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(71) Applicant: **mitsubishi electric corporation**
Chiyoda-ku
Tokyo 100-8310 (JP)

(72) Inventors:
• **SUGIMOTO, Takeshi**
Wakayama-shi, Wakayama 640-8686 (JP)

• **SUGAWA, Masaaki**
Wakayama-shi, Wakayama 640-8686 (JP)
• **HIKONE, Takahito**
Tokyo 100-8310 (JP)
• **YAMANO, Yoshio**
Tokyo 100-8310 (JP)
• **KADOWAKI, Kimitaka**
Tokyo 100-8310 (JP)
• **NAKATA, Hiroyuki**
Tokyo 102-0073 (JP)

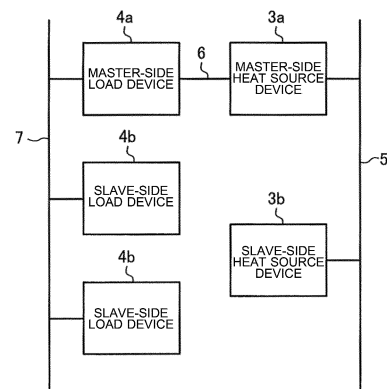
(74) Representative: **Witte, Weller & Partner**
Patentanwälte mbB
Postfach 10 54 62
70047 Stuttgart (DE)

(54) **AIR CONDITIONING DEVICE**

(57) An air-conditioning device includes, in a first heat medium circuit through which a first heat medium flows, one or more heat source devices cooling or heating the first heat medium, a plurality of load devices performing air-conditioning operation by exchanging heat between the first heat medium and air in an air-conditioned space, and circulation generation means causing the first heat medium to circulate through the first heat medium circuit. One of the one or more heat source devices is a master-side heat source device, and one of the plurality of load devices is a master-side load device. The master-side load device acquires detection information representing an operation state of each of the load devices, generates instruction information to control at least any of all or a part of the one or more heat source devices and the circulation generation means, based on the detection information, and transmits the instruction information to the master-side heat source device. The master-side heat source device controls at least any of all or a part of the one or more heat source devices and the

circulation generation means, based on the received instruction information.

FIG. 7



Description

Summary of Invention

Technical Field

Technical Problem

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

Background Art

[0002] In recent years, an air-conditioning device is required to use refrigerant that is not so high in global-warming potential (GWP) from a viewpoint of environment. Therefore, the refrigerant that is not so high in GWP, such as R32 and R152a, is often used for the air-conditioning device. Some types of the refrigerant, however, have combustibility.

[0003] Many air-conditioning devices each include a plurality of indoor units. To exchange heat between indoor air and the refrigerant in each of the plurality of indoor units, it is necessary to fill all of the indoor units with the refrigerant, which increases an amount of refrigerant filled in the air-conditioning device in many cases. If the refrigerant having combustibility leaks from such an air-conditioning device, concentration of the refrigerant in the air may reach combustion concentration in a short time.

[0004] Patent Literature 1 discloses an air-conditioning device in which a heat medium not having combustibility, for example, water flows through an indoor unit, for heat exchange with the air. In such an air-conditioning device, an outdoor unit is used as a heat source device, and a flow system causing the refrigerant such as R32 and chlorofluorocarbon to flow through the indoor unit is provided in addition to a flow system causing the heat medium to flow through the indoor unit. Further, the outdoor unit exchanges heat between the heat medium and the refrigerant, and sends the heat medium to the indoor unit. The indoor unit performs air-conditioning operation of an air-conditioned space by exchanging heat between the heat medium cooled or heated by the outdoor unit and air of the air-conditioned space. Therefore, the indoor unit is used as a load device. The refrigerant having combustibility or the refrigerant having high GWP is used only for the outdoor unit. Therefore, a total amount of the refrigerant can be reduced, which makes it possible to reduce possibility of combustion.

Citation List

Patent Literature

[0005] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2017-101897

[0006] In the above-described air-conditioning device, to adjust a temperature of the heat medium flowing through the indoor unit, it is necessary to appropriately adjust a temperature of the refrigerant flowing through the outdoor unit. In a case where the air-conditioning is performed while each of the indoor unit and the outdoor unit has the same flow system causing the same heat medium to flow, the outdoor unit can detect a pressure and the temperature of the refrigerant flowing through the indoor unit and other factors, and can appropriately control an internal compressor and other devices. In contrast, in a case where the flow system of the indoor unit is separated from the flow system including the compressor of the outdoor unit, the outdoor unit cannot detect the temperature and a pressure of the heat medium flowing through the indoor unit and other factors. Therefore, the outdoor unit cannot detect an operation state of the indoor unit, and cannot perform appropriate operation in some cases. As a result, the outdoor unit performs wasteful operation, which causes an issue that air-conditioning efficiency is deteriorated.

[0007] The present disclosure is made to solve the above-described issues, and an object of the present disclosure is to provide an air-conditioning device in which a heat source device performs operation based on instruction information generated by using information representing operation states of a plurality of respective load devices, to improve air-conditioning efficiency.

Solution to Problem

[0008] An air-conditioning device according to an embodiment of the present disclosure includes a first heat medium circuit through which a first heat medium flows; circulation generation means configured to generate a flow of the first heat medium and to cause the first heat medium to circulate through the first heat medium circuit; one or more heat source devices provided in the first heat medium circuit, each including a second heat medium circuit through which a second heat medium circulates, and each configured to heat or cool the first heat medium by internally exchanging heat between the first heat medium and the second heat medium; and a plurality of load devices provided in the first heat medium circuit, and each configured to perform air-conditioning operation of an air-conditioned space by exchanging heat between the first heat medium and air of the air-conditioned space. One of the one or more heat source devices is a master-side heat source device, and one of the plurality of load devices is a master-side load device. The plurality of load devices each include detection means configured to detect detection information representing an operation state of the load device. The master-side load device includes a load-side control device configured to gener-

ate instruction information representing contents instructed to all or a part of the one or more heat source devices by using the detection information acquired from the detection means of each of the plurality of load devices, and to transmit the instruction information to the master-side heat source device. The master-side heat source device is configured to receive the instruction information from the master-side load device, and control at least any of all or a part of the one or more heat source devices and the circulation generation means, based on the instruction information.

Advantageous Effects of Invention

[0009] In the air-conditioning device according to an embodiment of the present disclosure, the load device on the master side acquires the detection information representing the operation state of each of the plurality of load devices, detected by each of the plurality of load devices. Further, the load device on the master side generates the instruction information representing the contents instructed to the heat source devices by using the acquired detection information, and transmits the instruction information to the heat source devices. Each of the heat source devices performs operation based on the instruction information. Accordingly, the heat source devices can perform operation corresponding to the operation states of the load devices, which makes it possible to improve air-conditioning efficiency.

Brief Description of Drawings

[0010]

[Fig. 1] Fig. 1 is a schematic view illustrating a configuration of an air-conditioning device according to Embodiment 1.

[Fig. 2] Fig. 2 is a schematic view illustrating a configuration of a heat source device according to Embodiment 1.

[Fig. 3] Fig. 3 is a schematic view illustrating a configuration of a load device according to Embodiment 1.

[Fig. 4] Fig. 4 is a schematic view of a first heat medium circuit in a case where each of the load devices performs only one of cooling operation and heating operation.

[Fig. 5] Fig. 5 is a schematic view of the first heat medium circuit in a case where each of the load devices performs both of the cooling operation and the heating operation.

[Fig. 6] Fig. 6 is a diagram illustrating an outline of control contents of a motor-operated valve by a load-side control device according to Embodiment 1.

[Fig. 7] Fig. 7 is a diagram schematically illustrating a circuit configuration of signal lines connecting the one or more heat source devices and the plurality of load devices according to Embodiment 1.

[Fig. 8] Fig. 8 is a flowchart illustrating an example of operation of the load devices and operation of the heat source devices interlocked with the operation of the load devices, according to Embodiment 1.

[Fig. 9] Fig. 9 is a flowchart illustrating another example of the operation of the load devices and the operation of the heat source devices interlocked with the operation of the load devices, according to Embodiment 1.

[Fig. 10] Fig. 10 is a flowchart illustrating control processing corresponding to loads of the load devices, by the air-conditioning device according to Embodiment 1.

[Fig. 11] Fig. 11 is a flowchart illustrating control processing based on a difference between a set temperature and an indoor temperature, by an air-conditioning device according to Embodiment 2.

[Fig. 12] Fig. 12 is a flowchart illustrating control processing based on a set temperature, an indoor temperature, and an indoor humidity, by an air-conditioning device according to Embodiment 3.

[Fig. 13] Fig. 13 is a flowchart illustrating control processing of a flow rate of a first heat medium during heating operation, by an air-conditioning device according to Embodiment 4.

[Fig. 14] Fig. 14 is a flowchart illustrating control processing during defrosting operation, by an air-conditioning device according to Embodiment 5.

[Fig. 15] Fig. 15 is a flowchart illustrating control processing to improve or maintain comfortableness during defrosting operation, by an air-conditioning device according to Embodiment 6.

Description of Embodiments

[0011] Embodiments are described below with reference to drawings. Note that embodiments are not limited to the embodiments described below.

Embodiment 1.

[0012] Fig. 1 is a schematic view illustrating a configuration of an air-conditioning device according to Embodiment 1. An air-conditioning device 100 includes a first heat medium circuit 1 through which a first heat medium flows, one or more pumps 2 causing the first heat medium to circulate through the first heat medium circuit 1, one or more heat source devices 3 in the first heat medium circuit 1, and a plurality of load devices 4 in the first heat medium circuit 1. The air-conditioning device 100 illustrated in Fig. 1 includes two heat source devices 3 and three load devices 4; however, the number of heat source devices 3 and the number of load devices 4 included in the air-conditioning device 100 are not limited to the illustrated numbers.

[0013] The first heat medium circuit 1 is formed by connecting, by pipes through which the first heat medium flows, the one or more heat source devices 3 and the

plurality of load devices 4 through which the first heat medium flows to exchange heat. The first heat medium flowing through the first heat medium circuit 1 is, for example, water or brine obtained by adding an additive lowering a freezing point of water to water, and is a substance that is low in GWP and does not have combustibility. However, a heat medium having combustibility may be used as the first heat medium in a certain case. The certain case indicates a case where, even when the heat medium leaks, concentration of the heat medium in air does not reach combustion concentration. Each of the pumps 2 is an example of circulation generation means that generates a flow of the first heat medium to cause the first heat medium to circulate the first heat medium circuit 1. The pumps 2 may be controlled by inverters.

[0014] Each of the heat source devices 3 is, for example, a heat pump chiller, a boiler, or an electric water heater, and cools or heats the first heat medium. In Embodiment 1, one of the one or more heat source devices 3 included in the air-conditioning device 100 is defined as a heat source device 3 on a master side, and the other heat source devices 3 are defined as heat source devices 3 on a slave side. In a case where the air-conditioning device 100 includes only one heat source device 3, the one heat source device 3 corresponds to the heat source device 3 on the master side. In the case illustrated in Fig. 1, the heat source device 3 on the master side is referred to as a master-side heat source device 3a, and the heat source device 3 on the slave side is referred to as a slave-side heat source device 3b.

[0015] Each of the load devices 4 is disposed inside a room that is an air-conditioned space, and performs air conditioning by exchanging heat between the first heat medium and indoor air. The load devices 4 according to Embodiment 1 are classified into the load device 4 on a master side and the load devices 4 on a slave side. One of the plurality of load devices 4 included in the air-conditioning device 100 is defined as the load device 4 on the master side (master-side load device), and the other load devices 4 are defined as the load devices 4 on the slave side (slave-side load devices). In the case illustrated in Fig. 1, the load device 4 on the master side is referred to as a master-side load device 4a, and the load devices 4 on the slave side are referred to as a slave-side load device 4b and a slave-side load device 4c.

[0016] Fig. 2 is a schematic view illustrating a configuration of each of the heat source devices according to Embodiment 1. Each of the heat source devices 3 includes a refrigerant circuit 35 that is formed by sequentially connecting a compressor 30, a flow switching device 31, a heat source-side heat exchanger 32, a decompression device 33, and an intermediate heat exchanger 34 by pipes. Refrigerant circulates through the refrigerant circuit 35. The refrigerant is an example of a second heat medium, and the refrigerant circuit 35 is an example of a second heat medium circuit. In the refrigerant circuit 35 in the case illustrated in Fig. 2, the refrigerant flows in a direction of solid arrows during cooling operation and

during defrosting operation, and the refrigerant flows in a direction of dashed arrows during heating operation. Each of the heat source devices 3 further includes an air-sending device 36 and a heat source-side control device 37.

[0017] The compressor 30 compresses the refrigerant suctioned from a suction side, and discharges high-temperature high-pressure gas refrigerant from a discharge side. The flow switching device 31 is a device including, for example, a four-way valve switching the flowing directions of the refrigerant. During the cooling operation, the defrosting operation, and other operation, the flow switching device 31 connects the discharge side of the compressor 30 and the heat source-side heat exchanger 32 and connects the suction side of the compressor 30 and the intermediate heat exchanger 34, as illustrated by solid lines in Fig. 2. Further, during the heating operation, the flow switching device 31 connects the discharge side of the compressor 30 and the intermediate heat exchanger 34 and connects the suction side of the compressor 30 and the heat source-side heat exchanger 32, as illustrated by dashed lines in Fig. 2.

[0018] The heat source-side heat exchanger 32 exchanges heat between the refrigerant and outdoor air. The heat source-side heat exchanger 32 is used as a condenser for the refrigerant during the cooling operation and during the defrosting operation, and is used as an evaporator for the refrigerant during the heating operation. The air-sending device 36 includes a propeller fan driven by an unillustrated driving source such as a fan motor, guides the outdoor air to the heat source-side heat exchanger 32 inside the corresponding heat source device 3, and sends out the air having exchanged heat with the refrigerant to the outdoors.

[0019] The decompression device 33 includes an expansion valve that decompresses and expands the refrigerant flowing through the refrigerant circuit 35. The intermediate heat exchanger 34 exchanges heat between the refrigerant circulating through the refrigerant circuit 35 inside the corresponding heat source device 3 and the first heat medium circulating through the first heat medium circuit 1. The first heat medium is cooled at the intermediate heat exchanger 34 during the cooling operation and during the defrosting operation, and the first heat medium is heated at the intermediate heat exchanger 34 during the heating operation.

