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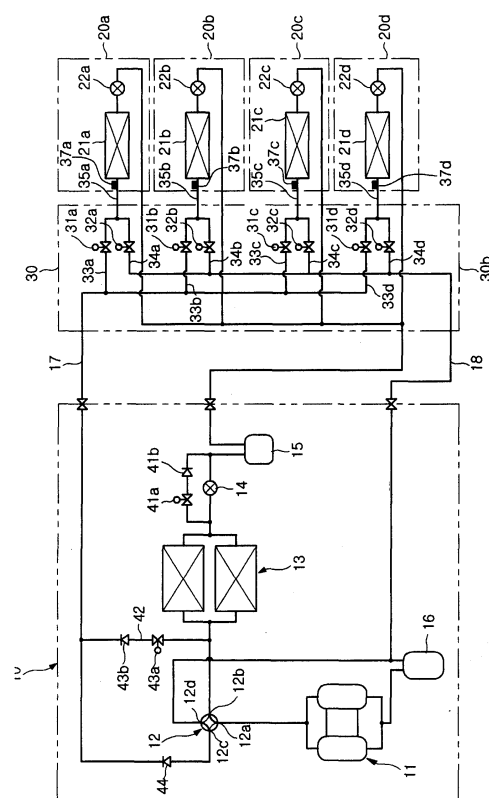
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(54) Checking Air Conditioning System Installation

(57) A multi air conditioning system and a method for inspecting pipe connection thereof, in which the pipe connection is rapidly inspected and the reliability in inspecting the pipe connection is improved. The method for inspecting the multi air conditioning system, which includes a plurality of indoor units and a mode converter having a plurality of heating valve-cooling valve sets for controlling refrigerant flowing into the indoor units, includes: changing opened and closed states of one heating valve-cooling valve set out of the plural heating valve-cooling valve sets during the operation of the system; detecting the indoor unit having a heat exchanger, the temperature of which varies corresponding to the change of the opened and closed states of the heating valve-cooling valve set; and determining, when the indoor unit having the heat exchanger, the temperature of which varies, matches with the heating valve-cooling valve set having the changed opened and closed states thereof, that the connection between the indoor unit having the heat exchanger, the temperature of which varies, and the heating valve-cooling valve set, having the changed the opened and closed states thereof, is normal.

FIG. 1



Description

[0001] In a first aspect, the present invention relates to a method for confirming correct installation of an air conditioning system, which comprises an outdoor unit and a plurality of indoor units, comprising operating a single indoor unit in heating mode, determining whether the temperature at the operated indoor unit changes by more than a predetermined amount and, if the temperature change does not exceed said predetermined amount, generating an indication that the air conditioning system has not been installed correctly.

[0002] In a second aspect, the present invention also relates to a method for confirming correct installation of an air conditioning system, which comprises an outdoor unit and a plurality of indoor units, comprising operating a single indoor unit in cooling mode, determining whether the temperature at the operated indoor unit changes by more than a predetermined amount and, if the temperature change does not exceed said predetermined amount, generating an indication that the air conditioning system has not been installed correctly.

[0003] Generally, a multi air conditioning system comprises an outdoor unit, a plurality of indoor units, connected in parallel and to the outdoor unit, communication lines connecting the outdoor unit with the indoor units, a power line, refrigerant pipes and electric valves installed in the refrigerant pipes.

[0004] In the above conventional multi air conditioning system, when the system is initially installed, a worker connects the outdoor unit and the indoor units by the communication lines, the power line and the refrigerant pipes and inputs the number of refrigerant pipes connected to the indoor units using input means (for example, rotary switches) provided on the indoor units, thereby informing an outdoor unit microcomputer or indoor unit microcomputers of the number of refrigerant pipes connected to respective indoor units. However, the multi air conditioning system is disadvantageous in that the system comprises the plural refrigerant pipes and the plural indoor units connected to the refrigerant pipes and it is difficult to determine whether or not the refrigerant pipes and the indoor units are connected on the basis of the data regarding the number of refrigerant pipes input by a worker using the input means.

[0005] In order to solve the above problem, a method for determining which indoor units are connected to which refrigerant pipes after a multi air conditioning system is installed has been proposed. KR-A-1991-0008349 discloses a method of inspecting the refrigerant pipes of the multi air conditioning system in detail.

