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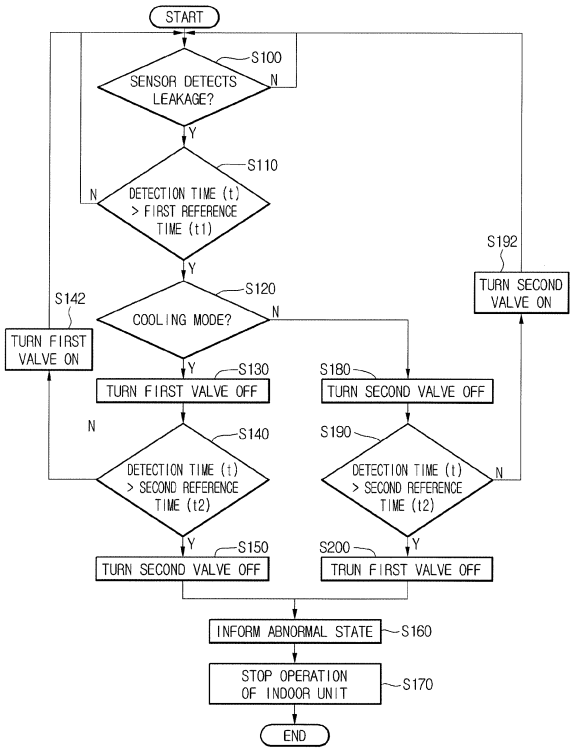
(54) **Air conditioner and control method thereof**

(57) Provided are an air conditioner and a control method thereof. The air conditioner includes a compressor compressing an inflow refrigerant to discharge the compressed refrigerant, an outdoor heat exchanger in which outdoor air introduced into an outdoor unit and the refrigerant are heat-exchanged with each other, an indoor heat exchanger in which indoor air introduced into an indoor unit and the refrigerant are heat-exchanged with each other, valves respectively disposed in an inflow-side tube and a discharge-side tube of the indoor heat exchanger, and a refrigerant leakage detection part directly or indirectly detecting leakage of the refrigerant. When the leakage of the refrigerant is detected, the valves are blocked in stages.

Fig. 3



EP 2 728 280 A1

Description

BACKGROUND

[0001] The present disclosure relates to an air conditioner and a control method thereof.

[0002] An air conditioner includes a compressor, an outdoor heat exchanger, an indoor heat exchanger, and an expansion valve.

[0003] Here, a refrigerant is used as a medium for operating the air conditioner. The air conditioner may operate in a heating cycle or cooling cycle according to a flow direction of the refrigerant.

[0004] When the air conditioner operates for a long time, the refrigerant circulating through the air conditioner may leak from a tube due to installation errors or user's carelessness.

[0005] Here, when the refrigerant leaks, heating or cooling performance of the air conditioner may be deteriorated, and also, the compressor may be damaged during the operation of the air conditioner. In addition, when the refrigerant that has a bad influence on the human body leaks, a user may have various diseases.

[0006] Thus, a refrigerant leakage detection unit and a control method thereof may be realized in the air conditioner.

[0007] For example, when a temperature difference between a heat exchanger and suctioned air is less than a preset value, it may be determined that the refrigerant leaks.

[0008] For another example, the leakage of the refrigerant may be directly detected by using two electrodes and an impedance measurement device that measures an impedance between the two electrodes.

[0009] Also, when the leakage of the refrigerant is detected, an operation of the air conditioner may be stopped to stop the circulation of the refrigerant.

[0010] In the air conditioner according to the related art, since the operation of the air conditioner is uniformly stopped even though it is determined that a refrigerant leaks due to misdetection of the refrigerant leakage detection unit, the air conditioner may be unnecessarily stopped in use.

[0011] Also, in a multi-type air conditioner in which a plurality of indoor units are connected to each other, when a refrigerant leaks in a partial area, an overall operation of all of the indoor units may be stopped to deteriorate convenience in use.

SUMMARY

[0012] Embodiments provide an air conditioner and a control method thereof.

[0013] In one embodiment, an air conditioner includes: a compressor compressing an inflow refrigerant to discharge the compressed refrigerant; an outdoor heat exchanger in which outdoor air introduced into an outdoor unit and the refrigerant are heat-exchanged with each other; an indoor heat exchanger in which indoor air introduced into an indoor unit and the refrigerant are heat-exchanged with each other; valves respectively disposed in an inflow-side tube and a discharge-side tube of the indoor heat exchanger; a refrigerant leakage detection part directly or indirectly detecting leakage of the refrigerant; and a control part configured, when the leakage of the refrigerant is detected, to block the valves in consecutive order.

[0014] The valves may include: a first valve disposed in the inflow-side tube of the indoor heat exchanger; and a second valve disposed in the discharge-side tube of the indoor heat exchanger. Herein, the control part may be configured, when the leakage of the refrigerant is detected, to block the first valve earlier than the second valve.

[0015] The control part may be configured, when the leakage of the refrigerant continues for a preset time (t2) after the first valve is blocked, to block the second valve.

[0016] The control part may be configured, when the leakage of the refrigerant does not continue for a preset time (t2) after the first valve is blocked, to open the first valve. Furthermore, the control part may be configured to maintain the second valve in an open state.

[0017] One of the valves may be an outdoor expansion valve or indoor expansion valve.

[0018] The indoor heat exchanger may be provided in plurality. The air conditioner may further include a branch tube for guiding the refrigerant into each of the indoor heat exchangers.

