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(54) **CONTROL METHOD FOR AIR TREATMENT SYSTEM, AND AIR TREATMENT SYSTEM**

(57) Provided are an air treatment system control method and an air treatment system that effectively prevent the appearance of mold with ease. The present invention provides an air treatment system control method for permitting an air treatment system to implement a mold prevention mode and, in the mold prevention mode, permitting the air treatment system to implement a mold preventing operation of decreasing a relative humidity in a target space to be adjusted by the air treatment system when the relative humidity is higher than a target relative humidity. The air treatment system control method includes setting the target relative humidity at a% when a relation of the relative humidity ≤ a% is satisfied, and changing the target relative humidity in accordance with an indoor temperature when a relation of the relative humidity > a% is satisfied.

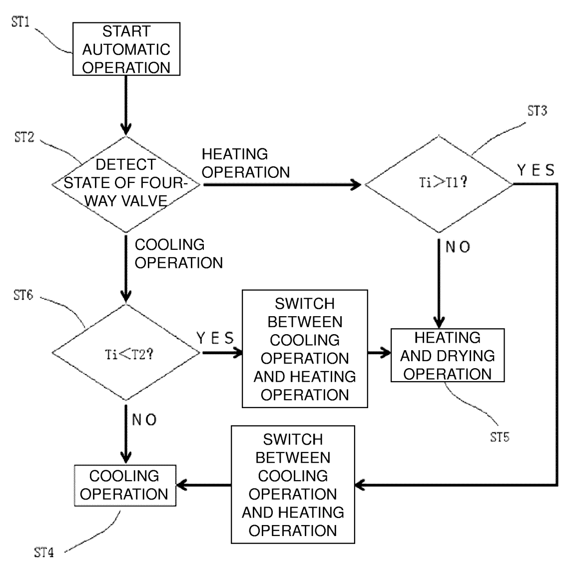

FIG. 3

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Description

TECHNICAL FIELD

[0001] The present invention relates to an air treatment system control method and an air treatment system.

BACKGROUND ART

[0002] With improvements in living standards, people are increasingly placing importance on issues of health in their office and residential environments.

[0003] For example, in recent years, problems caused by formaldehyde released from building materials, furniture, and the like have increasingly been emphasized; therefore, there is an increase in demand for various air treatment facilities, such as purifiers and air conditioning apparatuses, having a function of removing formaldehyde.

[0004] As well as to formaldehyde, mycotoxin produced by mold adhering to the surface of a building material or the like also affects human health, particularly children's health. Attention has therefore been focused on air treatment facilities having an antibacterial and antifungal mode.

[0005] A known air conditioning apparatus, which is one of the air treatment facilities described above, has inhibited the appearance of mold by decreasing a temperature of an indoor environment with a weak cooling scheme. However, this air conditioning apparatus often fails to satisfactorily produce an effect of mold prevention and merely results in a waste of energy in some instances.

SUMMARY OF THE INVENTION

<Technical Problem>

[0006] In view of the circumstances described above, an object of the present invention is to provide an air treatment system control method and an air treatment system that effectively prevent the appearance of mold with ease.

<Solution to Problem>

[0007] In order to achieve the object described above, the present invention provides an air treatment system control method for permitting an air treatment system to implement a mold prevention mode and, in the mold prevention mode, permitting the air treatment system to implement a mold preventing operation of decreasing a relative humidity in a target space to be adjusted by the air treatment system on condition that the relative humidity is higher than a target relative humidity, the air treatment system control method including setting the target relative humidity at a% on condition that a relation of the relative humidity ≤ a% is satisfied, and changing the target relative humidity in accordance with an indoor temperature on condition that a relation of the relative humidity > a% is satisfied.

[0008] The air treatment system control method according to the present invention permits, in the mold prevention mode, the air treatment system to implement the mold preventing operation of decreasing the relative humidity in the target space to be adjusted by the air treatment system on condition that the relative humidity is higher than the target relative humidity. In addition, the air treatment system control method according to the present invention sets the target relative humidity at a% on condition that the relation of the relative humidity ≤ a% is satisfied, and changes the target relative humidity in accordance with an indoor temperature on condition that the relation of the relative humidity > a% is satisfied, so as to set different target relative humidities in accordance with different indoor temperatures. In other words, the air treatment system control method according to the present invention subjects different temperature ranges to differentiation processing in accordance with an indoor humidity and an indoor temperature to implement the mold preventing operation at an appropriate target relative humidity. This configuration thus readily provides a temperature and humidity environment that inhibits the propagation of mold in a room, and effectively prevents the appearance of mold.

[0009] The air treatment system control method according to the present invention may include preferably setting the target relative humidity at b% on condition that a relation of the relative humidity >_ b% is satisfied.

[0010] The air treatment system control method according to the present invention sets the target relative humidity at a fixed value when the relative humidity (H%) is high. This configuration thus simplifies calculation of the target relative humidity. The target relative humidity is therefore adjusted in quick response to a temperature change.

[0011] The air treatment system control method according to the present invention may include preferably linearly changing the target relative humidity in a negative correlation with the indoor temperature on condition that a relation of a% < the relative humidity < b% is satisfied.

[0012] The air treatment system control method according to the present invention linearly changes the target relative humidity in the negative correlation with the indoor temperature on condition that the relation of a% < the relative humidity < b% is satisfied. This configuration thus simplifies calculation of the target relative humidity and reduces an amount of data calculation. This configuration accordingly reduces requirements for hardware devices, which results in cost reduction. The target relative humidity is therefore adjusted in quick response to a temperature change.

[0013] In the air treatment system control method according to the present invention, relations of a = 60, b = 90, and f(Tst) = -2 * Tst+ 110 may be preferably satisfied.

[0014] Herein, f(Tst) represents a function with the indoor temperature Tst as a variable.

[0015] The air treatment system control method according to the present invention may include preferably setting the relative humidity at H% and setting the target relative humidity at Hst%, stopping the mold preventing operation on condition that a relation of H% < (Hst-5)% is satisfied in the mold preventing operation, and restarting the mold preventing operation on condition that a relation of H% ≥ (Hst-2)% is satisfied after a stop of the mold preventing operation.

[0016] The air treatment system control method according to the present invention stops the mold preventing operation on condition that the relation of H% < (Hst-5)% is satisfied in the mold preventing operation. This configuration therefore avoids a situation in which a waste of energy owing to unnecessary implementation of the mold preventing operation exerts an adverse influence on the normal use of the air treatment system. In addition, the air treatment system control method according to the present invention restarts the mold preventing operation on condition that the relation of H% ≥ (Hst-2)% is satisfied after the stop of the mold preventing operation. This configuration therefore avoids a situation in which the repetitive start and stop of the mold preventing operation at an indoor humidity that varies in the vicinity of the target relative humidity exert an adverse influence on the normal use of the air treatment system.

[0017] The air treatment system control method according to the present invention may include preferably permitting the air treatment system to implement a cooling operation or a dehumidifying operation on condition that the indoor temperature is higher than a first indoor temperature in the mold preventing operation, and permitting the air treatment system to implement a heating operation on condition that the indoor temperature is lower than a second indoor temperature in the mold preventing operation. In the air treatment system control method according to the present invention, the second indoor temperature may be lower than the first indoor temperature.

[0018] The term "dehumidifying operation" as used herein may involve not only a dehumidifying operation using a dehumidifier, but also a dehumidifying operation to be implemented by an indoor unit of an air conditioning apparatus with a weak cooling scheme. In a case where the indoor unit of the air conditioning apparatus includes two or more heat exchangers, the term "dehumidifying operation" as used herein may also involve a reheating and dehumidifying operation to be implemented in such a manner that at least one of the heat exchangers carries out a cooling operation while at least one of the heat exchangers carries out a heating operation.

