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(54) AIR CONDITIONING DEVICE SPECIALIZED FOR HEATING

(57) The invention provides a heating dedicated air conditioner that, if performing test operation in a reverse cycle to that of the heating cycle, can prevent drain water from an indoor heat exchanger from overflowing a drain pan. The heating dedicated air conditioner comprises: a compressor (**21**); an indoor heat exchanger (**42**); an outdoor heat exchanger (**23**); an outdoor expansion valve (**24**), which is provided between one end of the indoor heat exchanger (**42**) and one end of the outdoor heat exchanger (**23**); a four-way switching valve (**22**) that switches between a first state, wherein a discharge side of the compressor (**21**) and an other end of the indoor heat exchanger (**42**) are connected and a suction side of the compressor (**21**) and an other end of the outdoor heat exchanger (**23**) are connected, and a second state, wherein the discharge side of the compressor (**21**) and the other end of the outdoor heat exchanger (**23**) are connected and the suction side of the compressor (**21**) and the other end of the indoor heat exchanger (**42**) are connected; an indoor fan (**43**), which ventilates the indoor heat exchanger (**42**); and a control unit, which controls at least the compressor (**21**), the outdoor expansion valve (**24**), the four-way switching valve (**22**), and the indoor fan (**43**); wherein, the control unit, in the test operation mode, switches the four-way switching valve (**22**) to the second state; and a drain water inhibited interval during which drain water inhibition control is performed, wherein the control unit operates the compressor (**21**) and stops the indoor fan (**43**), is provided to the test operation mode.

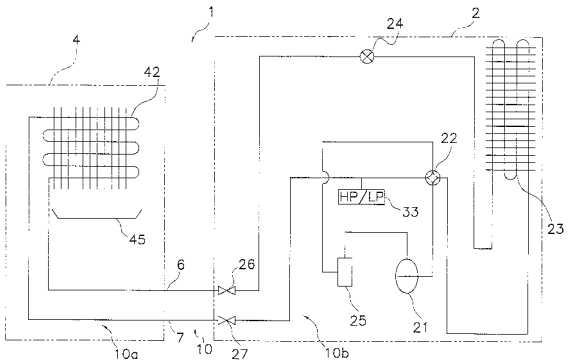


FIG. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a heating dedicated air conditioner.

BACKGROUND ART

[0002] In the conventional art, when an air conditioner is installed, a test operation is often performed in order to verify whether, for example, the various equipment of the air conditioner operates normally, the air conditioner has been constructed correctly, and the like. For example, in an air conditioner according to Patent Document 1 (i.e., Japanese Unexamined Patent Application Publication No. 2001-99459), a test operation is performed in a cooling cycle or a heating cycle; furthermore, in this test operation, a verification is simultaneously performed to determine whether the indoor fan is operating normally.

SUMMARY OF THE INVENTION

<Technical Problem>

[0003] Among the air conditioners discussed above, there are heating dedicated air conditioners that principally perform heating operation. In such a heating dedicated air conditioner, only heating operation is performed, and this principally in the winter season when the temperature is low; therefore, a drainage pipe that serves as drain water processing equipment is often not provided and only a drain pan is provided. Consequently, for example, in the summertime when the temperature and humidity are high, if a test operation of the heating dedicated air conditioner is performed in a reverse cycle to that of the heating cycle discussed above, then drain water from the indoor heat exchanger may overflow the drain pan and flow into the indoor space, which would be a problem.

[0004] Accordingly, an object of the present invention is to prevent drain water from an indoor heat exchanger from overflowing a drain pan in a case wherein a test operation of a heating dedicated air conditioner is performed in a reverse cycle to that of the heating cycle, for example, in summertime when the temperature and humidity are high.

<Solution to Problem>

[0005] A heating dedicated air conditioner according to a first aspect of the present invention comprises a compression mechanism, an indoor heat exchanger, an outdoor heat exchanger, an expansion mechanism, a four-way switching valve, a fan, and a control unit. The expansion mechanism is provided between one end of the indoor heat exchanger and one end of the outdoor heat exchanger. The four-way switching valve switches between a first state, wherein a discharge side of the compression mechanism and an other end of the indoor heat exchanger are connected and a suction side of the compression mechanism and an other end of the outdoor heat exchanger are connected, and a second state, wherein the discharge side of the compression mechanism and the other end of the outdoor heat exchanger are connected and the suction side of the compression mechanism and the other end of the indoor heat exchanger are connected. The fan ventilates the indoor heat exchanger. The control unit controls at least the compression mechanism, the expansion mechanism, the four-way switching valve, and the fan. In addition, the control unit, in the test operation mode, switches the four-way switching valve to the second state. Furthermore, the drain water inhibited interval during which drain water inhibition control is performed, wherein the control unit operates the compression mechanism and stops the fan, is provided to the test operation mode.

[0006] Here, in the heating dedicated air conditioner, if a drain pan is disposed, for example, below the indoor heat exchanger, then it is possible to accumulate drain water generated in the indoor heat exchanger. In addition, for example, the expansion mechanism is an expansion valve whose degree of opening may be fixed.

[0007] In the heating dedicated air conditioner according to the first aspect of the invention, the control unit, in the test operation mode, switches the four-way switching valve from the first state to the second state and stops the fan. Thereby, for example, in the heating dedicated air conditioner, it is possible to prevent drain water from overflowing the drain pan even if the drain pan alone is provided without drainage pipe that externally discharges the drain water accumulated in the drain pan, for example, even if test operation is performed in the summertime in a reverse cycle to that of a heating cycle.

[0008] A heating dedicated air conditioner according to a second aspect of the present invention is the heating dedicated air conditioner according to the first aspect of the invention, and further comprises a gas side shutoff valve and a pressure detector. The gas side shutoff valve is provided between the other end of the indoor heat exchanger and the four-way switching valve. The pressure detector is mounted to a gas refrigerant pipe that connects the other end of the indoor heat exchanger and the suction side of the compression mechanism.

[0009] In the heating dedicated air conditioner according to the second aspect of the invention, test operation in, for example, the test operation mode is performed in the state wherein the four-way switching valve is in the second state, namely, in the reverse cycle to that of the heating cycle. This is because, should test operation be performed in the heating cycle, the high pressure between the gas side shutoff valve and the discharge side of the compression mechanism will tend not to rise, and it might not be possible to promptly detect whether the gas side shutoff valve is in the open state, which is a

problem. Thereby, the open/close state of the gas side shutoff valve in the test operation mode can be promptly detected by performing, for example, test operation in the test operation mode in the reverse cycle to that of the heating cycle and providing the pressure detector to the gas refrigerant pipe that connects the other end of the indoor heat exchanger and the suction side of the compression mechanism.