[0020] The heat source-side control device 37 is connected to the compressor 30, the flow switching device 31, the decompression device 33, the driving source of the air-sending device 36, and other devices by unillustrated signal lines. The heat source-side control device 37 controls an operation capacity of the compressor 30, operation to switch the flow paths of the flow switching device 31, a flow rate of the air supplied to the heat source-side heat exchanger 32 by the air-sending device 36, an opening degree of the decompression device 33, and other operation through the signal lines.

[0021] Further, the heat source-side control device 37

is connected to the heat source-side control device 37 of other heat source device 3 through a signal line 5, and performs communication. Note that the heat source-side control devices 37 of all of the heat source devices 3 are not necessarily connected by the signal line 5, and it is sufficient to connect the heat source-side control device 37 of the heat source device 3 on the master side and the heat source-side control device 37 of each of the heat source devices 3 on the slave side.

[0022] The heat source-side control device 37 may be formed by including a processor such as a central processing unit (CPU) and a micro processing unit (MPU), a memory such as a read only memory (ROM) and a random access memory (RAM), and a communication interface. When the processor executes various kinds of programs stored in the memory, the above-described operation is performable. All or a part of the functions of the heat source-side control device 37 may be performed by dedicated hardware.

[0023] The above-described configuration is common to the heat source device 3 on the master side and the heat source devices 3 on the slave side, unless otherwise noted. In the following, the configuration and operation of the heat source device 3 on the master side are described. The heat source-side control device 37 included in the heat source device 3 on the master side is further connected to the pump 2 by a signal line 9, and controls the flow rate of the first heat medium by the pump 2. The pump 2 is provided between the intermediate heat exchanger 34 and the load devices 4. The pump 2 causes the first heat medium heated or cooled at the intermediate heat exchanger 34, to flow toward the load devices 4, and causes the first heat medium flowing out from the load devices 4 to flow toward the intermediate heat exchanger 34.

[0024] Further, the heat source-side control device 37 of the heat source device 3 on the master side is connected to a load-side control device 47 of the load device 4 on the master side described below by a signal line 6 (see Fig. 7). The heat source-side control device 37 of the heat source device 3 on the master side acquires instruction information representing contents instructed to the heat source devices 3 from the load-side control device 47 of the load device 4 on the master side. The instruction information is, for example, information representing a heat amount necessary for the load devices 4, or a stop command. The detail of the instruction information is described below. The heat source device 3 on the master side uses the instruction information to perform operation instruction to each of the heat source devices 3.

[0025] More specifically, the heat source-side control device 37 of the heat source device 3 on the master side calculates a control amount to appropriately control the flow rate of the first heat medium by the pump 2, the operation capacity of the compressor 30 to be controlled, and other settings based on the instruction information, and derives control contents to the pump 2, the compres-

sor 30 to be controlled, or other devices from the instruction information. Further, the heat source-side control device 37 of the heat source device 3 on the master side calculates a control amount to appropriately operate the compressor 30, the air-sending device, 36, or other devices included in each of the heat source devices 3 on the slave side based on the instruction information, and derives control contents to the components included in each of the heat source devices 3 on the slave side from the instruction information. In the following, the control amount, the control contents, and other settings to appropriately control the pump 2 and the components included in the heat source device 3 on the master side, obtained from the instruction information by the heat source device 3 on the master side, are referred to as first control information. Likewise, the control amount, the control contents, and other settings to appropriately control the components included in each of the heat source devices 3 on the slave side, obtained from the instruction information by the heat source device 3 on the master side, are referred to as second control information.

[0026] The heat source-side control device 37 of the heat source device 3 on the master side controls the heat source device 3 on the master side and the pump 2 based on the first control information. Further, the heat source-side control device 37 of the heat source device 3 on the master side transmits the second control information to each of the heat source devices 3 on the slave side. In place of acquisition of the first control information and the second control information from the instruction information by the heat source device 3 on the master side, the first control information and the second control information may be included in the instruction information.

[0027] Fig. 3 is a schematic view illustrating a configuration of each of the load devices according to Embodiment 1. Each of the load devices 4 is, for example, an indoor unit that is installed by being embedded in a ceiling of a room or being hung down from the ceiling, and is also referred to as a fan coil unit. Each of the load devices 4 includes a load-side heat exchanger 40, an air-sending device 41, an inlet temperature sensor 42, an outlet temperature sensor 43, an indoor temperature sensor 44, an indoor humidity sensor 45, a motor-operated valve 46, and the load-side control device 47. Each of the load devices 4 may perform only cooling operation or only heating operation, or may perform the cooling operation and the heating operation in a switchable manner.

[0028] Fig. 4 is a schematic view of the first heat medium circuit in a case where each of the load devices performs only one of the cooling operation and the heating operation. As illustrated in Fig. 4, the first heat medium circuit 1 is of a two-pipe type, and includes a first pipe 11 through which the first heat medium before cooling or before heating flows and a second pipe 12 through which the first heat medium after cooling or after heating flows. The first heat medium before cooling or before heating, flowing out from the load-side heat exchanger 40 flows

into the intermediate heat exchanger 34 through the first pipe 11. The first heat medium after cooling or after heating, flowing out from the intermediate heat exchanger 34 flows into the load-side heat exchanger 40 through the second pipe 12. The intermediate heat exchanger 34 includes an inlet 340 from which the first heat medium before cooling or before heating flows in, and an outlet 341 from which the first heat medium after cooling or after heating flows out. The load-side heat exchanger 40 includes an outlet 400 from which the first heat medium before cooling or before heating flows out, and an inlet 401 from which the first heat medium after cooling or after heating flows in.

[0029] Fig. 5 is a schematic view of the first heat medium circuit in a case where each of the load devices performs both of the cooling operation and the heating operation. As illustrated in Fig. 5, the first heat medium circuit 1 is of a four-pipe type, and includes a third pipe 13 through which the first heat medium before cooling flows, a fourth pipe 14 through which the first heat medium after cooling flows, a fifth pipe 15 through which the first heat medium before heating flows, and a sixth pipe 16 through which the first heat medium after heating flows. During the cooling operation, the first heat medium before cooling, flowing out from the load-side heat exchanger 40 flows into the intermediate heat exchanger 34 through the third pipe 13, and the first heat medium after cooling, flowing out from the intermediate heat exchanger 34 flows into the load-side heat exchanger 40 through the second pipe 12. During the heating operation, the first heat medium before heating, flowing out from the load-side heat exchanger 40 flows into the intermediate heat exchanger 34 through the fifth pipe 15, and the first heat medium after heating, flowing out from the intermediate heat exchanger 34 flows into the load-side heat exchanger 40 through the sixth pipe 16. The intermediate heat exchanger 34 includes an inlet 342 from which the first heat medium before cooling flows in, an outlet 343 from which the first heat medium after cooling flows out, an inlet 344 from which the first heat medium before heating flows in, and an outlet 345 from which the first heat medium after heating flows out. The load-side heat exchanger 40 includes an outlet 402 from which the first heat medium before cooling flows out, an inlet 403 from which the first heat medium after cooling flows in, an outlet 404 from which the first heat medium before heating flows out, and an inlet 405 from which the first heat medium after heating flows in.

[0030] The following description is made with reference to Fig. 3. The load-side heat exchanger 40 exchanges heat between the first heat medium cooled or heated at the intermediate heat exchanger 34 of each of the heat source devices 3 and air sent into the corresponding load device 4 from inside the room by the air-sending device 41. The air-sending device 41 includes a propeller fan driven by, for example, an unillustrated fan motor. The air-sending device 41 guides the indoor air to the load-side heat exchanger 40 inside the corresponding load

device 4, and sends the air having exchanged heat with the first heat medium, to inside the room.

[0031] The inlet temperature sensor 42 is provided in a pipe on the inlet side for the first heat medium of the load-side heat exchanger 40, and detects a temperature of the first heat medium. The outlet temperature sensor 43 is provided in a pipe on the outlet side for the first heat medium of the load-side heat exchanger 40, and detects the temperature of the first heat medium. In Embodiment 1 of the present disclosure, each of the load devices 4 includes the outlet temperature sensor 43 for a case where information on a difference between the temperature of the first heat medium at the inlet and the temperature of the first heat medium at the outlet of the load-side heat exchanger 40 is used by the load-side control device 47 described below in generation of the instruction information. However, in a case where the load-side control device 47 does not use the information on the temperature of the first heat medium at the outlet of the load-side heat exchanger 40 in generation of the instruction information, each of the load devices 4 may not include the outlet temperature sensor 43.

[0032] The indoor temperature sensor 44 is disposed on windward of the air-sending device 41, and detects a temperature of a room by detecting a temperature of indoor air before heat exchange. In the following, the temperature of the room is also referred to as an indoor temperature or a room temperature in some cases. As with the indoor temperature sensor 44, the indoor humidity sensor 45 is disposed on the windward of the air-sending device 41, and detects an indoor humidity by detecting a humidity of the indoor air before heat exchange. Each of the inlet temperature sensor 42, the outlet temperature sensor 43, the indoor temperature sensor 44, and the indoor humidity sensor 45 is an example of detection means. The motor-operated valve 46 adjusts an inflow amount of the first heat medium to the load-side heat exchanger 40. When the motor-operated valve 46 is opened, the first heat medium flows into the corresponding load device 4, whereas when the motor-operated valve 46 is closed, the first heat medium does not flow into the corresponding load device 4. In the following, a state where the load-side heat exchanger 40 exchanges heat between the first heat medium and the indoor air because of the open state of the motor-operated valve 46 and other factors is referred to as a thermo-on state, and a state where the load-side heat exchanger 40 does not exchange heat between the first heat medium and the indoor air because of the closed state of the motor-operated valve 46 and other factors is referred to as a thermo-off state, in some cases.

[0033] The load-side control device 47 is connected to a driving source of the air-sending device 41, the inlet temperature sensor 42, the outlet temperature sensor 43, the indoor temperature sensor 44, the indoor humidity sensor 45, the motor-operated valve 46, and other devices by unillustrated signal lines. The load-side control device 47 controls a flow rate of the air supplied to the

load-side heat exchanger 40 by the air-sending device 41, opening and closing of the motor-operated valve 46, and other settings. In the following, the flow rate of the air supplied to the load-side heat exchanger 40 by the air-sending device 41 and the flow rate of the air sent to outside the room by the air-sending device 41 are each referred to as an air volume. The motor-operated valve 46 may be put into any one of one opened state and one closed state by opening-closing control (on-off control) by the load-side control device 47, or an opening degree of the motor-operated valve 46 may be controlled by proportional control by the load-side control device 47.

[0034] To control the driving source of the air-sending device 41, the load-side control device 47 can detect whether the air-sending device 41 is operating, and can detect the air volume in a case where the air-sending device 41 is operating. Further, to control opening and closing of the motor-operated valve 46 and other operation, the load-side control device 47 can detect the opened and closed state of the motor-operated valve 46. Therefore, a portion of the load-side control device 47 that detects execution and non-execution of the operation of the air-sending device 41, the air volume by the air-sending device 41, the opening and closing of the motor-operated valve 46, and other operation is an example of the detection means.

[0035] Each of the load devices 4 is provided with a remote controller (remote control) 48 that is connected to the corresponding load-side control device 47 in a wired or wireless manner. The remote control 48 receives an instruction from a user, and transmits the instruction to the load-side control device 47. The load-side control device 47 controls the corresponding load device 4 based on contents of the instruction from the remote control 48. The contents of the instruction from the remote control 48 indicate a start command or a stop command of the air-conditioning operation, a set temperature, the air volume by the air-sending device 41, and other settings. The remote control 48 is an example of the detection means.

[0036] During the cooling operation, the load-side control device 47 opens or closes the motor-operated valve 46 based on a difference between a value of the set temperature set by the remote control 48 connected to the load-side control device 47 and a value of the indoor temperature detected by the indoor temperature sensor 44. In contrast, during the heating operation, the load-side control device 47 opens or closes the motor-operated valve 46 based on a difference between the value of the indoor temperature and the value of the set temperature.

[0037] In the following, the set temperature, the indoor temperature, and control of the motor-operated valve 46 by the load-side control device 47 are described with reference to Fig. 6. Fig. 6 is a diagram illustrating an outline of control contents of the motor-operated valve by the load-side control device according to Embodiment 1. In Fig. 6, a value T represents "value of set temperature - value of indoor temperature" during the cooling operation,

and represents "value of indoor temperature - value of set temperature" during the heating operation. The following description is given of a case where the motor-operated valve 46 is put into any one of one opened state and one closed state, to facilitate understanding.

[0038] In Fig. 6, when the indoor temperature is lowered and becomes less than or equal to the set temperature, and the value T (value of set temperature - value of indoor temperature) becomes one during the cooling operation, the load-side control device 47 controls the motor-operated valve 46 such that the motor-operated valve 46 is switched from the opened state to the closed state. When the motor-operated valve 46 is put into the closed state during the cooling operation, the first heat medium cooled by the heat source devices 3 does not flow into the corresponding load device 4. Therefore, the heat exchange between the cooled first heat medium and the indoor air is not performed, and lowering of the indoor temperature is stopped. When the room temperature is increased and becomes equal to the set temperature after the motor-operated valve 46 is put into the closed state, the load-side control device 47 controls the motor-operated valve 46 such that the motor-operated valve 46 is switched to the opened state again.

[0039] Likewise, in Fig. 6, when the indoor temperature is increased and becomes greater than or equal to the set temperature, and the value T (value of indoor temperature - value of set temperature) becomes one during the heating operation, the load-side control device 47 controls the motor-operated valve 46 such that the motor-operated valve 46 is switched from the opened state to the closed state. When the motor-operated valve 46 is put into the closed state during the heating operation, the first heat medium heated by the heat source devices 3 does not flow into the corresponding load device 4. Therefore, the heat exchange between the heated first heat medium and the indoor air is not performed, and increase of the indoor temperature is stopped. When the room temperature is lowered and becomes equal to the set temperature after the motor-operated valve 46 is put into the closed state, the load-side control device 47 controls the motor-operated valve 46 such that the motor-operated valve 46 is switched to the opened state again.