[0006] In order to detect which refrigerant pipe is connected to which indoor unit in the conventional multi air conditioning system, one of the electric valves is opened while the compressor is operating and the change in the temperature of the indoor unit, connected to the refrigerant pipe, in which the opened electric valve is installed, is observed. Then, the correspondence between the in-

door unit and the refrigerant pipe, in which the opened electric valve is installed, is obtained through the above change in temperature of the indoor unit. By repeating the above process, the connections between the refrigerant pipes and the indoor units are determined.

[0007] However, since the change in temperature of the indoor unit connected to the refrigerant pipe, in which the opened electric valve, is achieved slowly, in case that the number of the indoor units to be inspected is large, the above-described conventional method for inspecting the multi air conditioning system is disadvantageous in that it takes a long time to inspect the refrigerant pipes.

[0008] Furthermore, since variation in the temperature of the indoor unit connected to the refrigerant pipe, in which the opened electric valve is installed, is not large, the above-described conventional method for inspecting the multi air conditioning system is disadvantageous in that the reliability of the inspection of the refrigerant pipes is reduced.

[0009] A method, according to the first aspect of the present invention, is characterised in that all the indoor units are operated concurrently in cooling mode prior to operation said single indoor unit in heating mode.

[0010] A method, according to the second aspect of the present invention, is characterised in that all the indoor units are operated concurrently in heating mode prior to operation said single indoor unit in cooling mode.

[0011] Additional preferred and optional features of the present invention are set forth in claims 3 to 17 appended hereto.

[0012] Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic view illustrating the refrigerant circuit of a multi air conditioning system according to the present invention;

Figure 2 is a block diagram of the multi air conditioning system of Figure 1;

Figure 3 is a flowchart illustrating a first method of discovering the pipe connections in the multi air conditioning system shown in Figures 1 and 2; and

Figure 4 is a flowchart illustrating a second method of discovering the pipe connection in the multi air conditioning system shown in Figures 1 and 2.

[0013] Referring to Figure 1, a multi air conditioning system according to the present invention comprises an outdoor unit 10, first to fourth indoor units 20a, 20b, 20c, 20d, connected in parallel with each other and to the outdoor unit 10, and a mode changer 30 for changing the operating mode of the first to fourth indoor units 20a, 20b, 20c, 20d, e.g. from cooling mode to heating mode and from heating mode to cooling mode.

[0014] The outdoor unit 10 includes a four-way valve 12 for setting the flow direction of the refrigerant discharged from compressors 11, an outdoor heat exchanger 13 for achieving heat exchange by means of outdoor

air entering into the outdoor unit 10, an outdoor electric valve 14 and a receiver tank 15 and an accumulator 16 for separating the liquid and gaseous components of the refrigerant from each other. The refrigerant flows between the first to fourth indoor units 20a, 20b, 20c, 20d and the outdoor unit 10 through a high-pressure gas pipe 17, a low-pressure gas pipe 18, and a high-pressure liquid pipe 19.

[0015] In the outdoor unit 10, the low-pressure gas pipe 18 is connected to the inlets of the compressors 11 through the accumulator 16, the outdoor heat exchanger 13 is connected in series to the outdoor electric valve 14, and the high-pressure liquid pipe 19 is connected to the outdoor electric valve 14 through the receiver tank 15. A bypass valve 41 a, serving as a flow control valve, and a non-return valve 41 b are connected in parallel with the outdoor electric valve 14. Liquid refrigerant, discharged from the outdoor heat exchanger 13, passes through the bypass valve 41a and the non-return valve 41b, bypassing the outdoor electric valve 14, during cooling operation, and the bypass valve 41a is closed and the refrigerant passes through the outdoor electric valve 14 during heating operation.

[0016] A high-pressure branch pipe 42, which branches from the high-pressure gas pipe 17, is located between the four-way valve 12 and the high-pressure liquid pipe 19 and an electric valve 43a, serving as a switching valve, and a non-return valve 43b, for preventing back flow of the refrigerant discharged from the high-pressure gas pipe 17, are installed in the high-pressure branch pipe 42. Another non-return valve 44, for preventing the back flow of refrigerant, is installed between the four-way valve 12 and the high-pressure liquid pipe 19.