[0019] The branch tube may be disposed between the outdoor heat exchanger and the indoor heat exchanger. Furthermore, one of the valves may be disposed between the branch tube and the indoor heat exchanger.

[0020] The air conditioner may further include a counter detecting the number (N) of indoor units in which the leakage of the refrigerant occurs. The control part may be configured, when the number (N) of leakage occurrence indoor units detected by the counter exceeds a preset number (N1), to stop an operation of the outdoor unit.

[0021] The control part may be configured, when the number (N) of leakage occurrence indoor units exceeds the preset number (N1), to stop operations of the compressor and an outdoor unit fan.

[0022] In another embodiment, an air conditioner includes: a first valve disposed in a refrigerant suction-side tube of an indoor heat exchanger to selectively block a flow of a refrigerant on the basis of a cooling mode; a second valve disposed in a refrigerant discharge-side tube of the indoor heat exchanger to selectively block the flow of the refrigerant on the basis of the cooling mode; a flow switching valve switching a flow direction of the refrigerant according to an operation mode of the air conditioner; a refrigerant leakage detection part detecting a refrigerant leaking into an indoor space; and a control part successively closing the first and second valves when the leakage of the refrigerant is detected by the

refrigerant leakage detection part.

[0023] The control part may close the first valve earlier than the first valve in a cooling mode and close the second valve earlier than the first valve in a heating mode.

[0024] The air conditioner may further include an indoor unit fan guiding a flow of indoor air so that the indoor air passes through the indoor heat exchanger.

[0025] The control part may enable the indoor unit fan to continue to operate while one valve of the first and second valves is blocked.

[0026] When all of the first and second valves are blocked, the control part may stop an operation of the indoor unit fan.

[0027] In further another embodiment, a method of controlling an air conditioner includes: firstly detecting leakage of a refrigerant in an indoor space in which air-conditioning is performed; closing a first valve disposed in a refrigerant inflow-side tube of an indoor heat exchanger when the leakage of the refrigerant is detected in said first detecting; secondarily detecting the leakage of the refrigerant after the first valve is blocked; and closing a second valve disposed in a refrigerant discharge-side tube of the indoor heat exchanger when the leakage of the refrigerant is detected in said second detecting.

[0028] The closing of the valves may be performed when a time in which the leakage of the refrigerant continues exceeds a preset reference time.

[0029] When the leakage of the refrigerant is not detected in said second detecting, the first valve may be opened.

[0030] When the leakage of the refrigerant is detected in said first detecting, the method may determine whether an operation mode of the air conditioner is a cooling mode or a heating mode. The first valve disposed in the refrigerant inflow-side tube of the indoor heat exchanger may be blocked according to the determined operation mode.

[0031] When the leakage of the refrigerant is detected in said second detecting, an operation of an indoor unit may be stopped.

[0032] When the number (N) of indoor units in which the leakage of the refrigerant occurs exceeds the number (N1) of preset reference indoor units, an operation of an outdoor unit may be stopped.

[0033] The details of one or more embodiments are set forth in the accompanying drawings and the description below. Other features will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] Fig. 1 is a schematic view of an air conditioner according to an embodiment.

[0035] Fig. 2 is a block diagram of the air conditioner according to an embodiment.

[0036] Fig. 3 is a flowchart illustrating a method of controlling an air conditioner according to an embodiment.

[0037] Fig. 4 is a block diagram of an air conditioner according to another embodiment.

[0038] Fig. 5 is a flowchart illustrating a method of controlling an air conditioner according to another embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0039] Reference will now be made in detail to the embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings.

[0040] In the following detailed description of the preferred embodiments, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration specific preferred embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is understood that other embodiments may be utilized and that logical structural, mechanical, electrical, and chemical changes may be made without departing from the spirit or scope of the invention. To avoid detail not necessary to enable those skilled in the art to practice the invention, the description may omit certain information known to those skilled in the art. The following detailed description is, therefore, not to be taken in a limiting sense.

[0041] Fig. 1 is a schematic view of an air conditioner according to an embodiment.

[0042] An air conditioner 10 according to an embodiment includes an outdoor unit 100, at least one indoor unit 200, 300, or 400, and a circulation tube 500 that enables the outdoor unit 100 and the indoor unit 200, 300, or 400 to communicate with each other.

[0043] The outdoor unit 100 may include a compressor 110, a flow switching valve 120, an outdoor heat exchanger 130, an outdoor expansion valve 140, and an outdoor unit fan 150. Also, the compressor 110, the flow switching valve 120, the outdoor heat exchanger 130, and the outdoor expansion valve 140 may communicate with each other by the circulation tube 500.

[0044] The compressor 110 compresses a refrigerant introduced through a suction-side circulation tube 500 to discharge the compressed refrigerant into a discharge-side circulation tube 500.

[0045] The flow switching valve 120 may switch a flow direction of a refrigerant flowing into the circulation tube 500 according to an operation mode of the air conditioner 10. The flow switching valve 120 may be a four-way valve.

[0046] Air introduced into the outdoor unit 100 and a refrigerant passing through the outdoor heat exchanger 130 are heat-exchanged with each other in the outdoor heat exchanger 130.

[0047] The outdoor expansion valve 140 expands a refrigerant passing through the outdoor expansion valve 140. An electrical expansion valve (EEV) may be used as the outdoor expansion valve 140. A degree of openness of the outdoor expansion valve 140 may be adjustable. When the outdoor expansion valve 140 is fully opened, the circulating refrigerant may pass through the

outdoor expansion valve 140 in a state where the refrigerant is not expanded.