[0010] A heating dedicated air conditioner according to a third aspect of the present invention is the heating dedicated air conditioner according to the second aspect of the invention, and further comprises an indoor casing and an outdoor casing. The indoor heat exchanger and the fan are housed in the indoor casing. The compression mechanism, the outdoor heat exchanger, the expansion mechanism, the four-way switching valve, the gas side shutoff valve, and the pressure detector are housed in the outdoor casing.

[0011] In the heating dedicated air conditioner according to the third aspect of the invention, it is possible to prevent the drain water from overflowing the drain pan even if test operation is performed in the summertime.

[0012] A heating dedicated air conditioner according to a fourth aspect of the present invention is the heating dedicated air conditioner according to any one aspect of the first through third aspects of the invention, and further comprises a gas-liquid separator. The gas-liquid separator is provided between the suction side of the compression mechanism and the four-way switching valve.

[0013] In the heating dedicated air conditioner according to the fourth aspect of the invention, the amount of evaporation of the refrigerant in the indoor heat exchanger decreases because the fan is stopped. Consequently, the amount of the liquid refrigerant increases more than when the fan is operating. Accordingly, providing the gas-liquid separator makes it possible to prevent the liquid from being sucked into the compressor,

[0014] A heating dedicated air conditioner according to a fifth aspect of the present invention is the heating dedicated air conditioner according to any one aspect of the first through fourth aspects of the invention, wherein the drain water inhibited interval occupies 80% or more of the entire interval of the test operation mode.

[0015] In the heating dedicated air conditioner according to the fifth aspect of the invention, it is possible to reduce the amount of indoor air delivered from the fan to the indoor heat exchanger by stopping the fan for an interval that is 80% or more of the entire interval. Thereby, even if the fan is driven, it is possible to prevent the drain water from overflowing the drain pan.

[0016] A heating dedicated air conditioner according to a sixth aspect of the present invention is the heating dedicated air conditioner according to the fifth aspect of the invention, wherein in the test operation mode, a first interval other than the drain water inhibited interval is a beginning interval of the entire interval of the test operation mode.

[0017] In the heating dedicated air conditioner according to the sixth aspect of the invention, the fan is driven during the beginning interval in the test operation mode when the evaporation temperature does not fall all that much. Thereby, it is possible to prevent the drain water from overflowing the drain pan even if the fan is driven.

<Advantageous Effects of Invention>

[0018] In the heating dedicated air conditioner according to the first aspect of the invention, the control unit, in the test operation mode, switches the four-way switching valve from the first state to the second state and stops the fan. Thereby, for example, in the heating dedicated air conditioner, it is possible to prevent drain water from overflowing the drain pan even if the drain pan alone is provided without drainage pipe that externally discharges the drain water accumulated in the drain pan, for example, even if test operation is performed in the summertime in a reverse cycle to that of a heating cycle.

[0019] In the heating dedicated air conditioner according to the second aspect of the invention, the open/close state of the gas side shutoff valve in the test operation mode can be promptly detected by performing, for example, test operation in the test operation mode in the reverse cycle to that of the heating cycle and providing the pressure detector to the gas refrigerant pipe that connects the other end of the indoor heat exchanger and the suction side of the compression mechanism.

[0020] In the heating dedicated air conditioner according to the third aspect of the invention, it is possible to prevent the drain water from overflowing the drain pan even if test operation is performed in the summertime.

[0021] In the heating dedicated air conditioner according to the fourth aspect of the invention, the amount of evaporation of the refrigerant in the indoor heat exchanger decreases because the fan is stopped. Consequently, the amount of the liquid refrigerant increases more than when the fan is operating. Accordingly, providing the gas-liquid separator makes it possible to prevent the liquid from being sucked into the compressor.

[0022] In the heating dedicated air conditioner according to the fifth and sixth aspects of the invention, even if the fan is driven, it is possible to prevent the drain water from overflowing the drain pan.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a system diagram of a refrigerant circuit of a heating dedicated air conditioner.

FIG. **2** is a control block diagram of a control unit.

FIG 3 is a flow chart that illustrates operation during a test operation of the heating dedicated air conditioner according to a second embodiment.

DESCRIPTION OF EMBODIMENTS

[0024] The embodiments of the present invention will now be explained, referencing the drawings.

<First Embodiment>

<Configuration of Heating Dedicated Air Conditioner 1>

[0025] The heating dedicated air conditioner **1** is used to heat an indoor space of a building by performing a vapor compression type refrigeration cycle operation. As shown in **FIG. 1,** the heating dedicated air conditioner **1** comprises a single outdoor **unit 2** that serves as a heat source unit, a single indoor unit **4** that serves as a utilization unit and is connected to the outdoor unit **2,** and a liquid side refrigerant connection pipe **6** and a gas side refrigerant connection pipe **7** that serve as refrigerant connection pipes and connect the outdoor unit **2** and the indoor unit **4.** Namely, a refrigerant circuit **10** of the heating dedicated air conditioner **1** is configured by the connection of the outdoor unit **2,** the indoor unit **4,** the liquid side refrigerant connection pipe **6,** and the gas side refrigerant connection pipe **7.**

<Configuration of Indoor Unit 4>

[0026] First, the configuration of the indoor unit **4** will be explained.

[0027] The indoor unit **4** is installed either by embedding it in or suspending it from the ceiling of the indoor space of a building or by mounting it to a wall surface of the indoor space. The indoor unit **4** is connected to the outdoor unit **2** via the liquid side refrigerant connection pipe **6** and the gas side refrigerant connection pipe **7.**

[0028] The indoor unit **4** principally comprises an indoor side refrigerant circuit 10a, which constitutes part of the refrigerant circuit **10.** The indoor side refrigerant circuit 10a principally comprises an indoor heat exchanger **42.**

[0029] The indoor heat exchanger **42** is a cross fin type fin and tube heat exchanger, which comprises a heat transfer tube and numerous fins; during heating operation, the indoor heat exchanger **42** functions as a condenser that condenses a refrigerant (e.g., a fluorocarbon based refrigerant) and heats indoor air. Furthermore, during defrosting operation and during test operation, discussed below, (i.e., in the state wherein the refrigerant circuit **10** is in a reverse cycle to that of the heating cycle), it functions as an evaporator that evaporates the refrigerant.

[0030] In addition, the indoor unit **4** comprises an indoor fan **43** (refer to **FIG. 2**). The indoor fan **43** functions as a ventilation fan, which is for sucking the indoor air into the indoor unit **4,** causing heat to be exchanged between that air and the refrigerant in the indoor heat exchanger **42,** and then supplying that air to the indoor space as supply air. In addition, the indoor fan **43** is driven by a fan motor (not shown) and is capable of varying the airflow of the air supplied to the indoor heat exchanger **42.** The fan motor is configured such that it is driven by receiving the supply of electric power via an inverter apparatus (not shown); furthermore, by varying the inverter frequency, which varies the fan rotational speed, the airflow of the indoor fan **43** can be varied.

