(19) Europäisches Patentamt / European Patent Office / Office européen des brevets

(11) EP 2 363 659 A1

# (12) EUROPEAN PATENT APPLICATION

published in accordance with Art. 153(4) EPC

(43) Date of publication:
**07.09.2011 Bulletin 2011/36**

(21) Application number: **10784940.8**

(22) Date of filing: **08.01.2010**

(51) Int Cl.:
***F24F 11/02*** *(2006.01)*

(86) International application number:
**PCT/JP2010/000096**

(87) International publication number:
**WO 2011/083517 (14.07.2011 Gazette 2011/28)**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR**

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## (54) RADIATOR

(57) A radiator **(50)** is a radiator that cools an indoor space **(50a, 50b)** by sucking in cold water from a heat source unit **(10)** and comprises a heat exchanger **(52),** a first piping **(5a),** a three-way valve **(54),** a heat exchanger temperature detection unit **(56),** and a control unit **(60).** In the first piping **(5a),** the cold water flows from the heat source unit **(10)** side to the heat exchanger **(52)** side. The three-way valve **(54)** adjusts the flow volume of the cold water flowing through the heat exchanger **(52).** The heat exchanger temperature detection unit **(56)** is capable of detecting the temperature of the heat exchanger **(52).** The control unit **(60)** performs a first cooling control that controls the three-way valve **(54)** so that the temperature of the heat exchanger **(52)** detected by the heat exchanger temperature detection unit **(56)** is greater than or equal to the dew point temperature of air inside the indoor space **(50a, 50b).**

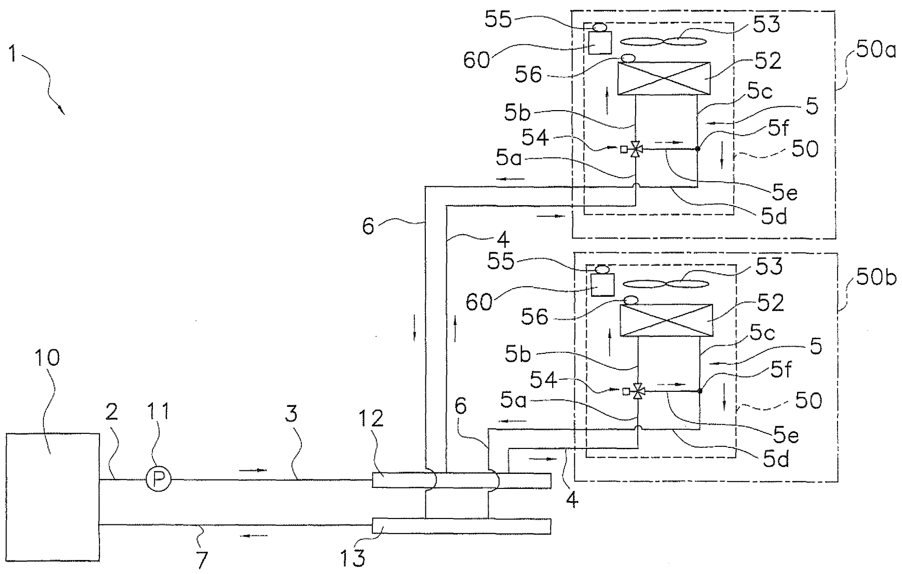


FIG. 1

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## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to a radiator that cools by sucking in cold water from a heat source unit.

### BACKGROUND ART

**[0002]** In the conventional art, a radiator that cools an indoor space is known wherein cold water is sucked from a heat source unit into a heat exchanger. For example, Patent Document 1 (i.e., Japanese Unexamined Patent Application Publication No. 2002-98344) discloses a radiator in an air conditioning system, wherein the radiator comprises a heat exchange coil (corresponding to the heat exchanger) and a ventilation fan. This air conditioning system cools by supplying cold water to the heat exchange coil (which corresponds to the heat exchanger).

### SUMMARY OF THE INVENTION

<Technical Problem>

**[0003]** Nevertheless, in the air conditioning system disclosed in Patent Document 1, the cold water is supplied to the heat exchange coil such that an indoor temperature or an outdoor temperature reaches a preset set temperature. Consequently, if, for example, the temperature of the cold water supplied to the heat exchange coil is lower than the dew point temperature of the air in the indoor space, then there is a risk that condensation will be formed in the heat exchanger.

**[0004]** Accordingly, an object of the present invention is to provide a radiator that can reduce the risk that condensation will form in the heat exchanger.

<Solution to Problem>

**[0005]** A radiator according to a first aspect of the present invention is a radiator that cools an indoor space by sucking in cold water from a heat source unit and comprises a heat exchanger, a first piping, a flow volume adjusting mechanism, a heat exchanger temperature detection unit, and a control unit. In the first piping, the cold water flows from the heat source unit side to the heat exchanger side. The flow volume adjusting mechanism adjusts the flow volume of the cold water flowing through the heat exchanger. The heat exchanger temperature detection unit is capable of detecting the temperature of the heat exchanger. The control unit performs a first cooling control that controls the flow volume adjusting mechanism so that the temperature of the heat exchanger detected by the heat exchanger temperature detection unit is greater than or equal to the dew point temperature of air inside the indoor space.

**[0006]** In the radiator according to the first aspect of the invention, the first cooling control is performed by the control unit. Consequently, if the first cooling control is performed, then it is possible to reduce the risk that the temperature of the heat exchanger during cooling of the indoor space will fall below the dew point temperature of the air inside the indoor space.

**[0007]** Thereby, it is possible to reduce the risk that condensation will form in the heat exchanger.

**[0008]** The radiator according to a second aspect of the present invention is the radiator according to the first aspect of the present invention wherein the flow volume adjusting mechanism is capable of assuming a blocked state, wherein the flow of the cold water from the heat source unit side to the heat exchanger side is blocked. In addition, in the first cooling control, the control unit switches the flow volume adjusting mechanism to the blocked state if the temperature of the heat exchanger that is detected by the heat exchanger temperature detection unit is lower than the dew point temperature of the air inside the indoor space. Consequently, if the temperature of the heat exchanger is lower than the dew point temperature of the air inside the indoor space, then the flow of the cold water from the heat source unit to the heat exchanger can be blocked. Accordingly, it is possible to reduce the risk of a further decrease in the temperature of the heat exchanger resulting from the continuation of the flow of the cold water into the heat exchanger.

**[0009]** Thereby, it is possible to reduce the risk that condensation will form in the heat exchanger.

**[0010]** The radiator according to a third aspect of the present invention is the radiator according to the second aspect of the present invention and further comprises a second piping and a bypass piping. In the second piping, water flows from the heat exchanger side to the heat source unit side. The bypass piping diverts the water from the first piping to the second piping without passing the water through the heat exchanger. In addition, if the flow volume adjusting mechanism assumes the blocked state, then the water flows from the first piping to the second piping via the bypass piping. Consequently, if the temperature of the heat exchanger is lower than the dew point temperature of the air inside the indoor space, then it is possible to divert the cold water flowing through the first piping to the second piping via the bypass piping.

**[0011]** Thereby, if the temperature of the heat exchanger is lower than the dew point temperature of the air inside the indoor space, then it is possible to reduce the risk that the cold water will flow into the heat exchanger.

**[0012]** The radiator according to a fourth aspect of the present invention is the radiator according to any one aspect of the first through third aspects of the present invention and further comprises an indoor temperature detection unit, which is capable of detecting the temperature of the air inside the indoor space. In addition, the control unit calculates the dew point temperature of the air inside the indoor space based on the temperature of the air that is detected by the indoor temperature detection unit. Consequently, the dew point temperature of the air inside the indoor space can be calculated based on the temperature of the air inside the indoor space.

**[0013]** The radiator according to a fifth aspect of the present invention is the radiator according to any one aspect of the first through fourth aspects of the present invention and further comprises a setting unit, by which a user can set whether the control unit performs the first cooling control during the cooling. Consequently, the user can set whether to perform the first cooling control during cooling.

**[0014]** Thereby, the indoor space can be cooled in accordance with the needs of the user.

<Advantageous Effects of Invention>

**[0015]** With the radiator according to the first aspect of the present invention, it is possible to reduce the risk that condensation will form in the heat exchanger.

**[0016]** With the radiator according to the second aspect of the present invention, it is possible to reduce the risk that condensation will form in the heat exchanger.

**[0017]** With the radiator according to the third aspect of the present invention, if the temperature of the heat exchanger is lower than the dew point temperature of the air inside the indoor space, then it is possible to reduce the risk that the cold water will flow into the heat exchanger.

**[0018]** In the radiator according to the fourth aspect of the present invention, the dew point temperature of the air inside the indoor space can be calculated based on the temperature of the air inside the indoor space.

**[0019]** In the radiator according to the fifth aspect of the present invention, the indoor space can be cooled in accordance with the needs of the user.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0020]**

**FIG. 1** is a schematic drawing of an air conditioning system that comprises radiators according to an embodiment of the present invention.
**FIG. 2** is an external oblique view of one of the radiators according to the embodiment of the present invention.
**FIG 3** is a control block diagram of a control unit provided by the radiator.
**FIG. 4** is a drawing that shows the relationship between the state of a three-way valve and a prescribed range.
**FIG 5** is a flow chart that depicts a control operation of a heat exchanger temperature determination unit.
**FIG. 6** is a schematic drawing of a heat exchanger and radiator pipings that constitute the radiator according to a modified example (A).