[0017] The first to fourth indoor units 20a, 20b, 20c, 20d include respective ones of first to fourth indoor heat exchangers 21a, 21b, 21c, 21d, respective ones of first to fourth indoor electric valves 22a, 22b, 22c, 22d connected in series with respective ones of the first to fourth indoor heat exchangers 21 a, 21b, 21c, 21d, and first to fourth temperature sensors 37a, 37b, 37c, 37d, installed between respective ones of the first to fourth indoor units 20a, 20b, 20c, 20d and the mode changer 30.

[0018] The mode changer 30 includes first to fourth heating valves 31a, 31b, 31c, 31d installed in first to fourth high-pressure gas branch pipes 33a, 33b, 33c, 33d, which branch from the high-pressure gas pipe 17, and first to fourth cooling valves 32a, 32b, 32c, 32d, installed respectively in first to fourth low-pressure gas branch pipes 34a, 34b, 34c, 34d, which branch from the low-pressure gas pipe 18. A valve set comprising the first heating valve 31a and the first cooling valve 32a is connected to a first refrigerant pipe 35a, connected to the first indoor heat exchanger 20a, and further valve sets comprising a respective heating valve and a respective cooling valve from the second to fourth heating valves 31b, 31c, 31d and the second to fourth cooling valves 32b, 32c, and 32d are respectively connected to second to fourth refrigerant pipes 35b, 35c, 35d.

[0019] As shown in Figure 2, the outdoor unit 10 further comprises an outdoor unit microcomputer 23 for controlling the outdoor unit 10.

[0020] The first to fourth indoor units 20a, 20b, 20c, 20d each include one of first to fourth indoor unit microcomputers 36a, 36b, 36c, 36d for controlling their operation.

[0021] The mode changer 30 further includes a mode changer microcomputer 38 for controlling the first to fourth cooling valves 32a, 32b, 32c, 32d and the first to fourth heating valves 31 a, 31 b, 31 c, 31 d.

[0022] Now, a first method of discovering the pipe connections of the multi air conditioning system shown in Figures 1 and 2 will be described with reference to Figure 3.

[0023] When the multi air conditioning system is installed, a worker connects the outdoor unit 10, the indoor units 20a, 20b, 20c, 20d and the mode changer 30 using pipes, and inputs the numbers of the branch holes (not shown) of the mode changer 30, connected to the indoor units 20a, 20b, 20c, 20d, using input means.

[0024] The branch holes are holes, formed through the case of the mode changer 30, through which the pipes connecting the indoor units 20a, 20b, 20c, 20d to the heating valve-cooling valve sets pass, in the mode changer 30 and the number of branch holes is the same as the number of pipes passing through the branch holes and the number of heating valve-cooling valve sets, connected to the corresponding pipes. For example, if the first through hole is connected to the first indoor unit, the first pipe passes through the first branch hole and the first heating valve and the first cooling valve are connected to the first pipe.

[0025] Various means can be used as the above input means. For example, a rotary switch may be installed in each indoor unit and used to indicate the number of the through hole, to which the corresponding indoor unit is connected, thereby allowing the corresponding indoor unit microcomputer to obtain the number of the through hole (i.e. the number of the heating valve-cooling valve set and the number of the pipe), to which the corresponding indoor unit is connected. Furthermore, when the indoor unit microcomputer obtains the number of the through hole, to which the corresponding indoor unit is connected, the indoor unit microcomputer sends data to the mode converter microcomputer so that the mode converter microcomputer learns the address/identity of the indoor unit connected to the heating valve-cooling valve set. In this embodiment of the present invention, the first indoor unit 20a is connected to the first heating valve-first cooling valve set and the second to fourth indoor units 20b, 20c, 20d are respectively connected to the second heating valve-second cooling valve set, the third heating valve-third cooling valve set and the fourth heating valve-fourth cooling valve set.

[0026] After the input of the data regarding the connections between the valves of the mode changer 30 and the indoor units is completed, all of the indoor units 20a,

20b, 20c, 20d are operated in a cooling mode (S50) and all of the heating valves 31a, 31 b, 31 c, 31 d of the mode changer 30 are closed and all of the cooling valves 32a, 32b, 32c, 32d of the mode changer 30 are open (S52).