[0019] The air treatment system control method according to the present invention permits the air treatment system to implement the cooling operation or the dehumidifying operation on condition that the indoor temperature is higher than the first indoor temperature in the mold preventing operation, and permits the air treatment system to implement the heating operation on condition that the indoor temperature is lower than the second indoor temperature that is lower than the first indoor temperature, in the mold preventing operation. This configuration therefore adjusts an indoor humidity in an appropriate mode, and avoids a situation in which the air conditioning apparatus is in a thermo-off state for long hours due to an inappropriate selection of a mode in the mold preventing operation, which results in a waste of energy and fails to produce an effect of mold prevention as expected.

[0020] In the air treatment system control method according the present invention, the air treatment system may include preferably an air conditioning apparatus, the air conditioning apparatus may include at least one outdoor unit, and the at least one outdoor unit may include a four-way valve configured to switch between the cooling operation and the heating operation or between the dehumidifying operation and the heating operation by the air conditioning apparatus (i.e., the four-way valve of the air conditioning apparatus has two switching states of a state switched to the cooling operation or the dehumidifying operation and a state switched to the heating operation). The air treatment system control method according to the present invention may include detecting a current switching state of the four-way valve at a start of the mold preventing operation.

[0021] The air treatment system control method according to the present invention detects a current switching state of the four-way valve at the start of the mold preventing operation. This configuration therefore facilitates a determination as to whether the air conditioning apparatus needs to switch between the cooling operation or dehumidifying operation and the heating operation in carrying out the mold preventing operation.

[0022] The air treatment system control method according to the present invention may include preferably upon detection that the four-way valve is in a switching state of permitting the air conditioning apparatus to carry out the heating operation at the start of the mold preventing operation, switching the four-way valve to a switching state of permitting the air conditioning apparatus to carry out the cooling operation or the dehumidifying operation on condition that the indoor temperature is higher than the first indoor temperature, on the other hand upon detection that the four-way valve is in the switching state of permitting the air conditioning apparatus to carry out the cooling operation or the dehumidifying operation at the start of the mold preventing operation, switching the four-way valve to the switching state of permitting the air conditioning apparatus to carry out the heating operation on condition that the indoor temperature is lower than the second indoor temperature.

[0023] In the air treatment system control method according to the present invention, the air conditioning apparatus may further include preferably one first indoor unit and one or more second indoor units, and the first indoor unit may be configured to carry out the mold preventing operation. The air treatment system control method according to the present invention may include upon detection that the four-way valve is in a switching state of permitting the air conditioning apparatus to carry out the heating operation, with at least one of the second indoor units carrying out the heating operation, at a start of the mold preventing operation by the first indoor unit, not switching the four-way valve in the switching state of permitting the air conditioning apparatus to carry out the cooling operation or the dehumidifying operation on condition that the indoor temperature is higher than the first indoor temperature, on the other hand upon detection that the four-way valve is in a switching state of permitting the air conditioning apparatus to carry out the cooling operation or the dehumidifying operation, with at least one of the second indoor units carrying out the cooling operation, at the start of the mold preventing operation by the first indoor unit, not switching the four-way valve in the switching state of permitting the air conditioning apparatus to carry out the heating operation on condition that the indoor temperature is lower than the second indoor temperature.

[0024] The air treatment system control method according to the present invention readily avoids a situation in which the switching between the cooling operation (the dehumidifying operation) and the heating mode by the first indoor unit exerts an adverse influence on the comfortability of a person in a place where another indoor unit is installed.

[0025] In the air treatment system according to the present invention, the air conditioning apparatus may be configured preferably to carry out a reheating and dehumidifying operation as the dehumidifying operation in the mold preventing operation.

[0026] In the air treatment system control method according to the present invention, the air treatment system may include preferably an air conditioning apparatus and a dehumidification apparatus. The air treatment system control method according to the present invention may include permitting the air conditioning apparatus to carry out the cooling operation or the dehumidifying operation and permitting the dehumidification apparatus to carry out a powerful dehumidifying operation on condition that the indoor temperature is higher than the first indoor temperature in the mold preventing operation, and permitting the air conditioning apparatus to carry out the heating operation and permitting the dehumidification apparatus to carry out a normal dehumidifying operation on condition that the indoor temperature is lower than the second indoor temperature in the mold preventing operation.

[0027] The air treatment system control method according to the present invention switches the air conditioning apparatus to the cooling operation or the dehumidifying operation and permits the dehumidification apparatus to carry out the powerful dehumidifying operation on condition that the indoor temperature is higher than the first indoor temperature. This configuration therefore reduces a heavy dehumidifying load on the air conditioning apparatus during the cooling operation and improves an effect of humidification.

[0028] The air treatment system control method according to the present invention may include preferably permitting the air treatment system to implement a cooling operation on condition that the indoor temperature is higher than a first indoor temperature in the mold preventing operation.

[0029] In this case, the first indoor temperature is settable at, for example, 22°C; however, the first indoor temperature is not limited thereto.

[0030] In the air treatment system control method according to the present invention, the relative humidity may be preferably detected by an independent sensor.

[0031] In the air treatment system control method according to the present invention, the relative humidity is detected by an independent sensor. A user is thus able to freely select a position where the sensor is placed. The sensor may be placed at a position where a user particularly needs to inhibit the appearance of mold. In addition, detection data at the selected position is usable for accurately determining whether the indoor relative humidity is higher than the target relative humidity. This configuration thus accurately starts the mold preventing operation and effectively prevents the appearance of mold in a specific region.

[0032] In order to achieve the object described above, the present invention also provides an air treatment system including: an air conditioning apparatus; a controller configured to control an operation in the air treatment system; and a detector configured to acquire indoor temperature data and indoor humidity data. In the air treatment system, the controller controls the operation in the air treatment system in accordance with the air treatment system control method described above, based on the data acquired by the detector.

[0033] The air treatment system according to the present invention may further include preferably a humidification apparatus installed in a room.

[0034] The air treatment system according to the present invention implements, in the mold prevention mode, the mold preventing operation of decreasing the relative humidity in the target space to be adjusted by the air treatment system on condition that the relative humidity is higher than the target relative humidity. In addition, the air treatment system according to the present invention sets the target relative humidity at a% on condition that the relation of the relative humidity ≤ a% is satisfied, and changes the target relative humidity in accordance with an indoor temperature on condition that the relation of the relative humidity > a% is satisfied, so as to set the different target relative humidities in accordance with different indoor temperatures. In other words, the air treatment system according to the present invention subjects different temperature ranges to differentiation processing in accordance with an indoor humidity and an indoor temperature to implement the mold preventing operation at the appropriate target relative humidity. This configuration thus readily provides a temperature and humidity environment that inhibits the propagation of mold in a room, and effectively prevents the appearance of mold.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035]

FIG. 1 is a schematic diagram of a structure of an air treatment system according to an embodiment of the present invention.
FIG. 2 is a schematic diagram of a circuit structure of an air conditioning apparatus in the air treatment system according to the embodiment of the present invention.
FIG. 3 is a flowchart of an exemplary operation in the air treatment system according to the embodiment of the present invention.
FIG. 4 is a flowchart of an exemplary operation in an air treatment system according to a modification of the present invention.
FIG. 5 is a schematic diagram of a circuit structure of an air conditioning apparatus in the air treatment system according to the modification of the present invention.

DESCRIPTION OF EMBODIMENTS

[0036] With reference to FIGS. 1 and 3, a description will be given of an air treatment system according to an embodiment of the present invention. FIG. 1 is a schematic diagram of a structure of the air treatment system according to the embodiment of the present invention. FIG. 3 is a flowchart of an exemplary operation in the air treatment system according to the embodiment of the present invention.

(General Structure of Air Treatment System)

[0037] As illustrated in FIG. 1, an air treatment system 1 includes an indoor unit 112 having a cooling function and a heating function in an air conditioning apparatus 110, an indoor detector 120 configured to acquire indoor temperature data and indoor humidity data on a room corresponding to a target space to be adjusted by the air treatment system 1, and a controller 130 configured to control an operation in the air treatment system 1, based on the data acquired by the indoor detector 120.

