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(54) AIR-CONDITIONING DEVICE

(57) To provide an air-conditioning device that, among indoor units connected to the same refrigerant system, enables recognition of the state of another indoor unit and can prevent reduction of the comfort of users.

When a refrigerant leakage sensor 40 detects refrigerant leakage of an indoor unit 20, a centralized controller 50 controls an opening/closing device located upstream of the indoor unit 20 to be closed. When the opening/closing device located upstream of the indoor unit 20 is in a closed state and the refrigerant leakage sensor 40 of the indoor unit 20 detects a refrigerant, the centralized controller 50 controls the indoor unit 20 to a refrigerant leakage state in which a cooling operation or a heating operation is stopped. When the opening/closing device located upstream of the indoor unit 20 is in a closed state and the refrigerant leakage sensor 40 of the indoor unit 20 detects no refrigerant, the centralized controller 50 controls the indoor unit 20 to a limited operation state in which the indoor unit 20 performs a fan operation or stops operation.

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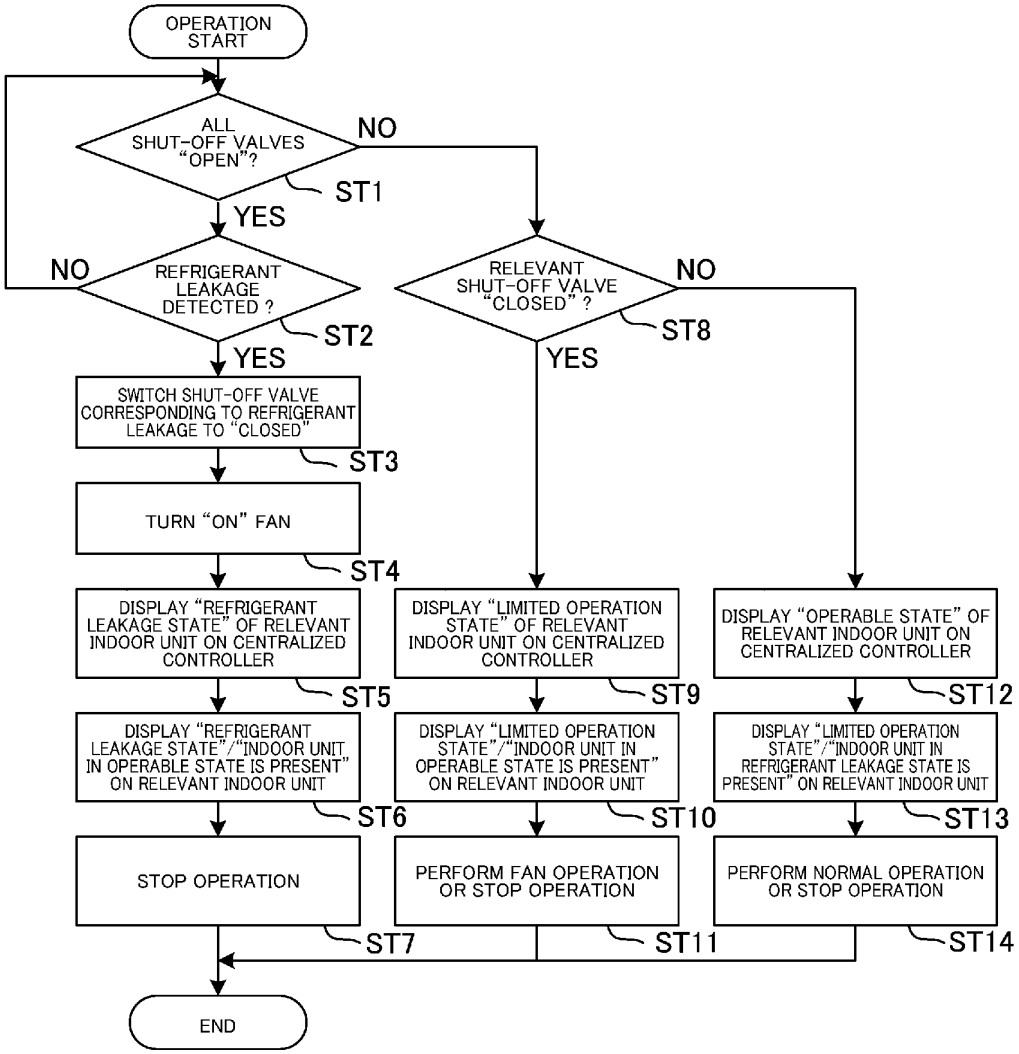
FIG.3


OPERATION START
ALL SHUT-OFF VALVES "OPEN"?
NO
ST1
YES
REFRIGERANT LEAKAGE DETECTED ?
NO
ST2
YES
RELEVANT SHUT-OFF VALVE "CLOSED" ?
NO
ST8
YES
SWITCH SHUT-OFF VALVE CORRESPONDING TO REFRIGERANT LEAKAGE TO "CLOSED"
ST3
TURN "ON" FAN
ST4
DISPLAY "REFRIGERANT LEAKAGE STATE" OF RELEVANT INDOOR UNIT ON CENTRALIZED CONTROLLER
ST5
DISPLAY "LIMITED OPERATION STATE" OF RELEVANT INDOOR UNIT ON CENTRALIZED CONTROLLER
ST9
DISPLAY "OPERABLE STATE" OF RELEVANT INDOOR UNIT ON CENTRALIZED CONTROLLER
ST12
DISPLAY "REFRIGERANT LEAKAGE STATE"/"INDOOR UNIT IN OPERABLE STATE IS PRESENT" ON RELEVANT INDOOR UNIT
ST6
DISPLAY "LIMITED OPERATION STATE"/"INDOOR UNIT IN OPERABLE STATE IS PRESENT" ON RELEVANT INDOOR UNIT
ST10
DISPLAY "LIMITED OPERATION STATE"/"INDOOR UNIT IN REFRIGERANT LEAKAGE STATE IS PRESENT" ON RELEVANT INDOOR UNIT
ST13
STOP OPERATION
ST7
PERFORM FAN OPERATION OR STOP OPERATION
ST11
PERFORM NORMAL OPERATION OR STOP OPERATION
ST14
END

Description

[Technical Field]

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

[Background Art]

[0002] There has been conventionally proposed an air-conditioning device that includes indoor units each provided with a refrigerant leakage sensor that detects refrigerant leakage and a display device that, when the refrigerant leakage sensor detects refrigerant leakage, makes a notification that the refrigerant leakage has occurred, and, when the refrigerant leakage sensor of any of the indoor units detects refrigerant leakage, notifies the plurality of display devices that the refrigerant leakage has occurred, thereby making it possible to effectively communicate to users that the refrigerant leakage has occurred and improve the safety of the users (e.g., refer to Patent Literature 1).

