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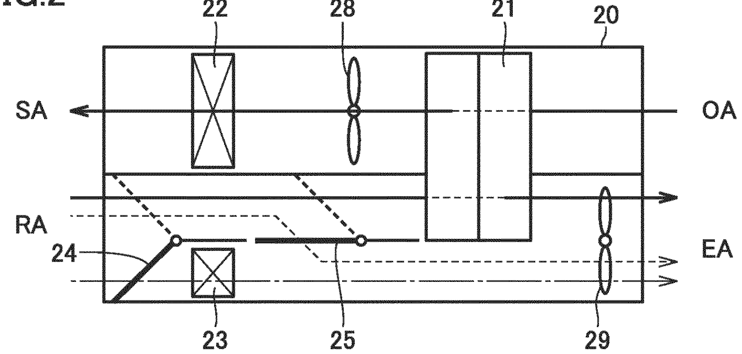
(54) AIR CONDITIONER

(57) An outdoor unit (10) includes a compressor (11) and an outdoor heat exchanger (13). An indoor unit (20) includes an expansion valve (26), a supply air heat exchanger (22) and a discharge air heat exchanger (23), each of which serves as an indoor heat exchanger, a blower (28) which serves as an air supply device configured to supply outdoor air (OA) into a room through an air supply passage, and a blower (29) which serves as an air discharge unit configured to discharge indoor air (RA) out of the room through an air discharge passage. The indoor heat exchanger is configured to allow air flowing through the air supply passage or air flowing through the air discharge passage to flow through the indoor heat exchanger. The indoor unit (20) further includes a first damper (24) which serves as a switching unit configured to switch whether or not to allow the indoor air (RA) flowing through the air discharge passage to flow through the discharge air heat exchanger (23) which serves as an indoor heat exchanger.

FIG.2



Description

TECHNICAL FIELD

[0001] The present disclosure relates to an air conditioner.

BACKGROUND ART

[0002] One air conditioning system is a convection air conditioning system which adjusts the temperature of air sucked from the outside of a room and then supplies the air into the room. In the convection air conditioning system, if the temperature of the air supplied into the room during a cooling operation is too low, an occupant in the room may feel cold air, which reduces the comfort. On the other hand, in the convection air conditioning system, if the temperature of the air supplied into the room during a heating operation is too high, the occupant may feel hot air, which also reduces the comfort.

[0003] In order to improve the comfort of an occupant, Japanese Patent No. 5054935 (PTL 1) discloses a technology for operating an air conditioner by setting a predetermined lower limit for the temperature of the supply air.

CITATION LIST

PATENT LITERATURE

[0004] PTL 1: Japanese Patent No. 5054935

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005] In the air conditioner of PTL 1, for example, when the temperature of the supply air is lower than a predetermined lower limit during the cooling operation, the cooling capacity is controlled by lowering the frequency of the compressor to increase the evaporation temperature or by lowering the opening degree of the expansion valve to increase the degree of superheat at the outlet of the evaporator, which thereby prevents the temperature of the supply air from decreasing. However, in the air conditioner of PTL 1, the cooling capacity may not be further lowered due to the restriction of the operation range such as the frequency of the compressor reaching the lower limit, and thereby the temperature of the supply air may become lower than the predefined temperature. In addition, the air conditioner of PTL 1 may stop the cooling operation so as to prevent the temperature of the supply air from decreasing, which may make the temperature of the supply air unstable.

[0006] It is an object of the present disclosure to provide an air conditioner capable of suitably maintaining a temperature of supply air while performing continuous operation.

SOLUTION TO PROBLEM

[0007] The present disclosure relates to an air conditioner including an outdoor unit and an indoor unit. The outdoor unit and the indoor unit are connected to each other by a refrigerant pipe to form a refrigerant circuit. The outdoor unit includes a compressor and an outdoor heat exchanger. The indoor unit includes an expansion valve, an indoor heat exchanger, an air supply device configured to supply outdoor air into a room through an air supply passage, and an air discharge device configured to discharge indoor air out of the room through an air discharge passage. The indoor heat exchanger is configured to allow air flowing through the air supply passage or air flowing through the air discharge passage to flow through the indoor heat exchanger. The indoor unit further includes a switching unit configured to switch whether or not to allow the indoor air flowing through the air discharge passage to flow through the indoor heat exchanger.

ADVANTAGEOUS EFFECTS OF INVENTION

[0008] According to the present disclosure, the air conditioner can suitably maintain the temperature of the supply air while performing continuous operation.

BRIEF DESCRIPTION OF DRAWINGS

[0009]

Fig. 1 is a schematic diagram illustrating the configuration of an air conditioner according to a first embodiment;
Fig. 2 is a schematic diagram illustrating the configuration of an indoor unit according to the first embodiment;
Fig. 3 is a diagram illustrating a refrigerant circuit of the air conditioner according to the first embodiment;
Fig. 4 is a flowchart illustrating the control of a damper during a cooling operation according to the first embodiment;
Fig. 5 is a diagram illustrating an example damper operation according to the first embodiment;
Fig. 6 is a diagram illustrating an example damper operation according to the first embodiment;
Fig. 7 is a diagram illustrating an example damper operation according to the first embodiment;
Fig. 8 is a diagram illustrating refrigerant state transition according to the first embodiment;
Fig. 9 is a flowchart illustrating the control of a damper during a heating operation according to the first embodiment;
Fig. 10 is a schematic diagram illustrating the configuration of an indoor unit according to a second embodiment;
Fig. 11 is a flowchart illustrating the control of a damper during the cooling operation according to

the second embodiment;

Fig. 12 is a schematic diagram illustrating the configuration of an indoor unit according to a third embodiment;

Fig. 13 is a flowchart illustrating the control of a damper during the cooling operation according to the third embodiment;

Fig. 14 is a diagram illustrating an example damper operation according to the third embodiment;

Fig. 15 is a diagram illustrating an example damper operation according to the third embodiment;

Fig. 16 is a diagram illustrating an example damper operation according to the third embodiment;

Fig. 17 is a schematic diagram illustrating the configuration of an indoor unit according to a modification of the third embodiment;

Fig. 18 is a schematic diagram illustrating the configuration of an indoor unit according to a fourth embodiment; and

Fig. 19 is a flowchart illustrating the control of a damper during the heating operation according to the fourth embodiment.

DESCRIPTION OF EMBODIMENTS

[0010] Hereinafter, embodiments of the present disclosure will be described in detail with reference to the drawings. In the embodiments described below, when a reference is made to a number, an amount or the like, the scope of the present disclosure is not necessarily limited to the number, the amount or the like unless otherwise specified. The same or corresponding components will be denoted by the same reference numerals, and the description thereof may not be repeated. It is intended from the beginning that proper combinations of the configurations of the respective embodiments may be used.

First Embodiment

<Configuration>

[0011] The configuration of an air conditioner 100 according to a first embodiment, the configuration of an indoor unit 20 of the air conditioner 100 according to the first embodiment, and the configuration of a refrigerant circuit of the air conditioner 100 according to the first embodiment will be described with reference to Figs. 1 to 3.

[0012] Fig. 1 is a schematic diagram illustrating the configuration of an air conditioner 100 according to the first embodiment, Fig. 2 is a schematic diagram illustrating the configuration of an indoor unit 20 according to the first embodiment, and Fig. 3 is a diagram illustrating a refrigerant circuit of the air conditioner 100 according to the first embodiment.

[0013] The air conditioner 100 includes an outdoor unit 10 and an indoor unit 20. The outdoor unit 10 and the indoor unit 20 are connected to each other by a refrigerant pipe 30. The indoor unit 20, which is an outdoor air treatment unit, is disposed on a ceiling surface 101. The indoor unit 20 takes in outdoor air OA, and blows out the outdoor air OA from a duct 40 as supply air SA through an outlet port 41. The indoor unit 20 takes indoor air RA into the duct 40 through an inlet port 42, and discharges the indoor air RA to the outside as discharge air EA.

[0014] The indoor unit 20 includes a total heat exchanger 21, a supply air heat exchanger 22, a discharge air heat exchanger 23, a blower 28 for supplying air, a blower 29 for discharging air, a supply air temperature detection unit 50, and an outdoor air temperature detection unit 51, which are enclosed in the main casing. Fig. 1 illustrates a schematic side view of the indoor unit 20. Fig. 2 illustrates a schematic top view of the indoor unit 20.

[0015] The total heat exchanger 21, for example, has a structure in which a plurality of air passages orthogonal to each other are alternately stacked. In the total heat exchanger 21, the indoor air RA and the outdoor air OA flow through the air passages, whereby a total heat exchange is performed between the indoor air RA and the outdoor air OA. In the total heat exchange, not only the sensible heat (temperature) but also the latent heat (water vapor) are exchanged.

[0016] Each of the supply air heat exchanger 22 and the discharge air heat exchanger 23 is an indoor heat exchanger that performs heat exchange between refrigerant and air. The supply air temperature detection unit 50 is configured to detect the temperature of the supply air SA supplied into the room. The outdoor air temperature detection unit 51 is configured to detect the temperature of the outside air OA supplied into the room from outside.

[0017] The outdoor air OA is guided to the total heat exchanger 21 by the blower 28 which serves as an air supply device, and is supplied to the room as the supply air SA after flowing through the supply air heat exchanger 22. The air passage through which the outdoor air OA is supplied to the room is referred to as an air supply passage. On the other hand, the indoor air RA is discharged out of the room as the discharge air EA by the blower 29 which serves as an air discharge device. The air passage through which the indoor air RA is discharged out of the room is referred to as an air discharge passage.

[0018] As illustrated in Fig. 2, a first damper 24 and a second damper 25 are disposed in the air discharge passage as a switching unit to switch the flow of air as indicated by various arrows. The first damper 24 is configured to switch whether or not to allow the indoor air RA flowing through the air discharge passage to flow through the discharge air heat exchanger 23. The second damper 25 is configured to switch whether or not to allow the indoor air RA flowing through the air discharge passage to flow through the total heat exchanger 21.

[0019] By switching the first damper 24 and the second damper 25, for example, the indoor air RA flows through the air discharge passage according to one of the following patterns: a pattern in which the air does not flow through the discharge air heat exchanger 23 but flows through the total heat exchanger 21, a pattern in which the air does not flow through both the discharge air heat exchanger 23 and the total heat exchanger 21, and a pattern in which the air does not flow through the discharge air heat exchanger 23 but flows through the total heat exchanger 21.

[0020] As illustrated in Fig. 3, in the air conditioner 100, the outdoor unit 10 and the indoor unit 20 are connected to each other by a refrigerant pipe 30a and a refrigerant pipe 30b. The outdoor unit 10 includes a compressor 11, a four-way valve 12, an outdoor heat exchanger 13, and a blower 14 which serves as an outdoor fan. The indoor unit 20 includes a supply air heat exchanger 22, a discharge air heat exchanger 23, and an expansion valve 26.

[0021] The air conditioner 100 circulates the refrigerant in the order of the compressor 11, the outdoor heat exchanger 13, the expansion valve 26, the discharge air heat exchanger 23, and the supply air heat exchanger 22 during the cooling operation. The air conditioner 100 circulates the refrigerant in the order of the compressor 11, the supply air heat exchanger 22, the discharge air heat exchanger 23, the expansion valve 26, and the outdoor heat exchanger 13 during the heating operation.

[0022] The compressor 11 sucks and compresses low-temperature and low-pressure refrigerant, and discharges the compressed refrigerant as high-temperature and highpressure gas refrigerant. The compressor 11 is driven by, for example, an inverter, and thereby the capacity (the amount of refrigerant discharged per unit time) thereof is controlled. The four-way valve 12 switches the flow of the refrigerant according to an operation mode of the air conditioner 100.

[0023] The outdoor heat exchanger 13 exchanges heat between the refrigerant flowing through the refrigerant circuit and the outdoor air. The blower 14 is disposed adjacent to the outdoor heat exchanger 13. The blower 14 is configured to blow air toward the outdoor heat exchanger 13. The expansion valve 26 is, for example, an electronic expansion valve with an adjustable opening degree. The air conditioner 100 includes a controller 60 that collectively controls the blower 14, the expansion valve 26, and other driving components.