## DESCRIPTION OF EMBODIMENTS

**[0021]** The text below explains an air conditioning system **1** that comprises radiators **50, 50** according to an embodiment of the present invention.

### <Configuration of the Air Conditioning System>

**[0022]** As shown in **FIG 1,** the air conditioning system **1** comprises a heat source unit **10,** a circulation pump **11,** a first header **12,** a second header **13,** and a plurality of (in the present embodiment, two) radiators **50, 50.** In addition, a water circulation circuit is configured by connecting the heat source unit **10,** the circulation pump **11,** the first header **12,** the second header **13,** and the radiators **50, 50** with pipings.

**[0023]** The heat source unit **10** produces cold water or hot water by exchanging heat between water and a refrigerant or the like. Furthermore, in the present embodiment, a setting unit (not shown) provided by the heat source unit **10** sets the temperature of the cold water or the hot water produced in the heat source unit **10.** Consequently, the heat source unit **10** exchanges heat between the refrigerant and the water such that the temperature of the water approaches a set temperature. The circulation pump **11** circulates the water inside the water circulation circuit. One of the radiators **50,**

**50** is installed in and air conditions each of two indoor spaces **50a, 50b.** In addition, the two radiators **50, 50** are connected to one another in parallel via the first header **12** and the second header **13.** Furthermore, the configuration of the radiators **50, 50** is explained in detail later.

**[0024]** The water circulation circuit comprises a first inflow side piping **2,** a second inflow side piping **3,** third inflow side pipings **4,** radiator pipings **5,** first outflow side pipings **6,** and a second outflow side piping **7.** The first inflow side piping **2** connects the heat source unit **10** and the circulation pump **11.** In addition, the second inflow side piping **3** connects the circulation pump **11** and the first header **12.** The third inflow side pipings **4** connect the first header **12** to the radiators **50, 50.** The radiator pipings **5** are disposed inside the radiators **50, 50.** Furthermore, the radiator pipings **5** are explained later. The first outflow side pipings **6** connect the radiators **50, 50** to the second header **13.** The second outflow side piping **7** connects the second header **13** and the heat source unit **10.** Based on such a configuration, in the water circulation circuit, the cold water or the hot water produced in the heat source unit **10** flows by the operation of the circulation pump **11** to the radiators **50, 50** via the first header **12,** and the water that flows from the radiators **50, 50** returns to the heat source unit **10** via the second header **13.**

**<Radiators>**

**[0025]** The radiators **50, 50** are compact indoor units that can be installed on a floor; furthermore, the radiators **50, 50** can cool and heat the indoor spaces **50a, 50b** by sucking in the cold and hot water, respectively, produced in the heat source unit **10.** Furthermore, the radiator **50** installed in the indoor space **50a** and the radiator **50** installed in the indoor space **50b** have the same configuration. In addition, although the radiators **50** of the present embodiment are compact indoor units that can be installed on a floor, the indoor unit is not limited thereto; for example, each of the radiators may be a wall mounted indoor unit or a ceiling cassette type indoor unit.

**[0026]** As shown in **FIG 1** and **FIG 2,** each of the radiators **50** comprises a casing **51,** a heat exchanger **52,** a fan **53,** a three-way valve **54,** an indoor temperature detection unit **55,** and a heat exchanger temperature detection unit **56.** Furthermore, in the present embodiment, each of the radiators **50** comprises the heat exchanger **52** and the fan **53** but the present invention is not limited thereto; for example, each of the radiators must comprise a heat exchanger, but does not have to comprise a fan.

**[0027]** Each of the casings **51** houses the heat exchanger **52,** the fan **53,** the indoor temperature detection unit **55,** the heat exchanger temperature detection unit **56,** the three-way valve **54,** and the radiator piping **5.** Each of the radiator pipings **5** comprises a first piping **5a,** a second piping **5b,** a third piping **5c,** a fourth piping **5d,** and a bypass piping **5e.** One end part of the first piping **5a** is connected to the third inflow side piping **4** via a connection port (not shown), and another end part of the first piping **5a** is connected to the three-way valve **54.** In addition, one end part of the second piping **5b** is connected to the three-way valve **54,** and another end part of the second piping **5b** is connected to the heat exchanger **52.** One end part of the third piping **5c** is connected to the heat exchanger **52,** and another end part of the third piping **5c** is connected to the fourth piping **5d.** One end part of the fourth piping **5d** is connected to the third piping **5c,** and another end part of the fourth piping **5d** is connected to the first outflow side piping **6** via a connection port (not shown). One end part of the bypass piping **5e** is connected to the three-way valve **54,** and another end part of the bypass piping **5e** is connected to a connecting part **5f** between the third piping **5c** and the fourth piping **5d.**

**[0028]** In addition, as shown in **FIG 2,** each of the casings **51** comprises a bottom frame **51a,** a front surface grill **51b** and a front surface panel **51c.** The bottom frame **51a** is substantially oblong. The front surface grill **51b** is attached to the front side of the bottom frame **51a.** In addition, an opening (not shown) is formed in the front surface of the front surface grill **51b.** The front surface panel **51c** is attached to the front side of the front surface grill **51b** such that it covers the opening formed in the front surface grill **51b.**

**[0029]** In addition, a first blow out port **51ba** is formed in an upper part of the front surface grill **51b.** A second blow out port **51bb** is formed in a lower part of the front surface grill **51b**. In addition, a flap **51d** is disposed in the vicinity of and is capable of covering the first blow out port **51ba.**

**[0030]** In addition, a first suction port **51ca** is formed in an upper part of the front surface panel **51c.** A second suction port **51cb** is formed in a lower part of the front surface panel **51c.** Third suction ports **51cc, 51cd** are respectively formed in the left and right side surfaces of the front surface panel **51c.**

**[0031]** Each of the heat exchangers **52** comprises a heat transfer pipe, which is folded multiple times at both ends in the longitudinal directions, and a plurality of fins, wherethrough the heat transfer pipe is inserted. In addition, one end part of the heat transfer pipe is connected to the second piping **5b,** and another end part of the heat transfer pipe is connected to the third piping **5c.** Consequently, in each of the heat exchangers **52,** by the circulation pump **11** feeding cold water or hot water from the heat source unit **10,** heat is exchanged between the indoor air and the cold water or hot water flowing inside the heat transfer pipe.

**[0032]** Each of the fans **53** is a turbofan that sucks air in from its front side (i.e., its front surface side) and blows the air out in the centrifugal directions. The fan **53** is disposed on the rear side (i.e., rear surface side) of a bell mouth (not shown); furthermore, the fan **53** sucks air in from the first suction port **51ca,** the second suction port **51cb,** and the third suction port **51cc, 51cd,** passes that air through the heat exchanger **52** and the bell mouth, and generates a flow of air that is blown out from the first blow out port **51ba** and the second blow out port **51bb.**

**[0033]** Each of the three-way valves **54** can assume a first state, wherein the first piping **5a** and the second piping **5b** are connected, and a second state (corresponding to a blocked state), wherein the first piping **5a** and the bypass piping **5e** are connected. Consequently, when the three-way valve **54** assumes the first state, a flow of water from the first piping **5a** to the second piping **5b** is permitted. Accordingly, when the three-way valve **54** assumes the first state, a flow of water from the heat source unit **10** to the heat exchanger **52** is permitted. In addition, when the three-way valve **54** assumes the first state, a flow of water from the first piping **5a** to the bypass piping **5e** (i.e., a flow of water in the direction of the broken line arrow in **FIG 1**) is completely blocked. Consequently, if the three-way valve **54** assumes the first state, then the water that flows through the third inflow side piping **4** flows into the heat exchanger **52** via the first piping **5a** and the second piping **5b.** Furthermore, the water that flows into the heat exchanger **52** flows to the first outflow side piping **6** via the third piping **5c** and fourth piping **5d.** In addition, if the three-way valve **54** assumes the second state, then the flow of water from the heat source unit **10** to the heat exchanger **52** is completely blocked. Consequently, if the three-way valve **54** assumes the second state, then the flow of water from the first piping **5a** to the second piping **5b** is completely blocked, and the flow of water from the first piping **5a** to the bypass piping **5e** (i.e., the flow of water in the direction of the broken line arrow in **FIG 1**) is permitted. Accordingly, if the three-way valve **54** assumes the second state, then the water that flows through the third inflow side piping **4** flows from the first piping **5a** to the fourth piping **5d** via the bypass piping **5e** and subsequently flows to the first outflow side piping **6.** Thereby, if the three-way valve **54** assumes the second state, then the water that flows from the heat source unit **10** flows back to the heat source unit **10** without flowing into the heat exchanger **52.**

**[0034]** The indoor temperature detection units **55** detect the temperature of the indoor spaces **50a, 50b,** wherein the radiators **50** are installed. In addition, each of the indoor temperature detection units **55** is disposed inside the corresponding casing **51** in the vicinity of the third suction port **51cc.** Furthermore, information about the indoor temperature detected by the indoor temperature detection unit **55** is transmitted to a control unit **60** (discussed below) as needed.