[Citation List]

[Patent Literature]

[0003] [Patent Literature 1]
Japanese Patent Laid-Open No. 2016-223650

[Summary of Invention]

[Technical Problem]

[0004] However, in the conventional technique described above, when indoor units are installed in a plurality of rooms, although a user of the indoor unit having refrigerant leakage can recognize the refrigerant leakage, the refrigerant leakage state cannot be recognized in another indoor unit connected to the same refrigerant system. Thus, there is a problem in that, when refrigerant supply to the other indoor unit is stopped or operation of the other indoor unit is disabled due to the refrigerant leakage, a user of the other indoor unit cannot recognize an operating state in the same refrigerant system.

[0005] Also, since, when refrigerant leakage has occurred, the operation of another indoor unit connected to the same refrigerant system as the indoor unit having the refrigerant leakage is stopped, there is a problem in that, although a user can recognize the presence or absence of refrigerant leakage, reduction in the comfort of the user thereafter cannot be avoided.

[0006] The present invention has been made in view of the points described above, and an object thereof is to provide an air-conditioning device that, among indoor units connected to the same refrigerant system, enables recognition of the state of another indoor unit and can prevent reduction of the comfort of users.

[Solution to Problem]

[0007] In order to achieve the above object, an air-conditioning device of the present invention includes: an outdoor unit including at least a compressor, and a heat source side heat exchanger; a plurality of indoor units each including at least a use side heat exchanger, and a fan; a liquid refrigerant pipe and a gas refrigerant pipe that connect the outdoor unit and the indoor units; an opening/closing device provided upstream of the indoor unit on the liquid refrigerant pipe and the gas refrigerant pipe, the opening/closing device being configured to shut off a flow of a refrigerant in the liquid refrigerant pipe and the gas refrigerant pipe; a refrigerant leakage sensor that detects leakage of the refrigerant from the indoor unit; and a control device that controls opening and closing of the opening/closing device based on a detection signal of the refrigerant leakage sensor, in which, when the refrigerant leakage sensor detects refrigerant leakage of the indoor unit, the control device controls the opening/closing device located upstream of the indoor unit to be closed, when the opening/closing device located upstream of the indoor unit is in a closed state and the refrigerant leakage sensor of the indoor unit detects the refrigerant, the control device controls the indoor unit to a refrigerant leakage state in which a cooling operation or a heating operation is stopped, and when the opening/closing device located upstream of the indoor unit is in a closed state and the refrigerant leakage sensor of the indoor unit detects no refrigerant, the control device controls the indoor unit to a limited operation state in which the indoor unit performs a fan operation or stops operation.

[0008] Note that the entire contents of Japanese Patent Application No. 2020-092271 filed May 27, 2020 are incorporated in this specification.

[Advantageous Effects of Invention]

[0009] According to the present invention, when the shut-off valves on the liquid refrigerant pipe and the gas refrigerant pipe are closed to stop operation when refrigerant leakage occurs in the indoor unit, another indoor unit connected to the same liquid refrigerant pipe and gas refrigerant pipe is controlled to the limited operation state. Thus, reduction in the comfort of a user of the other indoor unit can be prevented by causing the other indoor unit to perform the fan operation.

[Brief Description of Drawings]

[0010]

[FIG. 1] FIG. 1 is a schematic configuration diagram showing an embodiment of an air-conditioning device according to the present invention.
[FIG. 2] FIG. 2 is a block diagram showing a control configuration of the embodiment.

[FIG. 3] FIG. 3 is a flowchart showing operation of the embodiment.

[Description of Embodiment]

[0011] A first invention provides an air-conditioning device including: an outdoor unit including at least a compressor, and a heat source side heat exchanger; a plurality of indoor units each including at least a use side heat exchanger, and a fan; a liquid refrigerant pipe and a gas refrigerant pipe that connect the outdoor unit and the indoor units; an opening/closing device provided upstream of the indoor unit on the liquid refrigerant pipe and the gas refrigerant pipe, the opening/closing device being configured to shut off a flow of a refrigerant in the liquid refrigerant pipe and the gas refrigerant pipe; a refrigerant leakage sensor that detects leakage of the refrigerant from the indoor unit; and a control device that controls opening and closing of the opening/closing device based on a detection signal of the refrigerant leakage sensor, wherein when the refrigerant leakage sensor detects refrigerant leakage of the indoor unit, the control device controls the opening/closing device located upstream of the indoor unit to be closed, when the opening/closing device located upstream of the indoor unit is in a closed state and the refrigerant leakage sensor of the indoor unit detects the refrigerant, the control device controls the indoor unit to a refrigerant leakage state in which a cooling operation or a heating operation is stopped, and when the opening/closing device located upstream of the indoor unit is in a closed state and the refrigerant leakage sensor of the indoor unit detects no refrigerant, the control device controls the indoor unit to a limited operation state in which the indoor unit performs a fan operation or stops operation.

[0012] Accordingly, when the opening/closing device on the liquid refrigerant pipe and the gas refrigerant pipe is closed to stop operation when refrigerant leakage occurs in the indoor unit, another indoor unit connected to the same liquid refrigerant pipe and gas refrigerant pipe is controlled to the limited operation state. Thus, reduction in the comfort of a user of the other indoor unit can be prevented by causing the other indoor unit to perform the fan operation.