[0024] The controller 60 includes a CPU (Central Processing Unit) 61, a memory 62 (such as a ROM (Read Only Memory) or a RAM (Random Access Memory)), and an input/output device (not shown) for inputting/outputting various signals. The CPU 61 loads programs stored in the ROM into the RAM or the like and executes the programs. The programs stored in the ROM are programs that describe the processing procedure of the controller 60. The controller 60 controls each device in accordance with these programs. This control is not limited to being processed by software, but may be processed by dedicated hardware (electronic circuit).

[0025] The controller 60 adjusts the airflow rate by, for example, controlling the rotation speed of each of the blowers 14, 28 and 29. The controller 60 controls the pressure reduction amount of the refrigerant, for example, by controlling the opening degree of the expansion valve 26.

<Operation>

[0026] Fig. 4 is a flowchart illustrating the control of a damper during the cooling operation according to the first embodiment. Figs. 5 to 7 each illustrate an example damper operation according to the first embodiment.

[0027] As illustrated in Fig. 4, in step S1, the controller 60 determines whether or not a supply air temperature T_{SA} detected by the supply air temperature detection unit 50 is higher than a predefined air temperature lower limit T_L. The air temperature lower limit T_L is a temperature set as a temperature at which an occupant in the room feels cold air. When the supply air temperature T_{SA} is higher than the air temperature lower limit T_L (YES in step S1), in other words, when it is not necessary to suppress the cooling capacity, the controller 60 proceeds the procedure to step S2.

[0028] In step S2, as illustrated in Figs. 5 and 6, the controller 60 controls the first damper 24 so as to not allow the indoor air RA to flow through the discharge air heat exchanger 23. Next, the controller 60 compares an indoor air temperature T_{IN} with an outdoor air temperature T_{OA} (step S3). The indoor air temperature T_{IN} is measured by a thermometer (not shown) disposed in the indoor space. The outdoor air temperature T_{OA} is measured by the outdoor air temperature detection unit 51.

[0029] When the indoor air temperature T_{IN} is lower than the outdoor air temperature T_{OA} (YES in step S3), the controller 60 proceeds the procedure to step S4. In step S4, as illustrated in Fig. 5, the controller 60 controls the second damper 25 so as to allow the indoor air RA to flow through the total heat exchanger 21, and returns the procedure from the subroutine to the main routine. Thereby, the total heat exchange is performed between the indoor air RA and the outdoor air OA in the total heat exchanger 21, which makes it possible to cool the outdoor air OA flowing through the air supply passage.

[0030] When the indoor air temperature T_{IN} is higher than the outdoor air temperature T_{OA} (NO in step S3), the controller 60 proceeds the procedure to step S5. In step S5, as illustrated in Fig. 6, the controller 60 controls the second damper 25 so as to not allow the indoor air RA to flow through the total heat exchanger 21, and returns the procedure from the subroutine to the main routine. Thus, when it is not necessary to cool the outdoor air OA flowing through the air supply passage, the total heat exchange may not be performed between the indoor air RA and the outdoor air OA in the total heat exchanger 21.

[0031] When the supply air temperature T_{SA} is lower than the air temperature lower limit T_L in step S1 (NO in step S1), in other words, when it is necessary to suppress the cooling capacity, the controller 60 proceeds the procedure to step S6. In step S6, as illustrated in Fig. 7, the controller 60 controls the first damper 24 so as to allow the indoor air RA to flow through the discharge air heat exchanger 23. Next, in step S7, as illustrated in Fig. 7, the controller 60 controls the second damper 25 so as to not allow the indoor air RA to flow through the total heat exchanger 21, and returns the procedure from the subroutine to the main routine.

[0032] The process in step S6 allows the indoor air RA flowing through the air discharge passage to flow through the discharge air heat exchanger 23, and whereby the indoor air RA is cooled. Thereby, it is possible to suppress the cooling capacity of the supply air heat exchanger 22, which makes it possible to increase the supply air temperature T_{SA}. The process in step S7 prevents the indoor air RA from flowing through the total heat exchanger 21, and prevents the outdoor air OA flowing through the air supply passage from being cooled. Therefore, the minimum capacity (the amount of heat exchanged by the supply air SA) at the time of suppressing the cooling capacity can be made smaller than the conventional one, which makes it possible to widen the temperature range of the supply air which enables continuous operation.

[0033] Fig. 8 is a diagram illustrating refrigerant state transition according to the first embodiment. The vertical axis represents pressure p, and the horizontal axis represents specific enthalpy h. The p-h diagram illustrates a refrigeration cycle when the indoor unit 20 functions as an evaporator, which is represented by a line connecting points A to E. In Fig. 8, points A to C represent an evaporation process performed in the indoor unit 20, points C to D represent a condensation process performed in the compressor 11, points D to E represent a condensation process performed in the outdoor unit, and points E to A represent an expansion process performed in the expansion valve 26.

[0034] As illustrated in Fig. 8, in the evaporation process, the air flows through the discharge air heat exchanger 23 from the point A to the point B to exchange heat equal to a heat exchange amount Q_{EA} in the discharge air heat exchanger 23. Thereby, the specific enthalpy of the refrigerant flowing into the supply air heat exchanger 22 is increased from h1 to h2. In the evaporation process, the air flows through the supply air heat exchanger 22 from the point B to the point C to exchange heat equal to a heat exchange amount Q_{SA} in the supply air heat exchanger 22.

[0035] Thus, in the evaporation process, the specific enthalpy of the refrigerant is increased from h1 to h2 in the discharge air heat exchanger 23, and the specific enthalpy of the refrigerant is increased from h2 to h3 in the supply air heat exchanger 22. This reduces the heat exchange amount Q_{SA} in the supply air heat exchanger 22 as compared with a case where the air is not allowed to flow through the discharge air heat exchanger 23, which prevents the temperature of the supply air SA from decreasing.

[0036] Fig. 9 is a flowchart illustrating the control of the damper during the heating operation according to the first embodiment. As illustrated in Fig. 9, in step S11, the controller 60 determines whether or not the supply air temperature T_{SA} detected by the supply air temperature detection unit 50 is lower than a predefined air temperature upper limit T_H. The air temperature upper limit T_H is a temperature set as a temperature at which an occupant in the room feels warm air. When the supply air temperature T_{SA} is lower than the air temperature upper limit T_H (YES in step S11), in other words, when it is not necessary to suppress the heating capability, the controller 60 proceeds the procedure to step S12.

[0037] In step S12, the controller 60 controls the first damper 24 so as to not allow the indoor air RA to flow through the discharge air heat exchanger 23. Next, the controller 60 compares the indoor air temperature T_{IN} with the outdoor air temperature T_{OA} (step S13). The indoor air temperature T_{IN} is measured by a thermometer (not shown) disposed in the indoor space. The outdoor air temperature T_{OA} is measured by the outdoor air temperature detection unit 51.

[0038] When the indoor air temperature T_{IN} is higher than the outdoor air temperature T_{OA} (YES in step S13), the controller 60 proceeds the procedure to step S14. In step S14, the controller 60 controls the second damper 25 so as to allow the indoor air RA to flow through the total heat exchanger 21, and returns the procedure from the subroutine to the main routine. Thereby, the total heat exchange is performed between the indoor air RA and the outdoor air OA in the total heat exchanger 21, which makes it possible to heat the outdoor air OA flowing through the air supply passage.

[0039] When the indoor air temperature T_{IN} is lower than the outdoor air temperature T_{OA} (NO in step S13), the controller 60 proceeds the procedure to step S15. In step S15, the controller 60 controls the second damper 25 so as to not allow the indoor air RA to flow through the total heat exchanger 21, and returns the procedure from the subroutine to the main routine. Thus, when it is not necessary to heat the outdoor air OA flowing through the air supply passage, the total heat exchange may not be performed between the indoor air RA and the outdoor air OA in the total heat exchanger 21.

[0040] When the supply air temperature T_{SA} is higher than the air temperature upper limit T_H in step S11 (NO in step S11), in other words, when it is necessary to suppress the heating capability, the controller 60 proceeds the procedure to step S16. In step S16, the controller 60 controls the first damper 24 so as to allow the indoor air RA to flow through the discharge air heat exchanger 23. Next, in step S17, the controller 60 controls the second damper 25 so as to not allow the indoor air RA to flow through the total heat exchanger 21, and returns the procedure from the subroutine to the main routine.

[0041] The process in step S16 allows the indoor air RA flowing through the air discharge passage to flow through the discharge air heat exchanger 23, and whereby the indoor air RA is heated. Thereby, it is possible to suppress the heating capability of the supply air heat exchanger 22, which makes it possible to decrease the supply air temperature T_{SA}. The process in step S17 prevents the indoor air RA from flowing through the total heat exchanger 21, which makes it possible to prevent the outdoor air OA flowing through the air supply passage from being heated.

Second Embodiment

<Configuration>

[0042] Fig. 10 is a schematic diagram illustrating the configuration of an indoor unit 20A according to a second embodiment. The configuration of the indoor unit 20A according to the second embodiment is similar to that of the indoor unit 20 of the first embodiment except that the first damper 24 includes a mechanism that can adjust the angle. The controller 60 changes the angle of the first damper 24 as necessary.

<Operation>

[0043] Fig. 11 is a flowchart illustrating the control of a damper according to the second embodiment. In Fig. 11, the control of the damper will be described as an example control during the cooling operation.

[0044] As illustrated in Fig. 11, in step S21, the controller 60 determines whether or not the supply air temperature T_{SA} detected by the supply air temperature detection unit 50 is higher than a predefined target air temperature T_T. The target air temperature T_T is set as a temperature which is perceived by an occupant in the room as an appropriate temperature.

[0045] When the supply air temperature T_{SA} is higher than the target air temperature T_T (YES in step S21), in other words, when it is necessary to reduce the supply air temperature T_{SA}, the controller 60 proceeds the procedure to step S22. In step S22, the controller 60 controls the first damper 24 by changing the angle thereof so as to reduce the airflow rate of the indoor air RA flowing through the discharge air heat exchanger 23. Thereby, the airflow rate of the indoor air flowing through the discharge air heat exchanger 23 is reduced, which makes it possible to increase the amount of heat exchanged in the supply air heat exchanger 22. The increase in the amount of heat exchanged in the supply air heat exchanger 22 makes it possible to reduce the supply air temperature T_{SA}.

[0046] When the supply air temperature T_{SA} is lower than the target air temperature T_T (NO in step S21), in other words, when it is necessary to increase the supply air temperature T_{SA}, the controller 60 proceeds the procedure to step S23. In step S23, the controller 60 controls the first damper 24 by changing the angle thereof so as to increase the airflow rate of the indoor air RA flowing through the discharge air heat exchanger 23. Thereby, the airflow rate of the indoor air flowing through the discharge air heat exchanger 23 is increased, which makes it possible to reduce the amount of heat exchanged in the supply air heat exchanger 22. The reduction in the amount of heat exchanged in the supply air heat exchanger 22 makes it possible to increase the supply air temperature T_{SA}.

[0047] Thus, according to the indoor unit 20A of the second embodiment, when it is necessary to bring the supply air temperature T_{SA} close to the target air temperature T_T, the amount of heat exchanged in the supply air heat exchanger 22 can be controlled by increasing or decreasing the flow rate of the air flowing through the discharge air heat exchanger 23.

Third Embodiment

<Configuration>

[0048] Fig. 12 is a schematic diagram illustrating the configuration of an indoor unit 20B according to a third embodiment. The third embodiment is different from the first embodiment in that the supply air heat exchanger 22 is downsized and the discharge air heat exchanger 23 is disposed at a position adjacent to the supply air heat exchanger 22. As illustrated in Fig. 12, in the indoor unit 20B, since the supply air heat exchanger 22 is downsized and the discharge air heat exchanger 23 is disposed at a position adjacent to the supply air heat exchanger 22, the overall size of the heat exchanger can be reduced.