[0031] Furthermore, below the indoor heat exchanger **42,** the indoor unit **4** is provided with a drain pan **45.** The drain pan **45** serves to receive any drain water generated in the indoor heat exchanger **42** in the state wherein the refrigerant circuit **10** is in the reverse cycle to that of the heating cycle. Furthermore, a drainage pipe for discharging the drain water is not provided.

<Configuration of Outdoor Unit 2>

[0032] Next, the configuration of the outdoor unit **2** will be explained.

[0033] The outdoor unit **2** is installed in the outdoor space outside of a building and is connected to the indoor unit **4** via the liquid side refrigerant connection pipe **6** and the gas side refrigerant connection pipe **7.** Furthermore, the outdoor unit **2** principally comprises an outdoor side refrigerant circuit **10b,** which constitutes part of the refrigerant circuit 10. The outdoor side refrigerant circuit **10b** principally comprises: a compressor **21**; a four-way switching valve **22;** an outdoor heat exchanger **23,** which serves as a heat source heat exchanger; an outdoor expansion valve **24,** which serves as an expansion mechanism; an accumulator **25;** a liquid side shutoff valve **26;** and a gas side shutoff valve **27.**

[0034] The compressor **21** is capable of varying the operating capacity and is a displacement type compressor that is driven by a compressor motor (not shown).

[0035] The four-way switching valve **22** is for the purpose of switching the flow direction of the refrigerant and can assume a first state (refer to the broken lines of the four-way switching valve **22** in **FIG. 1**) and a second state (refer to the solid lines of the four-way switching valve **22** in **FIG. 1**). In the first state, the discharge side of the compressor **21** and the gas side of the indoor heat exchanger **42** (specifically, the gas side refrigerant connection pipe **7**) are connected, and the suction side of the compressor **21** (specifically, the accumulator **25**) and the gas side of the outdoor heat exchanger **23** are connected. Namely, when the four-way switching valve **22** is in the first state, the refrigerant circuit **10** is in the heating cycle. In the second state, the discharge side of the compressor **21** and the gas side of the outdoor heat exchanger **23** are connected, and the suction side of the compressor **21** and the gas side of the indoor heat exchanger **42** are connected. Namely, when the four-way switching valve **22** is in the second state, the refrigerant circuit **10** is in the state wherein it is in the reverse cycle to that of the heating cycle, that is, in the cooling cycle state.

[0036] The outdoor heat exchanger **23** is a cross fin

type fin and tube heat exchanger, which comprises heat transfer tubes and numerous fins. The outdoor heat exchanger **23** functions as an evaporator that evaporates the refrigerant during the heating operation. The gas side of the outdoor heat exchanger **23** is connected to the four-way switching valve **22,** and the liquid side is connected to the liquid side refrigerant connection pipe **6.** Furthermore, when the four-way switching valve **22** is in the second state, the outdoor heat exchanger **23** functions as a condenser that condenses the refrigerant.

[0037] The outdoor expansion valve **24** is a motor operated expansion valve that is provided between one end of the indoor heat exchanger **42** and one end of the outdoor heat exchanger **23** and is connected to the liquid side of the outdoor heat exchanger **23.** The outdoor expansion valve **24** regulates the pressure, the flow volume, and the like of the refrigerant that flows through the interior of the outdoor side refrigerant circuit 10b.

[0038] The outdoor unit **2** comprises an outdoor fan **28** (refer to **FIG. 2**). The outdoor fan **28** functions as a ventilation fan, which is for sucking outdoor air into the outdoor unit **2,** causing heat to be exchanged between that air and the refrigerant in the outdoor heat exchanger **23,** and then discharging that air to the outdoor space. In addition, the outdoor fan **28** is capable of varying the amount of the outdoor air supplied to the outdoor heat exchanger **23,** and is a propeller fan that is driven by a fan motor (not shown).

[0039] The accumulator **25** is a vessel that is provided between the four-way switching valve **22** and the suction side of the compressor **21** and is capable of accumulating surplus refrigerant generated inside the refrigerant circuit **10** in accordance with fluctuations in the operating loads of the indoor unit **4.**

[0040] The liquid side shutoff valve **26** and the gas side shutoff valve **27** are provided to a connection port that connects to external equipment and pipe (specifically, the liquid side refrigerant connection pipe **6** and the gas side refrigerant connection pipe **7**). The liquid side shutoff valve **26** is connected to the outdoor heat exchanger **23.** The gas side shutoff valve **27** is connected to the four-way switching valve **22.** The liquid side shutoff valve **26** and the gas side shutoff valve **27** have a function that seals the refrigerant with which the outdoor unit **2** is initially filled. Generally, when a builder mounts the heating dedicated air conditioner **1,** he or she completes the refrigerant circuit **10** by connecting onsite the indoor unit **4** and the outdoor unit **2** using the liquid side refrigerant connection pipe **6** and the gas side refrigerant connection pipe **7** and, afterward, manually sets the liquid side shutoff valve **26** and the gas side shutoff valve **27** to an open state. Thereby, the refrigerant that is sealed inside the outdoor unit **2** (specifically, the outdoor heat exchanger **23**) is made to spread to the refrigerant circuit **10**.

[0041] In addition, the outdoor unit **2** is provided with a refrigerant pressure sensor **33,** which detects the pressure of the refrigerant between the four-way switching valve **22** and the gas side shutoff valve **27.**

<Configuration of Liquid Side Refrigerant Connection Pipe 6 and Gas Side Refrigerant Connection Pipe 7>

[0042] The liquid side refrigerant connection pipe 6 and the gas side refrigerant connection pipe **7** are refrigerant pipes that are laid onsite when the heating dedicated air conditioner 1 is installed at an installation location inside a building; refrigerant pipes of various lengths and diameters are used for the pipes **6, 7** in accordance with the installation conditions such as the installation location and the particular combination of the outdoor unit **2** and indoor unit **4** to be configured.

<Configuration of Control Unit 9>

[0043] A control unit **9** comprises a microcomputer, memory, and the like and, as shown in **FIG. 2,** comprises an indoor control unit 9a and an outdoor control unit **9b**. The indoor control unit **9a** controls the operation of the various equipment (specifically, the indoor fan **43** and the like) that constitutes the indoor unit **4.** The outdoor control unit **9b** controls the operation of the various equipment (specifically, the compressor **21,** the outdoor fan **28,** and the like) that constitutes the outdoor unit **2.**

[0044] The indoor control unit **9a** is capable of transmitting control signals to and receiving control signals from a remote controller (not shown), which is for separately operating the indoor unit **4.** In addition, the indoor control unit **9a** and the outdoor control unit **9b** are configured such that they can transmit control signals between and receive control signals from one another via a transmission line. Furthermore, the control unit **9,** which comprises the indoor control unit **9a** and the outdoor control unit **9b,** is connected to the refrigerant pressure sensor **33** such that the control unit **9** can receive a detection signal therefrom and is configured such that it can control the rotational speed of the indoor fan **43** and the outdoor fan **28,** the rotational speed of the compressor **21,** and the like based on the detection signal, a control signal from the remote controller, and the like.