[0038] As illustrated in FIG. 1, the air treatment system 1 also includes a mobile terminal 140 configured to perform at least one of displaying an operating state in the air treatment system 1, setting a first indoor temperature and a second indoor temperature (to be described later), starting or stopping a mold prevention mode (to be described later), and setting a length of an operating time in the mold prevention mode.

(Air Conditioning Apparatus)

[0039] The indoor unit 112 of the air conditioning apparatus 110 has the cooling function and the heating function as described above.

[0040] In this embodiment, the air conditioning apparatus 110 is a multiple-type air conditioning apparatus and includes one outdoor unit 111 and a plurality of indoor units 112. The outdoor unit 111 and the indoor units 112 are connected with a liquid pipe P1 and a gas pipe P2 to constitute a refrigerant circuit. Figures illustrate two indoor units, that is, a first indoor unit 112A and a second indoor unit 112B. Not limited to those, the air conditioning apparatus 110 may include a plurality of first indoor units each capable of carrying out a mold preventing operation. The outdoor unit 111 includes a compressor 1111, a four-way valve 1112, an outdoor heat exchanger 1113, an outdoor fan 1114, and an outdoor expansion valve 1115. The compressor 1111 compresses a low-pressure refrigerant and discharges the high-pressure refrigerant, and the four-way valve 1112 changes a direction of the refrigerant circulating in the refrigerant circuit. The air conditioning apparatus 110 thus switches between a state capable of carrying out a cooling operation and a state capable of carrying out a heating operation. During the cooling operation, the high-pressure refrigerant discharged from the compressor 1111 flows toward an indoor heat exchanger 1112 (to be described later) of each indoor unit 112 via the four-way valve 1112. During the heating operation, the high-pressure refrigerant discharged from the compressor 1111 flows toward the outdoor heat exchanger 1113 of the outdoor unit 111 via the four-way valve 1112. The outdoor heat exchanger 1114 performs heat exchange between outdoor air and the refrigerant. The outdoor fan 1114 provides the outdoor air to the outdoor heat exchanger 1113. The outdoor expansion valve 1115 controls a flow rate of the refrigerant. The indoor units 112 include the first indoor unit 112A and the second indoor unit 112B. Each of the first indoor unit 112A and the second indoor unit 112B includes an indoor expansion valve 1121, the indoor heat exchanger 1122, and an indoor fan 1123. The indoor expansion valve 1121 controls a flow rate of the refrigerant. The indoor heat exchanger 1122 performs heat exchange between indoor air and the refrigerant. The indoor fan 1123 provides the indoor air to the indoor heat exchanger 1122.

(Indoor Detector)

[0041] As described above, the indoor detector 120 acquires indoor temperature data and indoor humidity data, specifically, a relative humidity H% and an indoor temperature Ti (to be described later).

[0042] In this embodiment, the indoor detector 120 is provided separately from the air conditioning apparatus 110. The indoor detector 120 includes, for example, a sensor.

(Controller)

[0043] As described above, the controller 130 controls an operation in the air treatment system 1, based on data acquired by the indoor detector 120.

[0044] In this embodiment, the controller 130 is provided separately from the air conditioning apparatus 110 and the indoor detector 120. The controller 130 receives a command from the mobile terminal 140, subjects the command to identification processing, and transmits the command to the air conditioning apparatus 110 (specifically, one of or both the outdoor unit 111 and each indoor unit 112) in a wired communication manner or a wireless communication manner. The controller 130 thus controls an action by the air conditioning apparatus 110.

(Mobile Terminal)

[0045] As described above, the mobile terminal 140 performs at least one of displaying an operating state in the air treatment system 1, setting a first indoor temperature and a second indoor temperature (to be described later), starting or stopping the mold prevention mode (to be described later), and setting a length of an operating time in the mold prevention mode.

[0046] In this embodiment, the mobile terminal 140 is a smartphone. The mobile terminal 140 communicates with the controller 130 via a router (not illustrated). The mobile terminal 140 communicates with the air conditioning apparatus 110 via the controller 130. The mobile terminal 140 is thus able to control an action by the air conditioning apparatus 110.

(Operation in Air Treatment System)

[0047] In the air treatment system 1, the controller 130 controls an operation in the air treatment system 1, based on temperature data and humidity data acquired by the indoor detector 120, and permits the air treatment system 1 to implement the mold prevention mode. In the mold prevention mode, the controller 130 permits the air treatment system 1 to implement a mold preventing operation when the relative humidity in the target space to be adjusted by the air treatment system 1 is higher than a target relative humidity.

[0048] In this embodiment, the relative humidity is set at H%, the target relative humidity is set at Hst%, and an indoor temperature is set at Tst°C. In this case, when a relation of H% ≤ a% is satisfied, Hst is set at a. When a relation of H% > a% is satisfied, Hst is changed in accordance with Tst. In this embodiment, when a relation of a% < H% < b% is satisfied, Hst is set at f(Tst) that represents a function with Tst as a variable. When a relation of H% ≥ b% is satisfied, Hst is set at b. These values a, b, and f(Tst) can be determined in advance by, for example, experiment. For example, these values can be set to satisfy relations of a = 60, b = 90, and f(Tst) = -2*Tst+110.

[0049] In the mold preventing operation, when a relation of H% < (Hst-5)% is satisfied, the controller 130 permits the air treatment system 1 to stop the mold preventing operation. After the stop of the mold preventing operation, when a relation of H% ≥ (Hst-2)% is satisfied, the controller 130 permits the air treatment system 1 to restart the mold preventing operation.

[0050] In the mold preventing operation, when the indoor temperature Ti is higher than a first indoor temperature T1, the controller 130 permits the air treatment system 1 to implement a cooling operation. On the other hand, when the indoor temperature Ti is lower than a second indoor temperature T2, the controller 130 permits the air treatment system 1 to implement a heating operation. In this case, the second indoor temperature T2 is lower than the first indoor temperature T1.

[0051] The mold prevention mode includes an information acquiring step of acquiring the relative humidity in the target space to be adjusted by the air treatment system 1, an information determining step of determining whether the relative humidity acquired in the information acquiring step is higher than the target relative humidity, and an implementing step of permitting the air treatment system 1 to implement the mold preventing operation when it is determined in the information determining step that the relative humidity is higher than the target relative humidity.

[0052] As illustrated in FIG. 3, after the air treatment system 1 starts the mold preventing operation (step ST1), the air conditioning apparatus 110 is started. In the outdoor unit 111, the compressor 1111 and the outdoor fan 1114 are operated. For example, when the first indoor unit 112A is started, the indoor fan 1123 is operated. The air conditioning apparatus 110 thus carries out the cooling operation or the heating operation in accordance with the flow of the refrigerant in the refrigerant circuit. In this state, when the first indoor unit 112A starts the mold preventing operation, the controller 130 detects a current switching state of the four-way valve 1112 (step ST2). At the start of the mold preventing operation, when the controller 130 detects that the four-way valve 1112 is in a switching state of permitting the air conditioning apparatus 110 to carry out the heating operation, then the controller 130 determines whether the indoor temperature Ti is higher than the first indoor temperature T1 (e.g., 22°C) (step ST3). When the indoor temperature Ti is higher than the first indoor temperature T1, the controller 130 switches the four-way valve 1112 to a switching state of permitting the air conditioning apparatus 110 to carry out the cooling operation. When the indoor temperature Ti is equal to or lower than the first indoor temperature T1, the controller 130 permits the air conditioning apparatus 110 to directly carry out a heating and drying operation (step ST5). On the other hand, at the start of the mold preventing operation, when the controller 130 detects that the four-way valve 1112 is in a switching state of permitting the air conditioning apparatus 110 to carry out the cooling operation, then the controller 130 determines whether the indoor temperature Ti is lower than the second indoor temperature T2 (e.g., 18°C) (step ST6). When the indoor temperature Ti is lower than the second indoor temperature T2, the controller 130 switches the four-way valve 1112 to a switching state of permitting the air conditioning apparatus 110 to carry out the heating operation. When the indoor temperature Ti is equal to or higher than the second indoor temperature T2, the controller 130 permits the air conditioning apparatus 110 to directly carry out the cooling operation (step ST4).