**[0035]** Each of the heat exchanger temperature detection units **56** detects the temperature of the corresponding heat exchanger **52.** In addition, the heat exchanger temperature detection unit **56** is disposed in the vicinity of the corresponding heat exchanger **52.** Furthermore, information about the temperature of the heat exchanger **52** detected by the heat exchanger temperature detection unit **56** is transmitted the control unit **60** (discussed below) as needed.

**[0036]** In addition, each of the radiators **50** comprises one of the control units **60,** which controls the corresponding three-way valve **54**. The control units **60** are explained below.

**<Control Units>**

**[0037]** As shown in **FIG 3,** each of the control units **60** is connected to the three-way valve **54** of the corresponding radiator **50;** furthermore, the control units **60** control the three-way valves **54** such that the indoor spaces **50a, 50b** are cooled or heated. In addition, as shown in **FIG. 1,** each of the radiators **50** comprises one of the control units **60.**

**[0038]** Each of the control units **60** is capable of receiving various instructions transmitted from a user via a wireless remote controller **80.** Furthermore, the various instructions include operation setting instructions, a set temperature instruction, and an air volume setting instruction. In addition, the operation setting instructions include a cooling setting instruction to cool the indoor spaces **50a, 50b** and a heating setting instruction to heat the indoor spaces **50a, 50b.** In addition, each of the remote controllers **80** comprises: an operation setting unit **81,** which transmits the operation setting instructions to the corresponding control unit **60;** a temperature setting unit **82,** which transmits the set temperature instruction to the corresponding control unit **60;** and an air volume setting unit **83,** which transmits the air volume setting instruction to the corresponding control unit **60.** By operating the operation setting unit **81,** the temperature setting unit **82,** and the air volume setting unit **83,** the user can transmit the various instructions to the corresponding control unit **60.**

**[0039]** In addition, each of the control units **60** comprises a cooling operation control unit **61,** which controls the corresponding three-way valve **54** when the cooling setting instruction is transmitted via the remote controller **80.** When the cooling operation control unit **61** cools the corresponding indoor space of the indoor spaces **50a, 50b,** namely, when it causes the corresponding radiator **50** to perform a cooling operation, the cooling operation control unit **61** performs a first cooling control and a second cooling control. When performing the first cooling control, the cooling operation control unit **61** switches the three-way valve **54** in either of the state selected from the first state and the second state so that a heat exchanger temperature detected by the heat exchanger temperature detection unit **56** does not fall below the dew point temperature of the air inside the corresponding indoor space of the indoor spaces **50a, 50b.** In addition, when performing the second cooling control, the cooling operation control unit **61** switches the three-way valve **54** to the first state. Furthermore, when performing the second cooling control, the cooling operation control unit **61** does not switch the three-way valve **54** from the first state to the second state. Consequently, if the second cooling control is performed during cooling of the corresponding indoor space of the indoor spaces **50a, 50b,** then the three-way valve **54** is not switched to the second state even if the heat exchanger temperature detected by the heat exchanger temperature detection unit **56** is lower than the dew point temperature of the air inside the corresponding indoor space of the indoor spaces **50a, 50b.**

**[0040]** In addition, each of the cooling operation control units **61** comprises a jumper **69,** a determination unit **63,** and an operation unit **64.**

**[0041]** The jumper **69** is used to set whether the first cooling control or the second cooling control is performed during cooling of the corresponding indoor space of the indoor spaces **50a, 50b.** If the jumper **69** is disconnected, then the cooling operation control unit **61** determines that the performance of the first cooling control is permitted, In addition, if the jumper **69** is not disconnected, then the cooling operation control unit **61** determines that the performance of the second cooling control is permitted. Consequently, the cooling operation control unit **61** determines whether the first cooling control or the second cooling control is performed during cooling of the corresponding indoor space of the indoor spaces **50a, 50b** based on the disconnection state of the jumper **69.**

**[0042]** Each of the determination unit **63** comprises a capacity supply determination unit **65**, a dew point temperature calculating unit **62,** and a heat exchanger temperature determination unit **66.**

**[0043]** The capacity supply determination unit **65** determines whether there is a need to supply capacity to the corresponding heat exchanger **52.** Specifically, the capacity supply determination unit **65** determines whether there is a need to flow cold water or hot water to the heat exchanger **52** by comparing a set temperature value, which is obtained from set temperature information based on a set temperature instruction transmitted from the corresponding remote controller **80,** and an indoor temperature value, which is obtained from the indoor temperature information transmitted from the corresponding indoor temperature detection unit **55.** More specifically, if the set temperature value and the indoor temperature value differ by a first prescribed temperature value (e.g., a value corresponding to 1°C as a temperature) or greater, then it is determined that there is a need to supply capacity. In addition, if the difference between the set temperature value and the indoor temperature value is less than the first prescribed temperature value, then the capacity supply determination unit **65** determines that there is no need to supply capacity. Furthermore, if the capacity supply determination unit **65** determines that there is a need to supply capacity, then the capacity supply determination unit **65** transmits capacity supply needed information (hereinbelow, called demand present information) to the operation unit **64.** In addition, if the capacity supply determination unit **65** determines that there is no need to supply capacity, then the capacity supply determination unit **65** transmits capacity supply unneeded information (hereinbelow, called demand absent information) to the operation unit **64.**

**[0044]** If the first cooling control is performed, then the dew point temperature calculating unit **62** calculates a threshold value *X* by estimating the dew point temperature of the air inside the corresponding indoor space of the indoor spaces **50a, 50b.** Specifically, the dew point temperature calculating unit **62** calculates the threshold value *X* based on an environmental condition of the geographical area in which the radiator **50** is installed and the indoor temperature value obtained from the indoor temperature information transmitted from the indoor temperature detection unit **55.** Furthermore, the dew point temperature calculating unit **62** calculates the threshold value *X* based on the equation below.

$$\text{Threshold value } X = \text{prescribed value } A \times \text{indoor temperature value} + \text{correction value } B$$

**[0045]** Furthermore, a prescribed value *A* is a coefficient that varies with the environmental condition of the geographical area. In addition, a correction value *B* is determined in accordance with the environmental condition of the geographical area in which the radiator **50** is installed. The user can switch between the correction value *B* being present or absent by operating a slide switch or the like. For example, if the correction value *B* is set to "none" and the indoor temperature in the geographical area with a relative humidity of 60% is 20°C, then the dew point temperature calculating unit **62** sets the prescribed value *A* to 0.6 and the indoor temperature value to 20, and then calculates the threshold value *X*.

**[0046]** If the first cooling control is performed, then the heat exchanger temperature determination unit **66** performs a heat exchanger temperature determination by determining whether a heat exchanger temperature value, which is obtained from heat exchanger temperature information transmitted from the heat exchanger temperature detection unit **56**, is within a prescribed range. Furthermore, herein, the prescribed range is a region of values greater than or equal to the threshold value *X*, which is calculated by the dew point temperature calculating unit **62.** If the heat exchanger temperature determination unit **66** determines that the heat exchanger temperature value is within the prescribed range, namely, if it determines that the temperature of the heat exchanger **52** is greater than or equal to the dew point temperature of the air inside the corresponding indoor space of the indoor spaces **50a, 50b,** then the heat exchanger temperature determination unit **66** determines that it is possible to further supply cold water to the heat exchanger **52** and therefore transmits supply possible information to the operation unit **64.** In addition, if the heat exchanger temperature determination unit **66** determines that the heat exchanger temperature value is not within the prescribed range, namely, if it determines that the temperature of the heat exchanger **52** is lower than the dew point temperature of the air inside the corresponding indoor space of the indoor spaces **50a, 50b,** then the heat exchanger temperature determination unit **66** determines that it is not possible to further supply the cold water to the heat exchanger **52** and therefore transmits supply not possible information to the operation unit **64.**

**[0047]** In addition, as shown in **FIG. 4,** the prescribed range includes a first range and a second range. The first range is a region of values from a value *X+C,* which is a value that is greater than threshold value *X* by a prescribed value *C,* to the threshold value *X.* In addition, the second range is a region of values that is greater than or equal to the value *X+C,* which is greater than the threshold value *X* by the prescribed value *C.*