[0040] The control of the motor-operated valve 46 in each of the load devices 4 described above is not to control the heat source devices 3. Therefore, even in the case where the room temperature becomes less than the set temperature during the cooling operation or even in the case where the room temperature becomes greater than the set temperature during the heating operation, the compressor 30, the air-sending device 36, or other devices in each of the heat source devices 3 may continue the operation, and the power may be wastefully consumed. In the following, a configuration in which the processing in the load devices 4 brings about change in the heat source devices 3 to achieve both energy saving and comfortableness of the air-conditioned space is described.

[0041] The load-side control device 47 acquires information representing detection contents from each of the inlet temperature sensor 42, the outlet temperature sensor 43, the indoor temperature sensor 44, and the indoor humidity sensor 45. In the following, at least one of the inlet temperature sensor 42, the outlet temperature sensor 43, the indoor temperature sensor 44, and the indoor humidity sensor 45 are referred to as various kinds of sensors in some cases. Information including at least one of information representing the detection results of the various kinds of sensors, information representing the contents of the instruction from the user detected by the remote control 48, information representing execution and non-execution of the operation of the air-sending device 41, information representing the air volume by the air-sending device 41, and information representing the opening and closing of the motor-operated valve 46, and the other information is referred to as detection information. It is determinable whether each of the load devices 4 is performing the air-conditioning operation, from the start command or the stop command of the air-conditioning operation from the user detected by the corresponding remote control 48. Therefore, the detection information may include information representing whether the corresponding load device 4 is performing the air-conditioning operation. The detection information represents an operation state of each of the load devices 4. The reason is described below.

[0042] The load-side control device 47 controls the operation of the corresponding load device 4 by using the information representing the detection results of the various kinds of sensors, the information representing the instruction contents through the remote control 48, or other information in the detection information. Therefore, the detection information such as the information representing the detection results of the various kinds of sensors and the information representing the instruction contents through the remote control 48 represents the operation state of the corresponding load device 4 at or after the current time point by the control of the load-side control device 47. Further, the detection information such as the information representing execution and non-execution of the operation of the air-sending device 41, the information representing the air volume by the air-sending device 41, and the information representing the opening and closing of the motor-operated valve 46 represents the operation state of the corresponding load device 4 at the current time point.

[0043] The load-side control device 47 is connected to the load-side control devices 47 of the other load devices 4 through signal lines 7, for example, for transmission and reception of the detection information. Note that the load-side control devices 47 of all of the load devices 4 are not necessarily connected to one another by the signal lines 7, and it is sufficient to connect the load-side control device 47 of the load device 4 on the master side to the load-side control device 47 of each of the load devices 4 on the slave side.

[0044] The load-side control device 47 may be formed by including a processor such as a CPU and an MPU, a memory such as ROM and RAM, and a communication interface. When the processor executes various kinds of programs stored in the memory, the above-described operation is performable. Note that all or a part of the functions of the load-side control device 47 may be performed by dedicated hardware.

[0045] The above-described configuration is common to the load device 4 on the master side and the load devices 4 on the slave side, unless otherwise noted. In the following, the configuration and operation of the load device 4 on the master side are described. The load-side control device 47 of the load device 4 on the master side stores an operation capacity of each of the load devices 4 and the total number of load devices 4 on the slave side. The load-side control device 47 included in the load device 4 on the master side acquires the detection information acquired by the load-side control device 47 of each of the load devices 4 on the slave side. This acquisition may be performed when the detection information is transmitted from at least one load device 4 on the slave side to the load device 4 on the master side in a case where change of the set temperature or the operation state is commanded through operation of the remote control 48 by the user in the at least one load device 4 on the slave side or in a case where change of the indoor temperature or the temperature of the first heat medium is detected. Further, the load device 4 on the master side may acquire the detection information in response to the fact that a request to acquire the detection information is regularly issued from the load device 4 on the master side to each of the load devices 4 on the slave side. The detection information transmitted from each of the load devices 4 on the slave side to the load device 4 on the master side may be detection information obtained in such a manner that the load-side control device 47 of each of the load devices 4 on the slave side performs processing on the detection information acquired from the various kinds of sensors, for simplification of the processing in the load-side control device 47 of the load device 4 on the master side.

[0046] The load-side control device 47 of the master-side load device 4a generates the instruction information representing contents requested for the heat source devices 3, based on the acquired detection information. The instruction information may be information representing the contents requested collectively for all or a part of the heat source device 3, or information representing contents requested for each of all or a part of the heat source devices 3. The instruction information includes information representing a heat amount requested to be generated by all or a part of the heat source devices 3 or each of the heat source devices 3, information representing an instruction to start or stop operation of the components included in all or a part of the heat source devices 3 or each of the heat source devices 3, information representing a control amount for the heat source-side control de-

vice 37 to control the components included in all or a part of the heat source devices 3 or each of the heat source devices 3, and information representing the flow rate of the first heat medium by the pump 2.

[0047] Fig. 7 is a diagram schematically illustrating a circuit configuration of the signal lines connecting the one or more heat source devices and the plurality of load devices according to Embodiment 1. Fig. 7 schematically illustrates the circuit configuration of the signal lines in the air-conditioning device 100 illustrated in Fig. 1. As illustrated in Fig. 7, the master-side load device 4a is connected to each of the slave-side load device 4b and the slave-side load device 4c by the signal lines 7. The detection information is transmitted from each of the slave-side load device 4b and the slave-side load device 4c to the master-side load device 4a through the signal lines 7. Further, the master-side load device 4a and the master-side heat source device 3a are connected by the signal line 6. The instruction information is transmitted from the master-side load device 4a to the master-side heat source device 3a through the signal line 6. Furthermore, the master-side heat source device 3a and the slave-side heat source device 3b are connected by the signal line 5. The second control information is transmitted from the master-side heat source device 3a to the slave-side heat source device 3b through the signal line 5.

[0048] Fig. 8 is a flowchart illustrating an example of operation of the load devices and operation of the heat source devices interlocked with the operation of the load devices according to Embodiment 1. In step S1, at least one of the load devices 4 performs air-conditioning operation. In a case where the at least one of the load devices 4 does not stop the air-conditioning operation in step S2 (NO in step S2), the processing by the air-conditioning device 100 returns to step S1. In a case where all of the load devices 4 stop the air-conditioning operation, for example, in response to operation of the respective remote controls 48 in step S2 (YES in step S2), the load-side control device 47 of the load device 4 on the master side generates the instruction information based on the detection information representing stop of the air-conditioning operation of all of the load devices 4 in step S3. The instruction information is information representing the contents instructed to the heat source devices 3, corresponding to stop of the air-conditioning operation of all of the load devices 4. In step S3, the load device 4 on the master side transmits the generated instruction information to the heat source device 3 on the master side.

[0049] In step S4, the heat source device 3 on the master side stops operation of the compressor 30 of the heat source device 3 on the master side and stops operation of the pump 2 based on the first control information from the instruction information received from the load device 4 on the master side. Further, in step S4, the heat source device 3 on the master side transmits the second control information from the instruction information to each of

the heat source devices 3 on the slave side. In step S4, each of the heat source devices 3 on the slave side stops operation of the compressor 30 of the heat source device 3 on the slave side based on the second control information received from the heat source device 3 on the master side. As a result, the compressors 30 of all of the heat source devices 3 stop operation, and the pump 2 also stops operation.

[0050] Fig. 9 is a flowchart illustrating another example of the operation of the load devices and the operation of the heat source devices interlocked with the operation of the load devices according to Embodiment 1. In step S11, at least one of the load devices 4 is in the thermo-on state. In a case where at least one of the load devices 4 is in the thermo-on state in step S12 (NO in step S12), the processing by the air-conditioning device 100 returns to step S11. In a case where all of the load devices 4 are in the thermo-off state in step S12 (YES in step S12), the load-side control device 47 of the load device 4 on the master side generates the instruction information based on the detection information representing the thermo-off states of all of the load devices 4 in step S13. The instruction information is information representing the contents instructed to the heat source devices 3, corresponding to the thermo-off states of all of the load devices 4. In step S13, the load device 4 on the master side transmits the generated instruction information to the heat source device 3 on the master side.

[0051] In step S14, the heat source device 3 on the master side stops the operation of the compressor 30 of the heat source device 3 on the master side, and controls and minimizes the flow rate of the first heat medium by the pump 2, based on the first control information from the instruction information received from the load device 4 on the master side. The minimum flow rate is previously determined. Further, in step S14, the heat source device 3 on the master side transmits the second control information from the instruction information to each of the heat source devices 3 on the slave side. In step S14, each of the heat source devices 3 on the slave side stops the operation of the compressor 30 of the heat source device 3 on the slave side based on the second control information received from the heat source device 3 on the master side. As a result, the compressors 30 of all of the heat source devices 3 stop operation.

[0052] Fig. 10 is a flowchart illustrating control processing corresponding to loads of the load devices, by the air-conditioning device according to Embodiment 1. In step S21, the air-conditioning device 100 performs the air-conditioning operation. In step S22, the load device 4 on the master side acquires the detection information from each of the load devices 4 on the slave side.

[0053] In step S23, the load-side control device 47 of the load device 4 on the master side calculates a ratio of a current load amount to a total load amount. The total load amount is a sum of load amounts obtained by quantifying loads applied to the respective load devices 4 in a case where all of the load devices 4 perform operation

at a maximum. On the other hand, the current load amount is a sum of load amounts obtained by quantifying loads applied to the respective load devices 4 operating at the current time point. A specific description is given below.

[0054] As described above, the load-side control device 47 of the load device 4 on the master side stores the operation capacity of each of the load device 4 on the master side and the load devices 4 on the slave side. For example, the load-side control device 47 of the load device 4 on the master side stores a number representing the operation capacity by the air-sending device 41 of each of the load device 4 on the master side and the load devices 4 on the slave side. In the following, the case illustrated in Fig. 1 is described as an example while numbers representing the operation capacities of the air-sending devices 41 of the master-side load device 4a, the slave-side load device 4b, and the slave-side load device 4c are respectively 800, 300, and 400. In addition, a load amount representing a load applied to each of the air-sending devices 41 is described as an example of the load amount.

[0055] In a case where the air-sending device 41 of each of the master-side load device 4a and the slave-side load device 4c does not operate and only the air-sending device 41 of the slave-side load device 4b operates, the current load amount is the number 300 that represents the capacity of the air-sending device 41 of the slave-side load device 4b. On the other hand, the total load amount is the sum of the numbers 800, 300, and 400 representing the capacities of the respective air-sending devices 41 of the master-side load device 4a, the slave-side load device 4b, and the slave-side load device 4c, namely, 1500. As a result, the ratio of the current load amount to the total load amount is 0.2 relative to the total load amount of 1.

[0056] In step S23, the load-side control device 47 of the load device 4 on the master side determines whether the ratio of the current load amount to the total load amount is less than or equal to a predetermined first threshold. In a case where the ratio of the current load amount to the total load amount is less than or equal to the first threshold (YES in step S23), the processing by the load device 4 on the master side proceeds to step S24. In a case where the ratio of the current load amount to the total load amount is greater than the first threshold (NO in step S23), the air-conditioning device 100 returns to the original state in step S21.

[0057] In step S24, the load-side control device 47 of the load device 4 on the master side generates the instruction information based on the ratio of the current load amount to the total load amount calculated from the acquired detection information and the operation capacities of the respective load devices 4, and transmits the generated instruction information to the heat source device 3 on the master side. For example, the instruction information at this time instructs each of the heat source devices 3 to control the temperature of the first heat me-

dium flowing out from each of the heat source devices 3. For example, in a case where the air-conditioning device 100 performs the cooling operation, the instruction information instructs increase of the temperature of the first heat medium flowing out from each of the heat source devices 3 by a predetermined temperature, for example, 1 degree C. The instruction information instructs increase of an evaporating temperature of the refrigerant, and is to control the compressor 30, the decompression device 33, or other devices such that a pressure of the refrigerant in a low-pressure state is increased. This is to reduce energy consumed during the cooling operation. Note that during the cooling operation, for example, in a case where the number of load devices 4 on the slave side is greater than or equal to a predetermined number or in a case where the current load amount to the total load amount is less than or equal to another threshold less than the first threshold, the instruction information may instruct further increase of the temperature of the first heat medium flowing out from each of the heat source devices 3. In a case where the air-conditioning device 100 performs the heating operation, the instruction information instructs decrease of the temperature of the first heat medium flowing out from each of the heat source devices 3 by a predetermined temperature.

[0058] In step S25, the heat source device 3 on the master side controls the compressor 30, the decompression device 33, or other devices of the heat source device 3 on the master side such that the temperature and the pressure of the refrigerant and other factors are controlled, based on the first control information from the instruction information received from the load device 4 on the master side. Further, in step S25, the heat source device 3 on the master side transmits the second control information from the instruction information to each of the heat source devices 3 on the slave side. In step S25, each of the heat source devices 3 on the slave side controls the compressor 30, the decompression device 33, or other devices of the heat source device 3 on the slave side such that the temperature and the pressure of the refrigerant and other factors are controlled based on the second control information received from the heat source device 3 on the master side. For example, during the cooling operation, each of the heat source devices 3 exercises control to increase the evaporating temperature of the refrigerant.

[0059] In the air-conditioning device 100 according to Embodiment 1, the load-side control device 47 of the load device 4 on the master side acquires the detection information representing the operation state of each of the plurality of load devices 4 included in the air-conditioning device 100, detected by the detection means of each of the plurality of load devices 4. Further, the load-side control device 47 of the load device 4 on the master side uses the acquired detection information to generate the instruction information representing the contents instructed to the one or more heat source device 3 included in the air-conditioning device 100, and transmits the in-

struction information to the heat source device 3 on the master side. The heat source device 3 on the master side having received the instruction information controls at least any of all or a part of the one or more heat source devices 3 and the pump 2, based on the instruction information. As a result, the heat source devices 3 can perform the operation corresponding to the operation states of the load devices 4, which makes it possible to improve air-conditioning efficiency.