[0053] In this embodiment, step ST4 is implemented by a predetermined cooling operation to be carried out by the air conditioning apparatus 110. During the predetermined cooling operation, for example, a temperature of air to be blown out of the first indoor unit 112A is set at 16°C. Also in this embodiment, step ST5 is implemented by a predetermined heating operation to be carried out by the air conditioning apparatus 110. During the predetermined heating operation, for example, a temperature of air to be blown out of the indoor unit is set to be higher than the indoor temperature by 2°C.

[0054] The cooling operation (see step ST4 in FIG. 3) and the heating and drying operation (see step ST5 in FIG. 3) each enable dehumidification, but are different in dehumidification process from each other. Specifically, during the cooling operation, a decrease in indoor temperature causes a decrease in concentration of saturated moisture in the air. Therefore, the moisture in the air is condensed and precipitated by decreasing the temperature to lower an absolute humidity of the air and to lower a relative humidity of the air. On the other hand, during the heating and drying operation, an increase in indoor temperature causes an increase in concentration of saturated moisture in the air and, accordingly, causes a decrease in the relative humidity of the air.

[0055] In this embodiment, the air conditioning apparatus 110 includes one first indoor unit 112A and one second indoor unit 112B. The first indoor unit 112A is capable of carrying out the mold preventing operation. At the start of the mold preventing operation by the first indoor unit 112A, in a case where the four-way valve 1112 is in the switching state of permitting the air conditioning apparatus 110 to carry out the heating operation and the second indoor unit 112B carries out the heating operation, when the indoor temperature Ti is higher than the first indoor temperature T1, the controller 130 does not switch the air conditioning apparatus 110 to the cooling operation. At the start of the mold preventing operation by the first indoor unit 112A, in a case where the four-way valve 1112 is in the switching state of permitting the air conditioning apparatus 110 to carry out the cooling operation and the second indoor unit 112B carries out the cooling operation, when the indoor temperature Ti is lower than the second indoor temperature T2, the controller 130 does not switch the air conditioning apparatus 110 to the heating operation.

(Main Technical Features of Embodiment)

[0056] According to this embodiment, the air treatment system 1 implements, in the mold prevention mode, the mold preventing operation of decreasing the relative humidity in the target space to be adjusted by the air treatment system 1 when the relative humidity is higher than a target relative humidity. In addition, the relative humidity is set at H%, the target relative humidity is set at Hst%, and an indoor temperature is set at Tst°C. When a relation of $H\% \leq a\%$ is satisfied, the air treatment system 1 sets Hst at a. When a relation of $H\% > a\%$ is satisfied, the air treatment system 1 changes Hst in accordance with Tst. The air treatment system 1 thus sets different target relative humidities in accordance with different indoor temperatures. In other words, the air treatment system 1 subjects different temperature ranges to differentiation processing in accordance with an indoor humidity and an indoor temperature to implement the mold preventing operation at an appropriate target relative humidity. This configuration thus readily provides a temperature and humidity environment that inhibits the propagation of mold in a room, and effectively prevents the appearance of mold.

[0057] According to this embodiment, when a relation of $a\% < H\% < b\%$ is satisfied, the air treatment system 1 linearly changes Hst in a negative correlation with Tst. This configuration thus simplifies calculation of the target relative humidity. The target relative humidity is therefore adjusted in quick response to a temperature change.

[0058] According to this embodiment, when the relative humidity H% in the target space to be adjusted by the air treatment system 1 is higher than the target relative humidity Hst%, the air treatment system 1 implements the mold preventing operation. In the mold preventing operation, when the indoor temperature Ti is higher than the first indoor temperature T1, the controller 130 permits the air conditioning apparatus 110 to carry out the cooling operation. When the indoor temperature Ti is lower than the second indoor temperature T2 that is lower than the first indoor temperature T1, the controller 130 permits the air conditioning apparatus 110 to carry out the heating operation. The air treatment system 1 thus contributes to an adjustment to an indoor humidity, thereby preventing the appearance of mold.

[0059] The present invention has been exemplified above with reference to the drawings; however, it is obvious that a specific embodiment of the present invention is not limited to the foregoing embodiment.

[0060] For example, in the foregoing embodiment, each indoor unit 112 of the air conditioning apparatus 110 has the cooling function and the heating function. In the mold preventing operation, when the indoor temperature Ti is higher than the first indoor temperature T1, the controller 130 permits the air conditioning apparatus 1 to carry out the cooling operation. When the indoor temperature Ti is lower than the second indoor temperature T2, the controller 130 permits the air conditioning apparatus 110 to carry out the heating operation. In the foregoing embodiment, the second indoor temperature T2 is lower than the first indoor temperature T1, but is not necessarily lower than the first indoor temperature T1. For example, each indoor unit 112 of the air conditioning apparatus 110 may have only the cooling function. In the mold preventing operation, when the indoor temperature Ti is higher than the first indoor temperature T1, the controller 130 may permit the air conditioning apparatus 110 to carry out the cooling operation.

[0061] Also in the foregoing embodiment, the air treatment system 1 may further include a dehumidification apparatus. In this case, for example, the dehumidification apparatus may include the indoor detector 120. Also in this case, the dehumidification apparatus may have a function of displaying a current humidity value. Also in this case, in the mold preventing operation, when the indoor temperature Ti is higher than the first indoor temperature T1, the controller 130 permits the air treatment system 1 to implement one of or both the cooling operation and the dehumidifying operation. Specifically, in step ST4, only the air conditioning apparatus 110 may carry out the cooling operation, the air conditioning apparatus 110 may carry out the cooling operation while the dehumidification apparatus may carry out the dehumidifying operation, or only the dehumidification apparatus may carry out the dehumidifying operation. For example, when each indoor unit 112 carries out the cooling operation in the mold preventing operation, the controller 130 permits the dehumidification apparatus to carry out a powerful dehumidifying operation. On the other hand, when each indoor unit 112 carries out the heating operation, the controller 130 permits the dehumidification apparatus to carry out a normal dehumidifying operation.

[0062] Also in the foregoing embodiment, the indoor detector 120 acquires the indoor temperature data and the indoor humidity data. In the mold preventing operation, when the indoor temperature Ti is higher than the first indoor temperature T1, the controller 130 permits the air treatment system 1 to implement one of or both the cooling operation and the dehumidifying operation. When the indoor temperature Ti is lower than the second indoor temperature T2, the controller 130 permits the air treatment system 1 to implement the heating operation. However, the present invention is not limited to this configuration. For example, the air treatment system 1 may include an outdoor detector configured to acquire outdoor temperature data, in addition to the indoor detector 120. As illustrated in FIG. 4, in the mold preventing operation, when the indoor temperature Ti is higher than the first indoor temperature T1 and an outdoor temperature To is higher than a first outdoor temperature T3 (e.g., 20°C) (step ST3: YES), the controller 130 may permit the air treatment system 1 to implement one of or both the cooling operation and the dehumidifying operation. When the indoor temperature Ti is lower than the second indoor temperature T2 and the outdoor temperature To is lower than a second outdoor temperature T4 (e.g., 16°C) that is lower than the first outdoor temperature T3 (step ST6: YES), the controller 130 may permit the air treatment apparatus 1 to implement the heating operation.