[0045] Furthermore, prescribed threshold values are set in the control unit **9** for the low pressure side pressure and the high pressure side pressure detected by the refrigerant pressure sensor **33,** and fluctuations, either upward or downward, in the low pressure side pressure and the high pressure side pressure are detected on the basis of these threshold values. Furthermore, this detection makes it possible to know whether there is an abnormal condition in any of the various equipment of the heating dedicated air conditioner **1.** For example, during a test operation in a test operation mode, discussed below, when the gas side shutoff valve **27** is in not the open but the closed state, the pressure detected by the refrigerant pressure sensor 33 falls below the threshold value of the low pressure side pressure.

<Operation of Heating Dedicated Air Conditioner 1>

[0046] The principal operation modes of the heating dedicated air conditioner **1** are a normal operation mode, wherein the various equipment of the outdoor unit **2** and the indoor unit **4** is controlled in accordance with the operating load of the indoor unit **4,** and the test operation mode, which is for verifying, for example, whether the various equipment of the outdoor unit **2** and the indoor unit **4** is operating normally, and whether the construction is correct (e.g., whether the liquid side shutoff valve **26** and the gas side shutoff valve **27** are in the open state). In the normal operation mode, heating operation is principally performed. In the test operation mode, test operation is performed. Furthermore, test operation is performed after the installation of the various equipment of the heating dedicated air conditioner **1** (specifically, test operation is not limited to being performed after the initial installation of the equipment, and may be performed, for example, after making modifications such as adding or removing various equipment of the outdoor unit **2** and the indoor unit **4,** after repairing an equipment failure, and the like).

[0047] The following text explains the operation of the heating dedicated air conditioner **1** in each of the operation modes, referencing **FIG. 1.** Furthermore, the operation of the heating dedicated air conditioner **1** is performed by the control unit **9.**

(1) Normal Operation Mode

(a) Heating Operation

[0048] First, heating operation in the normal operation mode will be explained.

[0049] During heating operation, control is performed such that the four-way switching valve **22** is in the first state. Namely, the four-way switching valve **22** is controlled such that the state obtains wherein the discharge side of the compressor **21** is connected to the gas side of the indoor heat exchanger **42** via the gas side shutoff valve **27** and the gas side refrigerant connection pipe **7,** and the suction side of the compressor **21** is connected to the gas side of the outdoor heat exchanger **23.**

[0050] Furthermore, in this state, if the compressor **21**, the outdoor fan **28**, and the indoor fan **43** are driven, then the low pressure gas refrigerant is suctioned into the compressor **21** and therefore is compressed and transitions to high pressure gas refrigerant. This high pressure gas refrigerant is delivered to the indoor unit **4** via the four-way switching valve **22,** the gas side shutoff valve **27,** and the gas side refrigerant connection pipe **7.** In the indoor heat exchanger **42,** the heat of the high pressure gas refrigerant delivered to the indoor unit **4** is exchanged with the indoor air supplied by the indoor fan **43,** and thereby that refrigerant is condensed and transitions to high pressure liquid refrigerant. The high pressure liquid refrigerant is delivered to the outdoor unit **2** via the liquid side refrigerant connection pipe **6** and the liquid side shutoff valve **26**. Furthermore, the pressure of the high pressure liquid refrigerant delivered to the outdoor unit **2** is reduced by the outdoor expansion valve **24,** and that refrigerant transitions to refrigerant in a low pressure gas-liquid two-phase state and is delivered to the outdoor heat exchanger **23.** In the outdoor heat exchanger **23,** the heat of the liquid refrigerant in the low pressure gas-liquid two-phase state is exchanged with the outdoor air supplied by the outdoor fan **28,** and thereby that refrigerant evaporates and transitions to low pressure gas refrigerant. This low pressure gas refrigerant flows into the accumulator **25** via the four-way switching valve **22** and then once again is suctioned into the compressor **21.**

[0051] Accordingly, the outdoor heat exchanger **23** functions as an evaporator that evaporates the refrigerant. However, if the heating operation of the heating dedicated air conditioner **1** is performed under the condition wherein the temperature of the outdoor air, which is the heat source of the outdoor heat exchanger **23,** is low, then one can assume that frost will adhere to the surface of the outdoor heat exchanger. Furthermore, if frost does adhere to the surface of the outdoor heat exchanger, then there is a risk that the heat exchange performance of the outdoor heat exchanger will decrease. Accordingly, in the heating dedicated air conditioner 1, when frost adheres to the outdoor heat exchanger **23** during heating operation, the four-way switching valve **22** is temporarily switched from the first state to the second state and defrosting operation is performed as below.

(b) Defrosting Operation

[0052] During defrosting operation, control is performed such that the four-way switching valve **22** is in the second state. Namely, the four-way switching valve **22** is controlled such that a state obtains wherein the discharge side of the compressor **21** is connected to the gas side of the outdoor heat exchanger **23,** and the suction side of the compressor **21** is connected to the gas side of the indoor heat exchanger **42** via the gas side shutoff valve **27** and the gas side refrigerant connection pipe **7.**

[0053] In this state, if the compressor **21** is driven, first, the low pressure gas refrigerant is suctioned into the compressor **21** where it is compressed and transitions to high pressure gas refrigerant. Furthermore, the high pressure gas refrigerant is delivered to the outdoor heat exchanger **23** via the four-way switching valve **22,** its heat is exchanged with the outdoor air in the outdoor heat exchanger **23,** and thereby condenses and transitions to high pressure liquid refrigerant. At this time, the frost or the ice that adheres to the surface of the outdoor heat exchanger **23** melts owing to the heat emitted from the high pressure gas refrigerant, which is undergoing the heat exchange process. Furthermore, during defrosting operation, control is performed such that the outdoor fan **28** is in the stopped state.

[0054] Furthermore, the outdoor expansion valve **24** reduces the pressure of the high pressure liquid refrigerant, which transitions to refrigerant in the low pressure gas-liquid two-phase state and is delivered to the indoor unit **4** via the liquid side shutoff valve **26** and the liquid side refrigerant connection pipe **6.** The refrigerant in the low pressure gas-liquid two-phase state delivered to the indoor unit **4** is then delivered to the indoor heat exchanger **42;** the heat of that refrigerant is exchanged with the indoor air at the indoor heat exchanger **42,** and thereby that refrigerant evaporates and transitions to low pressure gas refrigerant. At this time, the indoor fan **43** is controlled such that it is in the stopped state. This is done in order to prevent cold air from potentially being blown out into the indoor space when the indoor fan **43** is operating, thereby reducing the comfort of users of the indoor space.