[0049] The indoor unit 20B according to the third embodiment differs from the configuration of the first embodiment in that the indoor unit 20B includes a first damper group configured to switch whether or not to allow the indoor air RA or the outdoor air OA to flow through the discharge air heat exchanger 23 instead of the first damper 24. The first damper group includes a third damper 24a, a fourth damper 24b, and a fifth damper 24c. In the indoor unit 20B, the supply air heat exchanger 22 is disposed in the air supply passage, the discharge air heat exchanger 23 is disposed in a common air passage, and the controller 60 controls the third damper 24a, the fourth damper 24b, and the fifth damper 24c to switch one of the outdoor air OA and the indoor air RA to flow the common air passage. The controller 60 changes the positions of the third damper 24a, the fourth damper 24b, and the fifth damper 24c to switch whether or not to allow the indoor air RA or the outdoor air OA to flow through the discharge air heat exchanger 23.

<Operation>

[0050] Fig. 13 is a flowchart illustrating the control of a damper according to the third embodiment. Figs. 14 to 16 illustrate an example damper operation according to the third embodiment. In Fig. 13, the control of the damper will be described as an example control during the cooling operation.

[0051] As illustrated in Fig. 13, in step S31, the controller 60 determines whether or not the supply air temperature T_{SA} detected by the supply air temperature detection unit 50 is higher than a predefined air temperature lower limit T_L. The air temperature lower limit T_L is a temperature set as a temperature at which an occupant in the room feels cold air. When the supply air temperature T_{SA} is higher than the air temperature lower limit T_L (YES in step S31), in other words, when it is not necessary to suppress the cooling capacity, the controller 60 proceeds the procedure to step S32.

[0052] In step S32, as illustrated in Figs. 14 and 15, the controller 60 controls the third damper 24a, the fourth damper 24b, and the fifth damper 24c so as to not allow the indoor air RA to flow through the discharge air heat exchanger 23. In step S32, as illustrated in Figs. 14 and 15, the controller 60 controls the third damper 24a, the fourth damper 24b, and the fifth damper 24c so as to allow the outdoor air OA to flow through the discharge air heat exchanger 23.

[0053] Next, the controller 60 compares the indoor air temperature T_{IN} with the outdoor air temperature T_{OA} (step S33). The indoor air temperature T_{IN} is measured by a thermometer (not shown) disposed in the indoor space. The outdoor air temperature T_{OA} is measured by the outdoor air temperature detection unit 51.

[0054] When the indoor air temperature T_{IN} is lower than the outdoor air temperature T_{OA} (YES in step S33), the controller 60 proceeds the procedure to step S34. In step S34, as illustrated in Fig. 14, the controller 60 controls the second damper 25 so as to allow the indoor air RA to flow through the total heat exchanger 21, and returns the procedure from the subroutine to the main routine. Thereby, the total heat exchange is performed between the indoor air RA and the outdoor air OA in the total heat exchanger 21, which makes it possible to cool the outdoor air OA flowing through the air supply passage.

[0055] After steps S32 and S34, the first damper group (the third damper 24a, the fourth damper 24b, and the fifth damper 24c) and the second damper 25 are switched to the arrangement illustrated in Fig. 14. As illustrated in Fig. 14, the outdoor air OA is blown by the blower 28 to flow through the total heat exchanger 21 and then flow through the supply air heat exchanger 22 and the discharge air heat exchanger 23, and is supplied to the room as the supply air SA. The indoor air RA is blown by the blower 29 to flow through the total heat exchanger 21, and is discharged out of the room as the discharge air EA.

[0056] Thus, when it is not necessary to suppress the cooling capacity, the cooling capacity of the indoor unit 20B can be prevented from being lowered by preventing the indoor air RA from flowing through the discharge air heat exchanger 23. In the indoor unit 20B, since the outdoor air OA flows through both the supply air heat exchanger 22 and the discharge air heat exchanger 23, the cooling capacity can be improved. In the indoor unit 20B, the total heat exchange is performed between the indoor air RA and the outdoor air OA in the total heat exchanger 21, which makes it possible to cool the outdoor air OA flowing through the air supply passage.

[0057] When the indoor air temperature T_{IN} is higher than the outdoor air temperature T_{OA} (NO in step S33), the controller 60 proceeds the procedure to step S35. In step S35, as illustrated in Fig. 15, the controller 60 controls the second damper 25 so as to not allow the indoor air RA to flow through the total heat exchanger 21, and returns the procedure from the subroutine to the main routine. Thus, when it is not necessary to cool the outdoor air OA flowing through the air supply passage, the total heat exchange may not be performed between the indoor air RA and the outdoor air OA in the total heat exchanger 21.

[0058] After steps S32 and S35, the first damper group (the third damper 24a, the fourth damper 24b, and the fifth damper 24c) and the second damper 25 are switched to the arrangement illustrated in Fig. 15. As illustrated in Fig. 15, the outdoor air OA is blown by the blower 28 to flow through the total heat exchanger 21 and then flow through the supply air heat exchanger 22 and the discharge air heat exchanger 23, and is supplied to the room as the supply air SA. The indoor air RA is discharged out of the room as the discharge air EA by the blower 29 without flowing through the total heat exchanger 21.

[0059] Thus, when it is not necessary to suppress the cooling capacity, the cooling capacity of the indoor unit 20B can be prevented from being lowered by preventing the indoor air RA from flowing through the discharge air heat exchanger 23. In the indoor unit 20B, since the outdoor air OA flows through both the supply air heat exchanger 22 and the discharge air heat exchanger 23, the cooling capacity can be improved. In the indoor unit 20B, the indoor air RA is prevented from flowing through the total heat exchanger 21, and is prevented from exchanging heat with the outdoor air OA flowing through the air supply passage.

[0060] In step S31, when the supply air temperature T_{SA} is lower than the air temperature lower limit T_L (NO in step S31), in other words, when it is necessary to suppress the cooling capacity, the controller 60 proceeds the procedure to step S36. In step S36, as illustrated in Fig. 16, the controller 60 controls the third damper 24a, the fourth damper 24b, and the fifth damper 24c so as to allow the indoor air RA to flow through the discharge air heat exchanger 23. Next, in step S37, as illustrated in Fig. 16, the controller 60 controls the second damper 25 so as to not allow the indoor air RA to flow through the total heat exchanger 21, and returns the procedure from the subroutine to the main routine.

[0061] The process in step S36 allows the indoor air RA flowing through the air discharge passage to flow through the discharge air heat exchanger 23, whereby the indoor air RA is cooled. Thereby, it is possible to suppress the cooling capacity of the supply air heat exchanger 22, which makes it possible to increase the supply air temperature T_{SA}. The process in step S37 prevents the indoor air RA from flowing through the total heat exchanger 21, and prevents the outdoor air OA flowing through the air supply passage from being cooled. Therefore, the minimum capacity (the amount of heat exchanged by the supply air SA) at the time of suppressing the cooling capacity can be made smaller than the conventional one, which makes it possible to widen the temperature range of the supply air which enables continuous operation.

[0062] In the indoor unit 20B according to the third embodiment, when the supply air temperature T_{SA} is not lower than the air temperature lower limit T_L, the discharge air heat exchanger 23 can be used to cool the outdoor air OA as illustrated in Figs. 14 and 15. Therefore, the size and specification of the supply air heat exchanger 22 can be reduced, which makes it possible to reduce the cost of the product.

<Configuration>

[0063] Fig. 17 is a schematic diagram illustrating the configuration of an indoor unit 20C according to a modification of the third embodiment. The modification of the third embodiment differs from the third embodiment in that the supply air heat exchanger 22 also includes a part of the configuration of the discharge air heat exchanger 23 of the third embodiment. The other configuration is the same as that of the third embodiment.

[0064] In the indoor unit 20C, the air passage is partitioned by a third damper 24a, a fourth damper 24b, and a fifth damper 24c. In the indoor unit 20C, by partitioning the air passage, the supply air heat exchanger 22 may also function as the discharge air heat exchanger 23 of the third embodiment.

Fourth Embodiment

<Configuration>

[0065] Fig. 18 is a schematic diagram illustrating the configuration of an indoor unit 20D according to a fourth embodiment. The configuration of the indoor unit 20D according to the fourth embodiment is the same as the configuration of the indoor unit 20 according to the first embodiment. In the fourth embodiment, the control will be described when the outdoor air temperature T_{OA} is lower than a predefined freezing temperature T_f during the heating operation. The freezing temperature T_f is a temperature set as a temperature at which moisture in the air flowing through the air discharge passage may freeze.

[0066] When the outdoor air temperature T_{OA} is lower than the freezing temperature T_f, the indoor air RA flowing through the air discharge passage is cooled by the outdoor air OA, whereby moisture in the air may freeze. This causes the total heat exchanger 21 to be clogged.

<Operation>

[0067] Fig. 19 is a flowchart illustrating the control of a damper according to the fourth embodiment. In Fig. 19, the control of the damper will be described as an example control during the heating operation. In the indoor unit 20D, the supply air heat exchanger 22 and the discharge air heat exchanger 23 each function as a condenser.

[0068] As illustrated in Fig. 19, in step S41, the controller 60 determines whether or not the outdoor air temperature T_{OA} is higher than the freezing temperature T_f. When the outdoor air temperature T_{OA} is higher than the freezing temperature T_f (YES in step S41), the controller 60 proceeds the procedure to step S42. In step S42, the controller 60 performs the process of steps S11 to S17 of Fig. 9, and returns the procedure from the subroutine to the main routine.

[0069] When the outdoor air temperature T_{OA} is lower than the freezing temperature T_f (NO in step S41), the controller 60 proceeds the procedure to step S43. In step S43, the controller 60 controls the first damper 24 so as to allow the indoor air RA to flow through the discharge air heat exchanger 23. Next, in step S44, the controller 60 controls the second damper 25 so as to allow the indoor air RA to flow through the total heat exchanger 21, and returns the procedure from the subroutine to the main routine.

[0070] Thus, according to the indoor unit 20D of the fourth embodiment, the temperature of the indoor air RA flowing into the total heat exchanger 21 can be improved by allowing it to flow through the discharge air heat exchanger 23 (steps S43 and S44). This makes it possible to suppress the freezing of the air moisture in the air discharge passage and the clogging of the total heat exchanger 21.

<Summary>

[0071] The present disclosure relates to an air conditioner 100 including an outdoor unit 10 and an indoor unit 20. The outdoor unit 10 and the indoor unit 20 are connected to each other by a refrigerant pipe 30 to form a refrigerant circuit. The outdoor unit 10 includes a compressor 11 and an outdoor heat exchanger 13. The indoor unit 20 includes an expansion valve 26, a supply air heat exchanger (an indoor heat exchanger) 22, a discharge air heat exchanger 23, a blower 28 which serves as an air supply device configured to supply outdoor air OA into a room through an air supply passage, and a blower 29 which serves as an air discharge device configured to discharge indoor air RA out of the room through an air discharge passage. The indoor heat exchanger is configured to allow air flowing through the air supply passage or air flowing through the air discharge passage to flow through the indoor heat exchanger. The indoor unit 20 further includes a first damper 24 which serves as a switching unit configured to switch whether or not to allow the indoor air RA flowing through the air discharge passage to flow through the discharge air heat exchanger (an indoor heat exchanger) 23.

[0072] Preferably, the indoor heat exchanger includes a supply air heat exchanger 22 as a first indoor heat exchanger and a discharge air heat exchanger 23 as a second indoor heat exchanger. The indoor unit 20 further includes a controller 60 configured to control the operation of the first damper 24. The controller 60 controls the first damper 24 to allow the indoor air RA to flow through the discharge air heat exchanger 23 so as to suppress the amount of heat exchanged by the supply air heat exchanger 22 in the air supply passage.