[0063] Also in the foregoing embodiment, the air conditioning apparatus 110 includes the outdoor unit 111 and the indoor units 112 connected with the liquid pipe P1 and the gas pipe P2. That is, the air conditioning apparatus 110 is a two-pipe air conditioning apparatus. However, the present invention is not limited to this configuration. The air conditioning apparatus may be a three-pipe air conditioning apparatus in which an outdoor unit and at least some indoor units are connected with a liquid pipe, a gas pipe, and a high-pressure pipe. For example, the air conditioning apparatus 110 may have a structure illustrated in FIG. 5. In FIG. 5, constituent components corresponding to those of the air conditioning apparatus 110 according to the foregoing embodiment are denoted with the same reference signs as those denoting the constituent components of the air conditioning apparatus 110 according to the foregoing embodiment. In this case, the air conditioning apparatus may carry out a reheating and dehumidifying operation as the dehumidifying operation. Specifically, the air conditioning apparatus includes, in addition to the air conditioning apparatus 110, a high-pressure pipe, a four-way valve 1116, a flow rate adjustment valve 1124, an indoor heat exchanger 1125, a pipe P102, a pipe P103, and a flow rate adjustment device 1117. The high-pressure pipe branches off a discharge pipe Po of the compressor 1111 in the outdoor unit 111, and extends to the first indoor unit 112A. The high-pressure pipe includes a pipe P101-1, a pipe P101-2, a pipe P3, and a pipe P202 that are connected in sequence. The four-way valve 1116 is installed between the pipe P101-1 and pipe P101-2 of the high-pressure pipe in the outdoor unit 111. The flow rate adjustment valve 1124 is installed on the high-pressure pipe at a position inside the first indoor unit 112A. The indoor heat exchanger 1125 is disposed on the high-pressure pipe at a position inside the first indoor unit 112A and is located between the flow rate adjustment valve 1124 and the four-way valve 1116 on the high-pressure pipe. The indoor heat exchanger 1125 is also located downstream of the indoor heat exchanger 1122 in an airflow path formed by the outdoor fan 1123. The pipe P102 branches off a suction pipe Pi of the compressor 1111 in the outdoor unit 111. The pipe P103 branches off the pipe P102. The flow rate adjustment device 1117 is, for example, a capillary pipe and is installed at a position where in the middle of the pipe P103. The four-way valve 1112 is switchable between a first state in which a port a communicates with a port b while a port c communicates with a port d and a second state in which the port a communicates with the port d while the port b communicates with the port c. The four-way valve 1116 is switchable between a first state in which a port a1 communicates with a port b1 while a port c1 communicates with a port d1 and a second state in which the port a1 communicates with the port d1 while the port b1 communicates with the port c1. The air conditioning apparatus switches the four-way valve 1112 and the four-way valve 1116, thereby switching among a cooling operation (during which the four-way valve 1112 is in the first state while the four-way valve 1116 is in the second state), a reheating and dehumidifying operation as a dehumidifying operation (during which the four-way valve 1112 is in the first state while the four-way valve 1116 is in the first state (see the state illustrated in FIG. 5)), and a heating operation (during which the four-way valve 1112 is in the second state while the four-way valve 1116 is in the first state). In this case, the cooling operation or the reheating and dehumidifying operation can be selectively carried out in step ST4 described above. In carrying out the reheating and dehumidifying operation, for example, a temperature of air to be blown out of the first indoor unit 112A may be set to be lower than the indoor temperature by 2°C. The indoor heat exchanger 1125 may be installed downstream of the indoor heat exchanger 1122 and the air conditioning apparatus does not necessarily include the four-way valve 1116 in some cases. In this case, the air conditioning apparatus does not necessarily include the pipe P102, the pipe P103, and the flow rate adjustment device 1117.

[0064] Also in the foregoing embodiment, when one of the indoor units 112 carries out the mold preventing operation, the controller 130 may prohibit the remaining indoor units 112 from selecting the cooling operation or the heating operation.

[0065] Also in the foregoing embodiment, the air conditioning apparatus 110 includes one second indoor unit 112B. The air conditioning apparatus 110 may alternatively include a plurality of second indoor units 112B.

[0066] Also in the foregoing embodiment, the air conditioning apparatus 110 includes the plurality of indoor units 112. The air conditioning apparatus 110 may alternatively include one indoor unit 112.

[0067] Also in the foregoing embodiment, if the controller 130 unusually communicates with the sensor 120 or the air conditioning apparatus 110 in the mold preventing operation carried out by each indoor unit 112 of the air conditioning apparatus 110, the controller 130 may permit the air conditioning apparatus 110 to terminate the mold prevention mode.

[0068] Also in the foregoing embodiment, the air treatment system 1 may further include human detectors respectively installed in the rooms where the indoor units 112 are respectively installed. When each of the human detectors detects the presence of a human in the corresponding room, the controller 130 may prohibit the air conditioning apparatus 110 from carrying out the mold preventing operation. When the motion sensor detects the absence of a human, the controller 130 may permit the air conditioning apparatus 110 to carry out the mold preventing operation.

[0069] Also in the foregoing embodiment, when a time during which the air treatment system 1 implements the mold prevention mode reaches a preset total time or when the relative humidity H% becomes equal to another target relative humidity that is lower than the target relative humidity by a certain level (e.g., 5%), the air treatment system 1 may stop the mold prevention mode.

[0070] Also in the foregoing embodiment, when the mold preventing operation continues for a preset time (e.g., four hours) or more, that is, when the relative humidity is always higher than the target relative humidity, the air treatment system 1 may transmit a notification indicative of an abnormal situation. This configuration thus avoids a waste of energy owing to an abnormal situation (e.g., the insufficient ability, erroneous sensor data due to installation position and failure of an indoor unit, or a door or a window cannot be closed due to a high outdoor humidity, and others).

[0071] Also in the foregoing embodiment, the air treatment system 1 may include a hot air blower, an oil heater, and the like.

[0072] Also in the foregoing embodiment, the mobile terminal 140 is a smartphone. The mobile terminal 140 may as well as be a tablet personal computer, a cloud server, or the like.

[0073] Also in the foregoing embodiment, the controller 130 is provided separately from the air conditioning apparatus 110 and the indoor detector 120. The controller 130 may as well as be integrated in the air conditioning apparatus 110 or the indoor detector 120.

[0074] Also in the foregoing embodiment, the indoor detector 120 may include an independent sensor for detecting the relative humidity.

[0075] Also in the foregoing embodiment, the air treatment system 1 may further include a remote controller for controlling an operation in the air treatment system. In addition, after the start of the mold preventing operation in the air treatment system 1, in response to reception of a command from the remote controller (e.g., a command about a start or stop of an indoor unit, a command about an operating mode), the command from the remote controller may be executed preferentially.

[0076] Also in the foregoing embodiment, when the relation of H% ≥ b% is satisfied, Hst is set at b. Alternatively, when the relation of H% ≥ b% is satisfied, Hst may be set to be changed in accordance with Tst.

[0077] It should be understood that the present invention may be made by freely combining the components, the steps, and the like in the embodiment or appropriately changing or omitting the components, the steps, and the like in the embodiment, within the scope of the present invention.

REFERENCE SIGNS LIST

[0078]

1: air treatment system
110: air conditioning apparatus
111: outdoor unit
1111: compressor
1112: four-way valve

1113: outdoor heat exchanger
1114: outdoor fan
1115: outdoor expansion valve
1116: four-way valve
1117: flow rate adjustment device
112: indoor unit
112A: first indoor unit
112B: second indoor unit
1121: indoor expansion valve
1122: indoor heat exchanger
1123: indoor fan
1124: flow rate adjustment valve
1125: indoor heat exchanger
120: indoor detector
130: controller
140: mobile terminal
P1: liquid pipe
P2: gas pipe
P3: pipe
Po: discharge pipe
Pi: suction pipe
P101-1: pipe
P101-2: pipe
P102: pipe
P103: pipe
P202: pipe

Claims

1. An air treatment system control method for permitting an air treatment system to implement a mold prevention mode and, in the mold prevention mode, permitting the air treatment system to implement a mold preventing operation of decreasing a relative humidity in a target space to be adjusted by the air treatment system on condition that the relative humidity is higher than a target relative humidity,

    the air treatment system control method comprising
    setting the target relative humidity at a% on condition that a relation of the relative humidity ≤ a% is satisfied, and
    changing the target relative humidity in accordance with an indoor temperature on condition that a relation of the relative humidity > a% is satisfied.

2. The air treatment system control method according to claim 1, comprising
setting the target relative humidity at b% on condition that a relation of the relative humidity >_ b% is satisfied.