[0055] Furthermore, the low pressure gas refrigerant is delivered to the outdoor unit **2** via the gas side refrigerant connection pipe 7 and the gas side shutoff valve **27,** and then flows into the accumulator **25** via the four-way switching valve **22.** Furthermore, the low pressure liquid refrigerant that does not evaporate at the indoor heat exchanger **42** because the indoor fan **43** is stopped accumulates in the accumulator **25.**

[0056] Furthermore, the low pressure gas refrigerant that flows into the accumulator **25** is once again sucked into the compressor **21.**

(2) Test Operation Mode

[0057] Test operation in the test operation mode will be explained next. Note that test operation is performed by a worker operating an operation button, which is provided to a remote controller (not shown) and is for setting the operation mode to the test operation mode. In addition, the test operation interval, which is the entire interval during which test operation is performed in the test operation mode, is set in advance (e.g., to three minutes); furthermore, when the set test operation interval ends, the mode switches to the operation mode set by the user via the remote controller (i.e., to heating operation in the normal operation mode).

[0058] Here, ordinarily, test operation is often performed in the state wherein the four-way switching valve **22** is controlled such that it is in the second state (i.e., when the refrigerant circuit is in the so-called cooling cycle state). This is because if test operation is performed during the heating cycle, then the pressure detected by the refrigerant pressure sensor 33 will tend not to rise, and consequently it could become difficult to promptly detect whether the shutoff valve (e.g., the gas side shutoff valve **27**) is in the open state.

[0059] However, in a heating dedicated air conditioner, drainage work, such as for discharging drain water accumulated in a drain pan to the outdoor space, is often not undertaken. Consequently, if the heating dedicated air conditioner is used and test operation is performed during the cooling cycle in, for example, a high temperature and high humidity location or during a high temperature and high humidity season (e.g., summertime), then the refrigerant that flows through the interior of an indoor heat exchanger will take the heat of the indoor air delivered to the indoor heat exchanger by an indoor fan, and thereby a large amount of drain water is assumed to be generated in the indoor heat exchanger. Therefore, even if the drain water generated in the indoor heat exchanger could be accumulated in the drain pan, if the amount of the drain water exceeds the capacity of the drain pan to store water, then it is conceivable that the drain water will overflow the drain pan and flow into the indoor space.

[0060] Accordingly, during test operation of the heating dedicated air conditioner **1,** drain water inhibition control, which operates the compressor **21** and stops the indoor fan **43**, is performed. A drain water inhibited interval, during which drain water inhibition control is performed, is the same as the test operation interval. Namely, in the heating dedicated air conditioner 1, the indoor fan **43** is always stopped during test operation in the test operation mode.

[0061] Thereby, the generation of drain water is inhibited because the heat exchange efficiency between the refrigerant and the indoor air in the indoor heat exchanger **42** is lower than when the indoor fan **43** is being operated. Thereby, it is possible to prevent the drain water from overflowing the drain pan **45.**

[0062] Furthermore, the operation of the heating dedicated air conditioner **1** during test operation is substantially the same as the operation of the heating dedicated air conditioner **1** during defrosting operation. However, during defrosting operation, the outdoor fan **28** is stopped, whereas, during test operation, the outdoor fan **28** is operated and the degree of opening of the outdoor expansion valve **24** is fixed.

<Characteristics of Heating Dedicated Air Conditioner 1 According to the First Embodiment>

(1)

[0063] In the first embodiment, test operation is performed in the state wherein the four-way switching valve **22** is in the second state. Furthermore, during test operation, the indoor fan **43** is stopped.

[0064] Thereby, the indoor fan **43** no longer delivers the indoor air to the indoor heat exchanger **42,** and therefore the amount of the indoor air whose heat is exchanged with the refrigerant in the indoor heat exchanger **42** decreases. Accordingly, because the drain water generated in the indoor heat exchanger **42** also decreases, it becomes possible to prevent the drain water from overflowing the drain pan **45,** even during the summer. In addition, because the drain water does not overflow the drain pan **45,** it is possible to also prevent the drain water from flowing into the indoor space. In addition, drain work also thereby becomes unnecessary.

(2)

[0065] In the first embodiment, the indoor fan **43** is stopped during test operation and during defrosting operation. Consequently, the amount of evaporation of the refrigerant flowing through the indoor heat exchanger **42** is assumed to be less than when the indoor fan **43** is being operated. Furthermore, it is conceivable that the reduced amount of evaporation of the refrigerant flowing through the indoor heat exchanger **42** causes not only the gas refrigerant but also the refrigerant in the gas-liquid two-phase state to flow out of the indoor heat exchanger **42** and to the outdoor unit **2** side.

[0066] Accordingly, because the provision of the accumulator **25** between the suction side of the compressor **21** and the four-way switching valve **22** makes it possible to accumulate the liquid refrigerant in the accumulator **25** even if the refrigerant in the gas-liquid two-phase state flows to the outdoor unit **2** side, it is possible to cause the gas refrigerant alone to be suctioned to the compressor **21.** Thereby, it is possible to prevent damage to the compressor **21.**

<modified Example of Heating Dedicated Air Conditioned 1 According to the First Embodiment>

[0067] The above text explained an embodiment of the present invention based on the drawings, but the specific constitution is not limited to that embodiment, and it is understood that variations and modifications may be effected without departing from the spirit and scope of the invention.

(A)

[0068] The abovementioned embodiment explained a case that is limited to a separate type heating dedicated air conditioner **1,** wherein one indoor unit **4** is connected to one outdoor unit **2,** but the present invention is not limited thereto; for example, the present invention may be adapted to an integrated type heating dedicated air conditioner, wherein the outdoor unit **2** and the indoor unit **4** are integrated.

[0069] In addition, the abovementioned embodiment explained a case limited to a so-called paired heating dedicated air conditioner **1**, wherein one indoor unit **4** is connected to one outdoor unit **2,** but the present invention is not limited thereto. For example, the present invention may be adapted to a so-called multi type heating dedicated air conditioner, wherein a plurality of the indoor units is connected to one outdoor unit **2.**

(B)

[0070] In the abovementioned embodiment, the refrigerant is not limited to fluorocarbon based refrigerant, and may be a natural refrigerant such as CO_2 refrigerant.