**[0048]** If the heat exchanger temperature determination unit **66** determines that the heat exchanger temperature value is within the second range, then the heat exchanger temperature determination unit **66** determines that the heat exchanger temperature value is within the prescribed range. In addition, if the heat exchanger temperature determination unit **66** determines that the heat exchanger temperature value is within the first range, then, in accordance with the state of the corresponding three-way valve **54,** the heat exchanger temperature determination unit **66** determines whether the heat exchanger temperature value is within the prescribed range. For example, if the heat exchanger temperature determination unit **66** determines that the heat exchanger temperature value is within the first range and if the supply possible information was transmitted to the operation unit **64** in the previous heat exchanger temperature determination, then the heat exchanger temperature determination unit **66** determines that the heat exchanger temperature value is within the prescribed range. In addition, if the heat exchanger temperature determination unit **66** determines that the heat exchanger temperature value is within the first range and if the supply not possible information was transmitted to the operation unit **64** in the previous heat exchanger temperature determination, then the heat exchanger temperature determination unit **66** determines that the heat exchanger temperature value is not within the prescribed range. Thus, imparting so-called hysteresis characteristics to the operation of switching the state of the three-way valve **54** prevents the phenomenon of hunting, wherein the state of the three-way valve **54** is switched in micro steps when the heat exchanger temperature value is in the vicinity of the threshold value *X.*

**[0049]** The operation unit **64** switches the state of the three-way valve **54** by transmitting an energize signal or a de-energize signal to the three-way valve **54.** Specifically, the operation unit **64** switches the three-way valve **54** to the first state by transmitting the energize signal to the three-way valve **54.** In addition, the operation unit **64** switches the three-way valve **54** to the second state by transmitting the de-energize signal to the three-way valve **54.**

**[0050]** In addition, if the demand present information is transmitted from the capacity supply determination unit **65,** then the operation unit **64** transmits the energize signal to the three-way valve **54.** In addition, if the demand absent information is transmitted from the capacity supply determination unit **65,** then the operation unit **64** transmits the de-energize signal to the three-way valve **54.** Furthermore, if the supply possible information is transmitted from the heat exchanger temperature determination unit **66** after the demand present information has been transmitted from the capacity supply determination unit **65,** then the operation unit **64** transmits the energize signal to the three-way valve **54.** In addition, if the supply not possible information is transmitted from the heat exchanger temperature determination unit **66** after the demand present information has been transmitted from the capacity supply determination unit **65,** then the operation unit **64** transmits the de-energize signal to the three-way valve **54.** Furthermore, if the supply not possible information is transmitted from the heat exchanger temperature determination unit **66,** then the operation unit **64** ignores the demand present information transmitted from the capacity supply determination unit **65** until a first prescribed time has elapsed since the supply not possible information was transmitted. Consequently, if the supply not possible information is transmitted from the heat exchanger temperature determination unit **66,** then the operation unit **64** does not transmit the energize signal to the three-way valve **54** until the first prescribed time has elapsed since the supply not possible information was transmitted. Thereby, if the first cooling control is performed during cooling of one of the indoor spaces **50a, 50b** and the corresponding capacity supply determination unit **65** determines that there is a need to supply capacity and the heat exchanger temperature determination unit **66** determines that the heat exchanger temperature value is within the prescribed range, then the three-way valve **54** assumes the first state. In addition, if the first cooling control is performed during cooling of one of the indoor spaces **50a, 50b** and if the corresponding capacity supply determination unit **65** determines that there is no need to supply capacity or the capacity supply determination unit **65** determines that there is a need to supply capacity and the heat exchanger temperature determination unit **66** determines that the heat exchanger temperature value is not within the prescribed range, then the three-way valve **54** assumes the second state. In addition, if the second cooling control is performed during cooling of one of the indoor spaces **50a, 50b** and the corresponding capacity supply determination unit **65** determines that there is a need to supply capacity because the heat exchanger temperature determination unit **66** does not perform the heat exchanger temperature determination, then the three-way valve **54** always assumes the first state. In addition, if the second cooling control is performed during cooling of one of the indoor spaces **50a, 50b** and the corresponding capacity supply determination unit **65** determines that there is no need to supply capacity because the heat exchanger temperature determination unit **66** does not perform the heat exchanger temperature determination, then, and only then, does the three-way valve **54** assume the second state.

**[0051]** Furthermore, in the present embodiment, the three-way valve **54** and the fan **53** are controlled independently.

**<Operation of Controlling the Three-way Valve During the First Cooling Control>**

**[0052]** Next, the operation of controlling the three-way valve **54** when one of the cooling operation control units **61** performs the first cooling control will be explained, referencing **FIG 5.** Furthermore, **FIG. 5** is a flow chart that depicts the flow of the heat exchanger temperature determination, which is performed by the heat exchanger temperature determination unit **66.** Furthermore, the explanation herein addresses the case wherein the three-way valve **54** is in the second state and the flow of water from the first piping **5a** to the second piping **5b** is blocked.

**[0053]** If the capacity supply determination unit **65** determines that there is a need to supply capacity, then it transmits demand present information to the operation unit **64** so that cold water flows into the heat exchanger **52** (i.e., in a step **S1**). In response to the transmission of the demand present information from the capacity supply determination unit **65,** the operation unit **64** transmits the energize signal to the three-way valve **54** so that the three-way valve **54** transitions to the first state. Thereby, the three-way valve **54** switches from the second state to the first state and cold water flows into the heat exchanger **52.**

**[0054]** In addition, the heat exchanger temperature determination unit **66** performs the heat exchanger temperature determination after a second prescribed time has elapsed since the three-way valve **54** switched from the second state to the first state (e.g., after the time it takes for the temperature of the heat exchanger **52** and the temperature of the cold water flowing through the heat exchanger **52** to equalize) (i.e., in a step **S2**). Furthermore, if the heat exchanger temperature determination unit **66** determines that the supply of cold water to the heat exchanger **52** is possible, then it transmits the supply possible information to the operation unit **64** (i.e., in a step **S3** and a step **S4**). If the supply possible information is transmitted from the heat exchanger temperature determination unit **66,** then the operation unit **64** transmits the energize signal to the three-way valve **54** so that the three-way valve **54** maintains the first state as is. Thereby, the three-way valve **54** maintains the first state without switching to the second state. Subsequently, if the capacity supply determination unit **65** determines that there is no need to supply capacity, then it transmits the demand absent information to the operation unit **64** (i.e., in a step **S5**). If the demand absent information is transmitted from the capacity supply determination unit **65,** then the operation unit **64** transmits the de-energize signal to the three-way valve **54** so that the three-way valve **54** switches from the first state to the second state. Thereby, the three-way valve **54** switches from the first state to the second state.

**[0055]** In addition, if the heat exchanger temperature determination unit **66** transmits the supply possible information to the operation unit **64** and the capacity supply determination unit **65** does not subsequently determine that there is no need to supply capacity, namely, if the demand absent information is not transmitted from the capacity supply determination unit **65** to the operation unit **64,** then the heat exchanger temperature determination unit **66** once again performs the heat exchanger temperature determination (i.e., in a step **S6**). Furthermore, if the heat exchanger temperature determination unit **66** determines once again in the heat exchanger temperature determination of the step **S6** that the supply of cold water to the heat exchanger **52** is possible (i.e., in a step **S7**), then the method returns to the step **S4** and the heat exchanger temperature determination unit **66** transmits the supply possible information to the operation unit **64.** If the supply possible information is transmitted from the heat exchanger temperature determination unit **66,** then the operation unit **64** transmits the energize signal to the three-way valve **54** so that the three-way valve **54** maintains the first state as is. Thereby, the three-way valve **54** maintains the first state without switching to the second state. In addition, if the heat exchanger temperature determination unit **66** determines in the heat exchanger temperature determination (i.e., in the step **S6**) performed after the supply possible information has been transmitted to the operation unit **64** that the supply of cold water to the heat exchanger **52** is not possible, then the heat exchanger temperature determination unit **66** transmits the supply not possible information to the operation unit **64** so that the water does not further flow into the heat exchanger **52** (i.e., in a step **S8).** Furthermore, the heat exchanger temperature determination of the step **S6** is performed repetitively until either the capacity supply determination unit **65** determines that there is no need to supply capacity or it is determined in the heat exchanger temperature determination of the step **S6** that the supply of cold water to the heat exchanger **52** is not possible (i.e., in the step S5 and the step **S7**).

**[0056]** In addition, if the heat exchanger temperature determination unit **66** determines in the step **S3** that the supply of cold water to the heat exchanger **52** is not possible, then the heat exchanger temperature determination unit **66** transmits the supply not possible information to the operation unit **64** so that the water does not flow into the heat exchanger **52** (i.e., in the step **S8**). If the supply not possible information is transmitted from the heat exchanger temperature determination unit **66,** then the operation unit **64** transmits the de-energize signal to the three-way valve **54** so that the three-way valve **54** switches to the second state. Thereby, the three-way valve **54** switches from the first state to the second state.

**[0057]** Furthermore, until the first prescribed time has elapsed since the transmission of the supply not possible information from the heat exchanger temperature determination unit **66,** the operation unit **64** ignores the demand present information transmitted from the capacity supply determination unit **65.** Consequently, until the first prescribed time has elapsed since the transmission of the supply not possible information from the heat exchanger temperature determination unit **66,** the operation unit **64** does not transmit the energize signal to the three-way valve **54.** Consequently, even if the capacity supply determination unit **65** determines that there is a need to supply capacity, the three-way valve **54** maintains the second state, to which it has switched. In addition, if the demand absent information is transmitted from the capacity supply determination unit **65** before the first prescribed time has elapsed since the transmission of the supply not possible information from the heat exchanger temperature determination unit **66,** then the operation unit **64** transmits the de-energize signal to the three-way valve **54** (i.e., in a step **S9**). In this case, too, the three-way valve **54** maintains the second state, to which it has switched.