[0013] In a second invention, when the opening/closing device located upstream of the indoor unit is in an open state, the control device controls the indoor unit to an operable state in which the indoor unit performs the cooling operation, the heating operation, or the fan operation.

[0014] Accordingly, even when refrigerant leakage occurs in the indoor unit, in another indoor unit connected to the other liquid refrigerant pipe and gas refrigerant pipe that are not closed by the opening/closing device, the flow of the refrigerant is not shut off, and any of the cooling operation, the heating operation, and the fan operation can be performed. Thus, reduction of the comfort of a user can be prevented.

[0015] In a third invention, the control device includes a display unit for checking an operating state of the indoor unit, and the control device causes the display unit to display whether the indoor unit is in the refrigerant leakage state, the limited operation state, or the operable state.

[0016] Accordingly, by the control device causing the display unit to display whether the indoor unit is in the refrigerant leakage state, the limited operation state, or the operable state, an administrator can recognize the indoor unit that cannot perform an air-conditioning operation, the indoor unit that cannot perform the air-conditioning operation, but can perform the fan operation, and the indoor unit that can perform the air-conditioning operation. As a result, after the operation is stopped, it is possible to promptly communicate the operating state to a user in a space where each indoor unit is present.

[0017] In a fourth invention, each of the indoor units includes a display unit, and the control device causes the display unit of the indoor unit in the refrigerant leakage state to display being in the refrigerant leakage state and presence of the indoor unit in the operable state, causes the display unit of the indoor unit in the limited operation state to display being in the limited operation state and presence of the indoor unit in the operable state, and causes the display unit of the indoor unit in the operable state to display being in the operable state and presence of the indoor unit in the refrigerant leakage state.

[0018] Accordingly, a user of the indoor unit can recognize the indoor unit that cannot perform the air-conditioning operation and the indoor unit that can perform the air-conditioning operation. Also, since the state of the occurrence of refrigerant leakage in the same refrigerant pipe system and the other refrigerant pipe system can be recognized, the refrigerant leakage state can be notified to users of the plurality of indoor unit.

[0019] Hereinbelow, an embodiment of the present invention will be described with reference to the drawings.

[0020] FIG. 1 is a schematic configuration diagram showing the embodiment of the air-conditioning device according to the present invention. Note that an air-conditioning device to which the present invention is applied is not limited thereto, and the present invention is applicable to various air-conditioning devices.

[0021] As shown in FIG. 1, an air-conditioning device 1 includes an outdoor unit 10, and a plurality of indoor units 20. For example, a compressor 11 (refer to FIG. 2), an outdoor heat exchanger, and a four-way valve that switches a refrigerant channel are housed in the outdoor unit 10.

[0022] The outdoor unit 10 and the indoor units 20 include a liquid refrigerant pipe 30 and a gas refrigerant pipe 32 that connect the compressor of the outdoor unit and heat exchangers of the indoor units 20.

[0023] The present embodiment shows an example in which five rooms A to E are provided as rooms where the indoor units 20 are installed.

[0024] One indoor unit 20 is installed in each of the

rooms A, B, C, and E. Also, two indoor units 20 are installed in the room D.

[0025] The liquid refrigerant pipe 30 branches midway into a first liquid refrigerant pipe 30a and a second liquid refrigerant pipe 30b. The gas refrigerant pipe 32 branches midway into a first gas refrigerant pipe 32a and a second gas refrigerant pipe 32b.

[0026] The first liquid refrigerant pipe 30a and the first gas refrigerant pipe 32a are connected to the indoor unit 20 in the room A, the indoor unit 20 in the room B, and the indoor unit 20 in the room C.

[0027] The second liquid refrigerant pipe 30b and the second gas refrigerant pipe 32b are connected to the two indoor units 20 in the room D and the indoor unit 20 in the room E.

[0028] A first liquid shut-off valve 34a serving as the opening/closing device is provided in a middle part of the first liquid refrigerant pipe 30a. A first gas shut-off valve 36a serving as the opening/closing device is provided in a middle part of the first gas refrigerant pipe 32a.

[0029] The first liquid shut-off valve 34a is provided upstream of the room A on the first liquid refrigerant pipe 30a, and the first gas shut-off valve 36a is provided upstream of the room A on the first gas refrigerant pipe 32a.

[0030] A second liquid shut-off valve 34b serving as the opening/closing device and a third liquid shut-off valve 34c serving as the opening/closing device are provided in middle parts of the second liquid refrigerant pipe 30b. A second gas shut-off valve 36b serving as the opening/closing device and a third gas shut-off valve 36c serving as the opening/closing device are provided in middle parts of the second gas refrigerant pipe 32b.

[0031] The second liquid shut-off valve 34b is provided upstream of the room D on the second liquid refrigerant pipe 30b, and the second gas shut-off valve 36b is provided upstream of the room D on the second gas refrigerant pipe 32b.

[0032] The third liquid shut-off valve 34c is provided upstream of the room E and downstream of the room D on the second liquid refrigerant pipe 30b, and the third gas shut-off valve 36c is provided upstream of the room E and downstream of the room D on the second gas refrigerant pipe 32b.

[0033] Also, each indoor unit 20 is provided with a refrigerant leakage sensor 40. The refrigerant leakage sensor 40 detects a refrigerant leaking from each indoor unit 20 and is provided inside each indoor unit 20 in the present embodiment.

[0034] Note that the refrigerant leakage sensor 40 may be provided outside the indoor unit 20, provided in a remote control (not shown) for operating the indoor unit 20 installed in the room, or provided at a predetermined location inside the room separately from the indoor unit 20.

[0035] Each indoor unit 20 includes a display unit 42 that performs predetermined display, and the display unit 42 is, for example, a liquid crystal display device. The display unit 42 may be directly provided on the indoor unit 20 or provided, for example, on the remote control.

[0036] Next, a control configuration of the present embodiment will be described.

[0037] FIG. 2 is a block diagram showing the control configuration of the present embodiment.

[0038] As shown in FIG. 2, the air-conditioning device 1 includes a centralized controller 50 serving as the control device. The centralized controller 50 includes a display unit 52 for displaying the state of each indoor unit 20, and the display unit 52 is, for example, a liquid crystal display device.