[0060] In the air-conditioning device 100 according to Embodiment 1, the heat source device 3 on the master side generates the first control information to control the heat source device 3 on the master side and the second control information to control each of the heat source devices 3 on the slave side, based on the instruction information received from the load-side control device 47 of the load device 4 on the master side. Further, the heat source device 3 on the master side controls at least one of the heat source device 3 on the master side and the pump 2 based on the first control information, and transmits the second control information to each of the heat source devices 3 on the slave side. Each of the heat source devices 3 on the slave side controls the heat source device 3 on the slave side based on the received second control information. As a result, the heat source devices 3 can perform the operation corresponding to the operation states of the load devices 4, which makes it possible to improve air-conditioning efficiency.

[0061] In the air-conditioning device 100 according to Embodiment 1, in the case where the detection information detected by the detection means of each of the plurality of load devices 4 represents stop of the air-conditioning operation of each of the load devices 4, the load-side control device 47 of the load device 4 on the master side generates the instruction information representing an instruction to stop the operation of all of the one or more heat source device 3 and the operation of the pump 2. In response to the instruction information, the operation of the heat source devices 3 and the operation of the pump 2 are stopped by interlocking with the stop operation of the load devices 4. As a result, it is possible to stop the operation of all of the heat source devices 3 and the operation of the pump 2 by interlocking with the stop of the air-conditioning operation of all of the load devices 4, which makes it possible to reduce wasteful energy consumption.

[0062] In the air-conditioning device 100 according to Embodiment 1, in the case where the detection information detected by the detection means of each of the plurality of load devices 4 indicates that the corresponding motor-operated valve 46 is in the closed state, the load-side control device 47 of the load device 4 on the master side generates the instruction information representing an instruction to stop the operation of all of the heat source devices 3 and an instruction to minimize the flow rate of the first heat medium by the pump 2. In response to the instruction information, it is possible to stop wasteful operation to heat or cool the first heat medium by the

heat source devices 3 under a situation where none of the load devices 4 perform the heat exchange between the first heat medium and the indoor air, which makes it possible to reduce wasteful energy consumption by the operation of the heat source devices 3 and the operation of the pump 2.

[0063] In the air-conditioning device 100 according to Embodiment 1, the load-side control device 47 of the load device 4 on the master side stores the information representing the operation capacity of each of the load devices 4. In addition, the load-side control device 47 of the load device 4 on the master side calculates the current load amount that is the sum of load amounts obtained by quantifying the loads applied to the respective load devices 4 operating at the current time point, based on the detection information detected by the detection means of each of the load devices 4. Further, the load-side control device 47 of the load device 4 on the master side calculates the total load amount obtained by quantifying the loads applied to the respective load devices 4 in the case where all of the load devices 4 perform operation at a maximum, by using the information representing the operation capacity of each of the load devices 4. In the case where the air-conditioning operation is the cooling operation and in the case where the ratio of the current load amount to the total load amount is less than or equal to the first threshold, the load-side control device 47 of the load device 4 on the master side generates the instruction information to instruct increase of the temperature of the first heat medium flowing out from each of the heat source devices 3 by a predetermined temperature. In the case where the air-conditioning operation is the heating operation and in the case where the ratio of the current load amount to the total load amount is less than or equal to the first threshold, the load-side control device 47 of the load device 4 on the master side generates the instruction information to instruct decrease of the temperature of the first heat medium flowing out from each of the heat source devices 3 by a predetermined temperature. In the case where the current load amount is small, the processing by the heat source devices 3 can be reduced in response to the instruction information, which makes it possible to reduce wasteful energy consumption.

[0064] The air-conditioning device 100 according to Embodiment 1 can perform the cooling operation and the heating operation, which makes it possible to improve comfortableness of the user.

Embodiment 2.

[0065] The load-side control device 47 of the load device 4 on the master side in Embodiment 1 described above calculates the current load amount and the total load amount, and in the case where the value obtained by dividing the current load amount by the total load amount is less than or equal to the first threshold, the load-side control device 47 of the load device 4 on the

master side generates the instruction information to instruct control of the temperature of the first heat medium flowing out from each of the heat source devices 3. The load-side control device 47 of the load device 4 on the master side in the air-conditioning device 100 according to Embodiment 2 generates the instruction information to reduce wasteful operation of the compressor 30, the decompression device 33, and other devices without performing calculation of the current load amount and the total load amount, and division. In the following, descriptions of parts similar to the parts in Embodiment 1 described above are omitted, unless otherwise noted.

[0066] In Embodiment 2, the load-side control device 47 of the load device 4 on the master side calculates a difference between the value of the detected indoor temperature in each of the plurality of load devices 4 and the value of the set temperature by the remote control 48 in each of the plurality of load devices 4. In the case where the air-conditioning device 10 performs the cooling operation and an absolute value of the difference is less than or equal to a predetermined second threshold, the load-side control device 47 of the load device 4 on the master side generates the instruction information instructing each of the heat source devices 3 to increase the temperature of the first heat medium flowing out from each of the heat source devices 3 by a predetermined temperature. In contrast, in the case where the air-conditioning device 10 performs the heating operation and the above-described absolute value of the difference is less than or equal to the predetermined second threshold, the load-side control device 47 of the load device 4 on the master side generates the instruction information instructing each of the heat source devices 3 to decrease the temperature of the first heat medium flowing out from each of the heat source devices 3 by a predetermined temperature. Note that the predetermined temperature is, for example, 1 degree C as in the above description. The second threshold is, for example, one. In Embodiment 2 of the present disclosure, the load-side control device 47 of the load device 4 on the master side may store or may not store the operation capacity of each of the load devices 4.

[0067] Fig. 11 is a flowchart illustrating control processing based on the difference between the set temperature and the indoor temperature, by the air-conditioning device according to Embodiment 2. In step S31, the air-conditioning device 100 performs the air-conditioning operation. In step S32, the load device 4 on the master side acquires the detection information from each of the load devices 4 on the slave side. The detection information includes information representing the indoor temperature detected by the indoor temperature sensor 44 and information representing the set temperature input by the user through the remote control 48.

[0068] In step S33, the load-side control device 47 of the load device 4 on the master side calculates the absolute value of the difference between the value of the indoor temperature and the value of the set temperature,

represented by the detection information acquired in step S32. The absolute value of the difference between the value of the indoor temperature and the value of the set temperature may be calculated by each of the load devices 4 detecting the indoor temperature and the set temperature, in place of the load-side control device 47 of the load device 4 on the master side. The detection information in this case may include the difference between the value of the indoor temperature and the value of the set temperature, calculated by each of the load devices 4, or the absolute value of the difference.

[0069] In step S33, the load-side control device 47 of the load device 4 on the master side determines whether the absolute value of the difference obtained from the detection information detected in each of the load devices 4 is less than or equal to the second threshold. In a case where the absolute value of the difference is less than or equal to the second threshold (YES in step S33), the processing by the load device 4 on the master side proceeds to step S34. In a case where the absolute value of the difference is greater than the second threshold (NO in step S33), the air-conditioning device 100 returns to an original state in step S31. Note that the processing by the load-side control device 47 of the load device 4 on the master side may proceed to step S34 not in the case where the absolute value of the difference obtained from the detection information detected in each of the load devices 4 is less than or equal to the second threshold but in a case where the absolute value of the difference obtained from the detection information detected in each of a predetermined number or more of load devices 4 is less than or equal to the second threshold.

[0070] In step S34, the load-side control device 47 of the load device 4 on the master side generates the instruction information instructing control of the temperature of the first heat medium flowing out from each of the heat source devices 3, and transmits the generated instruction information to the heat source device 3 on the master side. In the case where the air-conditioning device 100 performs the cooling operation, the instruction information at this time instructs increase of the temperature of the first heat medium flowing out from each of the heat source devices 3, by a predetermined temperature. In the case where the air-conditioning device 100 performs the heating operation, the instruction information at this time instructs decrease of the temperature of the first heat medium flowing out from each of the heat source devices 3, by a predetermined temperature.

[0071] In step S35, the heat source device 3 on the master side controls the compressor 30, the decompression device 33, or other devices of the heat source device 3 on the master side such that the temperature and the pressure of the refrigerant and other factors are controlled, based on the first control information from the instruction information received from the load device 4 on the master side. Further, in step S35, the heat source device 3 on the master side transmits the second control information from the instruction information to each of

the heat source devices 3 on the slave side. In step S35, each of the heat source devices 3 on the slave side controls the compressor 30, the decompression device 33, or other devices of the heat source device 3 on the slave side such that the temperature and the pressure of the refrigerant and other factors are controlled, based on the second control information received from the heat source device 3 on the master side. For example, during the cooling operation, each of the heat source devices 3 exercises control to increase the evaporating temperature of the refrigerant.

[0072] The air-conditioning device 100 according to Embodiment 2 can reduce the calculation processing by the load-side control device 47 of the load device 4 on the master side.

Embodiment 3.

[0073] The air-conditioning device 100 in Embodiment 2 described above controls the temperature of the first medium flowing out from each of the heat source devices 3 in the case where the absolute value of the difference between the value of the indoor temperature and the value of the set temperature, represented by the detection information detected by the detection means of each of the load devices 4 is less than or equal to the second threshold. The air-conditioning device 100 according to Embodiment 3 controls the temperature of the first medium flowing out from each of the heat source devices 3 by also using information representing a humidity in the air-conditioned space. In the following, descriptions of parts similar to the parts in Embodiment 1 and Embodiment 2 described above are omitted, unless otherwise noted.

[0074] The detection information in Embodiment 3 includes the information representing the indoor temperature and the information representing the set temperature as in Embodiment 2 described above. The detection information in Embodiment 3 further includes information representing a humidity of a room (indoor humidity) detected by the indoor humidity sensor 45. The load-side control device 47 of the load device 4 on the master side calculates the difference between the value of the detected indoor humidity in each of the plurality of load devices 4 and the value of the set temperature by the remote control 48 in each of the plurality of load devices 4. During the cooling operation, in the case where the absolute value of the difference obtained from the detection information detected by the detection means of each of all or a predetermined number or more of load devices 4 is less than or equal to the second threshold and in a case where a value of the indoor humidity is less than or equal to a third threshold, the load-side control device 47 of the load device 4 on the master side generates the instruction information instructing each of the heat source devices 3 to increase the temperature of the first heat medium flowing out from each of the heat source devices 3 by a predetermined temperature. During the heating opera-

tion, in the case where the absolute value of the difference obtained from the detection information detected by the detection means of each of all or a predetermined number or more of load devices 4 is less than or equal to the predetermined second threshold and in the case the value of the indoor humidity is less than or equal to the third threshold, the load-side control device 47 of the load device 4 on the master side generates the instruction information instructing each of the heat source devices 3 to decrease the temperature of the first heat medium flowing out from each of the heat source devices 3 by a predetermined temperature. Note that the predetermined temperature is, for example, 1 degree C as in the above description. In addition, the third threshold is, for example, a value corresponding to a relative humidity of 50%. In Embodiment 3, the load-side control device 47 of the load device 4 on the master side may store or may not store the operation capacity of each of the load devices 4, as in Embodiment 2 described above.

[0075] In a case where the value representing the indoor humidity is greater than the third threshold, the load-side control device 47 of the load device 4 on the master side in Embodiment 3 does not instruct each of the heat source devices 3 to control the temperature of the first heat medium flowing out from each of the heat source devices 3. The reason is as follows. For example, in a case where the air-conditioning device 100 performs the cooling operation on a space with high humidity, the air-conditioning device 100 cools the air while changing water vapor in the air to water, in phase. In this case, it is necessary for the air-conditioning device 100 to remove heat including latent heat of the water vapor. Therefore, in a case where the indoor humidity is high, the air-conditioning device 100 is required to exert cooling capacity more than that in a case where the indoor humidity is low. Therefore, in the case where the indoor humidity is greater than the third threshold, the above-described control is not performed.

[0076] Fig. 12 is a flowchart illustrating control processing based on the set temperature, the indoor temperature, and the indoor humidity, by the air-conditioning device according to Embodiment 3. In step S41, the air-conditioning device 100 performs the air-conditioning operation. In step S42, the load device 4 on the master side acquires the detection information from each of the load devices 4 on the slave side. The detection information includes the information representing the indoor temperature detected by the indoor temperature sensor 44, the information representing the set temperature input by the user through the remote control 48, and the information representing the indoor humidity detected by the indoor humidity sensor 45.

[0077] In step S43, the load-side control device 47 of the load device 4 on the master side calculates the absolute value of the difference between the value of the indoor temperature and the value of the set temperature, represented by the detection information acquired in step S42. Note that the absolute value of the difference be-

tween the value of the indoor temperature and the value of the set temperature may be calculated by each of the load devices 4 detecting the indoor temperature and the set temperature, in place of the load-side control device 47 of the load device 4 on the master side. The detection information in this case may include the difference between the value of the indoor temperature and the value of the set temperature, calculated by each of the load devices 4, or the absolute value of the difference.

[0078] In step S43, the load-side control device 47 of the load device 4 on the master side determines whether the absolute value of the difference obtained from the detection information detected in each of the load devices 4 is less than or equal to the second threshold. In a case where the absolute value of the difference is less than or equal to the second threshold (YES in step S43), the processing by the load device 4 on the master side proceeds to step S44. In a case where the absolute value of the difference is greater than the second threshold (NO in step S43), the air-conditioning device 100 returns to an original state in step S41. The processing of the load-side control device 47 of the load device 4 on the master side may proceed to step S44 not in the case where the absolute value of the difference obtained from the detection information detected in each of the load devices 4 is less than or equal to the second threshold but in a case where the absolute value of the difference obtained from the detection information detected in each of a predetermined number or more of load devices 4 is less than or equal to the second threshold.

[0079] In step S44, the load-side control device 47 of the load device 4 on the master side determines whether the value of the indoor humidity represented by the detection information detected in each of the load devices 4 is less than or equal to the third threshold. In a case where the value of the indoor humidity is less than or equal to the third threshold (YES in step S44), the processing by the load device 4 on the master side proceeds to step S45. In a case where the absolute value of the difference is greater than the third threshold (NO in step S44), the air-conditioning device 100 returns to the original state in step S41.