**[0058]** Furthermore, if the demand absent information is not transmitted from the capacity supply determination unit **65** by the time the first prescribed time has elapsed since the transmission of the supply not possible information from the heat exchanger temperature determination unit **66,** namely, if the demand present information is transmitted from the capacity supply determination unit **65** after the first prescribed time has elapsed since the transmission of the supply not possible information from the heat exchanger temperature determination unit **66,** then the operation unit **64** transmits the energize signal to the three-way valve **54** (i.e., in a step **S10**). Thereby, the three-way valve **54** switches from the second state to the first state. Furthermore, after the second prescribed time has elapsed since the three-way valve **54** switched from the second state to the first state, the heat exchanger temperature determination unit **66** once again performs the heat exchanger temperature determination (i.e., in a step **S11**). Furthermore, if the heat exchanger temperature determination unit **66** determines that the supply of cold water to the heat exchanger **52** is possible in the heat exchanger temperature determination of the step **S11,** then the method returns to the step **S4** and the water temperature determination unit **66** transmits the supply possible information to the operation unit **64** (i.e., in a step **S12**). If the supply possible information is transmitted from the heat exchanger temperature determination unit **66,** then the operation unit **64** transmits the energize signal to the three-way valve **54** so that the three-way valve **54** maintains the first state as is. Thereby, the three-way valve **54** maintains the first state without switching to the second state.

**[0059]** In addition, if the heat exchanger temperature determination unit **66** determines in the heat exchanger temperature determination of the step **S11** that the supply of cold water to the heat exchanger **52** is not possible, then the method returns to the step **S8** and the heat exchanger temperature determination unit **66** transmits the supply not possible information to the operation unit **64** (i.e., the step **S12**). If the supply not possible information is transmitted from the heat exchanger temperature determination unit **66,** then the operation unit **64** transmits the de-energize signal to the three-way valve **54** so that the three-way valve **54** switches from the first state to the second state. Thereby, the three-way valve **54** switches from the first state to the second state.

**[0060]** Thus, the heat exchanger temperature determination unit **66** repetitively performs the heat exchanger temperature determination of the step **S6** or the step **S11** every time the prescribed time elapses until the capacity supply determination unit **65** determines that there is no need to supply capacity.

**<Features>**

**(1)**

**[0061]** In the abovementioned embodiment, the cooling operation control unit **61** performs the first cooling control, wherein the three-way valve **54** is switched from the first state to the second state so that the heat exchanger temperature value does not fall below the dew point temperature of the air in the corresponding indoor space of the indoor spaces **50a, 50b.** Consequently, if the cooling operation control unit **61** performs the first cooling control, then it is possible to reduce the risk that the temperature of the heat exchanger **52** during cooling will fall below the dew point temperature of the air in the corresponding indoor space of the indoor spaces **50a, 50b.**

**[0062]** Thereby, it is possible to reduce the risk that condensation will form in the heat exchanger **52.**

**[0063]** In addition, if the cooling operation control unit **61** performs the first cooling control, then it is possible to implement a cooling operation (i.e., a sensible cooling), wherein by controlling the three-way valve **54** no more capacity than is needed is supplied and wherein the air in the corresponding indoor space of the indoor spaces **50a, 50b** tends not to become dehumidified even during cooling. Thereby, comfort can be improved because the temperature of the air in the corresponding indoor space of the indoor spaces **50a, 50b** can be reduced without excessively ridding the air of moisture.

**[0064]** Furthermore, if condensation is not formed in the heat exchanger **52** as a result of the performance of the first cooling control during cooling, then there is no need to provide a drain piping for discharging the formed condensation to the outdoor space. Accordingly, if the first cooling control alone is performed during cooling, then the manufacturability of the radiator **50** can be improved because there is no need to provide the drain piping.

**(2)**

**[0065]** In the abovementioned embodiment, if, as a result of the performance of the first cooling control, the heat exchanger temperature determination unit **66** determines that the heat exchanger temperature value is not within the prescribed range, then the three-way valve **54** is switched to the second state. Here, the prescribed range is a region of values greater than or equal to the threshold value *X*, which is calculated by the dew point temperature calculating unit **62,** namely, values greater than or equal to an estimated value of the dew point temperature of the air in the corresponding indoor space of the indoor spaces **50a, 50b.** Consequently, if, as a result of the performance of the first cooling control, the heat exchanger temperature determination unit **66** determines that the heat exchanger temperature value is not within the prescribed range, then the flow of the cold water into the heat exchanger **52** is blocked, which makes it possible to ensure that the temperature of the heat exchanger **52** does not further decrease.

**[0066]** Thereby, it is possible to reduce the risk that the temperature of the heat exchanger **52** will fall below the dew point temperature of the air in the corresponding indoor space of the indoor spaces **50a, 50b.**

**(3)**

**[0067]** In the abovementioned embodiment, if the three-way valve **54** assumes the second state, then the flow of water from the first piping **5a** to the second piping **5b** is completely blocked and the flow of the water from the first piping **5a** to the bypass piping **5e** is permitted. Consequently, it is possible to return the cold water flowing through the first piping **5a** to the heat source unit **10** side via the bypass piping **5e.**

**[0068]** Thereby, if the temperature of the heat exchanger **52** is lower than the dew point temperature of the air inside the corresponding indoor space of the indoor spaces **50a, 50b,** then it is possible to return the cold water to the heat source unit **10** side without the cold water flowing to the heat exchanger **52.**

**(4)**

**[0069]** In the abovementioned embodiment, the dew point temperature calculating unit **62** calculates the threshold value *X*, which is obtained by estimating the dew point temperature of the air inside the corresponding indoor space of the indoor spaces **50a, 50b** based on the environmental condition of the geographical region in which the radiator **50** is installed and on the indoor temperature value obtained from the indoor temperature information transmitted from the indoor temperature detection unit **55.** Consequently, it is possible to estimate the dew point temperature of the air inside the corresponding indoor space of the indoor spaces **50a, 50b** even if a humidity sensor, which detects the humidity of the air therein, is not provided.

**(5)**

**[0070]** In the abovementioned embodiment, the cooling operation control unit **61** determines whether to perform the first cooling control or the second cooling control during cooling based on the disconnection state of the jumper **69.** Consequently, the user can set whether the cooling operation control unit **61** performs the first cooling control or the second cooling control during cooling of the corresponding indoor space of the indoor spaces **50a, 50b.**

**[0071]** Thereby, it is possible to cool the corresponding indoor space of the indoor spaces **50a, 50b** in accordance with the needs of the user.

**<Modified Examples>**

**(A)**

**[0072]** In the abovementioned embodiment, the three-way valve **54** is adopted to block the flow of the cold water into the heat exchanger **52.**

**[0073]** A two-way valve (i.e., a solenoid valve), which is configured such that it can only open or close, may be adopted as long as the flow of the cold water into the heat exchanger **52** can be blocked.

**[0074]** In addition, if a two-way valve **154** is adopted instead of the three-way valve **54** in the abovementioned embodiment, as shown in **FIG 6,** then a radiator piping **105** may comprise a first piping **105a,** which is connected to the third inflow side piping **4,** a second piping **105b,** which connects the two-way valve **154** and the heat exchanger **52,** and a third piping **105c,** which connects the heat exchanger **52** and the first outflow side piping **6.** Even in such a configuration, the flow of water from the heat source unit side to the heat exchanger **52** side can be blocked by setting the two-way valve **154** to a closed state, and the flow of the water from the heat source unit side to the heat exchanger **52** side can be permitted by setting the two-way valve **154** to an open state. Accordingly, the cooling operation control unit can perform the first cooling control by setting the two-way valve **154** to the open state or the closed state so that the temperature of the heat exchanger **52** is greater than or equal to the dew point temperature of the air inside the corresponding indoor space of the indoor spaces.

**[0075]** In addition, instead of a solenoid valve, a motor operated valve configured such that it is capable of flow volume adjustment may be provided. For example, if the motor operated valve is adopted instead of the three-way valve **54,** then the flow volume of the cold water flowing through the heat exchanger **52** may be adjusted by adjusting the opening degree of the motor operated valve so that the temperature of the heat exchanger **52** reaches a temperature that is greater than or equal to the dew point temperature.

**(B)**

**[0076]** In the abovementioned embodiment, the dew point temperature is estimated based on the indoor temperature value. However, instead, the radiator may comprise an indoor humidity detection unit that is capable of detecting the relative humidity of the corresponding indoor space of the indoor spaces **50a, 50b.** In such a case, a dew point temperature calculating unit may calculate the threshold value based on the indoor humidity value, which is obtained from the indoor humidity information detected by the indoor humidity detection unit, and the indoor temperature value.

**(C)**

**[0077]** In the abovementioned embodiment, by the performance of the first cooling control, the state of the three-way valve **54** is switched so that the heat exchanger temperature during cooling does not fall below the dew point temperature.