[0048] The outdoor fan 150 guides a flow of outdoor air so that the outdoor air passes through the outdoor heat exchanger 130.

[0049] The indoor units 200, 300, and 400 may include a first indoor unit 200, a second indoor unit 300, and a third indoor unit 400.

[0050] The first indoor unit 200 may include an indoor tube 210, an indoor expansion valve 220, an indoor heat exchanger 230, a refrigerant leakage detection part 240, first and second valves 250 and 260 that are respectively disposed in suction and discharge sides of the indoor tube 210, and an indoor unit fan 270. Duplicated descriptions with respect to the second and third indoor units 300 and 400 will be omitted.

[0051] The indoor tube 210 communicates with the circulation tube 500 to guide the refrigerant circulating through the indoor unit 200. The first valve 250, the indoor expansion valve 220, the indoor heat exchanger 230, and the second valve 260 may be connected to the indoor tube 210.

[0052] The indoor expansion valve 220 expands a refrigerant passing through the indoor expansion valve 220. An EEV may be used as the indoor expansion valve 220. A degree of openness of the indoor expansion valve 220 may be adjustable. When the indoor expansion valve 220 is fully opened, the circulating refrigerant may pass through the indoor expansion valve 220 in a state where the refrigerant is not expanded.

[0053] Air introduced into the indoor unit 200 and a refrigerant passing through the indoor heat exchanger 230 are heat-exchanged with each other in the indoor heat exchanger 230.

[0054] The refrigerant leakage detection part 240 detects whether a refrigerant within the indoor unit 200 leaks. The refrigerant leakage detection part 240 may be disposed on a side of the indoor tube 210 or disposed inside or outside the first indoor unit 200. The refrigerant leakage detection part 240 may be disposed on a tube welding portion at which a refrigerant is easily leakable. However, the present disclosure is not limited to the position of the refrigerant leakage detection part 240. The refrigerant leakage detection part 240 may be spaced apart form the first indoor unit 200 and disposed on one position in an indoor space.

[0055] The refrigerant leakage detection part 240 may directly or indirectly detect leakage of a refrigerant.

[0056] For example, the refrigerant leakage detection part 240 may include two electrodes spaced apart from each other and an impedance measurement part measuring an impedance in a space spaced between the two electrodes. A dielectric constant of air is different from that of a refrigerant. When a refrigerant is introduced between the two electrodes, an impedance value measured by the impedance measurement part may be changed. Thus, the leakage of the refrigerant may be directly detected by the refrigerant leakage detection part 240 by measuring the impedance value.

[0057] For another example, the refrigerant leakage detection part 240 may include a first temperature sensor measuring a temperature of indoor air introduced into the indoor heat exchanger 230, a second temperature sensor measuring a temperature of the indoor heat exchanger 230, and an arithmetic part calculating a difference between the temperatures measured by the first and second temperature sensors. When the temperature difference value calculated by the arithmetic part is less than a preset value, it may be determined that a refrigerant is not sufficiently supplied into the indoor heat exchanger 230. In this case, the leakage of the refrigerant may be doubtable. Thus, the refrigerant leakage detection part 240 may indirectly detect the leakage of the refrigerant by the above-described structure.

[0058] However, the present disclosure is not limited to the refrigerant leakage detection part 240 having the above-described structure.

[0059] The first and second valves 250 and 260 may selectively block a refrigerant suctioned from the circulation tube 500 into the indoor heat exchanger 230 or discharged from the indoor heat exchanger 230. For example, each of the first and second valves 250 and 260 may be a solenoid valve.

[0060] Particularly, the first valve 250 may be disposed in a refrigerant suction-side tube of the indoor heat exchanger 230 in a cooling mode. Also, the second valve 260 may be disposed in a refrigerant discharge-side tube of the indoor heat exchanger 230 in the cooling mode.

[0061] It may not be necessary to provide the first valve 250. When the first valve 250 is not provided, the outdoor expansion valve 140 or the indoor expansion valve 220 is closed to block a refrigerant suctioned into or discharged from the indoor heat exchanger 230. In this case, it is unnecessary to additionally provide a new valve. That is, the existing outdoor expansion valve 140 or the indoor expansion valve 220 may be utilized. The outdoor expansion valve 140 and the indoor expansion valve 220 may be commonly called an expansion valve.

[0062] The indoor unit fan 270 guides a flow of indoor air so that the indoor air passes through the indoor heat exchanger 230.

[0063] The circulation tube 500 may include a first branch tube 510 and a second branch tube 520. Also, the first and second branch tubes 510 and 520 may be connected to the indoor tube 210 of the first indoor unit 200 to guide a refrigerant flowing through the circulation tube 500 so that the refrigerant is introduced into or discharged from the indoor tube 210.

[0064] Particularly, the first branch tube 510 may be disposed between the outdoor heat exchanger 130 and the indoor heat exchanger 230. Also, the second branch tube 520 may be disposed between the compressor 110 and the indoor heat exchanger 230.

[0065] Although one indoor heat exchanger is provided in each of the indoor units 200, 300, and 400, the present disclosure is not limited thereto. For example, a plurality

of indoor heat exchangers may be provided in one indoor unit. That is to say, the first, second, and third indoor units 200, 300, and 400 may be disposed in the same indoor space to constitute one indoor unit.

[0066] Fig. 2 is a block diagram of the air conditioner according to an embodiment.

[0067] Referring to Fig. 2, the air conditioner 10 according to an embodiment may further include an indoor control part 600, a memory 610, and a timer 620.