3. The air treatment system control method according to claim 2, comprising
linearly changing the target relative humidity in a negative correlation with the indoor temperature on condition that a relation of a% < the relative humidity < b% is satisfied.

4. The air treatment system control method according to claim 1, comprising

    setting the relative humidity at H% and setting the target relative humidity at Hst%,
    stopping the mold preventing operation on condition that a relation of H% < (Hst-5)% is satisfied in the mold preventing operation, and
    restarting the mold preventing operation on condition that a relation of H% ≥ (Hst-2)% is satisfied after a stop of the mold preventing operation.

5. The air treatment system control method according to claim 1, comprising

    permitting the air treatment system to implement a cooling operation or a dehumidifying operation on condition that the indoor temperature is higher than a first indoor temperature in the mold preventing operation, and
    permitting the air treatment system to implement a heating operation on condition that the indoor temperature is lower than a second indoor temperature in the mold preventing operation,
    wherein
    the second indoor temperature is lower than the first indoor temperature.

6. The air treatment system control method according to claim 5, wherein

    the air treatment system includes an air conditioning apparatus,
    the air conditioning apparatus includes at least one outdoor unit,
    the at least one outdoor unit includes a four-way valve configured to switch between the cooling operation and the heating operation or between the dehumidifying operation and the heating operation by the air conditioning apparatus,
    the air treatment system control method comprising
    detecting a current switching state of the four-way valve at a start of the mold preventing operation.

7. The air treatment system control method according to claim 6, comprising

    upon detection that the four-way valve is in a switching state of permitting the air conditioning apparatus to carry out the heating operation at the start of the mold preventing operation, switching the four-way valve to a switching state of permitting the air conditioning apparatus to carry out the cooling operation or the dehumidifying operation on condition that the indoor temperature is higher than the first indoor temperature, and

upon detection that the four-way valve is in the switching state of permitting the air conditioning apparatus to carry out the cooling operation or the dehumidifying operation at the start of the mold preventing operation, switching the four-way valve to the switching state of permitting the air conditioning apparatus to carry out the heating operation on condition that the indoor temperature is lower than the second indoor temperature.

8. The air treatment system control method according to claim 6, wherein

the air conditioning apparatus further includes one first indoor unit and one or more second indoor units, and

the first indoor unit is configured to carry out the mold preventing operation,

the air treatment system control method comprising

upon detection that the four-way valve is in a switching state of permitting the air conditioning apparatus to carry out the heating operation, with at least one of the second indoor units carrying out the heating operation, at a start of the mold preventing operation by the first indoor unit, not switching the four-way valve in the switching state of permitting the air conditioning apparatus to carry out the cooling operation or the dehumidifying operation on condition that the indoor temperature is higher than the first indoor temperature, and

upon detection that the four-way valve is in a switching state of permitting the air conditioning apparatus to carry out the cooling operation or the dehumidifying operation, with at least one of the second indoor units carrying out the cooling operation, at the start of the mold preventing operation by the first indoor unit, not switching the four-way valve in the switching state of permitting the air conditioning apparatus to carry out the heating operation on condition that the indoor temperature is lower than the second indoor temperature.

9. The air treatment system control method according to claim 6, wherein
the air conditioning apparatus is configured to carry out a reheating and dehumidifying operation as the dehumidifying operation in the mold preventing operation.

10. The air treatment system control method according to claim 5, wherein

the air treatment system includes an air conditioning apparatus and a dehumidification apparatus,

the air treatment system control method comprising

permitting the air conditioning apparatus to carry out the cooling operation or the dehumidifying operation and permitting the dehumidification apparatus to carry out a powerful dehumidifying operation on condition that the indoor temperature is higher than the first indoor temperature in the mold preventing operation, and

permitting the air conditioning apparatus to carry out the heating operation and permitting the dehumidification apparatus to carry out a normal dehumidifying operation on condition that the indoor temperature is lower than the second indoor temperature in the mold preventing operation.

11. The air treatment system control method according to claim 1, comprising
permitting the air treatment system to implement a cooling operation on condition that the indoor temperature is higher than a first indoor temperature in the mold preventing operation.

12. The air treatment system control method according to claim 1, wherein
the relative humidity is detected by an independent sensor.

13. An air treatment system comprising:

an air conditioning apparatus (110);

a controller (130) configured to control an operation in the air treatment system; and

a detector configured to acquire indoor temperature data and indoor humidity data,

wherein

the controller (130) controls the operation in the air treatment system in accordance with the air treatment system control method according to any one of claims 1 to 12, based on the data acquired by the detector.