**[0078]** Additionally, if the determination unit further performs a water temperature determination, which determines whether the temperature of the water flowing into the heat exchanger **52** is within the prescribed temperature range (e.g., a temperature range that does not lie outside of the working range of the heat exchanger **52**), and it is thereby determined that the temperature of the water flowing into the heat exchanger **52** is not within the prescribed temperature range, namely, if it is determined that the temperature of the water flowing into the heat exchanger **52** falls outside of the working range of the heat exchanger **52** (e.g., a temperature so low the water freezes or so high the water adversely affects the heat resistance of the heat exchanger **52),** then control may be performed that switches the three-way valve **54** to the second state so that the water does not flow into the heat exchanger **52.** Thus, if the state of the three-way valve **54** is switched in accordance with the temperature of the water flowing into the heat exchanger **52,** then it is possible to reduce the risk that water of a temperature outside of the working range of the heat exchanger **52** will flow into the heat exchanger **52.** Accordingly, if, for example, the water temperature determination is performed together with the heat exchanger temperature determination in the first cooling control and the dew point temperature of the corresponding indoor space of the indoor spaces **50a, 50b** is lower than the working range of the heat exchanger **52,** then the three-way valve **54** is switched to the second state even if the heat exchanger temperature is higher than the dew point temperature. Consequently, during the performance of the first cooling control, it is possible to reduce the risk that water of a temperature outside of the working range of the heat exchanger **52** will flow into the heat exchanger **52,** which makes it possible to reduce the risk that the heat exchanger **52** will break.

## INDUSTRIAL APPLICABILITY

**[0079]** The present invention can reduce the risk that condensation will be formed in the heat exchanger, which makes it effective to adapt the present invention to a radiator that cools an indoor space by sucking in cold water.

## REFERENCE SIGNS LIST

**[0080]**

| | |
|---|---|
| **5a** | First piping |
| **5d** | Fourth piping (second piping) |
| **5e** | Bypass piping |
| **10** | Heat source unit |
| **50** | Radiator |
| **52** | Heat exchanger |
| **54** | Three-way valve (flow volume adjusting mechanism) |
| **55** | Indoor temperature detection unit |
| **56** | Heat exchanger temperature detection unit |
| **60** | Control unit |
| **69** | Jumper (setting unit) |
| **50a, 50b** | Indoor spaces |

## CITATION LIST

### PATENT LITERATURE

#### Patent Document 1

**[0081]** Japanese Unexamined Patent Application Publication No. 2002-98344

## Claims

1. A radiator **(50)** that cools an indoor space **(50a, 50b)** by sucking in cold water from a heat source unit **(10),** comprising:

    a heat exchanger **(52)**;
    a first piping **(5a),** wherethrough the cold water flows from the heat source unit side to the heat exchanger side;
    a flow volume adjusting mechanism **(54),** which adjusts the flow volume of the cold water flowing through the heat exchanger;
    a heat exchanger temperature detection unit **(56),** which is capable of detecting the temperature of the heat exchanger; and
    a control unit **(60),** which performs a first cooling control that controls the flow volume adjusting mechanism so that the temperature of the heat exchanger detected by the heat exchanger temperature detection unit is greater than or equal to the dew point temperature of air inside the indoor space.

2. The radiator according to claim 1, wherein
    the flow volume adjusting mechanism is capable of assuming a blocked state, wherein the flow of the cold water from the heat source unit side to the heat exchanger side is blocked; and
    in the first cooling control, the control unit switches the flow volume adjusting mechanism to the blocked state if the temperature of the heat exchanger that is detected by the heat exchanger temperature detection unit is lower than the dew point temperature of the air inside the indoor space.

3. The radiator according to claim 2, further comprising:

    a second piping **(5d),** wherethrough water flows from the heat exchanger side to the heat source unit side; and
    a bypass piping **(5e),** which diverts the water from the first piping to the second piping without passing the water through the heat exchanger;
    wherein,
    if the flow volume adjusting mechanism assumes the blocked state, then the water flows from the first piping to the second piping via the bypass piping.

4. The radiator according to any one claim of claim 1 through claim 3, further comprising:

    an indoor temperature detection unit **(55),** which is capable of detecting the temperature of the air inside the indoor space;
    wherein,
    the control unit calculates the dew point temperature of the air inside the indoor space based on the temperature of the air inside the indoor space that is detected by the indoor temperature detection unit.

5. The radiator according to any one claim of claim 1 through claim 4, further comprising:

    a setting unit **(69)**, by which a user can set whether the control unit performs the first cooling control during the cooling.