[0068] The indoor control part 600 may receive predetermined information from the refrigerant leakage detection part 240, the memory 600, and the timer 620 to control operations of the first valve 250, the second valve 260, and the indoor unit fan 270.

[0069] Also, the indoor control part 600 may determine an operation mode of the air conditioner 10. For example, the indoor control part 600 may determine whether the air conditioner 10 operates in a cooling or heating mode according to a switching direction of the flow switching valve 120.

[0070] Various information related to the operation of the air conditioner 10 may be stored in the memory 610. For example, a first reference time t1 and a second reference time t2 that are criterion of an operation of the first or second valve 250 and 260 may be stored in the memory 610.

[0071] The timer 620 may measure a leakage time t detected by the refrigerant leakage detection part 240.

[0072] Fig. 3 is a flowchart illustrating a method of controlling an air conditioner according to an embodiment.

[0073] Referring to Fig. 3, in an air conditioner according to an embodiment, a refrigerant leakage detection part 240 may detect leakage of a refrigerant firstly (S100). When the leakage of the refrigerant is detected by the refrigerant leakage detection part 240, a leakage detection time t of the refrigerant may be accumulated and measured by a timer 620. Then, it may be determined whether the leakage detection time t exceeds a first reference time t1 stored in a memory 610 (S110).

[0074] When the detection time t exceeds the first detection time t1, it is determined whether an operation mode of the air conditioner 10 is a cooling mode (S120).

[0075] When the operation mode of the air conditioner 10 is the cooling mode, a first valve 250 is blocked (S130). As the first valve 250 is blocked, a refrigerant introduced into an indoor heat exchanger 230 may be blocked.

[0076] Also, even when the first valve 250 is blocked, an indoor unit fan 270 may continuously operate for a predetermined time. As the indoor unit fan 270 operates, indoor air introduced into a first indoor unit 200 may be heat-exchanged with the refrigerant previously introduced into the indoor heat exchanger 230. Thus, in spite of the blocking of the first valve 250, the indoor air-conditioning may be continuously performed for a predetermined time without being stopped.

[0077] After the first valve 250 is blocked, whether a refrigerant leaks is detected secondarily. Particularly, the timer 620 accumulates and measures a time t at which the leakage of the refrigerant is detected. Then, it may be determined whether the measured detection time t exceeds the second reference time t2 (S140).

[0078] When the detection time t exceeds the second reference time t2, the second valve 260 is blocked (S150). As the second valve 260 is blocked, a refrigerant reversely flowing from a circulation tube 500 into the first indoor unit 200 may be blocked.

[0079] Then, the leakage of the refrigerant may be informed by a predetermined abnormality informing unit (S160). The abnormality informing unit may include a display or speaker provided in the air conditioner. The display may inform an abnormal state to a user by a character, a symbol, or a picture. The speaker may inform the abnormal state to the user by sound.

[0080] Also, an operation of the first indoor unit 200 may be stopped (S170). In this case, an operation of the indoor unit fan 270 may be also stopped.

[0081] In the operation S120, when the operation mode of the air conditioner 10 is a heating mode, the second valve 260 is blocked (S180). Hereinafter, since operations S190 to S200 are similar to the operations S140 to S150, descriptions with respect to the operations S190 to S200 will be omitted.

[0082] When the leakage of the refrigerant is not detected in the operation S100, or the detection time t does not exceed the first reference time t1 in the operation S110, the process returns to the operation S100 to detect the leakage of the refrigerant.

[0083] Also, when the detection time t does not exceed the second reference time t2 in the operation S140, the first valve 250 is opened (S142). Then, the process returns to the operation S100 to detect the leakage of the refrigerant.

[0084] Also, when the detection time t does not exceed the second reference time t2 in the operation S190, the second valve 260 is opened (S192). Then, the process returns to the operation S100 to detect the leakage of the refrigerant.

[0085] Fig. 4 is a block diagram of an air conditioner according to another embodiment.

[0086] Referring to Fig. 4, an air conditioner 10 according to another embodiment may further include a main control part 900, a main memory 910, and a leakage occurrence indoor unit number detection part 920.

[0087] The main control part 900 may receive predetermined information from the main memory 910, a first indoor unit control part 600, a second indoor unit control part 700, a third indoor unit control part 800, and the leakage occurrence indoor unit number detection part 920 to control operations of a compressor 110 and an outdoor unit fan 150.

[0088] Various information related to the operation of the air conditioner 10 may be stored in the main memory 910. For example, a reference indoor unit number N1 may be stored in the main memory 910.

[0089] The reference indoor unit number N1 serves as a criterion for determining whether an outdoor unit oper-

ates. When the number of leakage occurrence indoor units exceeds a predetermined number, capacity of each of indoor heat exchangers and capacity of each of outdoor heat exchangers may be unbalanced to deteriorate thermal efficiency or cause harm on an operation of the air conditioner 10. Thus, when the number N of leakage occurrence indoor units exceeds the number N1 of reference indoor units, an operation of the outdoor unit may be stopped as described below.

[0090] If a leakage occurrence indoor unit exists through the two refrigerant leakage detection processes, since an operation of the corresponding indoor unit is stopped, the number N of leakage occurrence indoor units may be referred to as the number N of indoor units of which operations are stopped.

[0091] The leakage occurrence indoor unit number detection part 920 detects the number N of indoor units in which the leakage of the refrigerant is detected. For example, the leakage occurrence indoor unit number detection part 920 may detect whether each of indoor unit fans 150 operates to detect the number of indoor unit fans of which operations are stopped. Also, whether each of the first and second valves 250 and 260 is blocked may be detected to detect the number of indoor unit in which all of the first and second valves 250 and 260 are blocked. The leakage occurrence indoor unit number detection part 920 may be called a "counter 920".