[0039] The centralized controller 50 includes, for example, a processor that executes a program, such as a CPU or an MPU, and a memory, such as a ROM or a RAM, and executes various processes through cooperation of hardware and software so that the processor reads a control program stored in the memory and executes processing.

[0040] The centralized controller 50 controls the compressor 11, the fan 12, and the expansion valve 13 of the outdoor unit 10, and the fan 21 and the expansion valve 22 of the indoor unit 20 based on the control program.

[0041] The centralized controller 50 controls the opening and closing of the first liquid shut-off valve 34a, the second liquid shut-off valve 34b, the third liquid shut-off valve 34c, the first gas shut-off valve 36a, the second gas shut-off valve 36b, and the third gas shut-off valve 36c based on a detection signal of the refrigerant leakage sensor 40 of each indoor unit 20.

[0042] Also, the centralized controller 50 is configured to perform predetermined display on the display unit 42 of each indoor unit 20 and the display unit 52 of the centralized controller 50 when the centralized controller 50 controls the opening and closing of the first liquid shut-off valve 34a, the second liquid shut-off valve 34b, the third liquid shut-off valve 34c, the first gas shut-off valve 36a, the second gas shut-off valve 36b, and the third gas shut-off valve 36c based on a detection signal of the refrigerant leakage sensor 40.

[0043] Next, the action of the present embodiment will be described with reference to a flowchart shown in FIG. 3.

[0044] In the present embodiment, the centralized controller 50 determines whether all of the liquid shut-off valves and the gas shut-off valves are "open" during an operation (ST1).

[0045] When the centralized controller 50 determines that all of the shut-off valves are "open" (ST1: YES), the centralized controller 50 continues the cooling or heating operation.

[0046] Then, when the refrigerant leakage sensor 40 detects refrigerant leakage (ST2: YES), the centralized controller 50 performs control to switch the liquid shut-off valve and the gas shut-off valve corresponding to the indoor unit 20 for which the refrigerant leakage sensor 40 detects the refrigerant leakage to "closed" based on a detection signal of the refrigerant leakage sensor 40 (ST3) .

[0047] For example, when the refrigerant leakage sen-

sor 40 of the indoor unit 20 in the room A detects refrigerant leakage, the first liquid shut-off valve 34a and the gas shut-off valve on the first liquid refrigerant pipe 30a and the first gas refrigerant pipe 32a through which the refrigerant is passed to the indoor unit 20 in the room A are switched to "closed".

[0048] Accordingly, the refrigerant is not delivered to the indoor units 20 in the room B and the room C. Thus, the centralized controller 50 controls the indoor units 20 in the room B and the room C to perform a fan only operation or stop operation.

[0049] The centralized controller 50 turns ON the fan 21 of the indoor unit 20 installed in the room where the refrigerant leakage has occurred (ST4). Accordingly, air can be agitated in the room where the refrigerant leakage has occurred.

[0050] Then, the centralized controller 50 displays, on the display unit 52 of the centralized controller 50, that the relevant indoor unit 20 having the refrigerant leakage (the indoor unit 20 in the room A) is in a "refrigerant leakage state" (ST5). Further, the centralized controller 50 displays, on the display unit 42 of the relevant indoor unit 20 having the refrigerant leakage (the indoor unit 20 in the room A), "refrigerant leakage state" and "indoor units in operable state are present" (ST6).

[0051] Then, the centralized controller 50 performs control to stop operation of the indoor unit 20 in the room A (ST7).

[0052] When the refrigerant leakage sensor 40 detects no refrigerant leakage (ST2: NO), the centralized controller 50 determines whether all of the liquid shut-off valves and the gas shut-off valves are "open" (ST1). In the present embodiment, since the first liquid shut-off valve 34a and the first gas shut-off valve 36a are controlled to be "closed" by the operation described above, it is determined that not all of the liquid shut-off valves and the gas shut-off valves are "open" (ST1: NO) .

[0053] Then, the centralized controller 50 determines whether the relevant liquid shut-off valve and gas shut-off valve (in this example, the first liquid shut-off valve 34a and the first gas shut-off valve 36a) are "closed" (ST8). When it is determined that these valves are "closed" (ST8: YES), the centralized controller 50 displays, on the display unit 52 of the centralized controller 50, that the relevant indoor units 20 (the indoor units 20 in the room B and the room C) are in a "limited operation state" (ST9).

[0054] Further, the centralized controller 50 displays, on the display units 42 of the indoor units 20 (in this example, the indoor units 20 in the room B and the room C) for which the liquid shut-off valve and the gas shut-off valve are "closed" due to the refrigerant leakage, "limited operation state" and "indoor units in operable state are present" (ST10).

[0055] Since the refrigerant is not delivered to the indoor units 20 in the room B and the room C, the centralized controller 50 performs control to switch the operation of the indoor units 20 in the room B and the room C to a fan only operation or stop the operation (ST11).

[0056] When it is determined that the relevant liquid shut-off valve and gas shut-off valve are not "closed" (ST8: NO), the centralized controller 50 displays, on the display unit 52 of the centralized controller 50, that the relevant indoor unit 20 is in an "operable state" (ST12).

[0057] That is, in this example, while the first liquid shut-off valve 34a and the first gas shut-off valve 36a are in a closed state, the second liquid shut-off valve 34b, the second gas shut-off valve 36b, the third liquid shut-off valve 34c, and the third gas shut-off valve 36c provided on the second liquid refrigerant pipe 30b and the second gas refrigerant pipe 32b are "open". Thus, the centralized controller 50 displays, on the display unit 52 of the centralized controller 50, that the indoor units 20 in the room D and the room E, the indoor units 20 being connected to the second liquid refrigerant pipe 30b and the second gas refrigerant pipe 32b, are in an "operable state".

[0058] The centralized controller 50 displays, on the display units 42 of the relevant indoor units 20 (in this example, the indoor units 20 in the room D and the room E), "operable state" and "indoor unit in refrigerant leakage state is present" (ST13).