[0073] Preferably, the indoor heat exchanger includes a supply air heat exchanger 22 as a first indoor heat exchanger and a discharge air heat exchanger 23 as a second indoor heat exchanger. The indoor unit 20 further includes a controller 60 configured to control the operation of the first damper 24. The first damper 24 is configured to adjust an airflow rate of the indoor air RA flowing through the discharge air heat exchanger 23. The controller 60 controls the first damper 24 to adjust the airflow rate of the indoor air RA flowing through the discharge air heat exchanger 23 so as to adjust the amount of heat exchanged by the supply air heat exchanger 22 in the air supply passage.

[0074] Preferably, the indoor heat exchanger includes a supply air heat exchanger 22 as a first indoor heat exchanger and a discharge air heat exchanger 23 as a second indoor heat exchanger. The indoor unit 20 further includes a controller 60 configured to control the operation of a third damper 24a, a fourth damper 24b, and a fifth damper 24c, each of which serves as a switching unit. The supply air heat exchanger 22 is disposed in the air supply passage, the discharge air heat exchanger 23 is disposed in a common air passage, and the controller 60 controls the third damper 24a, the fourth damper 24b, and the fifth damper 24c to switch one of the outdoor air OA and the indoor air RA to flow through the common air passage.

[0075] Preferably, the indoor unit 20 further includes a total heat exchanger 21 configured to exchange heat between the outdoor air OA and the indoor air RA. The second damper 25, which serves as a switching unit, is configured to switch whether or not to allow the indoor air RA flowing through the air discharge passage to flow through the total heat exchanger 21.

[0076] Preferably, the switching unit includes a first damper 24 configured to switch whether or not to allow the indoor air RA to flow through the discharge air heat exchanger 23 and a second damper 25 configured to switch whether or not to allow the indoor air RA to flow through the total heat exchanger 21. when the temperature T_{SA} of the air supplied into a room is higher than a predefined lower limit and the indoor air temperature T_{IN} is lower than the outdoor air temperature T_{OA}, the controller 60 controls the first damper 24 so as to not allow the indoor air RA to flow through the discharge air heat exchanger 23, and controls the second damper 25 so as to allow the indoor air RA to flow through the total heat exchanger 21.

[0077] Preferably, the switching unit includes a first damper 24 configured to switch whether or not to allow the indoor air RA to flow through the discharge air heat exchanger 23 and a second damper 25 configured to switch whether or not to allow the indoor air RA to flow through the total heat exchanger 21. When the temperature T_{SA} of the air supplied into a room is higher than a predefined lower limit and the indoor air temperature T_{IN} is higher than the outdoor air temperature T_{OA}, the controller 60 controls the first damper 24 so as to not allow the indoor air RA to flow through the discharge air heat exchanger 23, and controls the second damper 25 so as to not allow the indoor air RA to flow through the total heat exchanger 21.

[0078] Preferably, the switching unit includes a first damper 24 configured to switch whether or not to allow the indoor air RA to flow through the discharge air heat exchanger 23 and a second damper 25 configured to switch whether or not to allow the indoor air RA to flow through the total heat exchanger 21. When the temperature T_{SA} of the air supplied into a room is lower than a predefined lower limit, the controller 60 controls the first damper 24 so as to allow the indoor air RA to flow through the discharge air heat exchanger 23, and controls the second damper 25 so as to not allow the indoor air RA to flow through the total heat exchanger 21.

[0079] Preferably, the switching unit includes a first damper 24 configured to increase or decrease an airflow rate of the indoor air RA flowing through the discharge air heat exchanger 23, and a second damper 25 configured to switch whether or not to allow the indoor air RA to flow through the total heat exchanger 21. The controller 60 controls the first damper 24 so as to decrease the airflow rate of the indoor air RA flowing through the discharge air heat exchanger 23 when the temperature T_{SA} of the air supplied into a room is higher than a predefined target temperature, and controls the first damper 24 so as to increase the airflow rate of the indoor air RA flowing through the discharge air heat exchanger 23 when the temperature T_{SA} of the indoor air is lower than the predefined target temperature.

[0080] Preferably, the switching unit includes a third damper 24a, a fourth damper 24b, and a fifth damper 24c as a first damper group configured to switch whether or not to allow the indoor air RA or the outdoor air OA to flow through the discharge air heat exchanger 23, and includes a second damper 25 configured to switch whether or not to allow the indoor air RA to flow through the total heat exchanger 21. When the temperature T_{SA} of the air supplied into a room is higher than a predefined lower limit and the indoor air temperature T_{IN} is lower than the outdoor air temperature T_{OA}, the controller 60 controls the third damper 24a, the fourth damper 24b, and the fifth damper 24c so as to allow the outdoor air OA to flow through the discharge air heat exchanger 23, and controls the second damper 25 so as to allow the indoor air RA to flow through the total heat exchanger 21.

[0081] Preferably, the switching unit includes a third damper 24a, a fourth damper 24b, and a fifth damper 24c as a first damper group configured to switch whether or not to allow the indoor air RA or the outdoor air OA to flow through the discharge air heat exchanger 23, and includes a second damper 25 configured to switch whether or not to allow the indoor air RA to flow through the total heat exchanger 21. When the temperature T_{SA} of the air supplied into a room is higher than a predefined lower limit and the indoor air temperature T_{IN} is higher than the outdoor air temperature T_{OA}, the controller 60 controls the third damper 24a, the fourth damper 24b, and the fifth damper 24c so as to allow the outdoor air OA to flow through the discharge air heat exchanger 23 and controls the second damper 25 so as to not allow the indoor air RA to flow through the total heat exchanger 21.

[0082] Preferably, the switching unit includes a third damper 24a, a fourth damper 24b, and a fifth damper 24c as a first damper group configured to switch whether or not to allow the indoor air RA or the outdoor air OA to flow through the discharge air heat exchanger 23, and includes a second damper 25 configured to switch whether or not to allow the indoor air RA to flow through the total heat exchanger 21. When the temperature T_{SA} of the air supplied into a room is lower than a predefined lower limit, the controller 60 controls the third damper 24a, the fourth damper 24b, and the fifth damper 24c so as to allow the indoor air RA to flow through the discharge air heat exchanger 23, and controls the second damper 25 so as to not allow the indoor air RA to flow through the total heat exchanger 21.

[0083] Preferably, the switching unit includes a first damper 24 configured to switch whether or not to allow the indoor air RA to flow through the discharge air heat exchanger 23, and a second damper 25 configured to switch whether or not to allow the indoor air RA to flow through the total heat exchanger 21. When the outdoor air temperature T_{OA} is lower than a freezing temperature T_f, the controller 60 controls the first damper 24 so as to allow the indoor air RA to flow through the discharge air heat exchanger 23, and controls the second damper 25 so as to allow the indoor air RA to flow through the total heat exchanger 21.

[0084] The air conditioner 100 according to the present embodiment is provided with the above-described configuration, whereby the temperature of the supply air can be suitably maintained while the continuous operation is being performed.

<Modifications>

[0085] In any of the above embodiments, the total heat exchanger 21 and the second damper 25 may be omitted.

[0086] The methods of suppressing the cooling capacity include a method of reducing the frequency of the compressor 11 (decreasing the rotation speed) to increase the evaporation temperature, or a method of reducing the opening degree of the expansion valve 26 to increase the degree of superheat at the outlet of the evaporator. In any of the above embodiments, when the supply air temperature T_{SA} is lower than the air temperature lower limit T_L, the cooling capacity may be suppressed by combining these methods and the control method of the damper operation described above.

[0087] Specifically, when the supply air temperature T_{SA} is lower than the air temperature lower limit T_L, the controller 60 reduces the frequency of the compressor 11 or reduces the opening degree of the expansion valve 26. When the supply air temperature T_{SA} is lower than the air temperature lower limit T_L even if the frequency of the compressor 11 is reduced to the lower limit or the opening degree of the expansion valve 26 is reduced to the lower limit, the controller 60 causes the air to flow through the discharge air heat exchanger 23. Thus, the indoor air RA flowing through the air discharge passage is cooled, and the cooling capacity of the supply air heat exchanger 22 is suppressed, which thereby increases the supply air temperature T_{SA}.

[0088] The reduction in the frequency of the compressor 11 or the reduction in the opening degree of the expansion valve 26 leads to a reduction in the cooling capacity and at the same time to a reduction in the power consumption of the air conditioner 100. On the other hand, the damper control in the discharge air heat exchanger 23 reduces the cooling capacity of the supply air heat exchanger 22, but does not lead to a reduction in the power consumption of the air conditioner 100 because the discharge air heat exchanger 23 will operate to provide the reduced cooling capacity. Therefore, by performing the damper control in the discharge air heat exchanger 23 after reducing the frequency of the compressor 11 or reducing the opening degree of the expansion valve 26, it is possible to suppress the power consumption.

[0089] It should be understood that the embodiments disclosed herein are illustrative and non-restrictive in all respects. The scope of the present invention is defined by the terms of the claims rather than the description of the embodiments above, and is intended to include any modifications within the scope and meaning equivalent to the terms of the claims.

REFERENCE SIGNS LIST

[0090] 10: outdoor unit; 11: compressor; 12: four-way valve; 13: outdoor heat exchanger; 14, 28, 29: blower; 20, 20A, 20B, 20C, 20D: indoor unit; 21: total heat exchanger; 22: supply air heat exchanger; 23: discharge air heat exchanger; 24: first damper; 24a: third damper; 24b: fourth damper; 24c: fifth damper; 25: second damper; 26: expansion valve; 30, 30a, 30b: refrigerant pipe; 40: duct; 41: outlet port; 42: inlet port; 50: supply air temperature detection unit; 51: outdoor air temperature detection unit; 60: controller; 61: CPU; 62: memory; 100:

air conditioner; EA: discharge air; SA: supply air; OA: outdoor air; RA: indoor air

Claims

1. An air conditioner comprising:

an outdoor unit; and
an indoor unit, wherein
the outdoor unit and the indoor unit are connected to each other by a refrigerant pipe to form a refrigerant circuit,
the outdoor unit includes a compressor and an outdoor heat exchanger,
the indoor unit includes an expansion valve, an indoor heat exchanger, an air supply device configured to supply outdoor air into a room through an air supply passage, and an air discharge device configured to discharge indoor air out of the room through an air discharge passage,
the indoor heat exchanger is configured to allow air flowing through the air supply passage or air flowing through the air discharge passage to flow through the indoor heat exchanger,
the indoor unit further includes a switching unit configured to switch whether or not to allow the indoor air flowing through the air discharge passage to flow through the indoor heat exchanger.

2. The air conditioner according to claim 1, wherein

the indoor heat exchanger includes a first indoor heat exchanger and a second indoor heat exchanger,
the indoor unit further includes a controller configured to control an operation of the switching unit, and
the controller controls the switching unit to allow the indoor air to flow through the second indoor heat exchanger so as to suppress an amount of heat exchanged by the first indoor heat exchanger in the air supply passage.

3. The air conditioner according to claim 1, wherein

the indoor heat exchanger includes a first indoor heat exchanger and a second indoor heat exchanger,
the indoor unit further includes a controller configured to control an operation of the switching unit,
the switching unit is configured to adjust an airflow rate of the indoor air flowing through the second indoor heat exchanger, and
the controller controls the switching unit to adjust the airflow rate of the indoor air flowing through the second indoor heat exchanger so as to adjust an amount of heat exchanged by the first indoor heat exchanger in the air supply passage.

4. The air conditioner according to claim 1, wherein

the indoor heat exchanger includes a first indoor heat exchanger and a second indoor heat exchanger,
the indoor unit further includes a controller configured to control an operation of the switching unit,
the first indoor heat exchanger is disposed in the air supply passage,
the second indoor heat exchanger is disposed in a common air passage, and the controller controls the switching unit to switch one of the outdoor air and the indoor air to flow through the common air passage.

5. The air conditioner according to any one of claims 2 to 4, wherein

the indoor unit further includes a total heat exchanger configured to exchange heat between the outdoor air and the indoor air, and
the switching unit is configured to switch whether or not to allow the indoor air flowing through the air discharge passage to flow through the total heat exchanger.