[0080] In step S45, the load-side control device 47 of the load device 4 on the master side generates the instruction information instructing control of the temperature of the first heat medium flowing out from each of the heat source devices 3, and transmits the generated instruction information to the heat source device 3 on the master side. In the case where the air-conditioning device 100 performs the cooling operation, the instruction information at this time instructs increase of the temperature of the first heat medium flowing out from each of the heat source devices 3 by a predetermined temperature. In the case where the air-conditioning device 100 performs the heating operation, the instruction information at this time instructs decrease of the temperature of the first heat medium flowing out from each of the heat source devices 3 by a predetermined temperature.

[0081] In step S46, the heat source device 3 on the master side controls the compressor 30, the decompression device 33, or other devices of the heat source device 3 on the master side such that the temperature and the pressure of the refrigerant and other factors are controlled, based on the first control information from the instruction information received from the load device 4 on the master side. Further, in step S46, the heat source device 3 on the master side transmits the second control information from the instruction information to each of the heat source devices 3 on the slave side. In step S46, each of the heat source devices 3 on the slave side controls the compressor 30, the decompression device 33, or other devices of the heat source device 3 on the slave side such that the temperature and the pressure of the refrigerant and other factors are controlled, based on the second control information received from the heat source device 3 on the master side. For example, during the cooling operation, each of the heat source devices 3 exercises control to increase the evaporating temperature of the refrigerant.

[0082] As the air-conditioning device 100 according to Embodiment 3 performs the control using the indoor humidity in addition to the indoor temperature and the set temperature, it is possible to reduce wasteful energy consumption while maintaining comfortableness.

Embodiment 4.

[0083] The air-conditioning device 100 according to Embodiment 4 performs instruction to each of the heat source devices 3 based on each of cooling capacity and heating capacity in addition to the configuration and operation by the air-conditioning device 100 according to Embodiments 1 to 3 described above, and wasteful energy consumption is thus reduced. In the following, descriptions of parts similar to the parts in Embodiments 1 to 3 described above are omitted, unless otherwise noted.

[0084] Each of the cooling capacity and the heating stress is a product of the value of the difference between the indoor temperature and the temperature of the first heat medium, and the flow rate of the first heat medium. The temperature of the first heat medium is determined based on the indoor temperature or based on whether the air-conditioning operation is the cooling operation or the heating operation. For example, in the case where the indoor temperature is 27 degrees C during the cooling operation, the air-conditioning operation is often performed while the temperature of the first heat medium flowing out from each of the heat source devices 3 is set to, for example, 7 degrees C. In contrast, in the case where the indoor temperature is, for example, 20 degrees C during the heating operation, the air-conditioning operation is often performed while the temperature of the first heat medium flowing out from each of the heat source devices 3 is set to, for example, 45 degrees C. In the above-described air-conditioning operation, the differ-

ence between the indoor temperature and the temperature of the first heat medium is 20 degrees C during the cooling operation and is 25 degrees C during the heating operation. As described above, the value of the difference between the indoor temperature and the temperature of the first heat medium during the heating operation is often greater than the value of the difference between the indoor temperature and the temperature of the first heat medium during the cooling operation. Further, the flow rate of the first heat medium during the cooling operation and the flow rate of the first heat medium during the heating operation are equal to each other in many cases. Accordingly, the heating capacity is often higher than the cooling capacity.

[0085] In many cases, however, the cooling capacity and the heating capacity necessary for comfortableness of the user are not different from each other, and the energy is often wastefully used during the heating operation more than during the cooling operation.

[0086] In the case where the flow rate of the first heat medium during the heating operation and the flow rate of the first heat medium during the cooling operation are each previously set, the air-conditioning device 100 according to Embodiment 4 makes the flow rate of the first heat medium by the pump 2 during the heating operation lower than the preset flow rate (set flow rate), and wasteful energy consumption is thus reduced. In Embodiment 4, the load-side control device 47 of the load device 4 on the master side changes the value of the flow rate of the first heat medium during the heating operation from the value of the set flow rate, based on the indoor temperature or the temperature of the first heat medium. More specifically, the load-side control device 47 of the load device 4 on the master side instructs each of the heat source devices 3 to control the value of the flow rate of the first heat medium during the heating operation such that the flow rate is a flow rate of a value obtained by multiplying the value of the set flow rate by a numerical value determined based on the indoor temperature. For example, the numerical value is a value obtained by dividing a difference between a predicted value of the indoor temperature and the value of the temperature of the first heat medium during the cooling operation by the difference between the temperature of the first heat medium and the indoor temperature during the heating operation. Note that the predicted value of the indoor temperature during the cooling operation is previously determined.

[0087] Fig. 13 is a flowchart illustrating control processing of the flow rate of the first heat medium during the heating operation, by the air-conditioning device according to Embodiment 4. In step S51, the air-conditioning device 100 performs the air-conditioning operation. In step S52, the load device 4 on the master side acquires the detection information from each of the load devices 4 on the slave side. The detection information includes information representing any of the heating operation and the cooling operation detected by the remote control 48. The detection information represents whether the corre-

sponding load device 4 performs the heating operation or the cooling operation.

[0088] In step S53, the load-side control device 47 of the load device 4 on the master side determines whether the detection information acquired in step S52 is information indicating that the operation by the air-conditioning device 100 is the heating operation. In a case where the operation by the air-conditioning device 100 is the heating operation (YES in step S53), the processing by the load device 4 on the master side proceeds to step S54. In a case where the operation by the air-conditioning device 100 is not the heating operation (NO in step S53), the air-conditioning device 100 returns to an original state in step S51.

[0089] In step S54, the load-side control device 47 of the load device 4 on the master side generates the instruction information instructing control of the flow rate of the first heat medium flowing out from each of the heat source devices 3, and transmits the generated instruction information to the heat source device 3 on the master side. The instruction information at this time is to control the pump 2 such that the flow rate of the first heat medium is reduced.

[0090] In step S55, the heat source device 3 on the master side controls the pump 2, based on the first control information from the instruction information received from the load device 4 on the master side, such that the flow rate of the first heat medium by the pump 2 is reduced.

[0091] The air-conditioning device 100 according to Embodiment 4 can reduce unnecessary energy consumption by reducing the flow rate of the first heat medium during the heating operation.

[0092] The air-conditioning device 100 according to Embodiment 4 reduces the flow rate of the first heat medium during the heating operation by using the value of the temperature of the first heat medium and the predicted value of the indoor temperature during the cooling operation, in addition to the value of the temperature of the first heat medium and the value of the indoor temperature during the heating operation. This makes it possible to maintain comfortableness and to achieve energy saving.

Embodiment 5.

[0093] The air-conditioning device 100 according to Embodiment 5 further achieves maintenance of comfortableness by defrosting operation, in addition to the configuration and operation by the air-conditioning devices 100 according to Embodiments 1 to 4 described above. In the following, descriptions of parts similar to the parts in Embodiments 1 to 4 described above are omitted, unless otherwise noted.

[0094] The heat source-side heat exchanger 32 of each of the heat source devices 3 is frosted in a case where the outdoor temperature outside the air-conditioned space is low during the heating operation. This

lowers the heating capacity of the air-conditioning device 100. Therefore, periodic defrosting is necessary. For example, in many cases, defrosting operation is performed by causing hot gas to flow through the heat source-side heat exchanger 32 and switching operation by the flow switching device 31. In this case, the first heat medium circuit 1 is cooled at the intermediate heat exchanger 34, and the heating operation by the air-conditioning device 100 is accordingly stopped. As a result, the air-conditioning device 100 temporarily performs the cooling operation. Accordingly, during this period, cold air is blown out from the air-sending device 41 of each of the load devices 4.

[0095] The load-side control device 47 of the load device 4 on the master side acquires information representing the defrosting operation from the heat source-side control device 37 of the heat source device 3 on the master side through the signal line 6. The load-side control device 47 of the load device 4 on the master side having received the information representing the defrosting operation reduces the air volume by the air-sending device 41 of each of the load devices 4, to a predetermined minimum air volume.

[0096] Fig. 14 is a flowchart illustrating control processing during the defrosting operation, by the air-conditioning device according to Embodiment 5. In step S61, the air-conditioning device 100 performs the air-conditioning operation. In step S62, in a case where the load device 4 on the master side receives information indicating that each of the heat source devices 3 performs the defrosting operation, from the heat source device 3 on the master side (YES in step S62), the processing proceeds to step S63. In step S62, in a case where the load device 4 on the master side does not receive the information indicating that each of the heat source devices 3 performs the defrosting operation, from the heat source device 3 on the master side (NO in step S62), the air-conditioning device 100 returns to an original state in step S61.

[0097] In step S63, the load-side control device 47 of the load device 4 on the master side controls the air volume by the air-sending device 41 of the load device 4 on the master side such that the air volume is reduced to the minimum air volume. In step S63, the load-side control device 47 of the load device 4 on the master side transmits an instruction to control the air volume by the air-sending device 41 of each of the load devices 4 on the slave side such that the air volume is reduced to the minimum air volume, to the load-side control device 47 of each of the load devices 4 on the slave side through the signal lines 7. In step S63, the load-side control device 47 of each of the load devices 4 on the slave side having received the instruction controls the air volume by the air-sending device 41 of the load device 4 on the slave side such that the air volume is reduced to the minimum air volume.

[0098] In the air-conditioning device 100 according to Embodiment 5, the load-side control device 47 of each of the load devices 4 controls the corresponding air-sending

device 41 such that the volume of air to be sent is minimized while each of the heat source devices 3 performs the defrosting operation. As a result, it is possible to reduce wasteful energy consumption without impairing comfortableness of the user.

Embodiment 6.

[0099] The air-conditioning device 100 according to Embodiment 6 further achieves improvement of comfortableness during the defrosting operation, in addition to the configuration and operation by the air-conditioning device 100 according to Embodiment 5 described above. In the following, descriptions of parts similar to the parts in Embodiments 1 to 5 described above are omitted, unless otherwise noted.

[0100] As described above in Embodiment 5, in the case where the outdoor temperature is low during the heating operation, the heat source-side heat exchanger 32 is frosted, and periodic defrosting is necessary. During the defrosting operation, however, as described above, cold air is blown out from each of the load devices 4, which impairs comfortableness. The air-conditioning device 100 according to Embodiment 5 described above minimizes the air volume by the air-sending device 41 during the defrosting operation, whereas the air-conditioning device 100 according to Embodiment 6 previously increases the indoor temperature before the defrosting operation, to further improve comfortableness during the defrosting operation. A detailed description is given below.

[0101] In the air-conditioning device 100 according to Embodiment 6, at least one of the heat source device 3 on the master side and the load device 4 on the master side can acquire information about a time until the defrosting operation is performed by, for example, storing schedule of the defrosting operation of each of the heat source devices 3 or having a set timer. In a case where it is determined that the defrosting operation is performed within a predetermined time, the heat source-side control device 37 of the heat source device 3 on the master side or the load-side control device 47 of the load device 4 on the master side exercises control to previously increase the indoor temperature such that the indoor temperature is not excessively lowered by the cold air from each of the load devices 4 during the defrosting operation, as compared with the set temperature.

[0102] Fig. 15 is a flowchart illustrating control processing to improve or maintain comfortableness during the defrosting operation, by the air-conditioning device according to Embodiment 6. In step S71, the air-conditioning device 100 performs the air-conditioning operation. In step S72, in a case where the heat source device 3 on the master side or the load device 4 on the master side does not acquire information representing execution start of the defrosting operation within the predetermined time (NO in step S72), the processing by the air-conditioning device 100 returns to step S71. In step S72, in a

case where the heat source device 3 on the master side or the load device 4 on the master side acquires the information representing execution start of the defrosting operation within the predetermined time (YES in step S72), the processing by the air-conditioning device 100 proceeds to step S73.

[0103] In step S73, the heat source device 3 on the master side exercises control to increase the temperature of the first heat medium flowing out from the heat source device 3 on the master side. Further, the heat source device 3 on the master side instructs each of the heat source devices 3 on the slave side to exercise control of increasing the temperature of the first heat medium flowing out from each of the heat source devices 3 on the slave side. Each of the heat source devices 3 on the slave side performs the control in response to the instruction. The air-conditioning device 100 causes the first heat medium increased in temperature by the control to circulate through the first heat medium circuit 1 and continues the air-conditioning operation.

[0104] In step S74, in a case where the load device 4 on the master side does not receive, from the heat source device 3 on the master side, the information indicating that each of the heat source devices 3 performs the defrosting operation, while the air-conditioning device 100 performs the air-conditioning operation (NO in step S74), the processing by the air-conditioning device 100 returns to step S74. In step S74, in a case where the load device 4 on the master side receives, from the heat source device 3 on the master side, the information indicating that each of the heat source devices 3 performs the defrosting operation, while the air-conditioning device 100 performs the air-conditioning operation (YES in step S74), the processing by the air-conditioning device 100 proceeds to step S75.

[0105] In step S75, the load-side control device 47 of the load device 4 on the master side controls the air volume by the air-sending device 41 of the load device 4 on the master side such that the air volume is reduced to the minimum air volume. In step S75, the load-side control device 47 of the load device 4 on the master side transmits an instruction to control the air volume by the air-sending device 41 of each of the load devices 4 on the slave side such that the air volume is reduced to the minimum air volume, to the load-side control device 47 of each of the load devices 4 on the slave side through the signal lines 7. In step S75, the load-side control device 47 of each of the load devices 4 on the slave side having received the instruction controls the air volume by the air-sending device 41 of the load device 4 on the slave side such that the air volume is reduced to the minimum air volume.

[0106] The air-conditioning device 100 according to Embodiment 6 can further improve comfortableness during the defrosting operation.