[0059] The indoor units 20 in the room D and the room E continue the operation such as a cooling operation or a heating operation as is (ST14).

[0060] By performing such control, when refrigerant leakage occurs in the indoor unit 20 in the room A, the display of "refrigerant leakage state" and "indoor units 20 in operable state are present" on the display unit 42 of the indoor unit 20 in the room A enables a user of the indoor unit 20 in the room A to recognize the refrigerant leakage state and that the indoor units 20 in an operable state (the indoor units 20 in the room D and the room E) are present among the other indoor units 20.

[0061] Also, the display of "limited operation state" and "indoor units in an operable state (the indoor units 20 in the room D and the room E) are present" on the display units 42 of the indoor units 20 in the room B and the room C enables users of the indoor units 20 in the room B and the room C to recognize that the indoor units 20 in the room B and the room C are in a limited operation state in which a fan only operation can be performed or the operation is stopped due to the refrigerant leakage in another indoor unit 20 and that the indoor units in an operable state (the indoor units 20 in the room D and the room E) are present among the other indoor units 20.

[0062] Further, the display of "operable state" and "indoor units in refrigerant leakage state are present" on the display units 42 of the indoor units 20 in the room D and the room E enables users of the indoor units 20 in the room D and the room E to recognize that a cooling operation, a heating operation, or a fan operation can be performed and that the indoor unit 20 in the refrigerant leakage state (the indoor unit 20 in the room A) is present.

[0063] As described above, according to the present embodiment, the air-conditioning device 1 includes: the

shut-off valves 34, 36 (opening/closing device) provided upstream of the indoor unit 20 on the liquid refrigerant pipe 30a, 30b and the gas refrigerant pipe 32a, 32b, the shut-off valves 34, 36 being configured to shut off the flow of a refrigerant in the liquid refrigerant pipe 30a, 30b and the gas refrigerant pipe 32a, 32b; the refrigerant leakage sensor 40 that detects leakage of the refrigerant from the indoor unit 20; and the centralized controller 50 (control device) that controls the opening and closing of the shut-off valves 34, 36 based on a detection signal of the refrigerant leakage sensor 40, in which when the refrigerant leakage sensor 40 detects refrigerant leakage of the indoor unit 20, the centralized controller 50 controls the opening/closing device located upstream of the indoor unit 20 to be closed, when the opening/closing device located upstream of the indoor unit 20 is in a closed state and the refrigerant leakage sensor 40 of the indoor unit 20 detects the refrigerant, the centralized controller 50 controls the indoor unit 20 to a refrigerant leakage state in which a cooling operation or a heating operation is stopped, and when the shut-off valves 34, 36 located upstream of the indoor unit 20 are in a closed state and the refrigerant leakage sensor 40 of the indoor unit 20 detects no refrigerant, the centralized controller 50 controls the indoor unit 20 to a limited operation state in which the indoor unit 20 performs a fan operation or stops operation.

[0064] Accordingly, when the shut-off valves 34, 36 on the liquid refrigerant pipe 30a, 30b and the gas refrigerant pipe 32a, 32b are closed to stop operation when refrigerant leakage occurs in the indoor unit 20, another indoor unit 20 connected to the same liquid refrigerant pipe 30a, 30b and gas refrigerant pipe 32a, 32b is controlled to the limited operation state. Thus, reduction in the comfort of a user of the other indoor unit 20 can be prevented by causing the other indoor unit 20 to perform the fan operation.

[0065] Also, according to the present embodiment, when the shut-off valves 34, 36 located upstream of the indoor unit 20 are in an open state, the centralized controller 50 controls the indoor unit 20 to an operable state in which the indoor unit performs the cooling operation, the heating operation, or the fan operation.

[0066] Accordingly, even when refrigerant leakage occurs in the indoor unit 20, in another indoor unit 20 connected to the other liquid refrigerant pipe 30a, 30b and gas refrigerant pipe 32a, 32b that are not closed by the shut-off valves 34, 36, the flow of the refrigerant is not shut off, and any of the cooling operation, the heating operation, and the fan operation can be performed. Thus, reduction of the comfort of a user can be prevented.

[0067] Also, according to the present embodiment, the centralized controller 50 includes the display unit 52 for checking an operating state of the indoor unit 20, and the centralized controller 50 causes the display unit 52 to display whether the indoor unit 20 is in the refrigerant leakage state, the limited operation state, or the operable state.

[0068] Accordingly, by the centralized controller 50 causing the display unit 52 to display whether the indoor unit 20 is in the refrigerant leakage state, the limited operation state, or the operable state, an administrator can recognize the indoor unit 20 that cannot perform an air-conditioning operation, the indoor unit 20 that cannot perform the air-conditioning operation, but can perform the fan operation, and the indoor unit 20 that can perform the air-conditioning operation. As a result, after the operation is stopped, it is possible to promptly communicate the operating state to a user in a space where each indoor unit 20 is present.

[0069] Also, according to the present embodiment, each of the indoor units 20 includes the display unit 42, and the centralized controller 50 causes the display unit 42 of the indoor unit 20 in the refrigerant leakage state to display being in the refrigerant leakage state and presence of the indoor unit 20 in the operable state, causes the display unit 42 of the indoor unit 20 in the limited operation state to display being in the limited operation state and presence of the indoor unit 20 in the operable state, and causes the display unit 42 of the indoor unit 20 in the operable state to display being in the operable state and presence of the indoor unit 20 in the refrigerant leakage state.

[0070] Accordingly, a user of the indoor unit 20 can recognize the indoor unit 20 that cannot perform the air-conditioning operation and the indoor unit 20 that can perform the air-conditioning operation. Also, since the state of the occurrence of refrigerant leakage in the same refrigerant pipe system and the other refrigerant pipe system can be recognized, the refrigerant leakage state can be notified to users of the plurality of indoor units 20.

[0071] Note that the present invention is not limited to the above embodiment and can be variously modified without departing from the gist of the present invention.