6. The air conditioner according to claim 5, wherein

the switching unit includes a first damper configured to switch whether or not to allow the indoor air to flow through the second indoor heat exchanger, and a second damper configured to switch whether or not to allow the indoor air to flow through the total heat exchanger,
when the temperature of the air supplied into a room is higher than a predefined lower limit and the temperature of the indoor air is lower than the temperature of the outdoor air, the controller controls the first damper so as to not allow the indoor air to flow through the second indoor heat exchanger, and controls the second damper so as to allow the indoor air to flow through the total heat exchanger.

7. The air conditioner according to claim 5, wherein

the switching unit includes a first damper configured to switch whether or not to allow the indoor air to flow through the second indoor heat exchanger, and a second damper configured to switch whether or not to allow the indoor air to flow through the total heat exchanger,
when the temperature of the air supplied into a room is higher than a predefined lower limit and

the temperature of the indoor air is higher than the temperature of the outdoor air, the controller controls the first damper so as to not allow the indoor air to flow through the second indoor heat exchanger, and controls the second damper so as to not allow the indoor air to flow through the total heat exchanger

8. The air conditioner according to claim 5, wherein

the switching unit includes a first damper configured to switch whether or not to allow the indoor air to flow through the second indoor heat exchanger, and a second damper configured to switch whether or not to allow the indoor air to flow through the total heat exchanger,
when the temperature of the air supplied into a room is lower than a predefined lower limit, the controller controls the first damper so as to allow the indoor air to flow through the second indoor heat exchanger, and controls the second damper so as to not allow the indoor air to flow through the total heat exchanger.

9. The air conditioner according to claim 5, wherein

the switching unit includes a first damper configured to increase or decrease an airflow rate of the indoor air flowing through the second indoor heat exchanger and a second damper configured to switch whether or not to allow the indoor air to flow through the total heat exchanger,
when the temperature of the air supplied into a room is higher than a predefined target temperature, the controller controls the first damper so as to decrease the airflow rate of the indoor air flowing through the second indoor heat exchanger, and
when the temperature of the indoor air is lower than the predefined target temperature, the controller controls the first damper so as to increase the airflow rate of the indoor air flowing through the second indoor heat exchanger.

10. The air conditioner according to claim 5, wherein

the switching unit includes a first damper group configured to switch whether or not to allow the indoor air or the outdoor air to flow through the second indoor heat exchanger, and a second damper configured to switch whether or not to allow the indoor air to flow through the total heat exchanger,
when the temperature of the air supplied into a room is higher than a predefined lower limit and the temperature of the indoor air is lower than the temperature of the outdoor air, the controller controls the first damper group so as to allow the outdoor air to flow through the second indoor heat exchanger, and controls the second damper so as to allow the indoor air to flow through the total heat exchanger.

11. The air conditioner according to claim 5, wherein

the switching unit includes a first damper group configured to switch whether or not to allow the indoor air or the outdoor air to flow through the second indoor heat exchanger, and a second damper configured to switch whether or not to allow the indoor air to flow through the total heat exchanger,
when the temperature of the air supplied into a room is higher than a predefined lower limit and the temperature of the indoor air is higher than the temperature of the outdoor air, the controller controls the first damper group so as to allow the outdoor air to flow through the second indoor heat exchanger, and controls the second damper so as to not allow the indoor air to flow through the total heat exchanger.

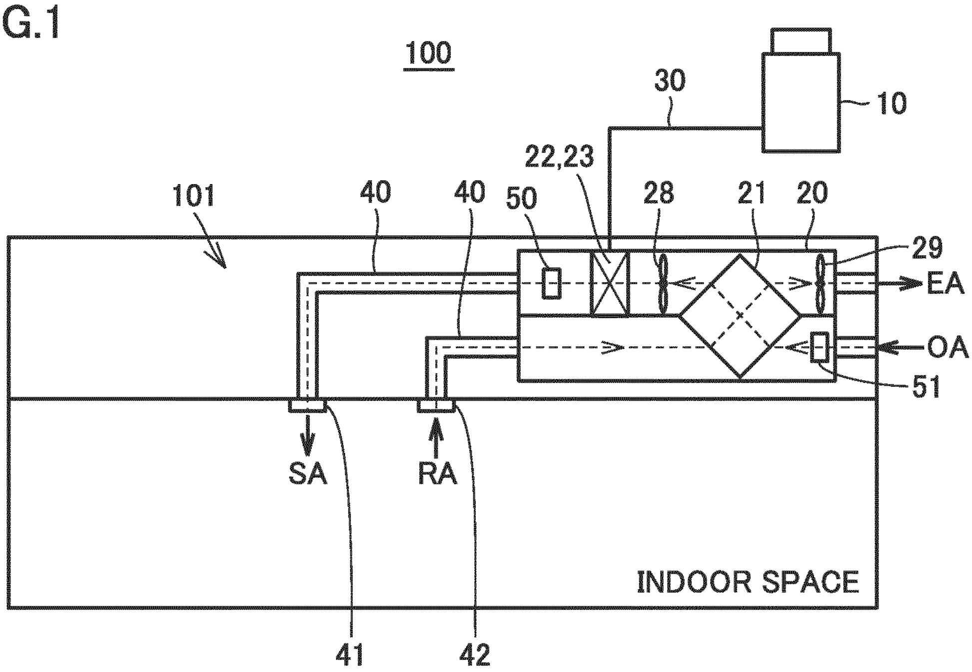
12. The air conditioner according to claim 5, wherein

the switching unit includes a first damper group configured to switch whether or not to allow the indoor air or the outdoor air to flow through the second indoor heat exchanger, and a second damper configured to switch whether or not to allow the indoor air to flow through the total heat exchanger,
when the temperature of the air supplied into a room is lower than a predefined lower limit, the controller controls the first damper group so as to allow the indoor air to flow through the second indoor heat exchanger, and controls the second damper so as to not allow the indoor air to flow through the total heat exchanger.

13. The air conditioner according to claim 5, wherein

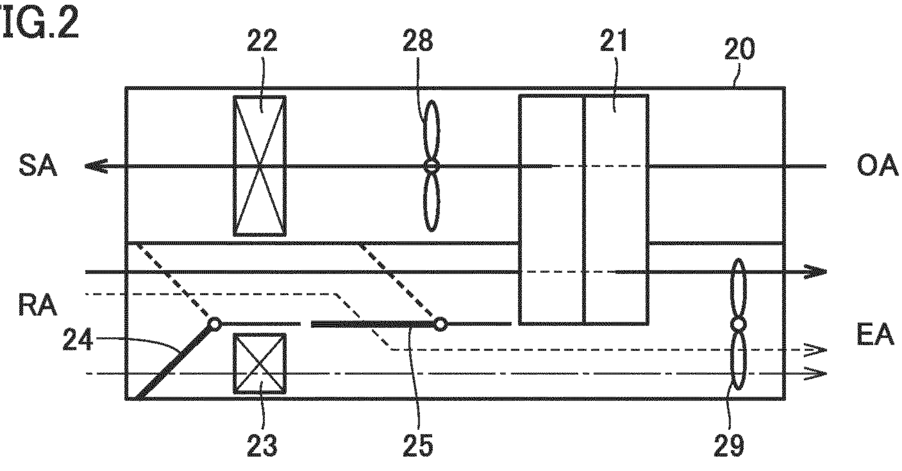
the switching unit includes a first damper configured to switch whether or not to allow the indoor air to flow through the second indoor heat exchanger, and a second damper configured to switch whether or not to allow the indoor air to flow through the total heat exchanger,
when the temperature of the outdoor air is lower than a freezing temperature, the controller controls the first damper so as to allow the indoor air to flow through the second indoor heat exchanger, and controls the second damper so as to allow the indoor air to flow through the total heat exchanger.