Reference Signs List

[0107] 1: first heat medium circuit, 2: pump, 3: heat source device, 3a: master-side heat source device, 3b: slave-side heat source device, 4: load device, 4a: master-side load device, 4b, 4c: slave-side load device, 5, 6, 7, 9: signal line, 11: first pipe, 12: second pipe, 13: third pipe, 14: fourth pipe, 15: fifth pipe, 16: sixth pipe, 30: compressor, 31: flow switching device, 32: heat source-side heat exchanger, 33: decompression device, 34: intermediate heat exchanger, 35: refrigerant circuit, 36: air-sending device, 37: heat source-side control device, 40: load-side heat exchanger, 41: air-sending device, 42: inlet temperature sensor, 43: outlet temperature sensor, 44: indoor temperature sensor, 45: indoor humidity sensor, 46: motor-operated valve, 47: load-side control device, 48: remote control, 100: air-conditioning device, 340, 342, 344, 401, 403, 405: inlet, 341, 343, 345, 400, 402, 404: outlet

Claims

1. An air-conditioning device, comprising:

a first heat medium circuit through which a first heat medium flows;
circulation generation means configured to generate a flow of the first heat medium and to cause the first heat medium to circulate through the first heat medium circuit;
one or more heat source devices provided in the first heat medium circuit, each including a second heat medium circuit through which a second heat medium circulates, and each configured to heat or cool the first heat medium by internally exchanging heat between the first heat medium and the second heat medium; and
a plurality of load devices provided in the first heat medium circuit, and each configured to perform air-conditioning operation of an air-conditioned space by exchanging heat between the first heat medium and air of the air-conditioned space,
one of the one or more heat source devices being a master-side heat source device,
one of the plurality of load devices being a master-side load device,
the plurality of load devices each including detection means configured to detect detection information representing an operation state of the load device,
the master-side load device including a load-side control device configured to generate instruction information representing contents instructed to all or a part of the one or more heat source devices by using the detection information acquired from the detection means of each

of the plurality of load devices, and to transmit the instruction information to the master-side heat source device,
the master-side heat source device being configured to receive the instruction information from the master-side load device, and control at least any of all or a part of the one or more heat source devices and the circulation generation means, based on the instruction information.

2. The air-conditioning device of claim 1, wherein

the air-conditioning device includes a plurality of the heat source devices, among the plurality of the heat source devices, the heat source devices other than the master-side heat source device are slave-side heat source devices,
the master-side heat source device is configured to generate first control information to control at least one of the master-side heat source device and the circulation generation means, based on the instruction information received from the master-side load device, control at least one of the master-side heat source device and the circulation generation means based on the first control information, generate second control information to control each of the slave-side heat source devices, and transmit the second control information to each of the slave-side heat source devices, and
the slave-side heat source devices are each configured to control the slave-side heat source device based on the second control information.

3. The air-conditioning device of claim 1 or 2, wherein

in a case where the detection information detected by the detection means of each of the plurality of load devices represents stop of the air-conditioning operation, the load-side control device of the master-side load device is configured to generate the instruction information representing an instruction to stop operation by the one or more heat source devices and operation by the circulation generation means, and transmit the instruction information to the master-side heat source device, and
the master-side heat source device receiving the instruction information is configured to stop the operation by the one or more heat source devices and the operation by the circulation generation means based on the instruction information.

4. The air-conditioning device of any one of claims 1 to 3, wherein

the plurality of load devices each include a mo-

tor-operated valve configured to perform opening and closing operation to adjust an inflow amount of the first heat medium to the load device,

in a case where the detection information detected by the detection means of each of the plurality of load devices indicates that the corresponding motor-operated valve is in a closed state, the load-side control device of the master-side load device is configured to generate the instruction information that represents an instruction to stop operation of each of the one or more heat source devices and an instruction to reduce a flow rate of the first heat medium by the circulation generation means to a predetermined minimum flow rate, and transmit the instruction information to the master-side heat source device, and

the master-side heat source device receiving the instruction information is configured to stop operation by the one or more heat source devices, and control the circulation generation means such that the flow rate of the first heat medium is reduced to the minimum flow rate, based on the instruction information.

5. The air-conditioning device of any one of claims 1 to 4, wherein

the load-side control device of the master-side load device is configured to store information representing an operation capacity of each of the plurality of load devices,
calculate a current load amount that is a sum of load amounts obtained by quantifying loads applied to the respective load devices operating at a current time point, based on the detection information detected by the detection means of each of the plurality of load devices,
calculate a total load amount obtained by quantifying the loads applied to all of the plurality of load devices in a case where all of the plurality of load devices perform operation at a maximum, by using the information representing the operation capacity of each of the plurality of load devices,

in a case where the air-conditioning operation is cooling operation and in a case where a ratio of the current load amount to the total load amount is less than or equal to a first threshold, generate the instruction information instructing increase of a temperature of the first heat medium flowing out from each of the one or more heat source devices, by a predetermined temperature,

in a case where the air-conditioning operation is heating operation and in a case where the ratio of the current load amount to the total load

amount is less than or equal to the first threshold, generate the instruction information instructing decrease of the temperature of the first heat medium flowing out from each of the one or more heat source devices, by a predetermined temperature, and transmit the generated instruction information to the master-side heat source device, and the master-side heat source device is configured to control the one or more heat source devices based on the received instruction information.

6. The air-conditioning device of any one of claims 1 to 5, wherein

the detection means is configured to detect the detection information including information representing a set temperature set by a user and information representing a temperature of the air-conditioned space, the detection means or the load-side control device of the master-side load device is configured to calculate an absolute value of a difference between a value of the set temperature and a value of the temperature of the air-conditioned space, by using the detection information, in a case where the air-conditioning operation is cooling operation and in a case where the absolute value of the difference calculated by using the detection information detected by the detection means of each of all or a predetermined number or more of the plurality of load devices is less than or equal to a second threshold, the load-side control device of the master-side load device is configured to generate the instruction information instructing increase of a temperature of the first heat medium flowing out from each of the one or more heat source devices, by a predetermined temperature, in a case where the air-conditioning operation is heating operation and in a case where the absolute value of the difference calculated by using the detection information detected by the detection means of each of all or a predetermined number or more of the plurality of load devices is less than or equal to the second threshold, the load-side control device of the master-side load device is configured to generate the instruction information instructing decrease of the temperature of the first heat medium flowing out from each of the one or more heat source devices, by a predetermined temperature, the load-side control device of the master-side load device is configured to transmit the generated instruction information to the master-side heat source device, and

the master-side heat source device is configured to control the one or more heat source devices based on the received instruction information.

7. The air-conditioning device of any one of claims 1 to 5, wherein

the detection means is configured to detect the detection information including information representing a set temperature set by a user, information representing a temperature of the air-conditioned space, and information representing a humidity of the air-conditioned space, the detection means or the load-side control device of the master-side load device is configured to calculate an absolute value of a difference between a value of the set temperature and a value of the temperature of the air-conditioned space, by using the detection information, in a case where the air-conditioning operation is cooling operation, in a case where the absolute value of the difference calculated by using the detection information detected by the detection means of each of all or a predetermined number or more of the plurality of load devices is less than or equal to a second threshold, and in a case where a value of the humidity represented by the detection information is less than or equal to a third threshold, the load-side control device of the master-side load device is configured to generate the instruction information instructing increase of a temperature of the first heat medium flowing out from each of the one or more heat source devices, by a predetermined temperature, in a case where the air-conditioning operation is heating operation, in a case where the absolute value of the difference calculated by using the detection information detected by the detection means of each of all or a predetermined number or more of the plurality of load devices is less than or equal to the second threshold, and in a case where the value of the humidity represented by the detection information is less than or equal to the third threshold, the load-side control device of the master-side load device is configured to generate the instruction information instructing decrease of the temperature of the first heat medium flowing out from each of the one or more heat source devices, by a predetermined temperature, the load-side control device of the master-side load device is configured to transmit the generated instruction information to the master-side heat source device, and the master-side heat source device is configured to control the one or more heat source de-

vices based on the received instruction information.

8. The air-conditioning device of any one of claims 1 to 7, wherein

in a case where it is determined that each of the plurality of load devices performs heating operation, from the detection information acquired from the detection means of each of the plurality of load devices, the load-side control device of the master-side load device is configured to generate the instruction information instructing decrease of a flow rate of the first heat medium from a predetermined set flow rate, based on at least one of a value of a temperature of the first heat medium and a value of a temperature of the air-conditioned space detected by the detection means, and is configured to transmit the instruction information to the master-side heat source device, and

the master-side heat source device is configured to control the circulation generation means based on the received instruction information.

9. The air-conditioning device of claim 8, wherein

the instruction information instructs to set a value of the flow rate of the first heat medium to a value of a product of a value of the set flow rate and a numerical value based on at least one of the value of the temperature of the first heat medium and a value of the temperature of the air-conditioned space detected by the detection means, and

the numerical value is a value obtained by dividing a difference between a predicted value of the temperature of the air-conditioned space and the value of the temperature of the first heat medium during cooling operation by a difference between the value of the temperature of the first heat medium and the value of the temperature of the air-conditioned space detected by the detection means during the heating operation.

10. The air-conditioning device of any one of claims 1 to 9, wherein

in a case where all or a predetermined number or more of the one or more heat source devices perform defrosting operation, the master-side heat source device is configured to transmit information indicating that the defrosting operation is under execution, to the load-side control device of the master-side load device, and the load-side control device of the master-side load device is configured to control an air volume by an air-sending device of each of the plurality

of load devices such that the air volume is reduced to a predetermined minimum air volume.

11. The air-conditioning device of claim 10, wherein, in a case where all or a predetermined number or more of the one or more heat source devices perform the defrosting operation within a predetermined time, the master-side heat source device is configured to control the all or the predetermined number or more of the one or more heat source devices such that a temperature of the first heat medium is increased by a predetermined temperature before execution start of the defrosting operation.

12. The air-conditioning device of any one of claims 1 to 11, wherein the first heat medium circuit includes a pipe through which the first heat medium before cooling flows, a pipe through which the first heat medium after cooling flows, a pipe through which the first heat medium before heating flows, and a pipe through which the first heat medium after heating flows.