[Industrial Applicability]

[0072] As described above, the air-conditioning device according to the present invention is suitably useful as an air-conditioning device that includes a plurality of indoor units connected to an outdoor unit and can recognize, when any of the indoor units detects refrigerant leakage, a refrigerant leakage state, an operating state, and the like in the other indoor unit.

[Reference Signs List]

[0073]

1	air-conditioning device
10	outdoor unit
11	compressor
12	fan
13	expansion valve
20	indoor unit
21	fan

22	expansion valve
30	liquid refrigerant pipe
30a	first liquid refrigerant pipe
30b	second liquid refrigerant pipe
32	gas refrigerant pipe
32a	first gas refrigerant pipe
32b	second gas refrigerant pipe
34, 36	shut-off valve
34a	first liquid shut-off valve
34b	second liquid shut-off valve
34c	third liquid shut-off valve
36a	first gas shut-off valve
36b	second gas shut-off valve
36c	third gas shut-off valve
40	refrigerant leakage sensor
42	display unit
50	centralized controller
52	display unit

Claims

1. An air-conditioning device (1) comprising:

an outdoor unit (10) including at least a compressor (11), and a heat source side heat exchanger;
a plurality of indoor units (20) each including at least a use side heat exchanger, and a fan (21); and
a liquid refrigerant pipe (30) and a gas refrigerant pipe (32) that connect the outdoor unit and the indoor units; **characterized by** comprising:

an opening/closing device (34, 36) provided upstream of the indoor unit on the liquid refrigerant pipe and the gas refrigerant pipe, the opening/closing device being configured to shut off a flow of a refrigerant in the liquid refrigerant pipe and the gas refrigerant pipe;
a refrigerant leakage sensor (40) that detects leakage of the refrigerant from the indoor unit; and
a control device (50) configured to control opening and closing of the opening/closing device based on a detection signal of the refrigerant leakage sensor, wherein
when the refrigerant leakage sensor detects refrigerant leakage of the indoor unit, the control device controls the opening/closing device located upstream of the indoor unit to be closed,
when the opening/closing device located upstream of the indoor unit is in a closed state and the refrigerant leakage sensor of the indoor unit detects the refrigerant, the control device controls the indoor unit to a refrigerant leakage state in which a cooling operation or a heating operation is stopped, and
when the opening/closing device located upstream of the indoor unit is in a closed state and the refrigerant leakage sensor of the indoor unit detects no refrigerant, the control device controls the indoor unit to a limited operation state in which the indoor unit performs a fan operation or stops operation.

2. The air-conditioning device according to claim 1, wherein, when the opening/closing device located upstream of the indoor unit is in an open state, the control device controls the indoor unit to an operable state in which the indoor unit performs the cooling operation, the heating operation, or the fan operation.

3. The air-conditioning device according to claim 2, wherein

the control device includes a display unit (52) for checking an operating state of the indoor unit, and
the control device causes the display unit to display whether the indoor unit is in the refrigerant leakage state, the limited operation state, or the operable state.

4. The air-conditioning device according to claim 2 or 3, wherein

each of the indoor units includes a display unit (42), and
the control device causes the display unit of the indoor unit in the refrigerant leakage state to display being in the refrigerant leakage state and presence of the indoor unit in the operable state, causes the display unit of the indoor unit in the limited operation state to display being in the limited operation state and presence of the indoor unit in the operable state, and causes the display unit of the indoor unit in the operable state to display being in the operable state and presence of the indoor unit in the refrigerant leakage state.