FIG.1



100
30
10
22,23
101
40
40
50
28
21
20
29
EA
OA
51
SA
RA
INDOOR SPACE
41
42

FIG.2



22
28
21
20
SA
OA
RA
24
EA
23
25
29

FIG.3

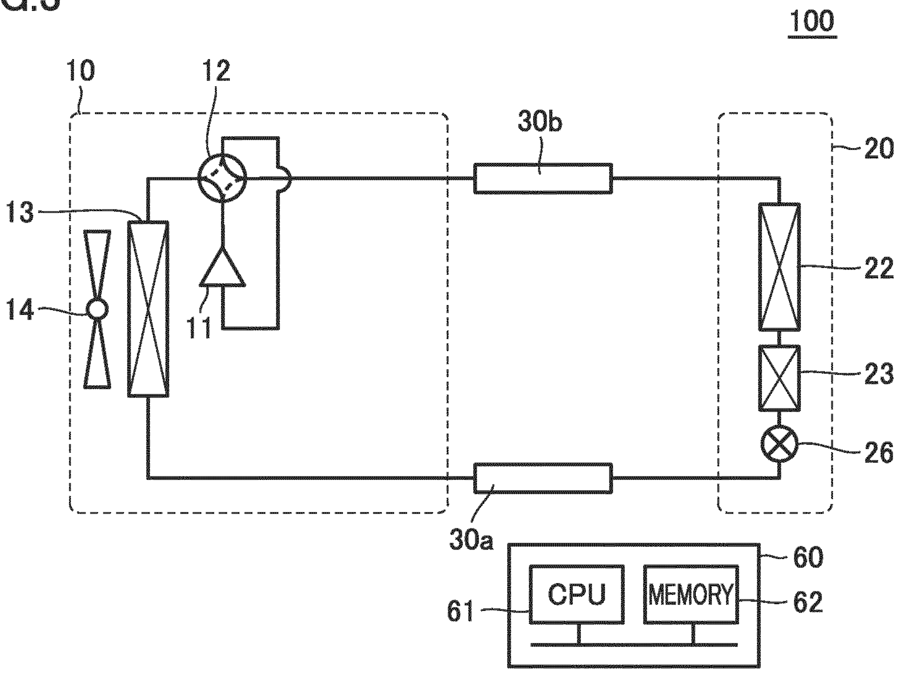

100
10
12
30b
20
13
14
11
22
23
26
30a
60
CPU
MEMORY
61
62

FIG.4

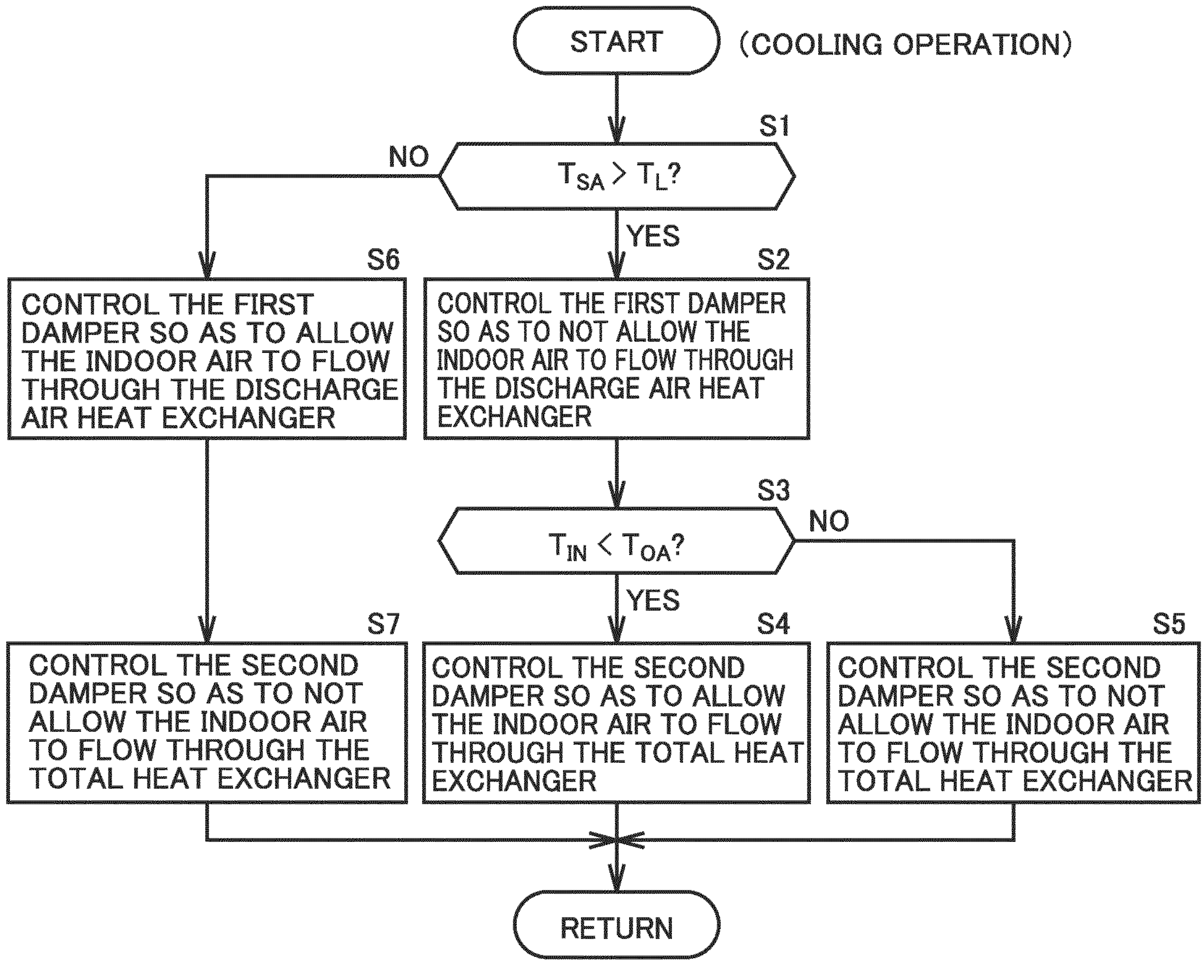

START
(COOLING OPERATION)
S1
NO
$T_{SA} > T_L$?
YES
S6
CONTROL THE FIRST DAMPER SO AS TO ALLOW THE INDOOR AIR TO FLOW THROUGH THE DISCHARGE AIR HEAT EXCHANGER
S2
CONTROL THE FIRST DAMPER SO AS TO NOT ALLOW THE INDOOR AIR TO FLOW THROUGH THE DISCHARGE AIR HEAT EXCHANGER
S3
$T_{IN} < T_{OA}$?
NO
YES
S7
CONTROL THE SECOND DAMPER SO AS TO NOT ALLOW THE INDOOR AIR TO FLOW THROUGH THE TOTAL HEAT EXCHANGER
S4
CONTROL THE SECOND DAMPER SO AS TO ALLOW THE INDOOR AIR TO FLOW THROUGH THE TOTAL HEAT EXCHANGER
S5
CONTROL THE SECOND DAMPER SO AS TO NOT ALLOW THE INDOOR AIR TO FLOW THROUGH THE TOTAL HEAT EXCHANGER
RETURN

FIG.5

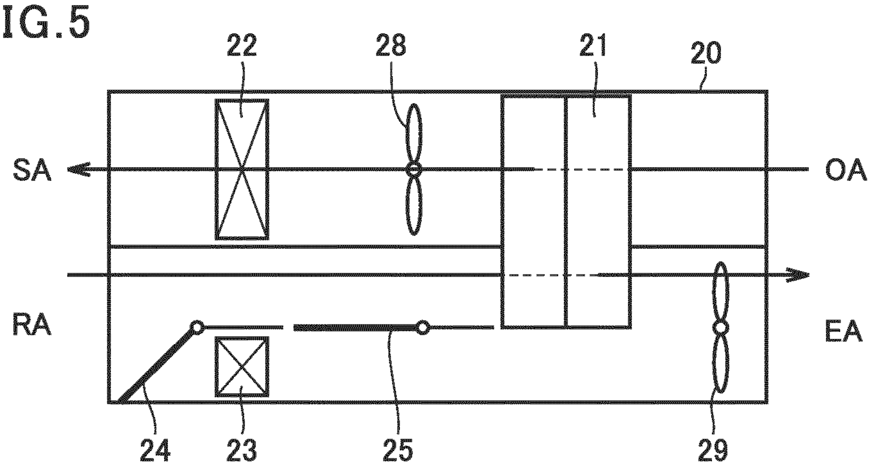


FIG.6

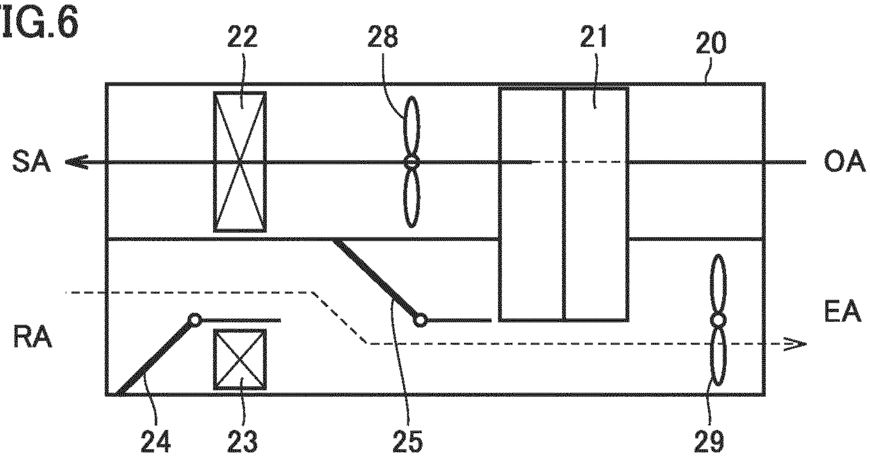


FIG.7

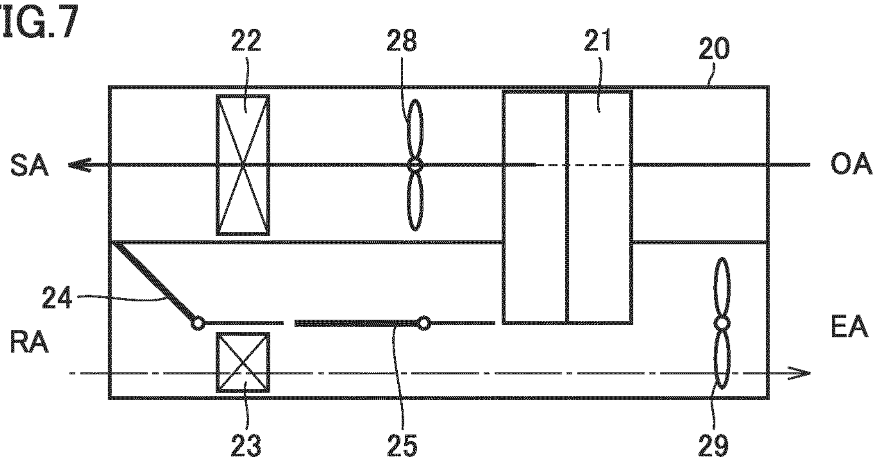

22
28
21
20
SA
OA
24
RA
EA
23
25
29

FIG.8

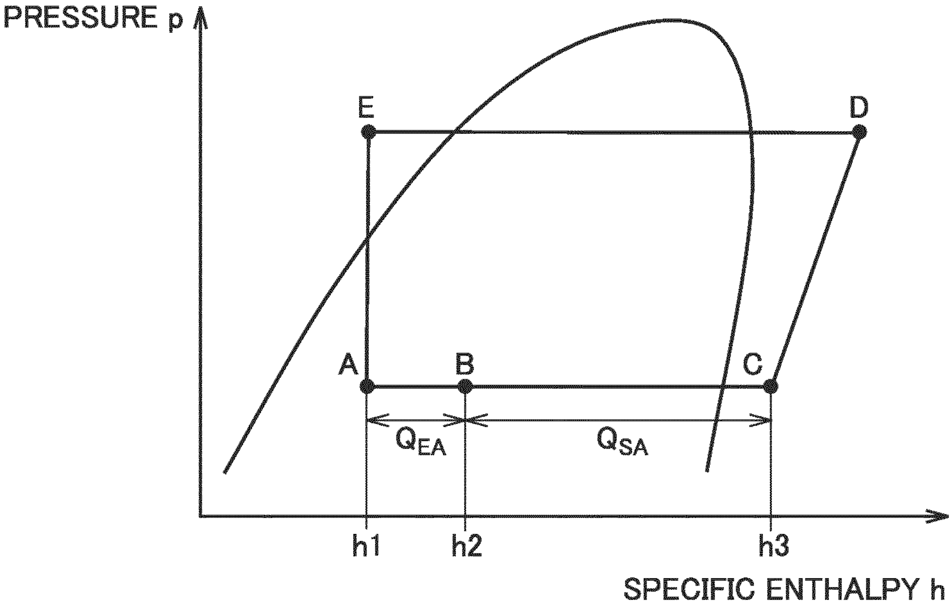

PRESSURE p
E
D
A
B
C
Q_{EA}
Q_{SA}
h1
h2
h3
SPECIFIC ENTHALPY h

FIG.9

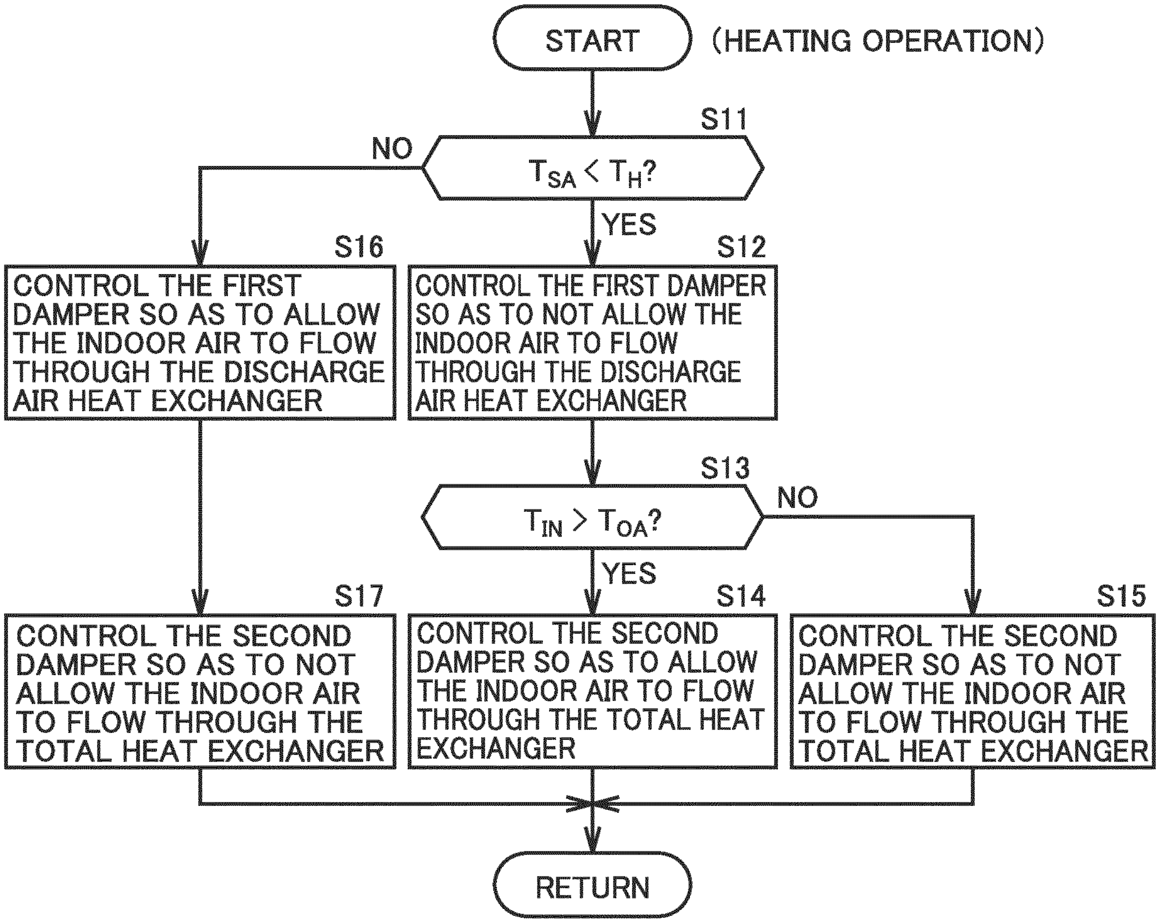

START
(HEATING OPERATION)
S11
$T_{SA} < T_H$?
NO
YES
S16
CONTROL THE FIRST DAMPER SO AS TO ALLOW THE INDOOR AIR TO FLOW THROUGH THE DISCHARGE AIR HEAT EXCHANGER
S12
CONTROL THE FIRST DAMPER SO AS TO NOT ALLOW THE INDOOR AIR TO FLOW THROUGH THE DISCHARGE AIR HEAT EXCHANGER
S13
$T_{IN} > T_{OA}$?
NO
YES
S17
CONTROL THE SECOND DAMPER SO AS TO NOT ALLOW THE INDOOR AIR TO FLOW THROUGH THE TOTAL HEAT EXCHANGER
S14
CONTROL THE SECOND DAMPER SO AS TO ALLOW THE INDOOR AIR TO FLOW THROUGH THE TOTAL HEAT EXCHANGER
S15
CONTROL THE SECOND DAMPER SO AS TO NOT ALLOW THE INDOOR AIR TO FLOW THROUGH THE TOTAL HEAT EXCHANGER
RETURN