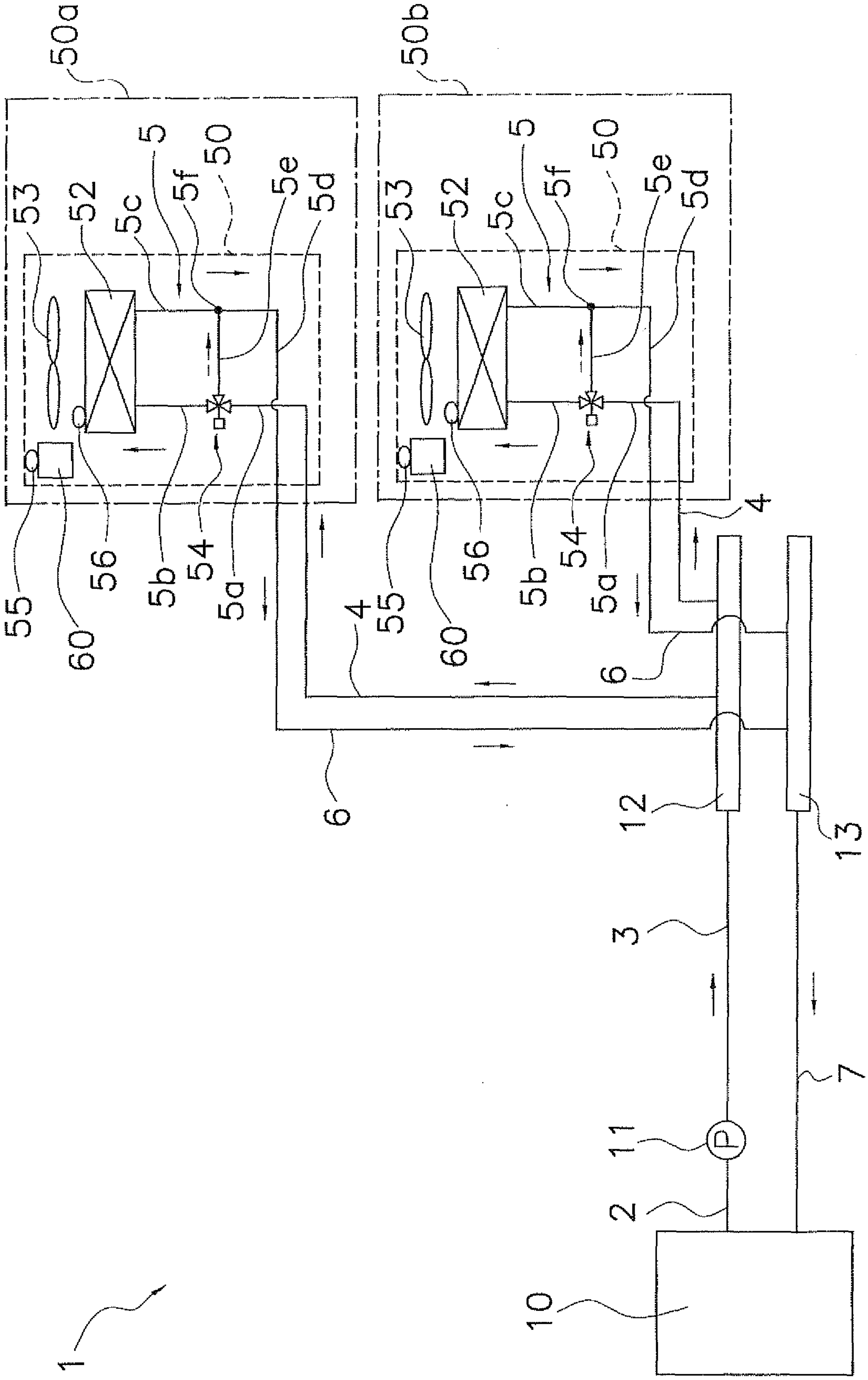


FIG. 1

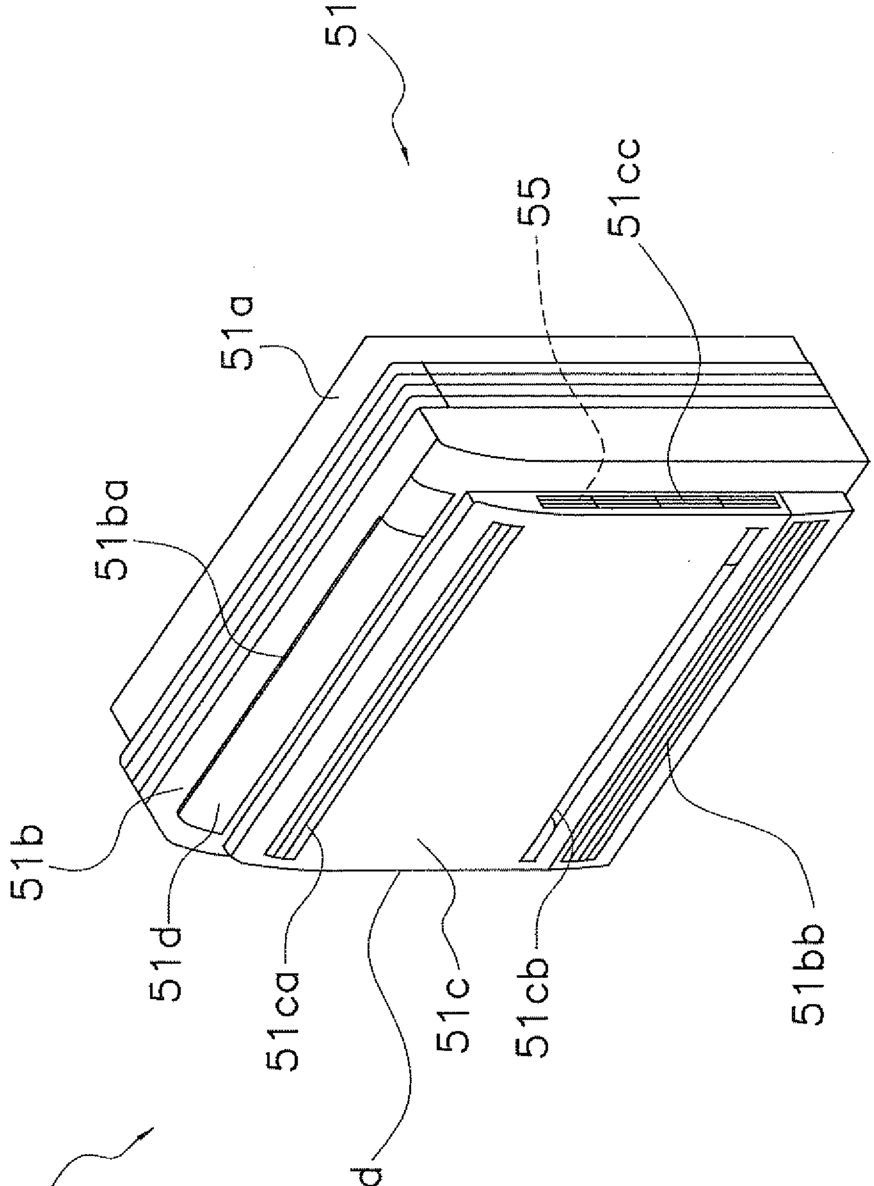


FIG. 2

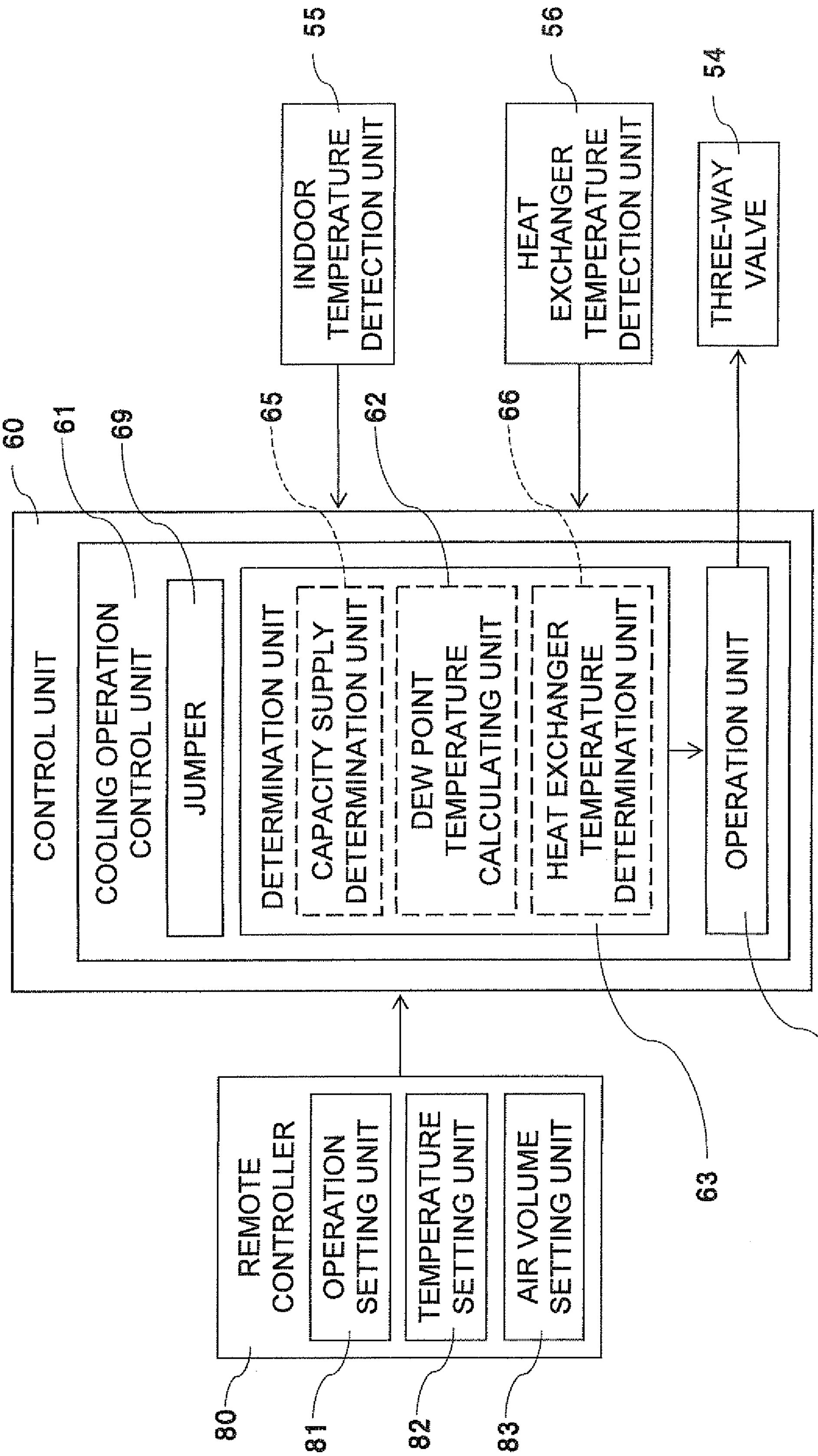
CONTROL UNIT
COOLING OPERATION CONTROL UNIT
JUMPER
DETERMINATION UNIT
CAPACITY SUPPLY DETERMINATION UNIT
DEW POINT TEMPERATURE CALCULATING UNIT
HEAT EXCHANGER TEMPERATURE DETERMINATION UNIT
OPERATION UNIT
INDOOR TEMPERATURE DETECTION UNIT
HEAT EXCHANGER TEMPERATURE DETECTION UNIT
THREE-WAY VALVE
REMOTE CONTROLLER
OPERATION SETTING UNIT
TEMPERATURE SETTING UNIT
AIR VOLUME SETTING UNIT
60
61
69
65
62
66
63
64
55
56
54
80
81
82
83

FIG. 3

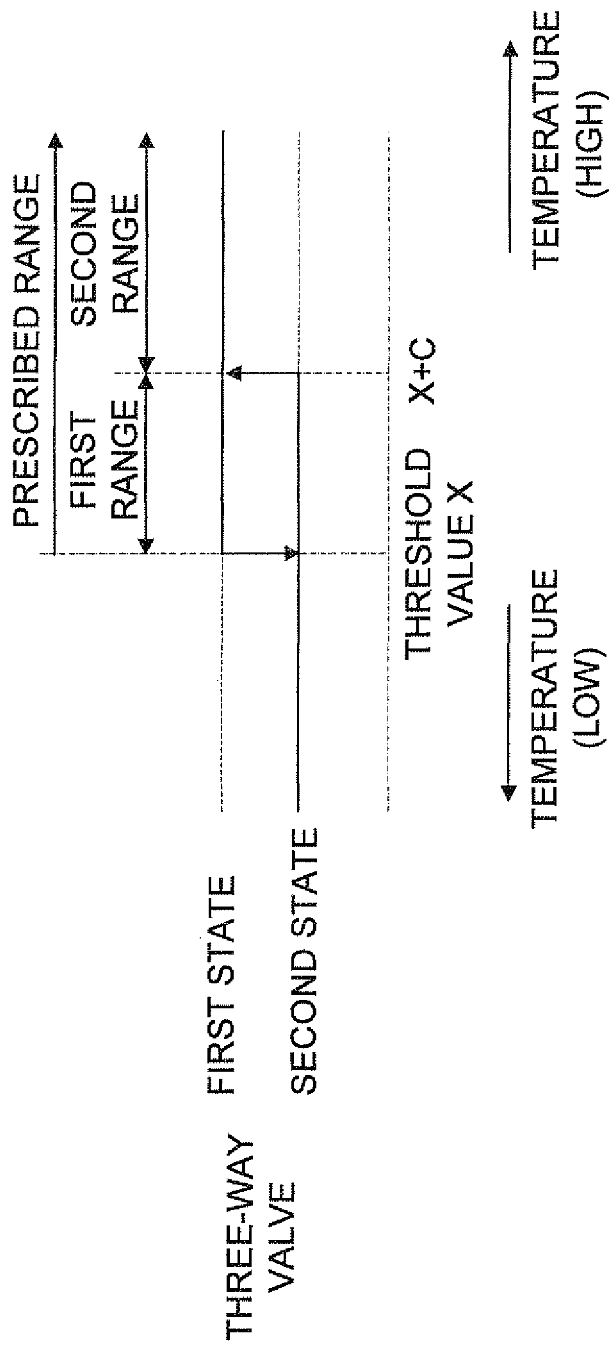
PRESCRIBED RANGE
FIRST RANGE
SECOND RANGE
THREE-WAY VALVE
FIRST STATE
SECOND STATE
THRESHOLD VALUE X
X+C
TEMPERATURE (LOW)
TEMPERATURE (HIGH)