FIG.1

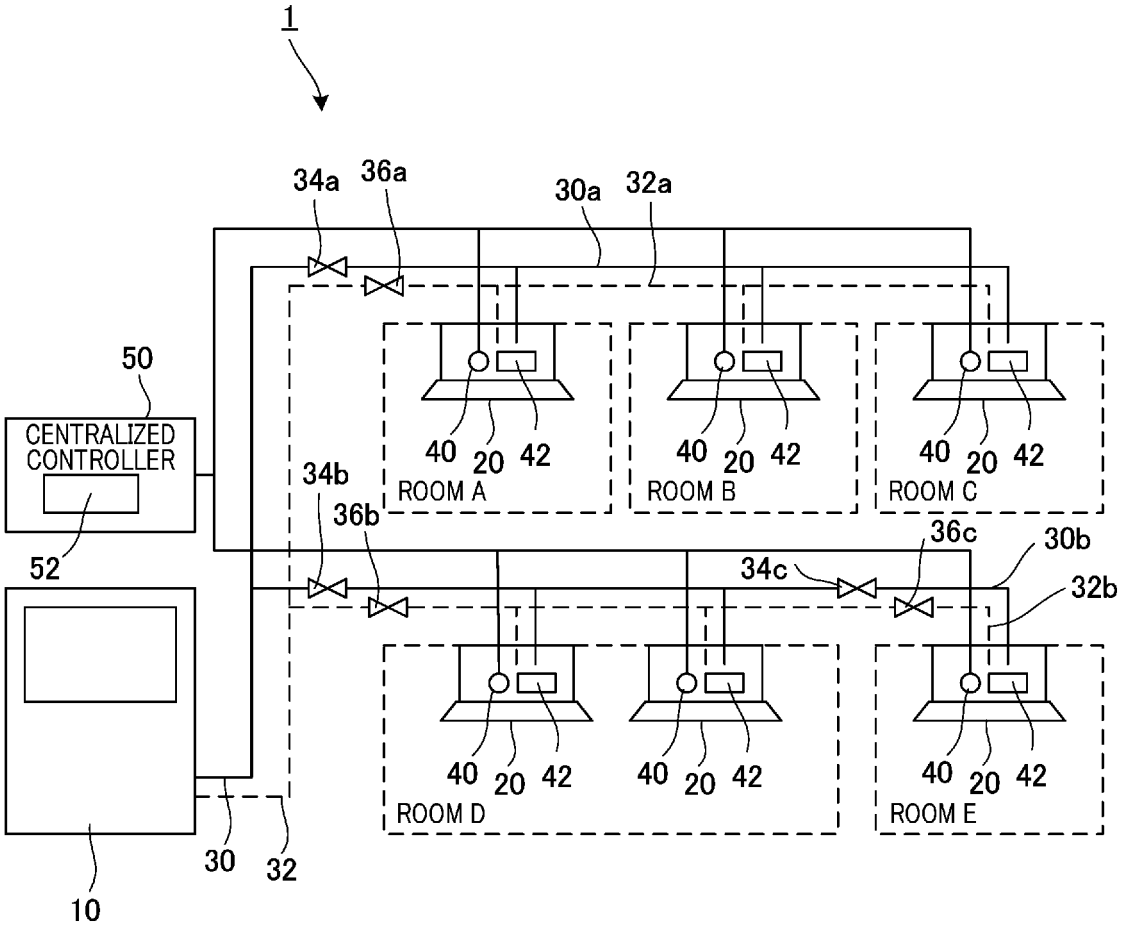

1
34a
36a
30a
32a
50
CENTRALIZED CONTROLLER
52
34b
36b
36c
30b
34c
32b
40
20
42
ROOM A
ROOM B
ROOM C
ROOM D
ROOM E
30
32
10

FIG.2

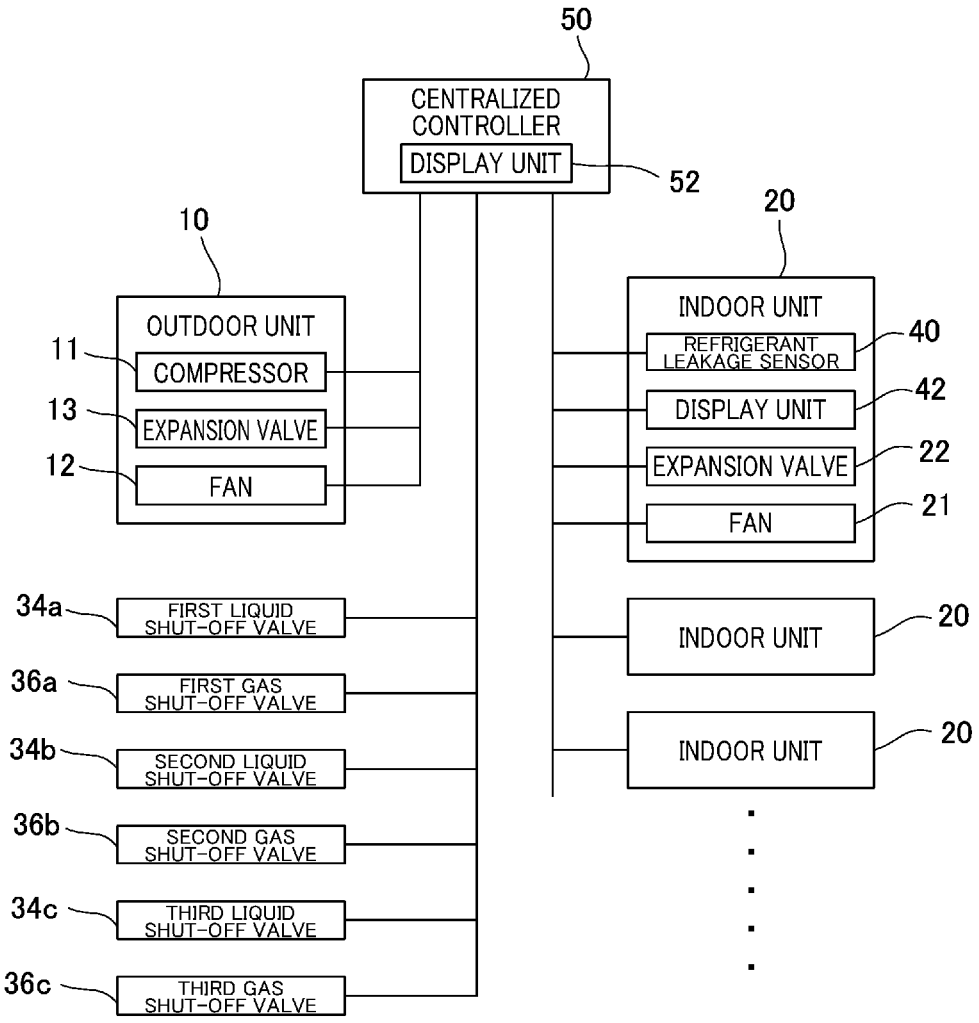
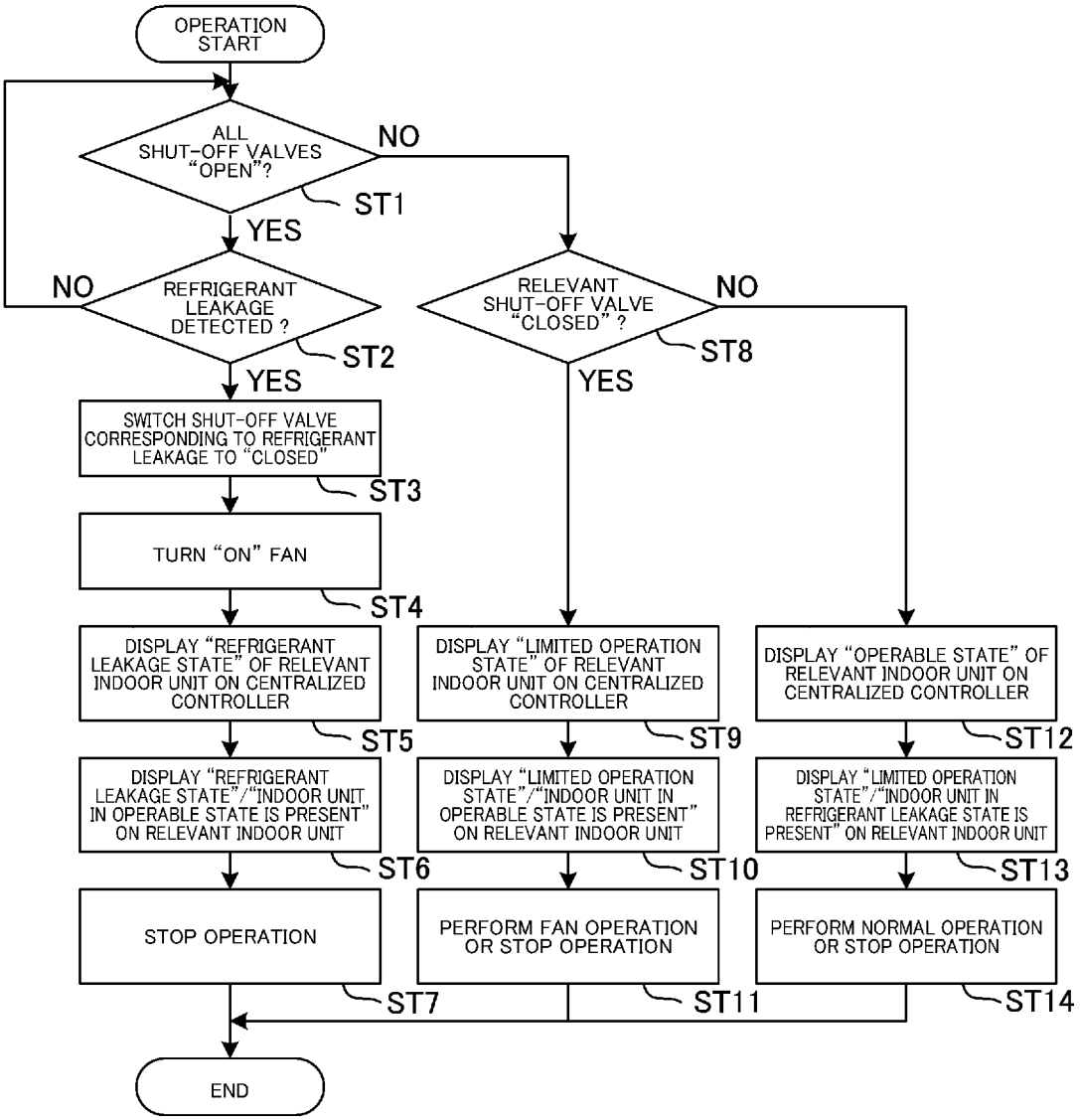