FIG.10

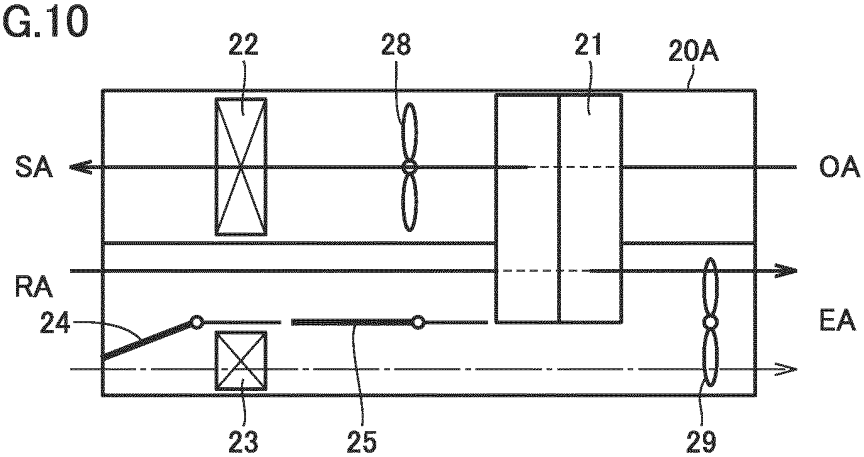

22
28
21
20A
SA
OA
RA
EA
24
23
25
29

FIG.11

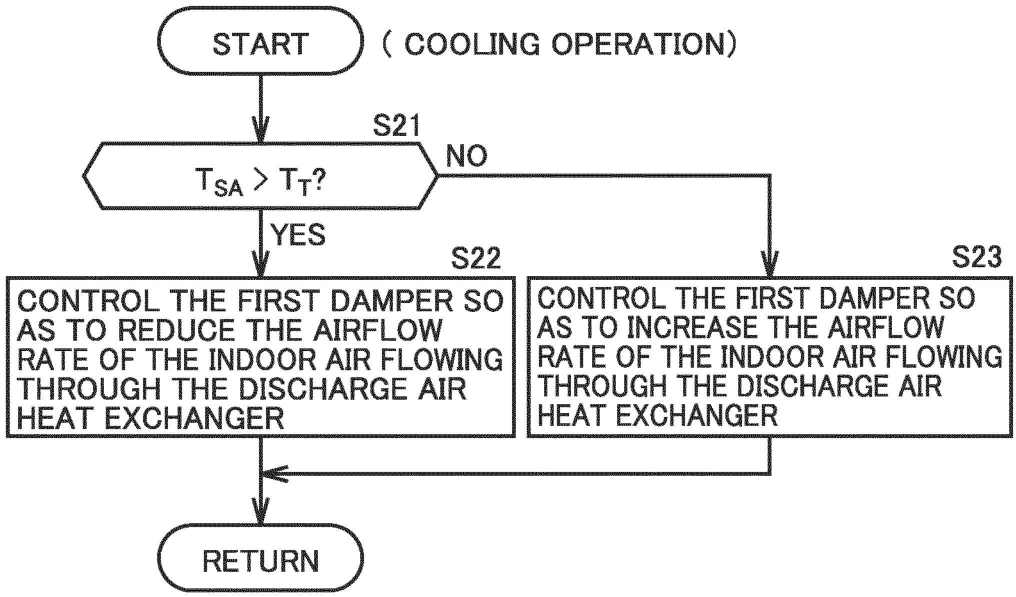

START
(COOLING OPERATION)
S21
$T_{SA} > T_T$?
NO
YES
S22
CONTROL THE FIRST DAMPER SO AS TO REDUCE THE AIRFLOW RATE OF THE INDOOR AIR FLOWING THROUGH THE DISCHARGE AIR HEAT EXCHANGER
S23
CONTROL THE FIRST DAMPER SO AS TO INCREASE THE AIRFLOW RATE OF THE INDOOR AIR FLOWING THROUGH THE DISCHARGE AIR HEAT EXCHANGER
RETURN

FIG.12

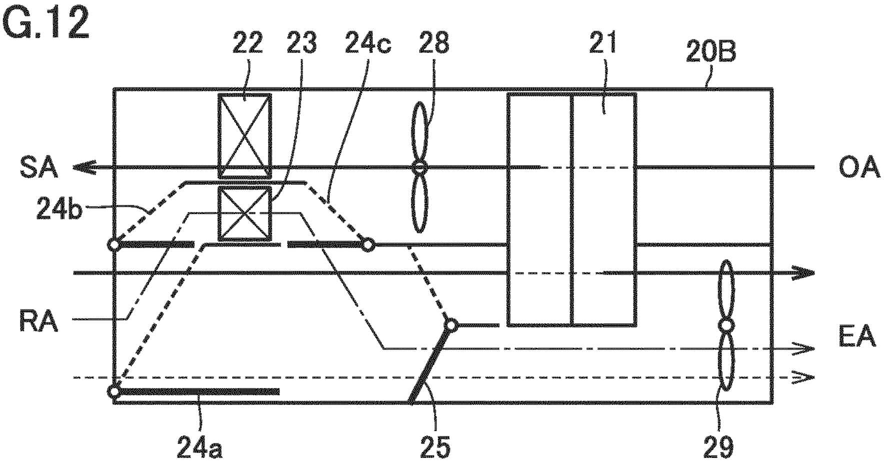

22
23
24c
28
21
20B
SA
OA
24b
RA
EA
24a
25
29

FIG.13

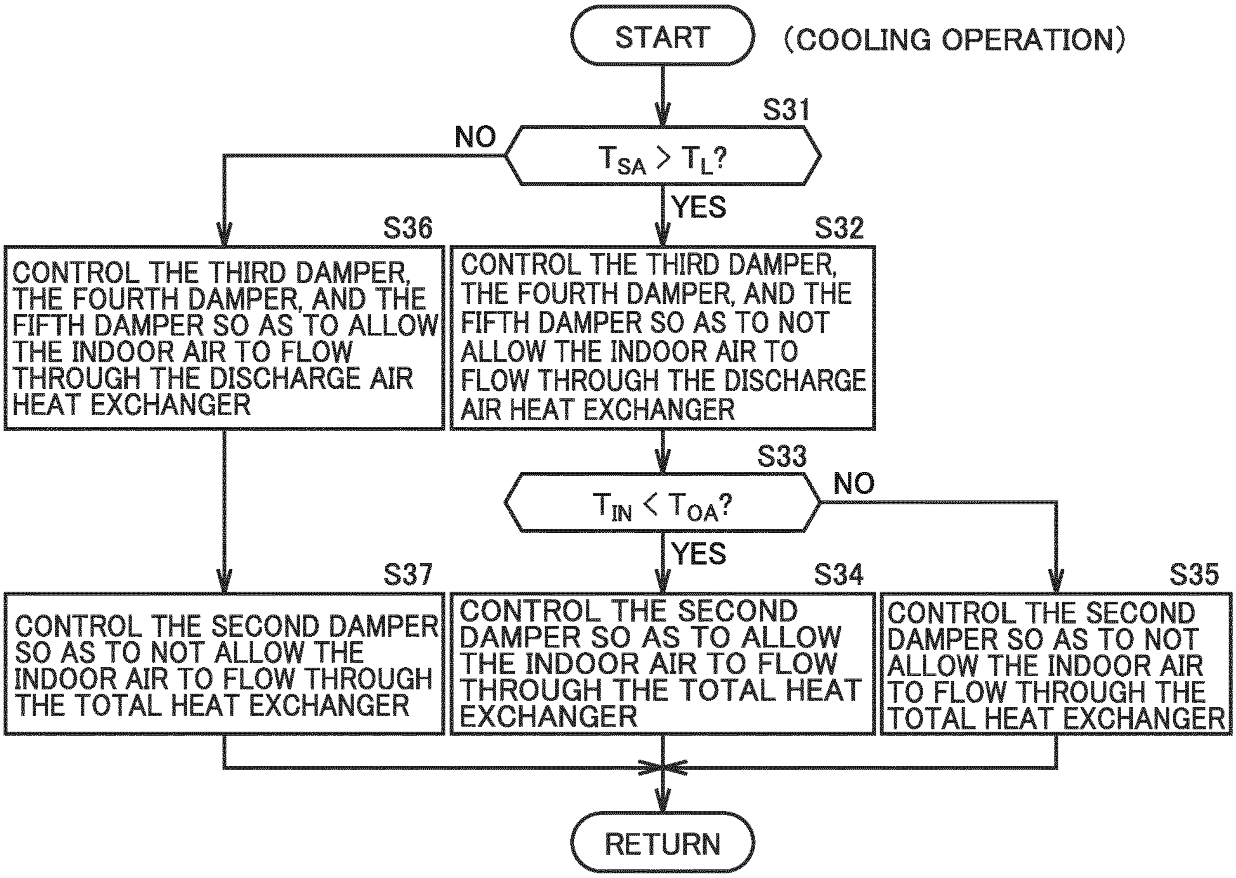

START
(COOLING OPERATION)
S31
NO
$T_{SA} > T_L$?
YES
S36
CONTROL THE THIRD DAMPER, THE FOURTH DAMPER, AND THE FIFTH DAMPER SO AS TO ALLOW THE INDOOR AIR TO FLOW THROUGH THE DISCHARGE AIR HEAT EXCHANGER
S32
CONTROL THE THIRD DAMPER, THE FOURTH DAMPER, AND THE FIFTH DAMPER SO AS TO NOT ALLOW THE INDOOR AIR TO FLOW THROUGH THE DISCHARGE AIR HEAT EXCHANGER
S33
$T_{IN} < T_{OA}$?
NO
YES
S37
CONTROL THE SECOND DAMPER SO AS TO NOT ALLOW THE INDOOR AIR TO FLOW THROUGH THE TOTAL HEAT EXCHANGER
S34
CONTROL THE SECOND DAMPER SO AS TO ALLOW THE INDOOR AIR TO FLOW THROUGH THE TOTAL HEAT EXCHANGER
S35
CONTROL THE SECOND DAMPER SO AS TO NOT ALLOW THE INDOOR AIR TO FLOW THROUGH THE TOTAL HEAT EXCHANGER
RETURN