[0092] Although the main control part 900, the first indoor unit control part 600, the second indoor unit control part 700, and the third indoor unit control part 800 are distinguished from each other, the present disclosure is not limited thereto. For example, operations of each of the control parts may be performed by one control part. The main control part 900 and each of the indoor unit control parts 600, 700, and 800 may be commonly called a "control part".

[0093] Although the memory 610 and the main memory 910 are distinguished from each other, the present disclosure is not limited thereto. The memory 610 and the main memory 910 may be commonly called a "memory".

[0094] Fig. 5 is a flowchart illustrating a method of controlling an air conditioner according to another embodiment.

[0095] Referring to Fig. 5, in an air conditioner according to another embodiment, a leakage occurrence indoor unit number detection part 920 detects the number N of indoor units in which leakage of a refrigerant occurs (S500). Also, it is determined whether the number N of leakage occurrence indoor units exceeds the number N1 of reference indoor units (S510).

[0096] Also, when the number N of leakage occurrence indoor units exceeds the number N1 of reference indoor units, this may be informed by a predetermined abnormality informing unit (S520). As described above, the abnormality informing unit may include a display or speaker.

[0097] A main control part 900 stops an operation of an outdoor unit 100. Particularly, the main control part 900 may stop an operation of a compressor 110 and an outdoor unit fan 150 which are disposed in the outdoor unit 100.

[0098] According to the air conditioner and the control method thereof, it may prevent the operation of the air conditioner from being unnecessarily stopped due to the misdetection of the leakage detection part.

[0099] Particularly, the leakage of the refrigerant may be detected two times to block the circulation of the refrigerant, thereby improving reliability of the leakage detection part. Also, the valve in a side of the tube having a relatively high pressure in the circulation tube may be blocked to improve efficiency of the leakage blocking.

[0100] Also, in the case of the multi-type air conditioner including the plurality of indoor units, only an actual indoor unit in which the refrigerant leaks may be stopped in operation. Also, since the operation of the outdoor unit is stopped in consideration of condensation/evaporation of each of the indoor and outdoor heat exchangers, it may prevent the air conditioner from being deteriorated in efficiency and damaged.

[0101] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the scope of the claims. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

Claims

1. An air conditioner comprising:

a compressor (110) for compressing an inflow refrigerant to discharge the compressed refrigerant;
an outdoor heat exchanger (130) in which outdoor air introduced into an outdoor unit (100) and the refrigerant are heat-exchanged with each other;
an indoor heat exchanger (230) in which indoor air introduced into an indoor unit (200) and the refrigerant are heat-exchanged with each other;
valves (140, 220, 250, 260) respectively disposed in an inflow-side tube and a discharge-side tube of the indoor heat exchanger (230);
a refrigerant leakage detection part (240) for directly or indirectly detecting leakage of the refrigerant; and
a control part (600, 700, 800, 900) configured, when the leakage of the refrigerant is detected, to block the valves (140, 220, 250, 260) in consecutive order.

2. The air conditioner according to claim 1, wherein the valves (140, 220, 250, 260) comprise:

a first valve (250) disposed in the inflow-side tube of the indoor heat exchanger (200); and
a second valve (260) disposed in the discharge-side tube of the indoor heat exchanger (200),
wherein the control part (600, 700, 800, 900) is configured, when the leakage of the refrigerant is detected, to block the first valve (250) earlier than the second valve (260).

3. The air conditioner according to claim 2, wherein the control part (600, 700, 800, 900) is configured, when the leakage of the refrigerant continues for a preset time (t2) after the first valve (250) is blocked, to block the second valve (260).

4. The air conditioner according to claim 2 or 3, wherein the control part (600, 700, 800, 900) is configured, when the leakage of the refrigerant does not continue for a preset time (t2) after the first valve (250) is blocked, to open the first valve, and maintain the second valve (260) in an open state.

5. The air conditioner according to any one of the preceding claims, wherein one of the valves is an outdoor expansion valve (140) or indoor expansion valve (220).

6. The air conditioner according to any one of the preceding claims, wherein the indoor heat exchanger (230) is provided in plurality, and
the air conditioner further comprises a branch tube (510, 520) for guiding the refrigerant into each of the indoor heat exchangers (230).

7. The air conditioner according to claim 6, wherein the branch tube (510) is disposed between the outdoor heat exchanger (130) and the indoor heat exchanger (230), and
one of the valves (220, 250) is disposed between the branch tube (510) and the indoor heat exchanger (230).

8. The air conditioner according to claim 6 or 7, further comprising a counter (920) configured for detecting the number (N) of indoor units (200, 300, 400) in which the leakage of the refrigerant occurs,
wherein the control part (600, 700, 800, 900) is configured, when the number (N) of leakage occurrence indoor units detected by the counter (920) exceeds a preset number (N1), to stop an operation of the outdoor unit (100).

9. The air conditioner according to claim 8, wherein the control part (600, 700, 800, 900) is configured, when the number (N) of leakage occurrence indoor units exceeds the preset number (N1), to stop operations of the compressor (110) and an outdoor unit fan (150).

10. A method of controlling an air conditioner, the method comprising:

firstly detecting leakage of a refrigerant in an indoor space in which air-conditioning is performed;
closing a first valve (250) disposed in a refrigerant inflow-side tube of an indoor heat exchanger (230) when the leakage of the refrigerant is detected in said first detecting;
secondarily detecting the leakage of the refrigerant after the first valve (250) is blocked; and
closing a second valve (260) disposed in a refrigerant discharge-side tube of the indoor heat exchanger (230) when the leakage of the refrigerant is detected in said second detecting.