<Second Embodiment>

[0071] Continuing, a second embodiment of the heating dedicated air conditioner **1** will now be explained. Note that components and the like identical to those in the first embodiment are assigned the same symbols, and explanations thereof are therefore omitted.

[0072] The second embodiment differs from the first embodiment as follows: in the first embodiment, the indoor fan **43** is always stopped during test operation in the test operation mode; however, in the second embodiment, there is a case wherein the indoor fan 43 is operated, and is not always stopped, during test operation.

[0073] The text below explains the operation during test operation of the heating dedicated air conditioner **1** in the second embodiment, referencing **FIG. 3.**

[0074] **FIG. 3** is a flow chart that illustrates operation during test operation of the heating dedicated air conditioner 1 according to the second embodiment.

[0075] First, in a step **S101,** the four-way switching valve **22** is controlled such that it is in the second state, as in the first embodiment. Furthermore, in a step **S102,** the compressor **21** and the outdoor fan **28** are driven, as in the first embodiment. At this time, in the first embodiment, the indoor fan **43** is always stopped during test operation in the test operation mode, and consequently the indoor fan **43** is not driven; however, in the second embodiment, the indoor fan **43** is driven in addition to the compressor **21** and the outdoor fan **28.**

[0076] Next, in a step **S103,** it is determined whether the indoor fan **43** is operating normally. If it is determined that it is operating normally, then the process transitions to a step **S104;** if, however, it is determined that it is not operating normally, then the process transitions to a step **S105**.

[0077] In the step **S104,** drain water inhibition control is performed, as in the first embodiment. Namely, the compressor **21** maintains its operation state as is, and the indoor fan **43** stops.

[0078] In the step **S105,** it has been determined that the indoor fan **43** is not operating normally, and therefore a warning is displayed via a reporting unit (not shown; e.g., an LED or a character display).

[0079] Accordingly, in the heating dedicated air conditioner 1 according to the second embodiment, the interval during which the indoor fan **43** is driven (corresponding to a first interval) is approximately 5-10 s. Thereby, the drain water inhibited interval, which is the interval during which the drain water inhibition control is performed, occupies 80% or more (specifically, approximately 94%-97%) of the test operation interval (e.g., 3 minutes).

[0080] In addition, as discussed above, the interval during which the indoor fan **43** is driven is the beginning interval in the test operation interval. This is because drain water tends to be generated if the indoor fan **43** is driven when the evaporation temperature has fallen.

[0081] Furthermore, as in the indoor fan **43,** a warning is displayed even if the compressor **21,** the outdoor fan

28, or the like is not being driven normally.

<Characteristics of Heating Dedicated Air Conditioner 1 According to the Second Embodiment>

[0082] In the heating dedicated air conditioner 1 according to the second embodiment, the indoor fan **43** can be driven during test operation in the test operation mode, which is effective if, for example, one wishes to verify whether the indoor fan **43** is operating normally.

[0083] In addition, in the heating dedicated air conditioner **1** according to the second embodiment, the drain water inhibited interval, which is the interval during which drain water inhibition control is performed, occupies 80% or more of the test operation interval.

[0084] During test operation in the test operation mode, it is possible to reduce the amount of the indoor air delivered from the indoor fan **43** to the indoor heat exchanger **42** by stopping the indoor fan **43** for an interval that is 80% or more of the entire interval. Thereby, the amount of drain water generated in the indoor heat exchanger **42** decreases. Accordingly, even if the indoor fan **43** is driven in order to verify whether the indoor fan **43** is operating normally, it is still possible to prevent the drain water from overflowing the drain pan **45.**

[0085] In addition, in the heating dedicated air conditioner **1** according to the second embodiment, the interval during which the indoor fan **43** is driven is the beginning interval in the test operation interval. Namely, the indoor fan **43** is driven in the beginning interval during test operation when the evaporation temperature does not drop all that much. Thereby, it is possible to prevent the drain water from overflowing the drain pan **45** even if the indoor fan 43 is driven in order to verify whether the indoor fan **43** is operating normally. In addition, drain work also thereby becomes unnecessary.

<modified Example of the Heating Dedicated Air Conditioner 1 According to the Second Embodiment>

[0086] In the abovementioned embodiments, the indoor fan **43** is driven in order to verify whether it is operating normally, but the present invention is not limited thereto; the indoor fan 43 may be driven as discussed above for some other purpose. Even so, the same effects as those discussed above are obtained.

INDUSTRIAL APPLICABILITY

[0087] In the present invention, if test operation of the heating dedicated air conditioner is performed in the reverse cycle to that of the heating cycle in, for example, summertime when the temperature and humidity are high, then it is possible to prevent drain water generated in the indoor heat exchanger from overflowing the drain pan, thereby making drain work unnecessary, which is useful.

REFERENCE SIGNS LIST

[0088]

1	Heating dedicated air conditioner
2	Outdoor casing (outdoor unit)
4	Indoor casing (indoor unit)
7	Gas side refrigerant connection pipe (gas refrigerant pipe)
9	Control unit
21	Compressor (compression mechanism)
22	Four-way switching valve
23	Outdoor heat exchanger
24	Outdoor expansion valve (expansion mechanism)
25	Accumulator (gas-liquid separator)
27	Gas side shutoff valve
33	Refrigerant pressure sensor (pressure detector)
42	Indoor heat exchanger
43	Indoor fan (fan)

CITATION LIST

PATENT LITERATURE

[0089]

Patent Document 1
Japanese Unexamined Patent Application Publication No. 2001-99459

Claims

1. A heating dedicated air conditioner (**1**), comprising:

a compression mechanism (**21**);
an indoor heat exchanger (**42**);
an outdoor heat exchanger (**23**);
an expansion mechanism (**24**), which is provided between one end of the indoor heat exchanger (**42**) and one end of the outdoor heat exchanger (**23**);
a four-way switching valve (**22**) that switches between a first state, wherein a discharge side of the compression mechanism (**21**) and an other end of the indoor heat exchanger (**42**) are connected and a suction side of the compression mechanism (**21**) and an other end of the outdoor heat exchanger (**23**) are connected, and a second state,
wherein the discharge side of the compression mechanism (**21**) and the other end of the outdoor heat exchanger (**23**) are connected and the suction side of the compression mechanism (**21**) and the other end of the indoor heat exchanger (**42**) are connected;
a fan (**43**), which ventilates the indoor heat exchanger (**42**); and

a control unit (**9**), which controls at least the compression mechanism (**21**), the expansion mechanism (**24**), the four-way switching valve (**22**), and the fan (**43**);

wherein,

the control unit (**9**), in the test operation mode, switches the four-way switching valve (**22**) to the second state; and
a drain water inhibited interval during which drain water inhibition control is performed, wherein the control unit (**9**) operates the compression mechanism (**21**) and
stops the fan (**43**), is provided to the test operation mode.