50
CENTRALIZED CONTROLLER
DISPLAY UNIT
52
10
OUTDOOR UNIT
11
COMPRESSOR
13
EXPANSION VALVE
12
FAN
20
INDOOR UNIT
REFRIGERANT LEAKAGE SENSOR
40
DISPLAY UNIT
42
EXPANSION VALVE
22
FAN
21
34a
FIRST LIQUID SHUT-OFF VALVE
36a
FIRST GAS SHUT-OFF VALVE
34b
SECOND LIQUID SHUT-OFF VALVE
36b
SECOND GAS SHUT-OFF VALVE
34c
THIRD LIQUID SHUT-OFF VALVE
36c
THIRD GAS SHUT-OFF VALVE
INDOOR UNIT
20
INDOOR UNIT
20

FIG.3


OPERATION START
ALL SHUT-OFF VALVES "OPEN"?
NO
ST1
YES
NO
REFRIGERANT LEAKAGE DETECTED ?
ST2
YES
RELEVANT SHUT-OFF VALVE "CLOSED" ?
NO
ST8
YES
SWITCH SHUT-OFF VALVE CORRESPONDING TO REFRIGERANT LEAKAGE TO "CLOSED"
ST3
TURN "ON" FAN
ST4
DISPLAY "REFRIGERANT LEAKAGE STATE" OF RELEVANT INDOOR UNIT ON CENTRALIZED CONTROLLER
ST5
DISPLAY "LIMITED OPERATION STATE" OF RELEVANT INDOOR UNIT ON CENTRALIZED CONTROLLER
ST9
DISPLAY "OPERABLE STATE" OF RELEVANT INDOOR UNIT ON CENTRALIZED CONTROLLER
ST12
DISPLAY "REFRIGERANT LEAKAGE STATE"/"INDOOR UNIT IN OPERABLE STATE IS PRESENT" ON RELEVANT INDOOR UNIT
ST6
DISPLAY "LIMITED OPERATION STATE"/"INDOOR UNIT IN OPERABLE STATE IS PRESENT" ON RELEVANT INDOOR UNIT
ST10
DISPLAY "LIMITED OPERATION STATE"/"INDOOR UNIT IN REFRIGERANT LEAKAGE STATE IS PRESENT" ON RELEVANT INDOOR UNIT
ST13
STOP OPERATION
ST7
PERFORM FAN OPERATION OR STOP OPERATION
ST11
PERFORM NORMAL OPERATION OR STOP OPERATION
ST14
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/018467

A. CLASSIFICATION OF SUBJECT MATTER
F25B 49/02(2006.01)i; F24F 11/36(2018.01)i; F24F 11/49(2018.01)i; F24F 11/52(2018.01)i; F25B 41/20(2021.01)i
FI: F25B49/02 520M; F25B41/20 Z; F25B49/02 570Z; F24F11/36; F24F11/49; F24F11/52
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)
F25B49/02; F24F11/36; F24F11/49; F24F11/52; F25B41/20

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

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2020/021593 A1 (MITSUBISHI ELECTRIC CORP.) 30 January 2020 (2020-01-30) paragraphs [0071]-[0088]	1-4
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 2103/1984 (Laid-open No. 116163/1985) (SANYO ELECTRIC CO., LTD.) 06 August 1985 (1985-08-06) page 5, line 15 to page 8, line 16	1-4
Y	JP 5-44978 A (MITSUBISHI ELECTRIC CORP.) 23 February 1993 (1993-02-23) paragraphs [0003], [0011]-[0015]	2-4

☐ 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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"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
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 May 2021 (25.05.2021)	15 June 2021 (15.06.2021)

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

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/018467

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
WO 2020/021593 A1	30 Jan. 2020	(Family: none)	
JP 60-116163 U1	06 Aug. 1985	(Family: none)	
JP 5-44978 A	23 Feb. 1993	(Family: none)	

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2016223650 A **[0003]**
- JP 2020092271 A **[0008]**