14. The air treatment system according to claim 13, further comprising a dehumidification apparatus.

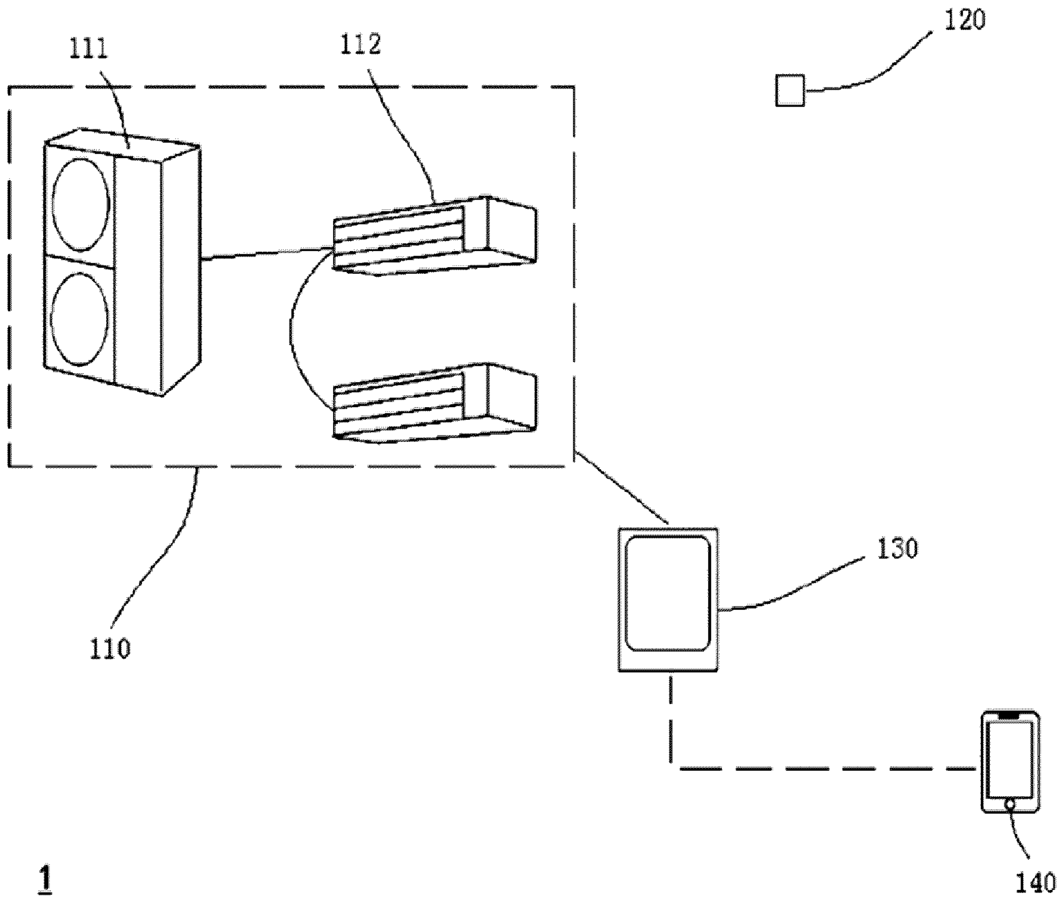
111
112
120
110
130
140
1

FIG. 1

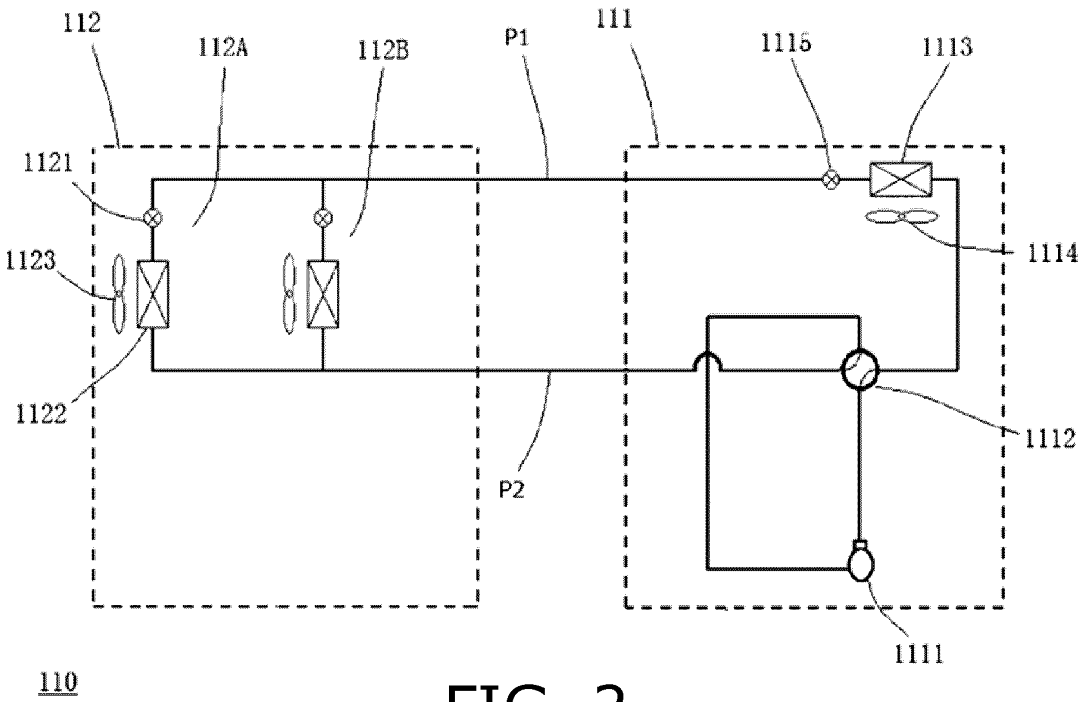
112
112A
112B
P1
111
1115
1113
1121
1114
1123
1122
1112
P2
1111
110

FIG. 2

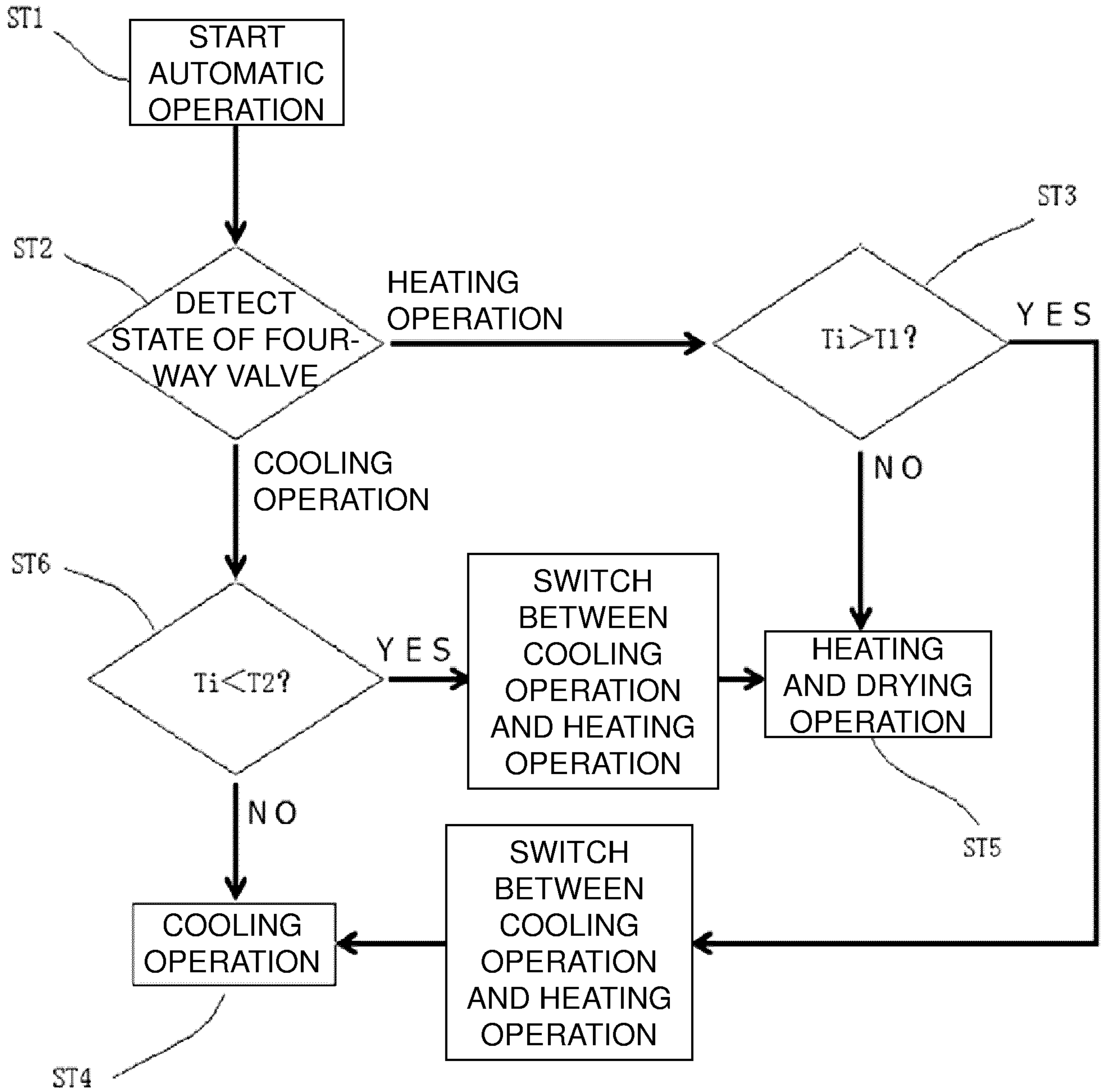
ST1
START AUTOMATIC OPERATION
ST2
DETECT STATE OF FOUR-WAY VALVE
HEATING OPERATION
ST3
Ti>T1?
YES
NO
COOLING OPERATION
ST6
Ti<T2?
YES
SWITCH BETWEEN COOLING OPERATION AND HEATING OPERATION
HEATING AND DRYING OPERATION
ST5
NO
COOLING OPERATION
SWITCH BETWEEN COOLING OPERATION AND HEATING OPERATION
ST4