FIG. 1

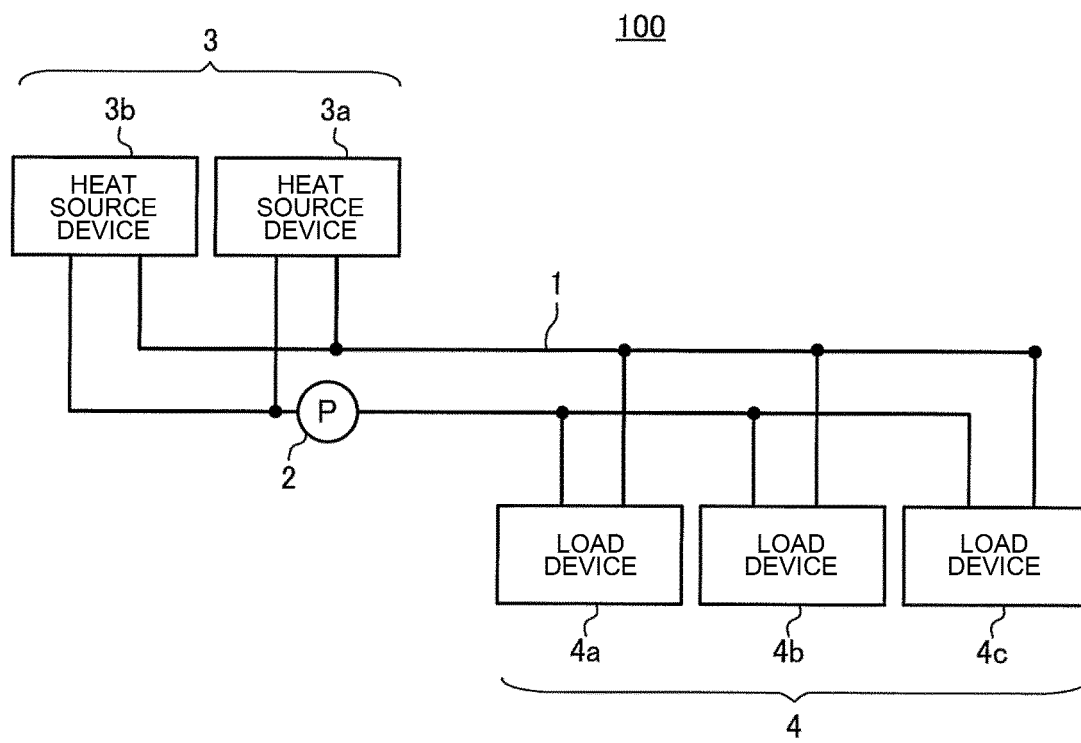


FIG. 2

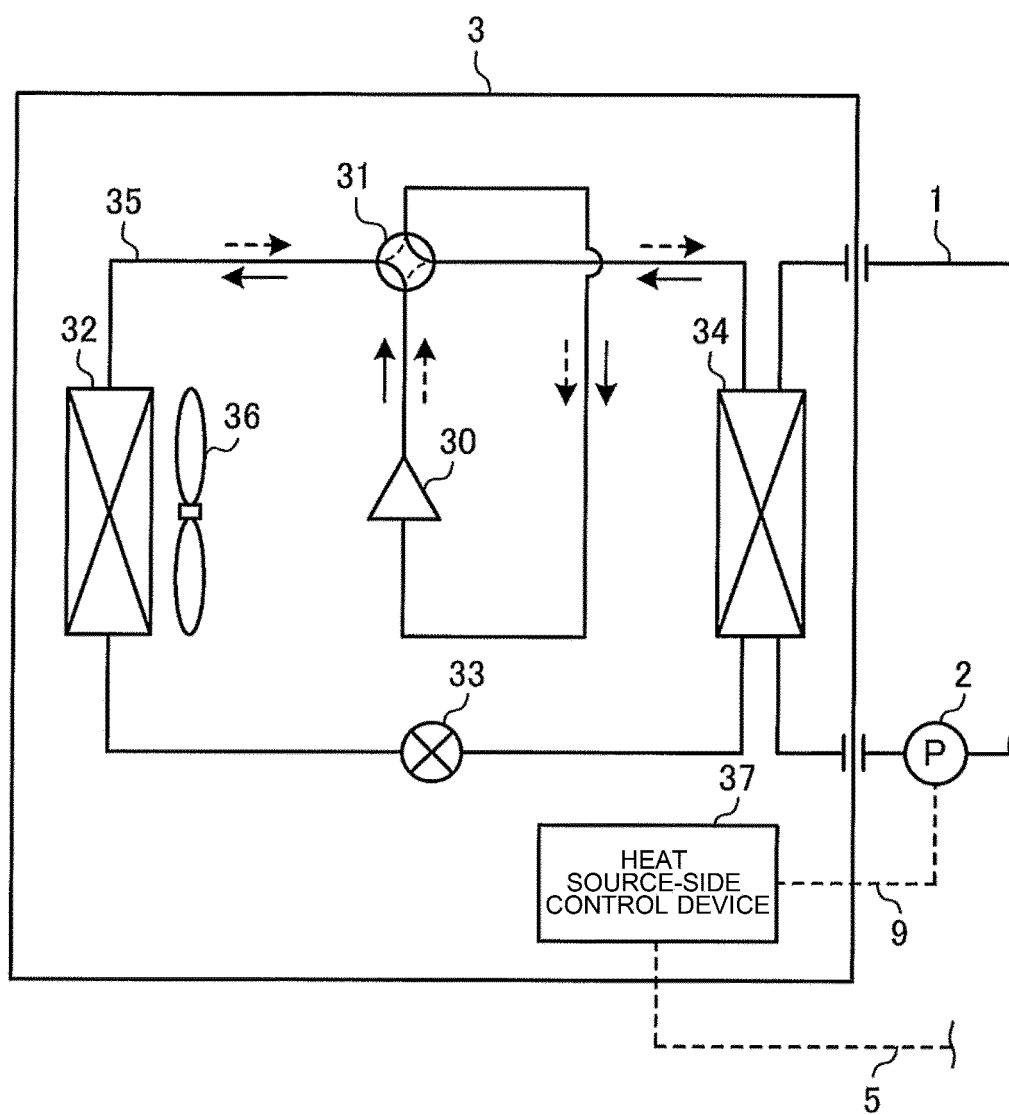


FIG. 3

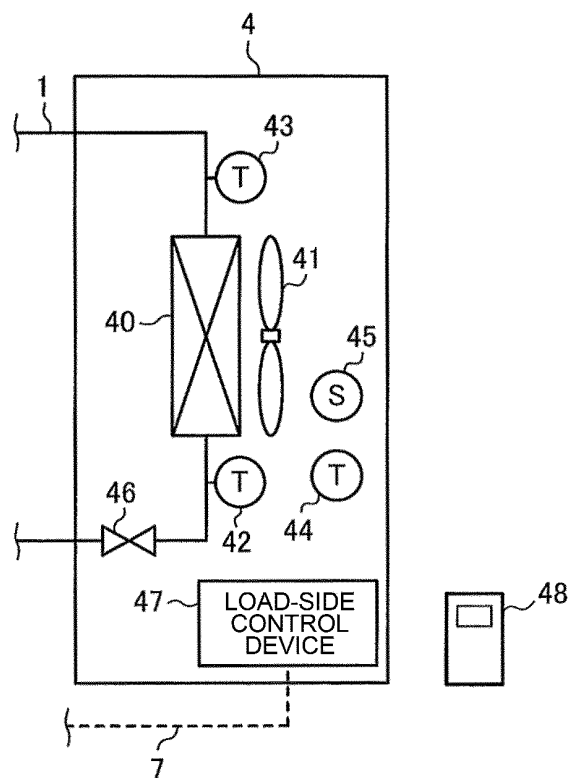


FIG. 4

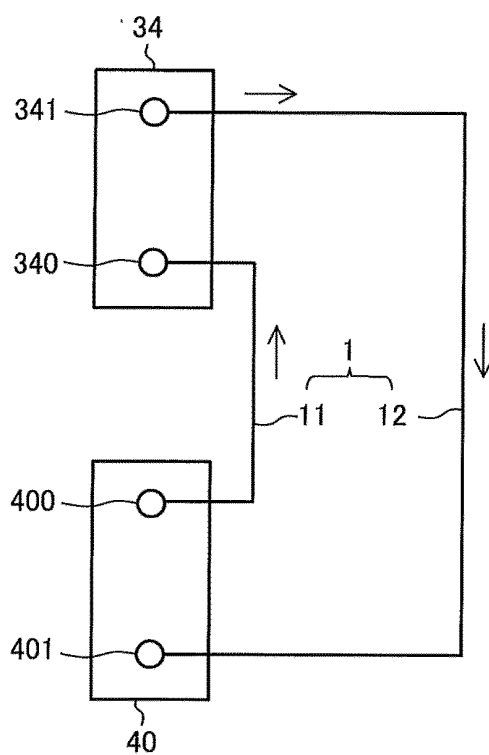


FIG. 5

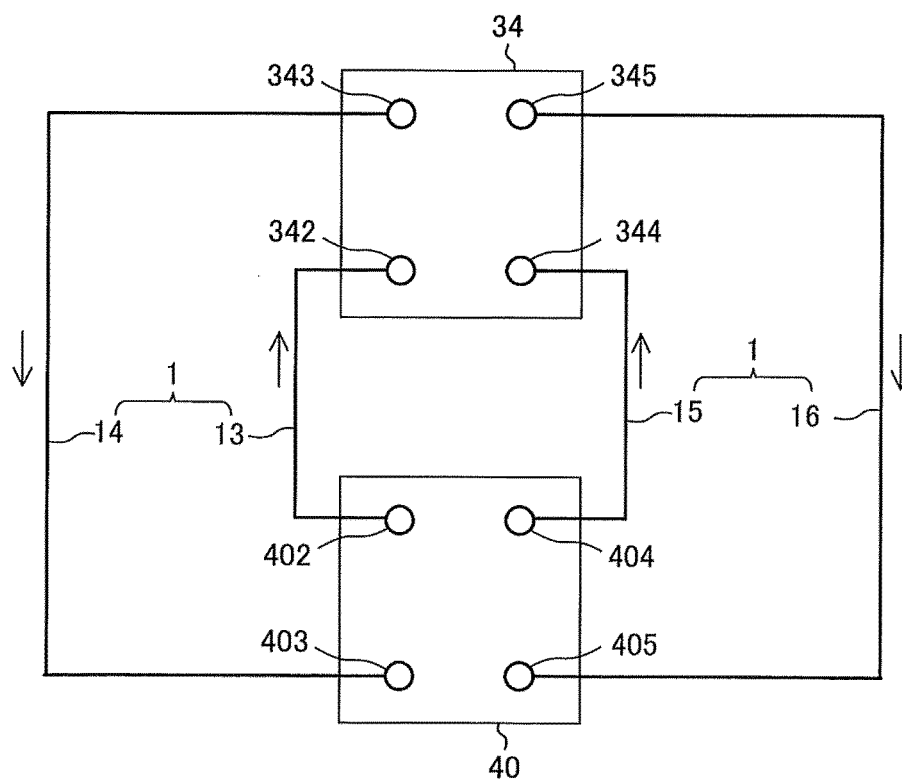


FIG. 6

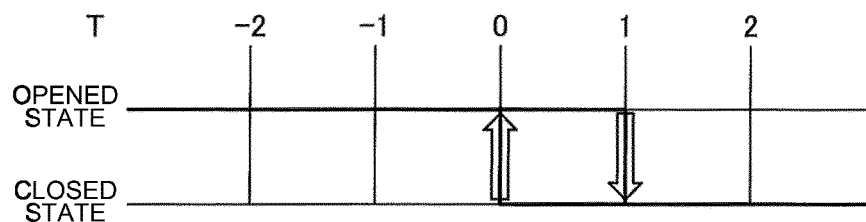


FIG. 7

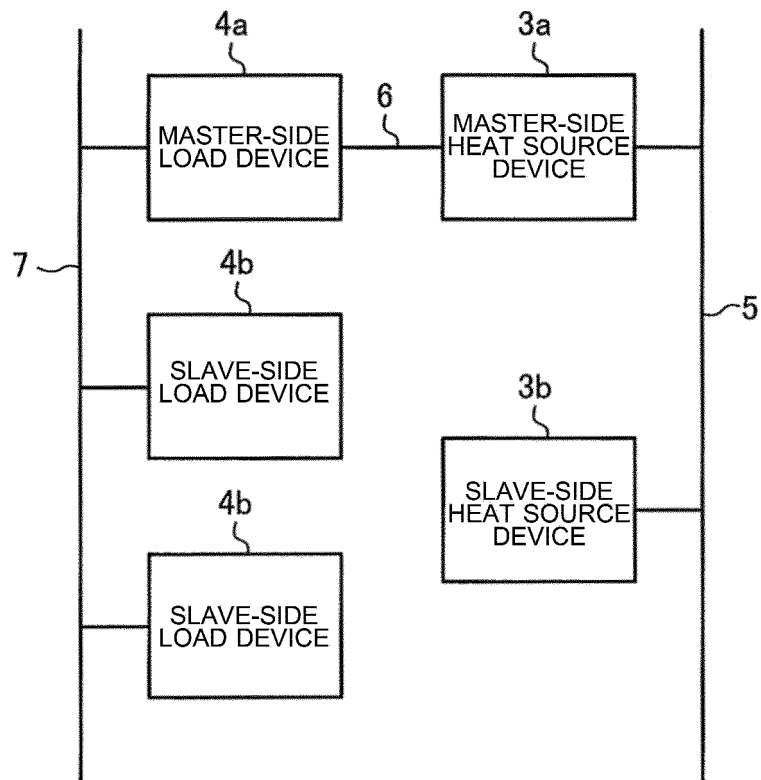


FIG. 8

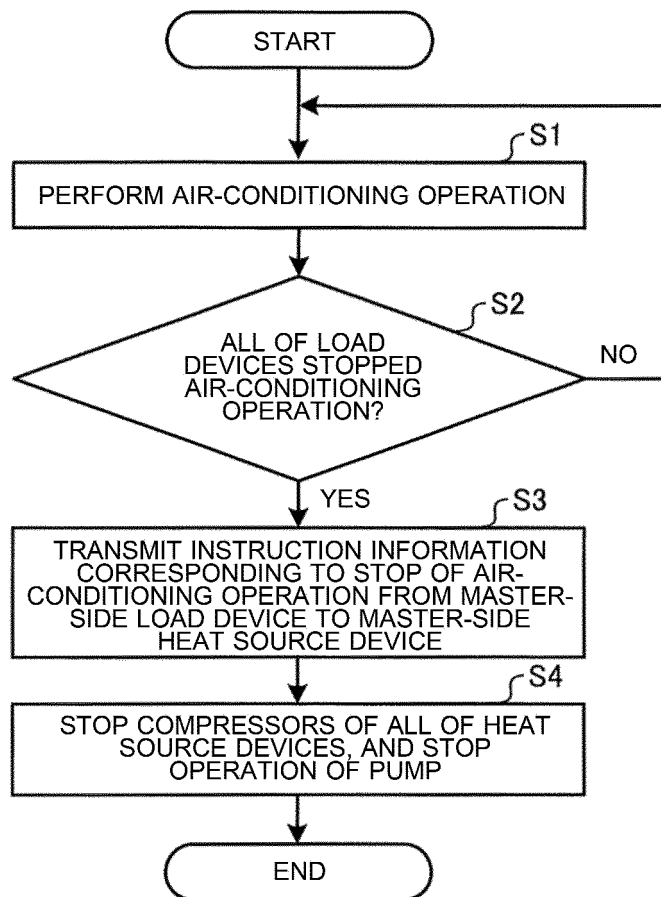


FIG. 9

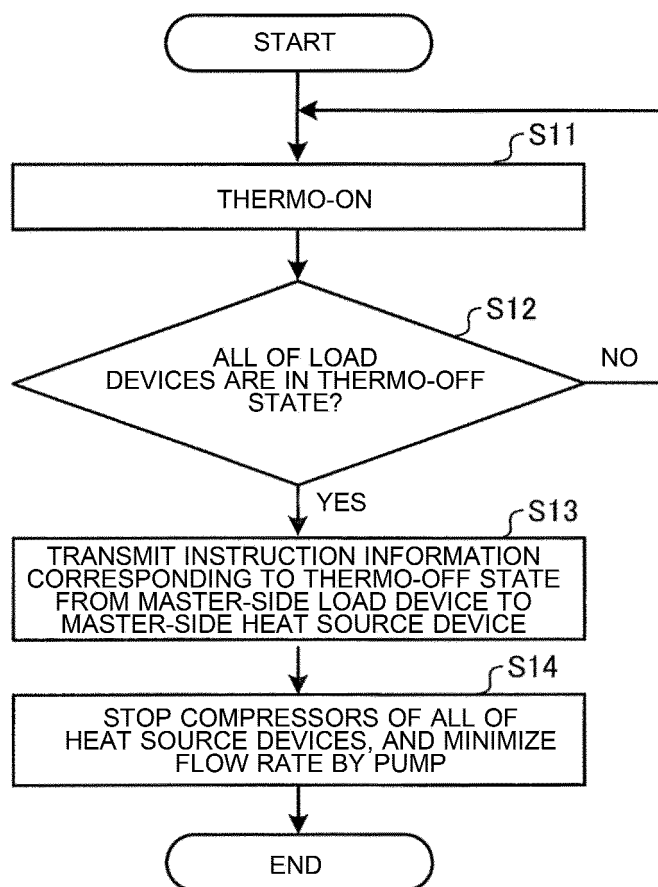


FIG. 10

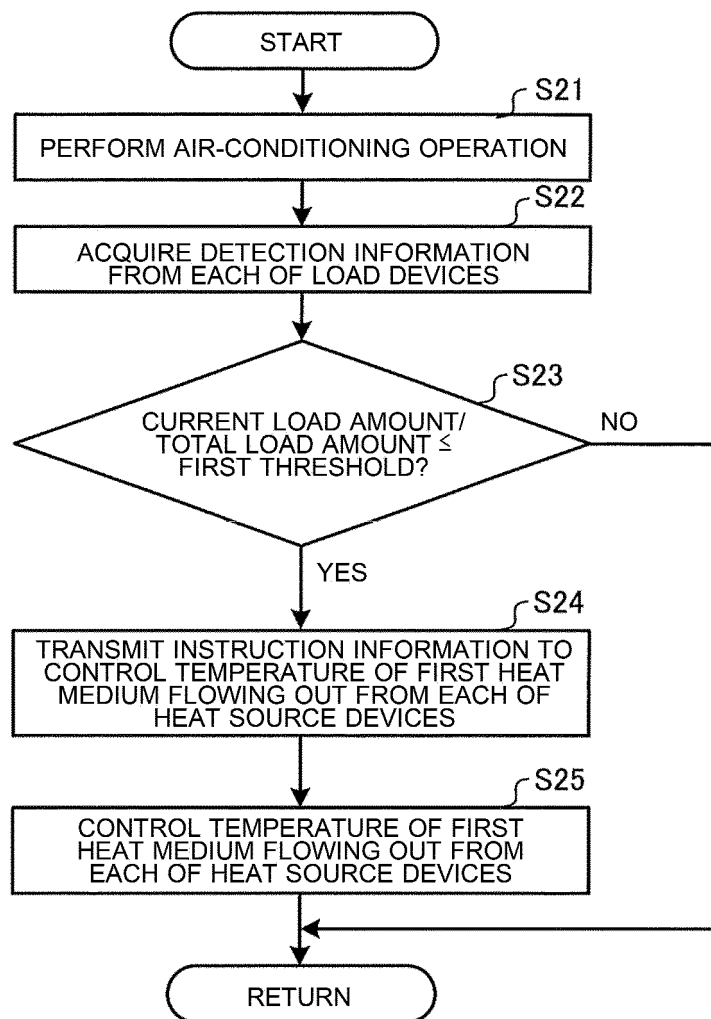


FIG. 11

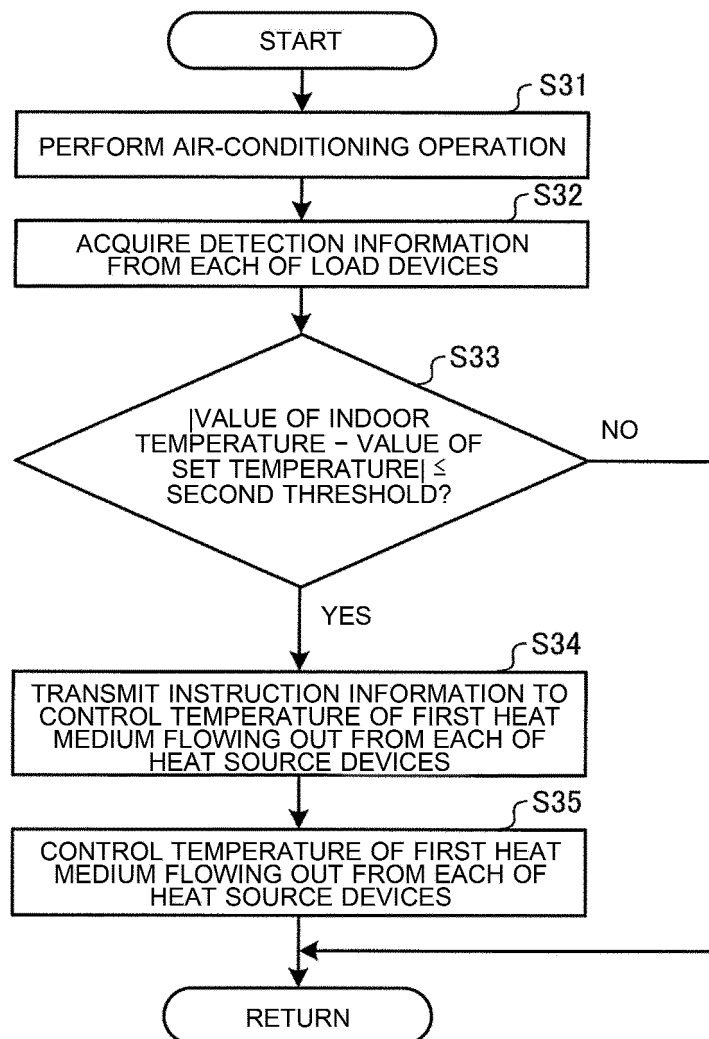


FIG. 12

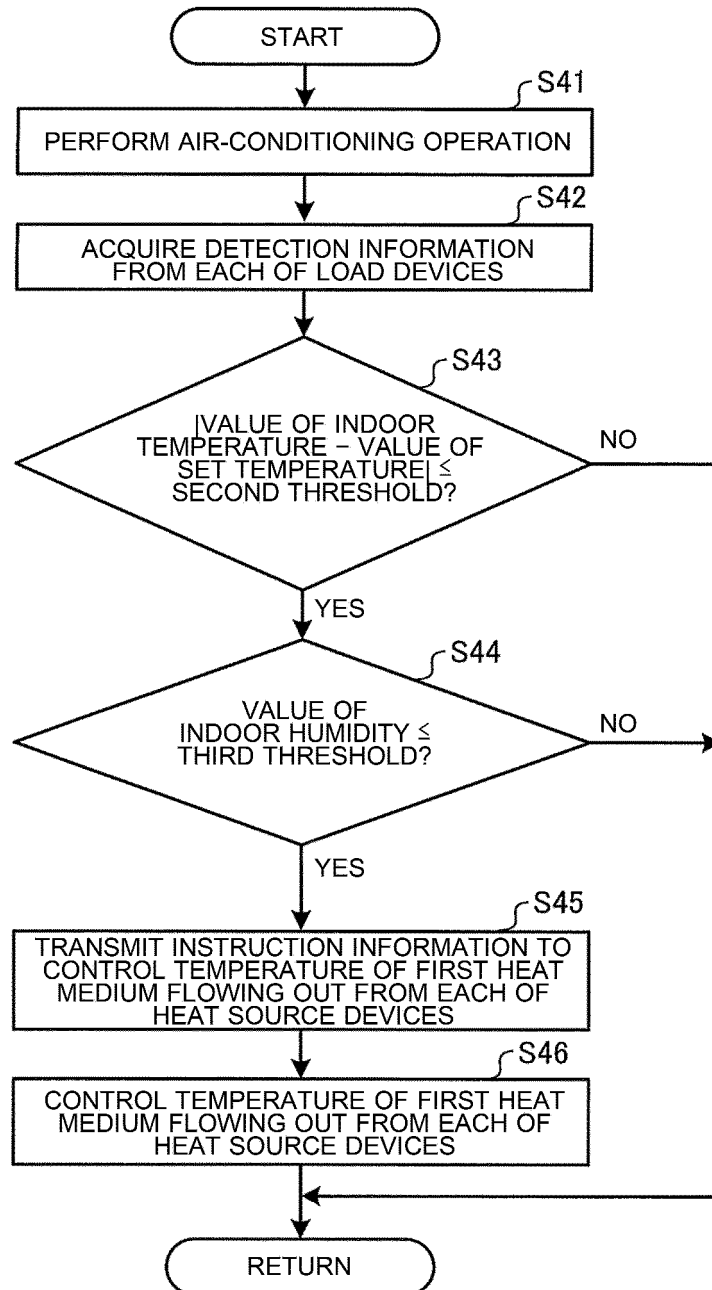


FIG. 13

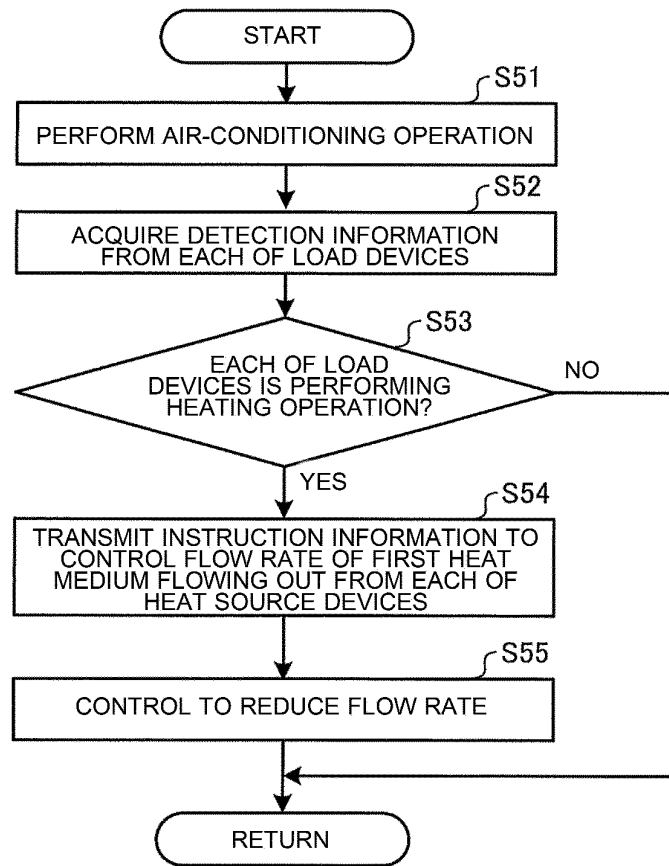


FIG. 14

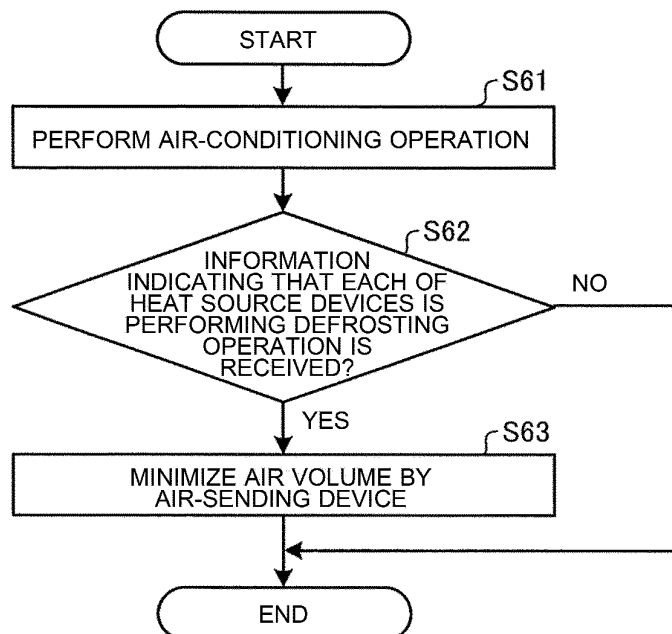
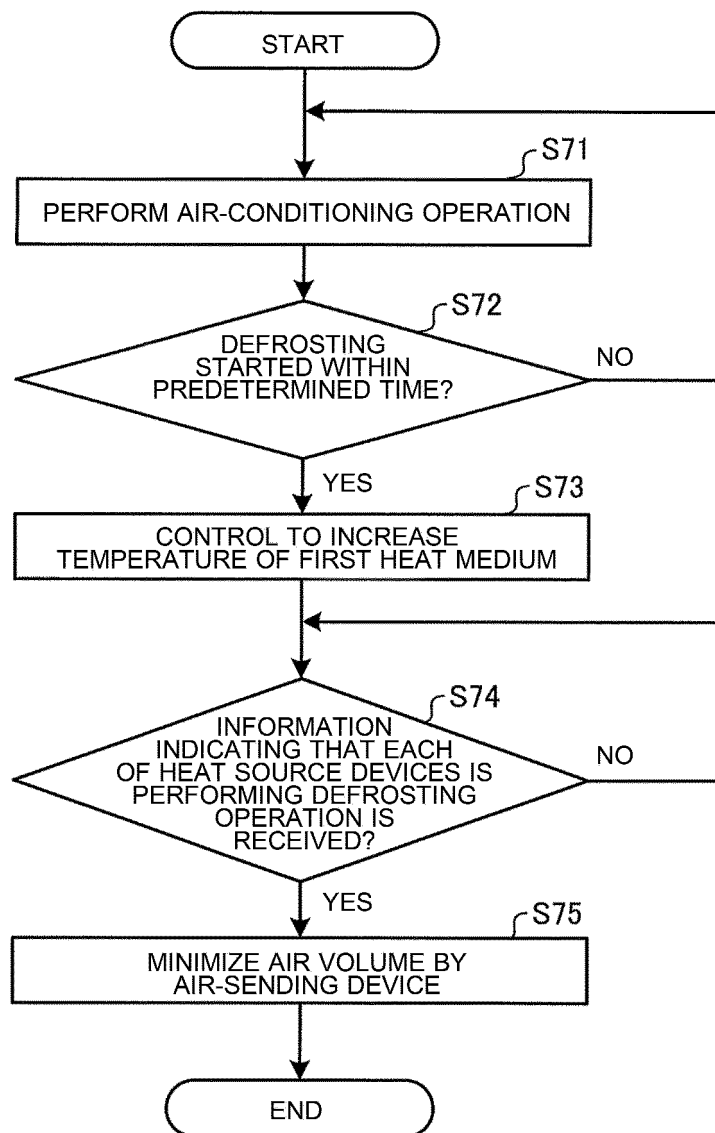


FIG. 15



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2019/015673

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. F24F11/85 (2018.01) i, F24F5/00 (2006.01) i, F24F11/86 (2018.01) i,
F25B1/00 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl. F24F11/85, F24F5/00, F24F11/86, F25B1/00

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 1971-2019

Registered utility model specifications of Japan 1996-2019

Published registered utility model applications of Japan 1994-2019