FIG.14

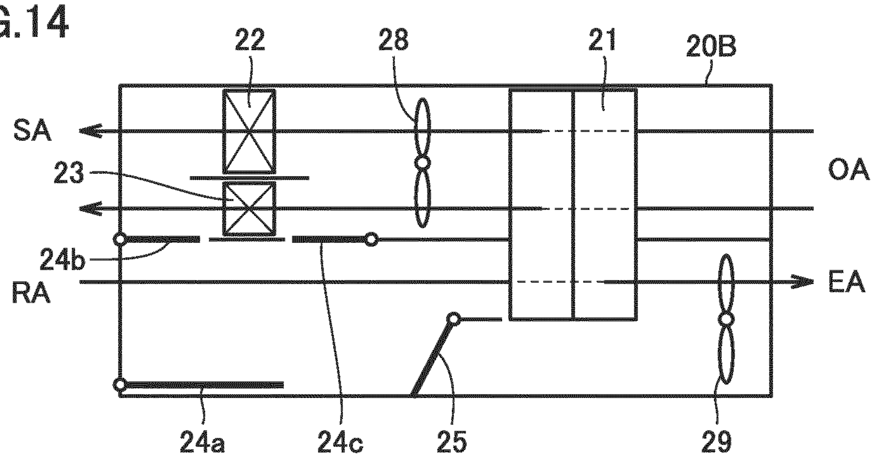

22
28
21
20B
SA
23
OA
24b
RA
EA
24a
24c
25
29

FIG.15

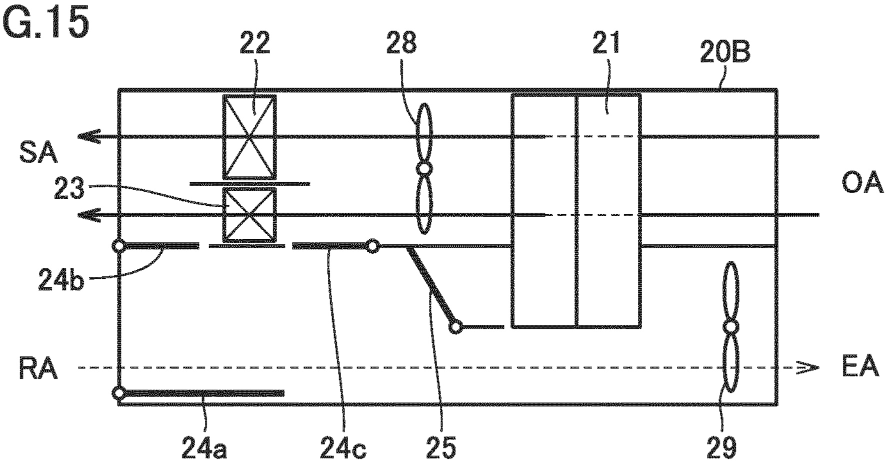

22
28
21
20B
SA
23
OA
24b
RA
EA
24a
24c
25
29

FIG.16

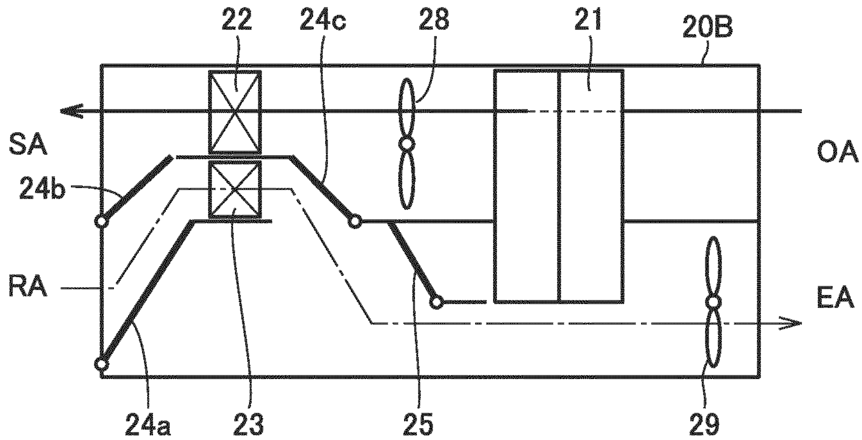

22
24c
28
21
20B
SA
OA
24b
RA
EA
24a
23
25
29

FIG.17

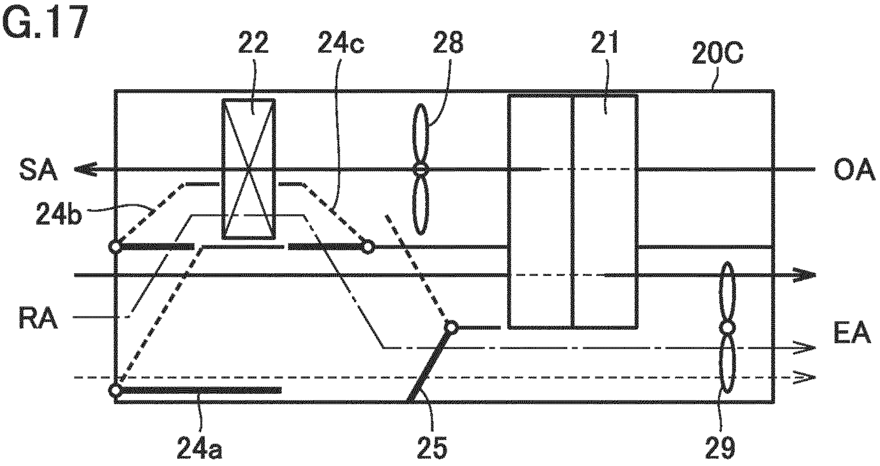

22
24c
28
21
20C
SA
OA
24b
RA
EA
24a
25
29

FIG.18

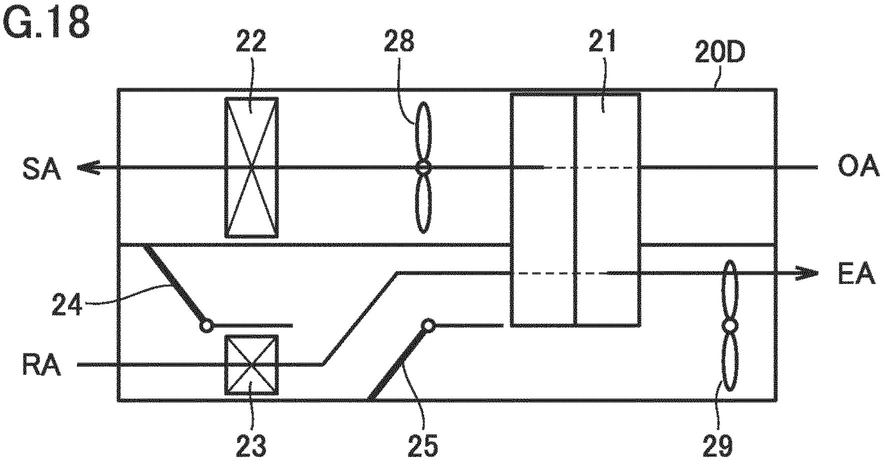
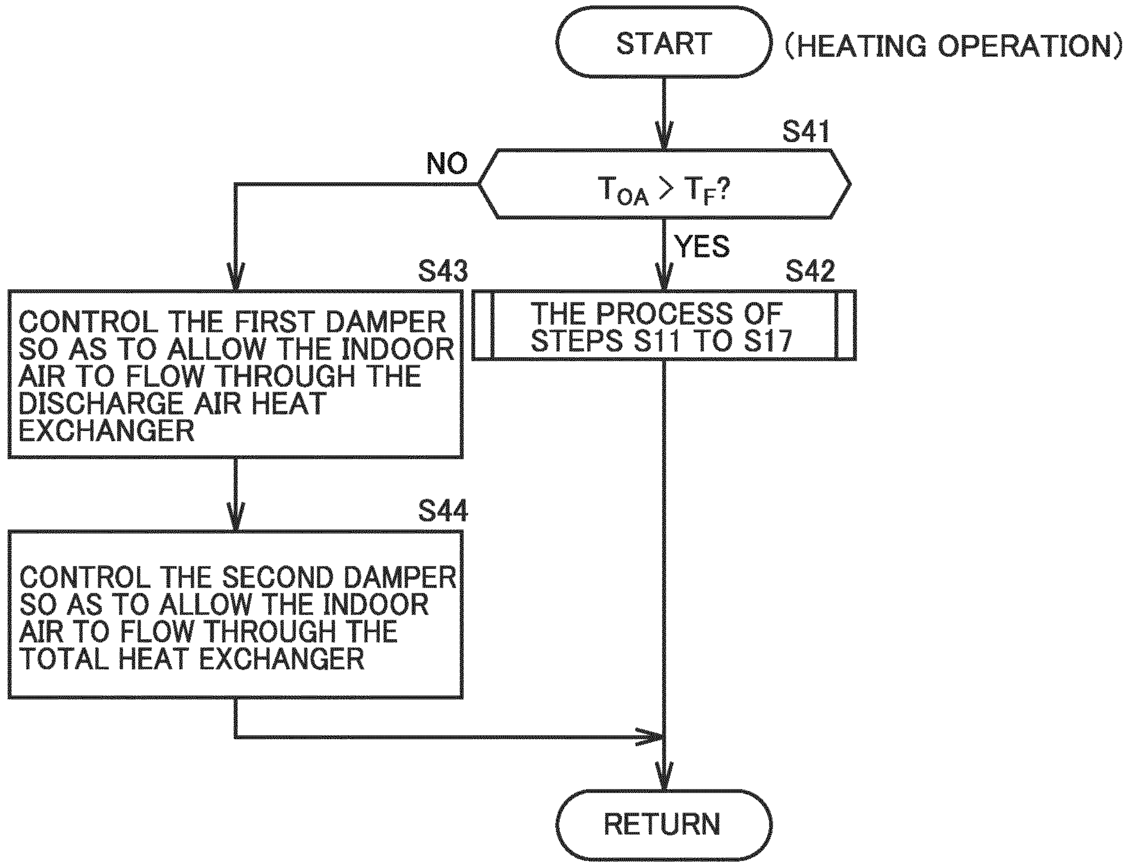

22
28
21
20D
SA
OA
EA
24
RA
23
25
29

FIG.19


START
(HEATING OPERATION)
S41
$T_{OA} > T_F$?
NO
YES
S43
CONTROL THE FIRST DAMPER SO AS TO ALLOW THE INDOOR AIR TO FLOW THROUGH THE DISCHARGE AIR HEAT EXCHANGER
S42
THE PROCESS OF STEPS S11 TO S17
S44
CONTROL THE SECOND DAMPER SO AS TO ALLOW THE INDOOR AIR TO FLOW THROUGH THE TOTAL HEAT EXCHANGER
RETURN

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/037196

A. CLASSIFICATION OF SUBJECT MATTER

F24F 11/81(2018.01)i
FI: F24F11/81

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F11/81

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2021
Registered utility model specifications of Japan 1996-2021
Published registered utility model applications of Japan 1994-2021

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 2005-114294 A (DAIKIN INDUSTRIES, LTD.) 28 April 2005 (2005-04-28) paragraphs [0040]-[0073], fig. 1-9	1, 4 2-3, 5-13
A	WO 2019/082377 A1 (MITSUBISHI ELECTRIC CORP.) 02 May 2019 (2019-05-02) entire text, all drawings	1-13
A	WO 2020/230590 A1 (DAIKIN INDUSTRIES, LTD.) 19 November 2020 (2020-11-19) entire text, all drawings	1-13
A	EP 2113725 A2 (LG ELECTRONICS INC.) 04 November 2009 (2009-11-04) entire text, all drawings	1-13

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 December 2021	**21 December 2021**

Name and mailing address of the ISA/JP	Authorized officer
Japan Patent Office (ISA/JP) **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/037196

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2005-114294 A	28 April 2005	US 2007/0125115 A1 paragraphs [0067]-[0100], fig. 1-9 WO 2005/036062 A1 EP 1681518 A1 KR 10-2006-0085648 A CN 1864034 A AU 2004280427 A	
WO 2019/082377 A1	02 May 2019	US 2020/0200448 A1 entire text, all drawings	
WO 2020/230590 A1	19 November 2020	JP 2020-186820 A	
EP 2113725 A2	04 November 2009	KR 10-2009-0115256 A CN 101571311 A	

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

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- JP 5054935 B **[0003] [0004]**