11. The method according to claim 10, wherein the closing of the valves (250, 260) is performed when a time in which the leakage of the refrigerant continues exceeds a preset reference time.

12. The method according to claim 10 or 11, further comprising, when the leakage of the refrigerant is not detected in said second detecting, opening the first valve (250).

13. The method according to any of claims 10 to 12, further comprising, when the leakage of the refrigerant is detected in said first detecting, determining whether an operation mode of the air conditioner is a cooling mode or a heating mode,
wherein the first valve (250) disposed in the refrigerant inflow-side tube of the indoor heat exchanger (230) is blocked according to the determined operation mode.

14. The method according to any of claims 10 to 13, further comprising, when the leakage of the refrigerant is detected in said second detecting, stopping an operation of an indoor unit (200).

15. The method according to any of claims 10 to 14, further comprising, when the number (N) of indoor units (200, 300, 400) in which the leakage of the refrigerant occurs exceeds the number (N1) of preset reference indoor units, stopping an operation of an outdoor unit (100).

Fig.1

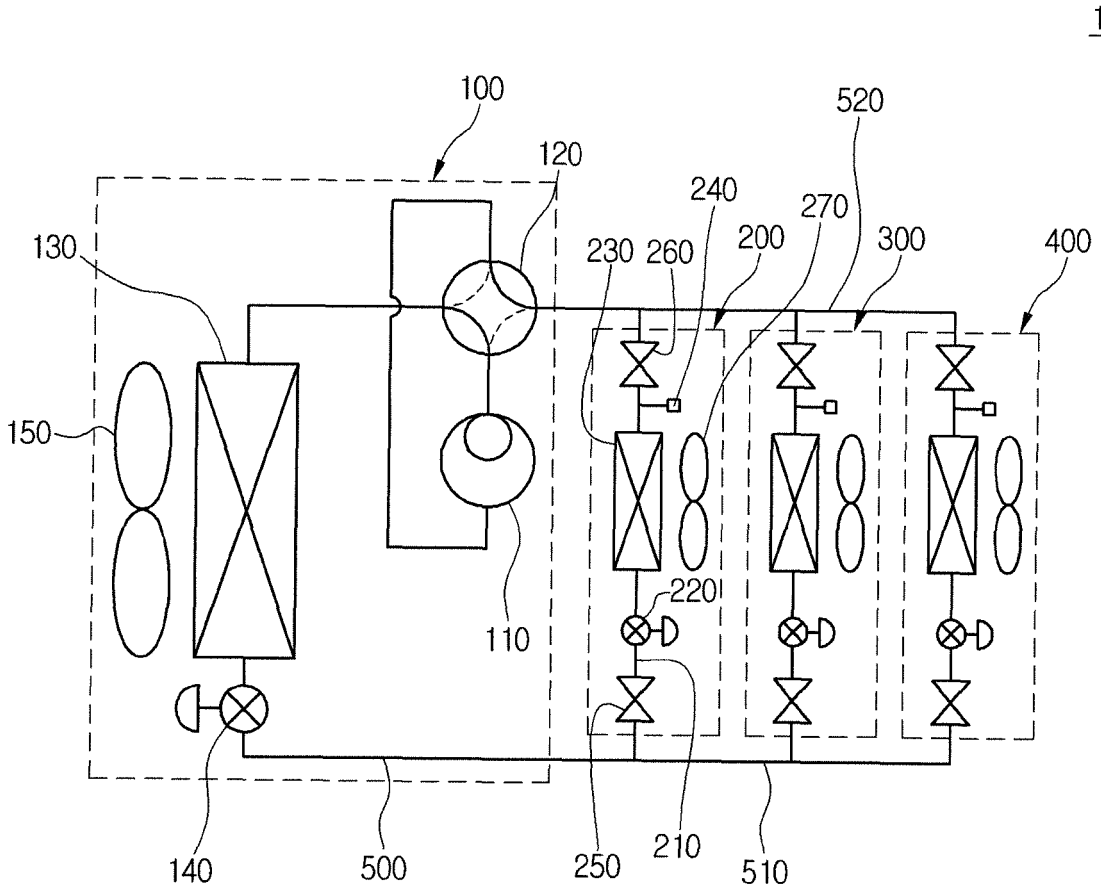

10
100
120
520
240
270
130
230
260
200
300
400
150
220
110
140
500
250
210
510

Fig.2

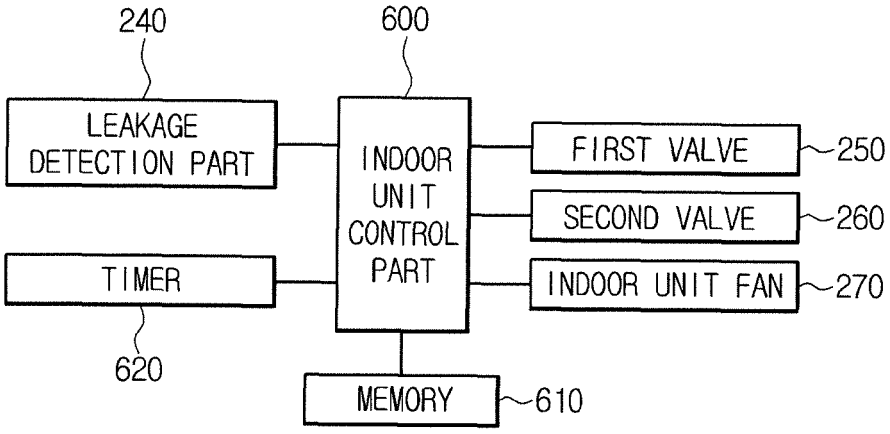

240
600
LEAKAGE DETECTION PART
INDOOR UNIT CONTROL PART
FIRST VALVE
250
SECOND VALVE
260
TIMER
INDOOR UNIT FAN
270
620
MEMORY
610