FIG. 3

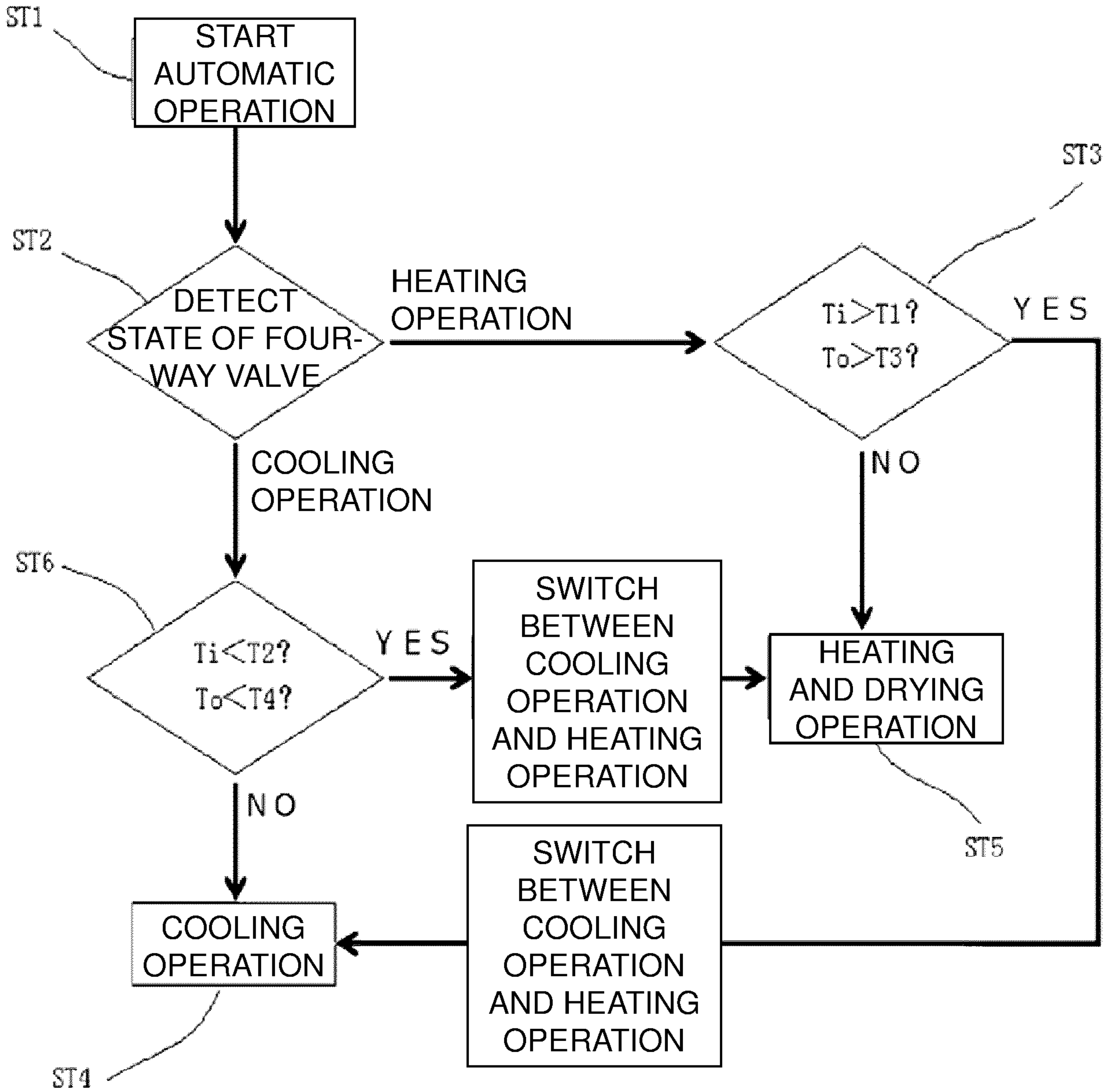
ST1
START AUTOMATIC OPERATION
ST2
DETECT STATE OF FOUR-WAY VALVE
HEATING OPERATION
ST3
Ti>T1?
To>T3?
YES
NO
COOLING OPERATION
ST6
Ti<T2?
To<T4?
YES
SWITCH BETWEEN COOLING OPERATION AND HEATING OPERATION
HEATING AND DRYING OPERATION
ST5
NO
COOLING OPERATION
ST4
SWITCH BETWEEN COOLING OPERATION AND HEATING OPERATION

FIG. 4

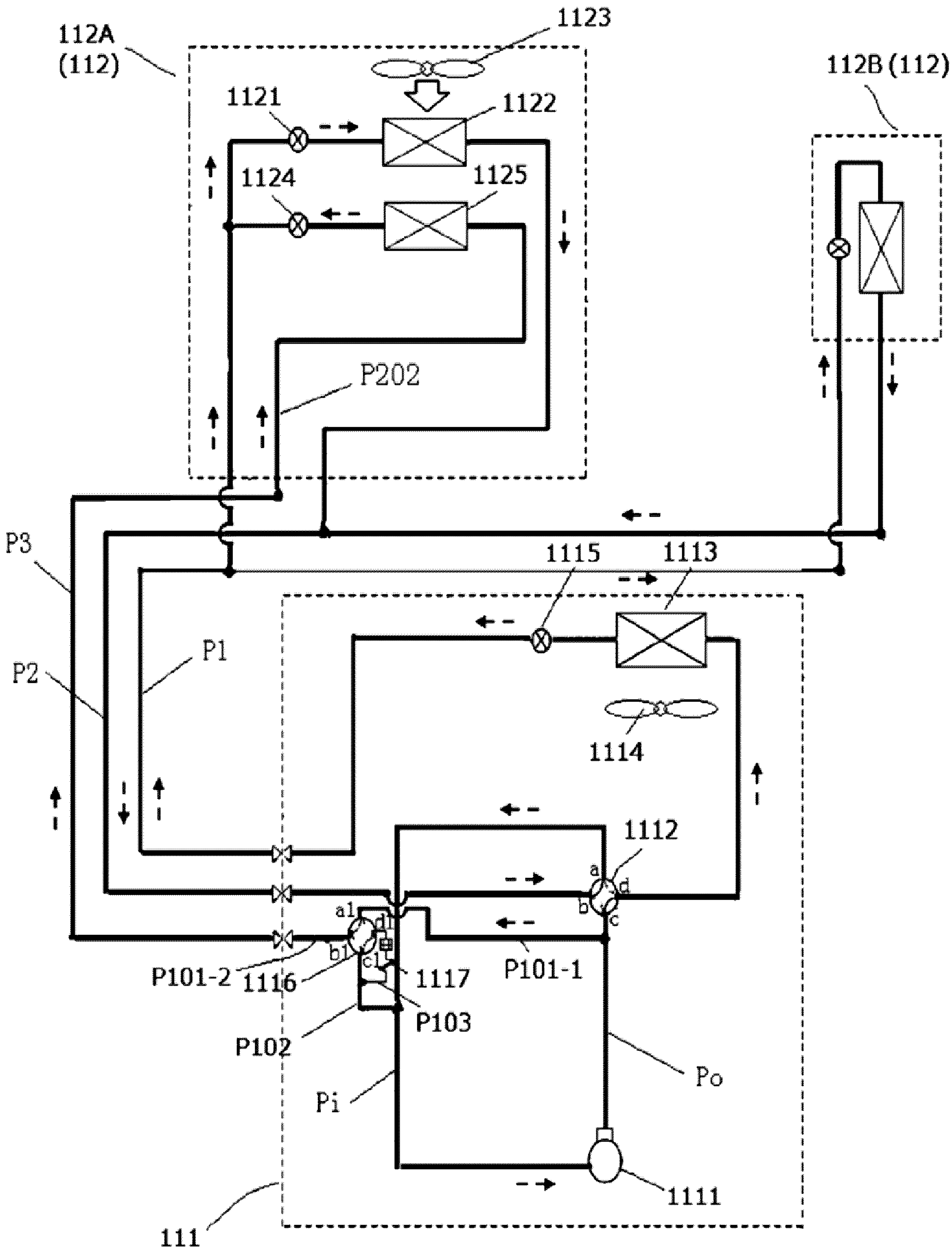
112A
(112)
1123
1121
1122
1124
1125
112B (112)
P202
P3
1115
1113
P1
P2
1114
1112
a
d
b
c
a1
d1
b1
c1
P101-2
1116
1117
P101-1
P103
P102
Po
Pi
1111
111

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/023484

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F24F11/62(2018.01)i
FI: F24F11/62

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. F24F11/62

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

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2001-317796 A (DAIKIN INDUSTRIES, LTD.) 16 November 2001 (2001-11-16)	1-14
A	JP 2001-235214 A (MITSUBISHI ELECTRIC CORPORATION) 31 August 2001 (2001-08-31)	1-14

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
30 July 2021	10 August 2021

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

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/023484

JP 2001-317796 A	16 November 2001	(Family: none)
JP 2001-235214 A	31 August 2001	(Family: none)

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