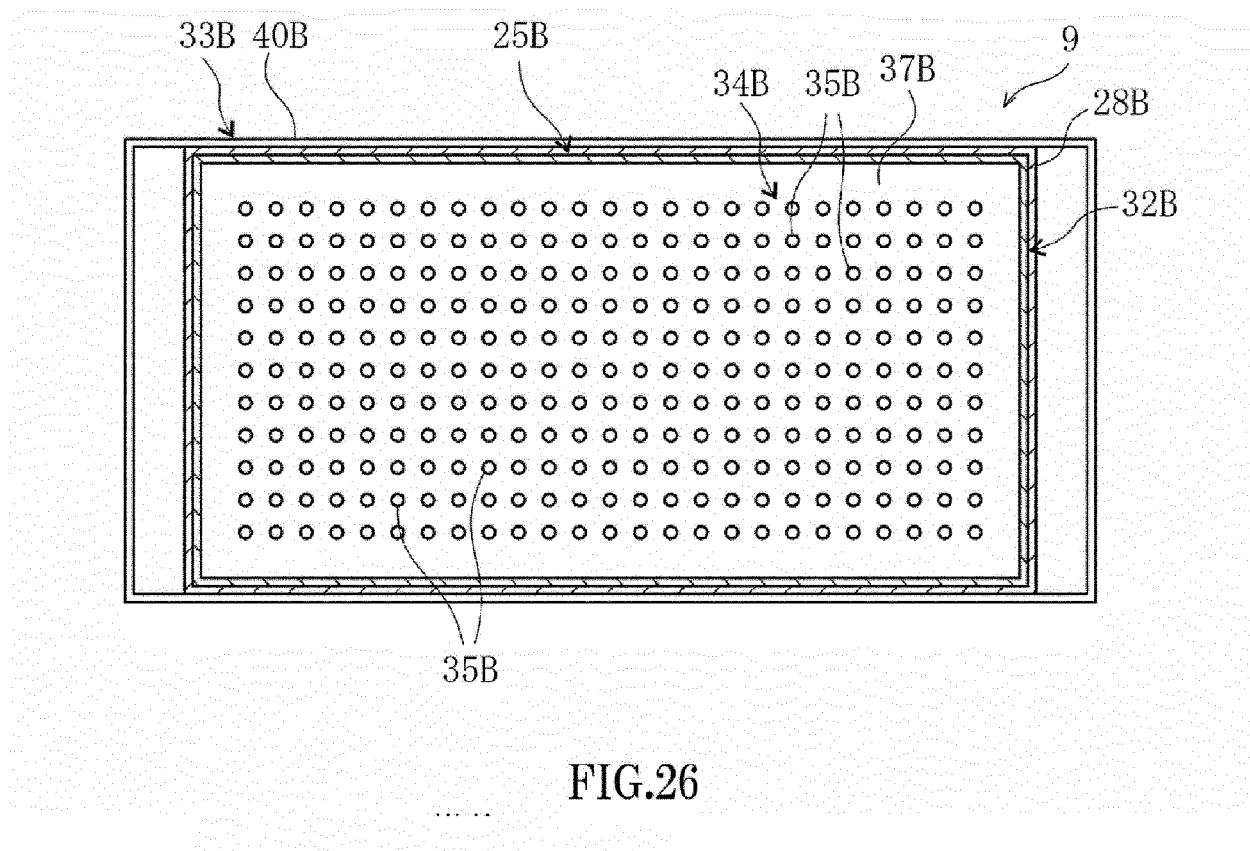


FIG.26



EUROPEAN SEARCH REPORT

Application Number
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Place of search Munich		Date of completion of the search 8 September 2020	Examiner Decking, Oliver
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