Fig. 3

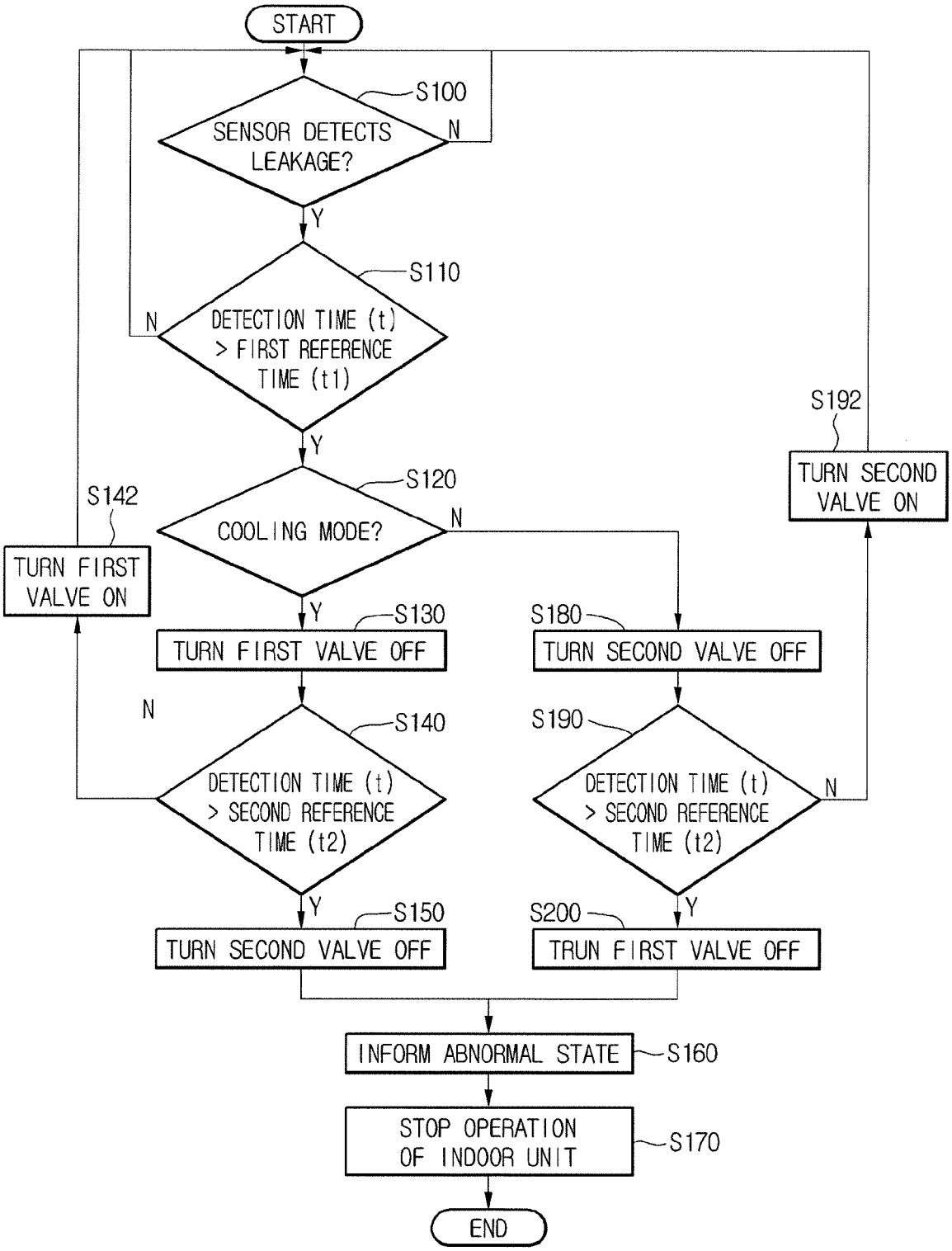

START
S100
SENSOR DETECTS LEAKAGE?
N
Y
S110
DETECTION TIME (t) > FIRST REFERENCE TIME (t1)
N
Y
S120
COOLING MODE?
N
Y
S142
TURN FIRST VALVE ON
S130
TURN FIRST VALVE OFF
S180
TURN SECOND VALVE OFF
N
S140
DETECTION TIME (t) > SECOND REFERENCE TIME (t2)
S190
DETECTION TIME (t) > SECOND REFERENCE TIME (t2)
N
Y
S150
TURN SECOND VALVE OFF
S200
TRUN FIRST VALVE OFF
Y
S192
TURN SECOND VALVE ON
INFORM ABNORMAL STATE
S160
STOP OPERATION OF INDOOR UNIT
S170
END