[0027] The temperatures around the indoor heat exchangers are measured by the temperature sensors 37a, 37b, 37c, 37d, and the mode changer 30 stands by until the measured temperatures have stabilized (S54). When the temperatures sensed by the temperature sensors 37a, 37b, 37c, 37d have stabilized, the mode converter microcomputer 38 opens the first heating valve 31 a and closes the first cooling valve 32a (S56 and S58).

[0028] After a designated time from the above change of the opened and closed states of the first heating valve 31 a and the first cooling valve 32a elapses, the increase of temperature around the first indoor heat exchanger 21 a is calculated from the temperatures measured by the temperature sensors 37a, 37b, 37c, 37d (S60). Since the designated time varies according to the system, it is preferable that the designated time is set to a time taken to sufficiently sense the increase of temperature.

[0029] As described above, in the case that refrigerant in a low-temperature and low-pressure liquid state is supplied to the indoor unit, connected to the first heating valve-first cooling valve set, through the first cooling valve 32a, and then the first cooling valve 32a is closed and refrigerant in a high-temperature and high-pressure gaseous state is supplied to the indoor unit, connected to the first heating valve-first cooling valve set, through the first heating valve 31a, the variation of temperatures sensed by the temperature sensors 37a, 37b, 37c, 37d is increased due to the high difference of temperatures of the refrigerant, and it is easily determined whether or not the temperatures change.

[0030] Thereafter, it is determined whether or not the indoor unit, the temperature of which has increased more than a reference range, is the first indoor unit 20a (S62). In case that it is determined that the temperature of the first indoor unit 20a is increased more than the reference range, it is determined that the pipe connection between the first indoor unit 20a and the first heating valve-first cooling valve set is normal (S64). Here, the reference range serves to exclude the influence of factors, on the variation of temperatures, other than the change of the opened and closed states of the valves, and is set to a suitable value by experimentation.

[0031] If it is determined that the pipe connection between the first indoor unit 20a and the first heating valve-first cooling valve set is normal, it is determined whether or not the inspection of all the pipe connections is completed (S66). If it is determined that the inspection of all of the pipe connections has not been completed, the opened and closed states of the next heating valve-cooling valve set are changed to determine whether or not the pipe connection between the next indoor unit and the next heating valve-first cooling valve set is normal (S68).

[0032] In the case that it is determined that the indoor unit, the temperature of which has increased more than

the reference range, is not the first indoor unit 20a in step S62, it is determined that the pipe connection between the first indoor unit 20a and the first heating valve-first cooling valve set has failed, and a warning is given through a display (not shown) (S72).

[0033] In the case that it is determined that the pipe connection between the first indoor unit 20a and the first heating valve-first cooling valve set has failed, the first indoor unit 20a is not connected to the first heating valve-first cooling valve set and another indoor unit is connected to the first heating valve-first cooling valve set.

[0034] Now, a second method of inspecting the pipe connection in the multi air conditioning system shown in Figures 1 and 2 will be described with reference to Figure 4.

[0035] When the multi air conditioning system is installed, a worker connects the outdoor unit 10, the indoor units 20a, 20b, 20c, 20d, and the mode changer 30 using pipes, and inputs the numbers of the branch holes of the mode changer 30, connected to the indoor units 20a, 20b, 20c, 20d (i.e., the numbers of the heating valve-cooling valve sets connected to the corresponding branch holes) using input means.

[0036] After the input of the data regarding the pipe connection between the valves of the mode changer 30 and the indoor units 20a, 20b, 20c, 20d is complete, all of the indoor units 20a, 20b, 20c, 20d are operated in a heating mode (S80), and all of the cooling valves 32a, 32b, 32c, 32d of the mode changer 30 are closed and all of the heating valves 31a, 31b, 31c, 31d of the mode changer 30 are opened (S82).

[0037] The temperatures around the indoor heat exchangers are measured by the temperature sensors 37a, 37b, 37c, 37d, and the mode changer 30 stands by until the measured temperatures have stabilized (S84). When the temperatures sensed by the temperature sensors 37a, 37b, 37c, 37d have stabilized, the mode converter microcomputer 38 opens the first cooling valve 32a and closes the first heating valve 31a (S88) of the first heating valve-cooling valve set.