FIG. 4

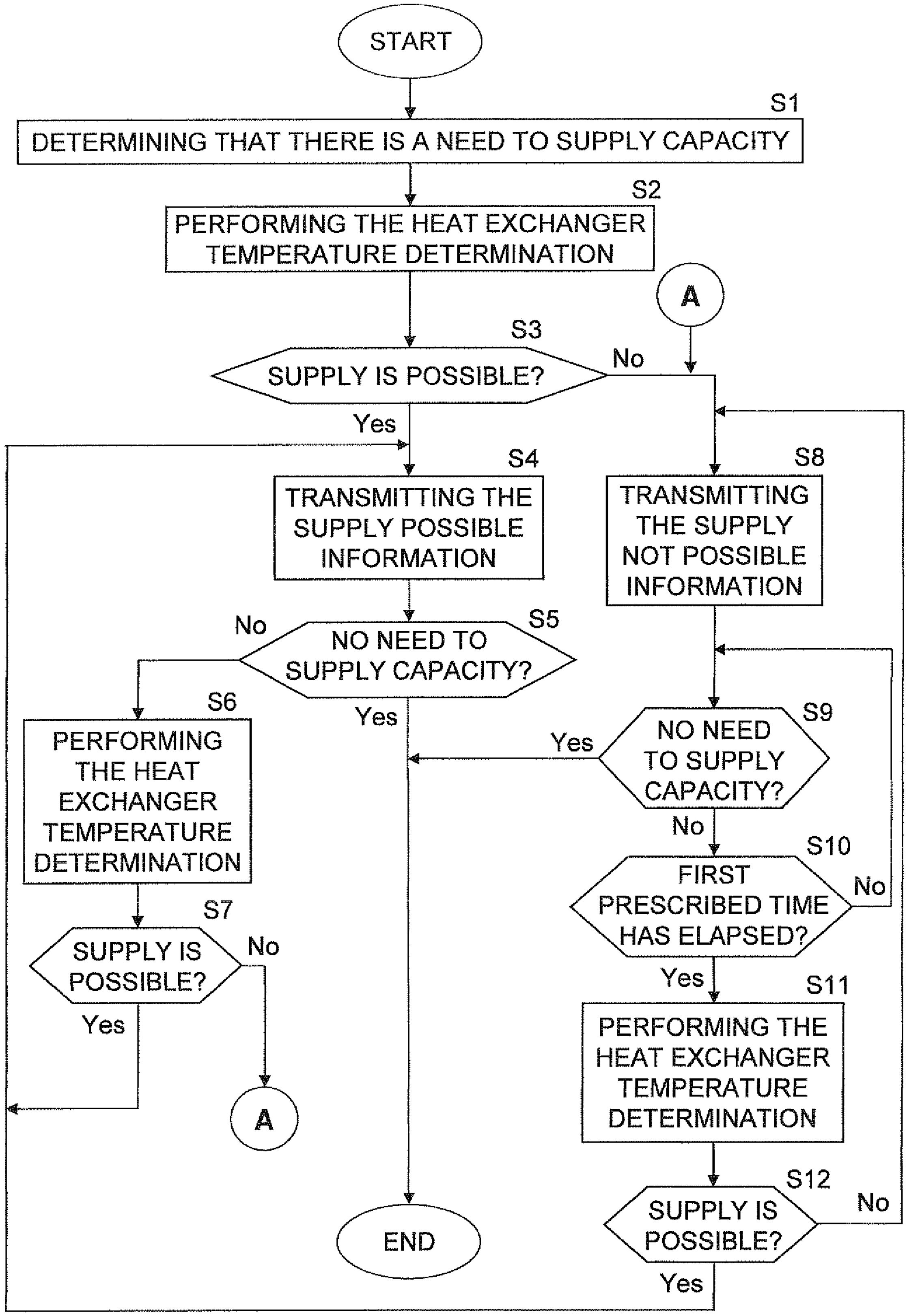
START
S1
DETERMINING THAT THERE IS A NEED TO SUPPLY CAPACITY
S2
PERFORMING THE HEAT EXCHANGER TEMPERATURE DETERMINATION
A
S3
SUPPLY IS POSSIBLE?
No
Yes
S4
TRANSMITTING THE SUPPLY POSSIBLE INFORMATION
S8
TRANSMITTING THE SUPPLY NOT POSSIBLE INFORMATION
No
S5
NO NEED TO SUPPLY CAPACITY?
Yes
S6
PERFORMING THE HEAT EXCHANGER TEMPERATURE DETERMINATION
S9
NO NEED TO SUPPLY CAPACITY?
Yes
No
S10
FIRST PRESCRIBED TIME HAS ELAPSED?
No
Yes
S7
SUPPLY IS POSSIBLE?
No
Yes
A
S11
PERFORMING THE HEAT EXCHANGER TEMPERATURE DETERMINATION
S12
SUPPLY IS POSSIBLE?
No
Yes
END

FIG. 5

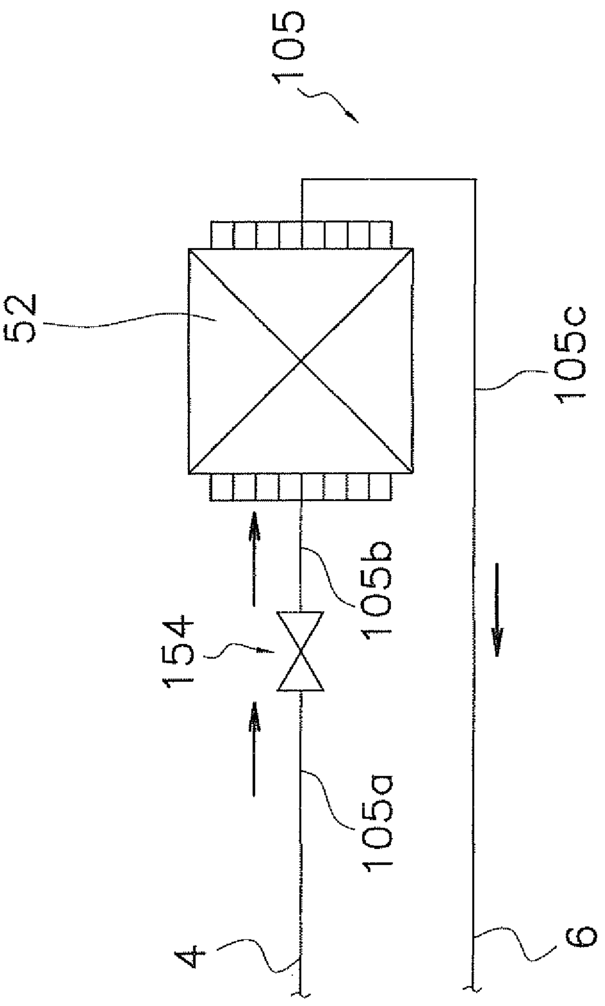


FIG. 6

**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2010/000096

A. CLASSIFICATION OF SUBJECT MATTER
*F24F11/02*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F11/02

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

| | | | |
|---|---|---|---|
| Jitsuyo Shinan Koho | 1922-1996 | Jitsuyo Shinan Toroku Koho | 1996-2010 |
| Kokai Jitsuyo Shinan Koho | 1971-2010 | Toroku Jitsuyo Shinan Koho | 1994-2010 |

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | JP 2007-212095 A (Hitachi Plant Technologies, Ltd.), 23 August 2007 (23.08.2007), paragraph [0003]; fig. 3 (Family: none) | 1-5 |
| Y | JP 5-10549 A (Daikin Industries, Ltd.), 19 January 1993 (19.01.1993), paragraphs [0012], [0021]; fig. 1 (Family: none) | 1-5 |
| A | JP 9-280630 A (Taikisha Ltd.), 31 October 1997 (31.10.1997), paragraph [0033] (Family: none) | 1-5 |

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

* Special categories of cited documents:
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## REFERENCES CITED IN THE DESCRIPTION



### Patent documents cited in the description

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