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	WO 2016/135802 A1 (MITSUBISHI ELECTRIC CORP.) 01 September 2016, paragraphs [0005]-[0009], [0013]- [0032], [0037]-[0044], fig. 1-8 & GB 2550697 A, paragraphs [0005]-[0009], [0013]-[0032], [0037]- [0044], fig. 1-8	1-4, 8, 10-12 5-7, 9
Y A	JP 2012-97971 A (DAIKIN INDUSTRIES, LTD.) 24 May 2012, paragraph [0019], fig. 1 (Family: none)	1-4, 8, 10-12 5-7, 9
Y	JP 2017-207243 A (SHARP CORP.) 24 November 2017, paragraphs [0036], [0041], fig. 6, 7 (Family: none)	10-12



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

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Date of the actual completion of the international search
20.06.2019

Date of mailing of the international search report
02.07.2019

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Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/015673

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2011/114368 A1 (MITSUBISHI ELECTRIC CORP.) 22 September 2011, entire text, all drawings & US 2012/0297812 A1 & EP 2549201 A1 & CN 102812309 A	1-12
A	JP 4-283341 A (SANYO ELECTRIC CO., LTD.) 08 October 1992, paragraphs [0007]-[0009], fig. 3 (Family: none)	1-12

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2017101897 A [0005]