2. The heating dedicated air conditioner (**1**) according to claim 1, further comprising:

a gas side shutoff valve (**27**), which is provided between the other end of the indoor heat exchanger (**42**) and the four-way switching valve (**22**); and
a pressure detector (**33**), which is mounted to a gas refrigerant pipe (**7**) that connects the other end of the indoor heat exchanger (**42**) and the suction side of the compression mechanism (**21**).

3. The heating dedicated air conditioner (**1**) according to claim 2, further comprising:

an indoor casing (**4**); and
an outdoor casing (**2**);

wherein,

the indoor heat exchanger (**42**) and the fan (**43**) are housed in the indoor casing (**4**); and
the compression mechanism (**21**), the outdoor heat exchanger (**23**), the expansion mechanism (**24**), the four-way switching valve (**22**), the gas side shutoff valve (**27**),
and the pressure detector (**33**) are housed in the outdoor casing (**2**).

4. The heating dedicated air conditioner (**1**) according to any one claim of claim 1 through claim 3, further comprising:

a gas-liquid separator (**25**), which is provided between the suction side of the compression mechanism (**21**) and the four-way switching valve (**22**).

5. The heating dedicated air conditioner (**1**) according to any one claim of claim 1 through claim 4, wherein
the drain water inhibited interval occupies 80% or more of the entire interval of the test operation mode.

6. The heating dedicated air conditioner (**1**) according to claim 5, wherein
in the test operation mode, a first interval other than the drain water inhibited interval is a beginning interval of the entire interval of the test operation mode.