Fig.4

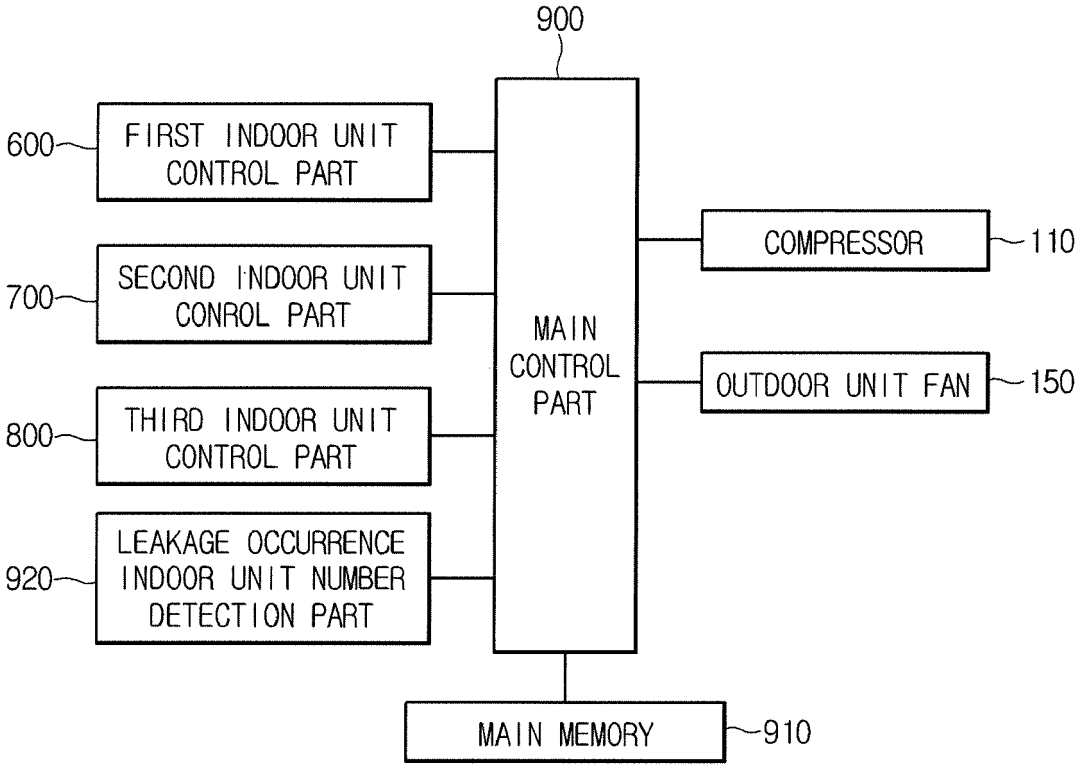
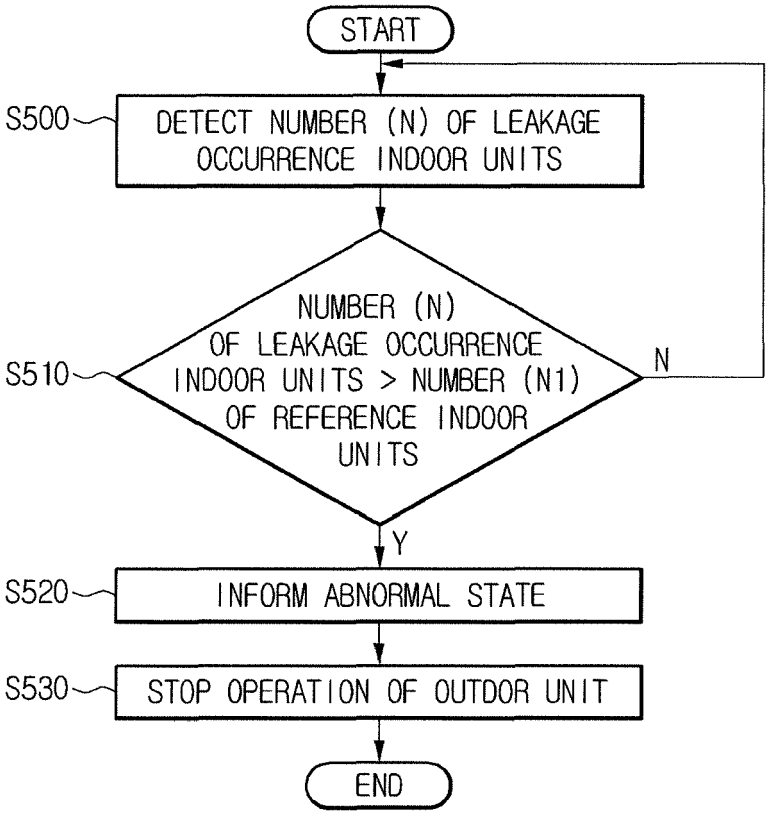

900
600
FIRST INDOOR UNIT CONTROL PART
700
SECOND INDOOR UNIT CONROL PART
800
THIRD INDOOR UNIT CONTROL PART
920
LEAKAGE OCCURRENCE INDOOR UNIT NUMBER DETECTION PART
MAIN CONTROL PART
COMPRESSOR
110
OUTDOOR UNIT FAN
150
MAIN MEMORY
910

Fig.5


START
S500
DETECT NUMBER (N) OF LEAKAGE OCCURRENCE INDOOR UNITS
S510
NUMBER (N) OF LEAKAGE OCCURRENCE INDOOR UNITS > NUMBER (N1) OF REFERENCE INDOOR UNITS
N
Y
S520
INFORM ABNORMAL STATE
S530
STOP OPERATION OF OUTDOOR UNIT
END

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EUROPEAN SEARCH REPORT

Application Number
EP 13 18 1511

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F25B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 October 2013	Ritter, Christoph

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