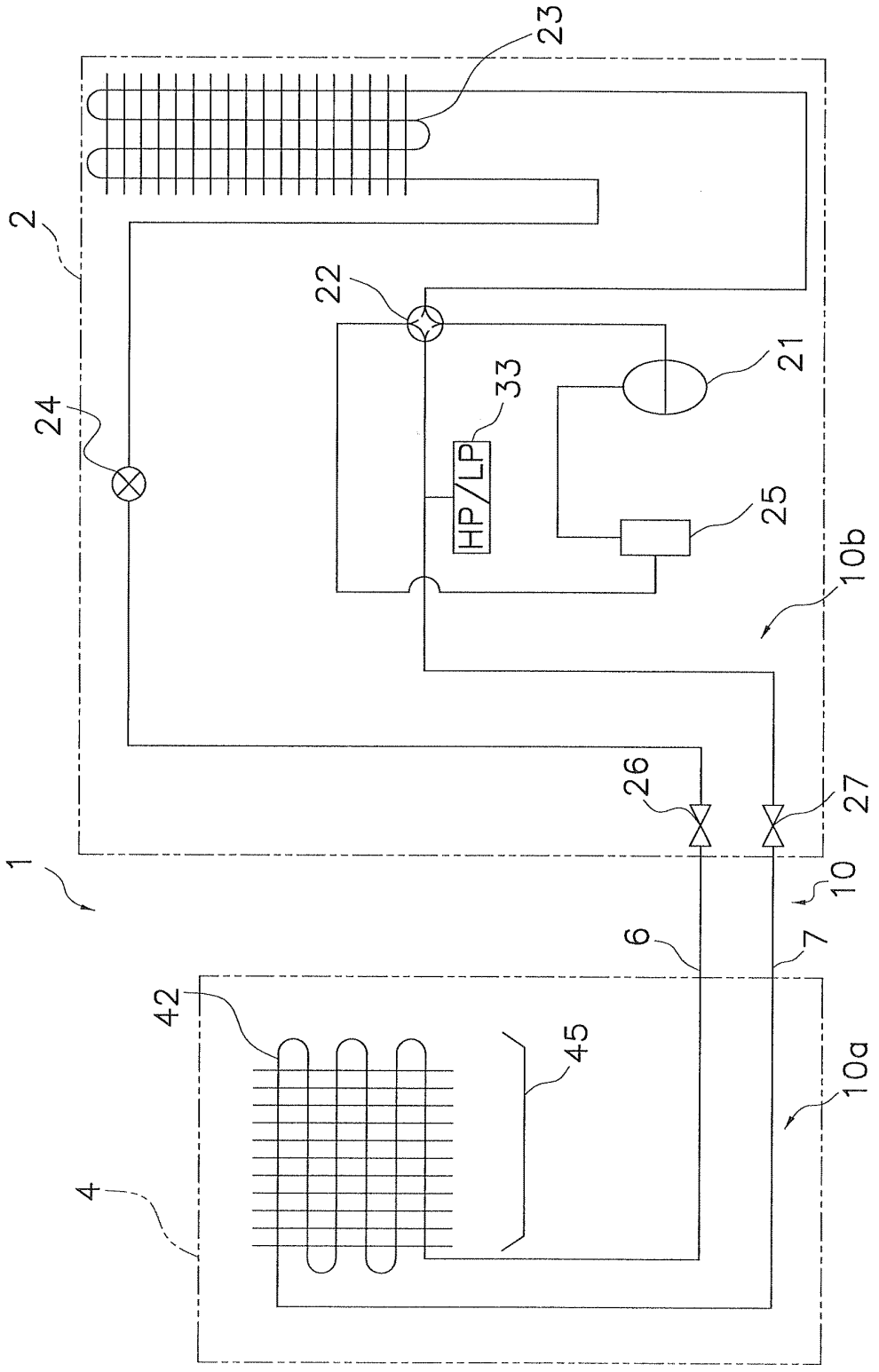


FIG. 1

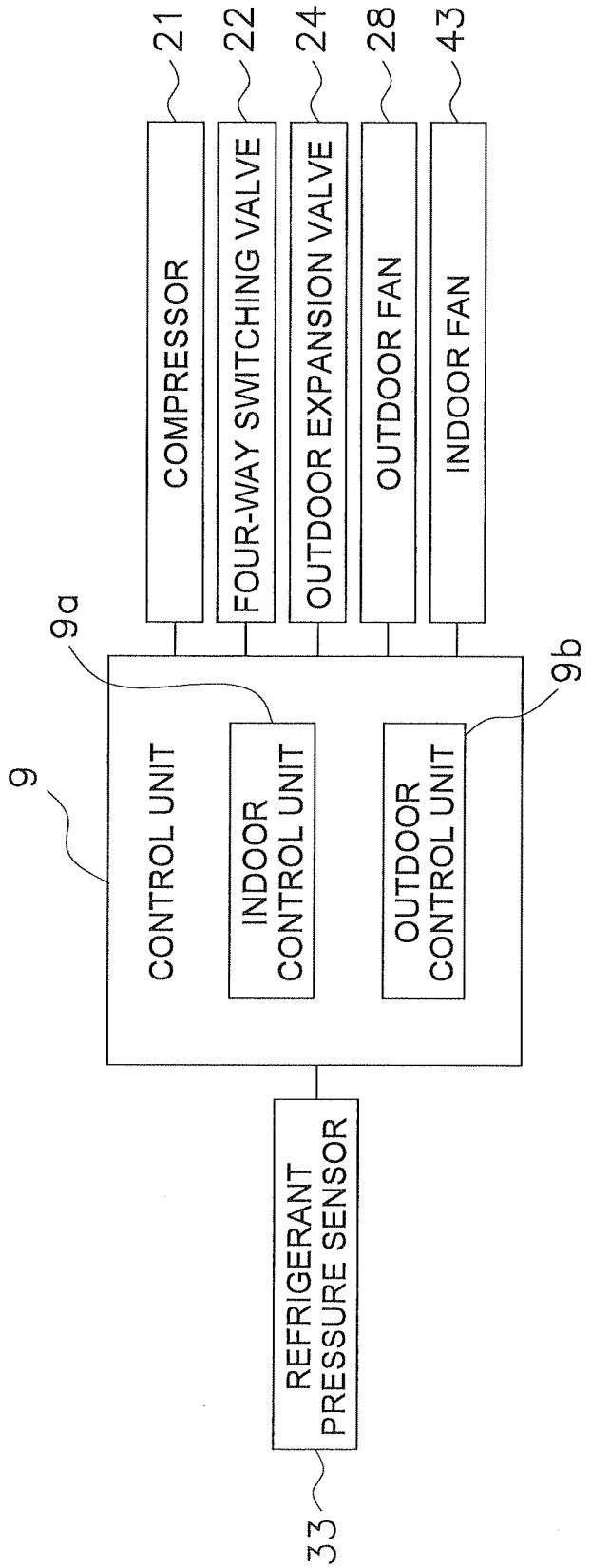

21
22
24
28
43
COMPRESSOR
FOUR-WAY SWITCHING VALVE
OUTDOOR EXPANSION VALVE
OUTDOOR FAN
INDOOR FAN
9a
9b
9
CONTROL UNIT
INDOOR CONTROL UNIT
OUTDOOR CONTROL UNIT
REFRIGERANT PRESSURE SENSOR
33

FIG. 2

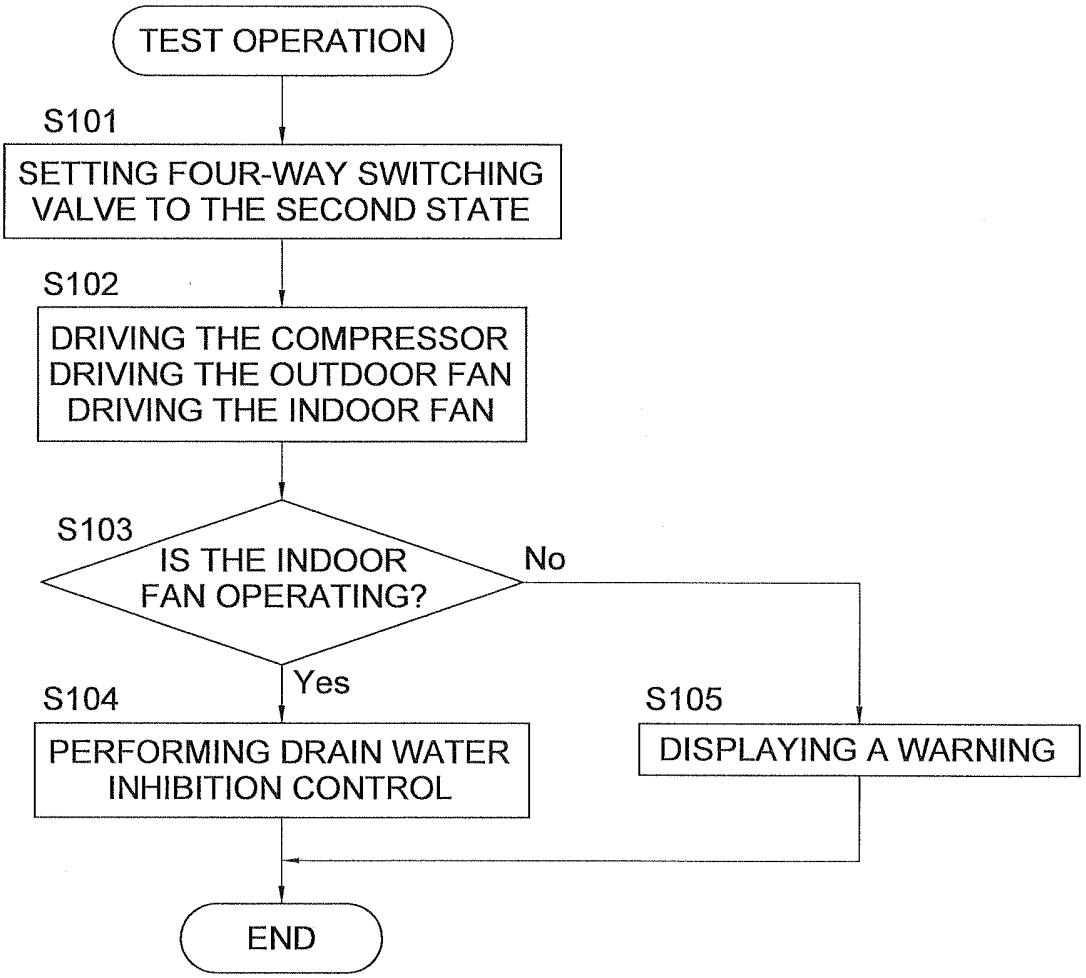

TEST OPERATION
S101
SETTING FOUR-WAY SWITCHING VALVE TO THE SECOND STATE
S102
DRIVING THE COMPRESSOR
DRIVING THE OUTDOOR FAN
DRIVING THE INDOOR FAN
S103
IS THE INDOOR FAN OPERATING?
No
Yes
S104
PERFORMING DRAIN WATER INHIBITION CONTROL
S105
DISPLAYING A WARNING
END

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/003531

A. CLASSIFICATION OF SUBJECT MATTER
F24F1/00(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F1/00

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.
A	JP 2006-349302 A (Toyo Standard Corp.), 28 December 2006 (28.12.2006), entire text; all drawings (Family: none)	1-6
A	JP 11-118213 A (Sanden Corp.), 30 April 1999 (30.04.1999), entire text; all drawings (Family: none)	1-6
A	JP 11-72259 A (Daikin Industries, Ltd.), 16 March 1999 (16.03.1999), entire text; all drawings (Family: none)	1-6

☐ 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
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"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
16 July, 2010 (16.07.10)	03 August, 2010 (03.08.10)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2001099459 A **[0002] [0089]**