[0038] After a designated time from the above change of the opened and closed states of the first heating valve 31 a and the first cooling valve 32a has elapsed, the decrease in temperature around the first indoor heat exchanger 21a is calculated from the temperatures measured by the temperature sensors 37a, 37b, 37c, 37d (S90). Since the designated time varies according to the system, it is preferable that the designated time is set to a time taken to sufficiently sense the decrease of temperature.

[0039] As described above, in the case that refrigerant in a high-temperature and high-pressure gaseous state is supplied to the indoor unit, connected to the first heating valve-cooling valve set, through the first heating valve 31 a, and then the first heating valve 31a is closed and refrigerant in a low-temperature and low-pressure liquid state is supplied to the indoor unit, connected to the first heating valve-cooling valve set, through the first cooling

valve 32a, the variations in the temperature sensed by the temperature sensors 37a, 37b, 37c, 37d is increased due to the high difference of temperatures of the refrigerant, and it is easily determined whether or not the temperatures vary.

[0040] Thereafter, it is determined whether or not the indoor unit, the temperature of which has decreased more than a reference range, is the first indoor unit 20a (S92). In the case that it is determined that the temperature of the first indoor unit 20a has decreased more than the reference range, it is determined that the pipe connection between the first indoor unit 20a and the first heating valve-first cooling valve set is normal (S94). Here, the reference range serves to exclude the influence of factors, on the variation of temperatures, other than the change of the opened and closed states of the valves, and is set to a suitable value by experimentation.

[0041] In the case that it is determined that the pipe connection between the first indoor unit 20a and the first heating valve-cooling valve set is normal, it is determined whether or not the inspection of all the pipe connections has been completed (S96). In the case that it is determined that the inspection of all the pipe connections has not been completed, the opened and closed states of the next heating valve-cooling valve set are changed to find out whether or not the pipe connection between the next indoor and the next heating valve-first cooling valve set is normal (S98).

[0042] In the case that it is determined that the indoor unit, the temperature of which has decreased more than the reference range, is not the first indoor unit 20a in step S92, it is determined that the pipe connection between the first indoor unit 20a and the first heating valve-first cooling valve set has failed, and a warning is given through a display (not shown) (S100 and S102).

[0043] In the case that it is determined that the pipe connection between the first indoor unit 20a and the first heating valve-cooling valve set has failed, the first indoor unit 20a is not connected to the first heating valve-first cooling valve set and another indoor unit is connected instead to the first heating valve-cooling valve set.

[0044] As apparent from the above description, the present invention provides a multi air conditioning system, in which pipe connection is inspected using the variation of temperatures before and after the change of opened and closed states of heating valve-cooling valve sets, and a method for inspecting pipe connection of the multi air conditioning system, thereby shortening the time taken to detect the variation of temperatures and rapidly inspecting the pipe connection.

[0045] Further, since the variation of temperatures before and after the change of opened and closed states of the heating valve-cooling valve sets is high, the multi air conditioning system of the present invention improves the reliability of inspecting the pipe connection.

[0046] Although embodiments of the invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these

embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

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Claims

1. A method for confirming correct installation of an air conditioning system, which comprises an outdoor unit (10) and a plurality of indoor units (20a, ..., 20d), the method comprising:

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operating a single indoor unit (20a) in heating mode;
determining whether the temperature at the operated indoor unit (20a) changes by more than a predetermined amount; and
if the temperature change does not exceed said predetermined amount, generating an indication that the air conditioning system has not been installed correctly,

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characterised in that all the indoor units (20a, ..., 20d) are operated concurrently in cooling mode prior to operation said single indoor unit (20a) in heating mode.

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2. A method for confirming correct installation of an air conditioning system, which comprises an outdoor unit (10) and a plurality of indoor units (20a, ..., 20d), the method comprising:

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operating a single indoor unit (20a) in cooling mode;
determining whether the temperature at the operated indoor unit (20a) changes by more than a predetermined amount; and
if the temperature change does not exceed said predetermined amount, generating an indication that the air conditioning system has not been installed correctly,

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characterised in that all the indoor units (20a, ..., 20d) are operated concurrently in heating mode prior to operation said single indoor unit (20a) in cooling mode.

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3. A method for inspecting pipe connection of a multi air conditioning system, which comprises a plurality of indoor units and a mode converter having a plurality of heating valve-cooling valve sets for controlling refrigerant flowing into the indoor units, comprising:

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changing opened and closed states of one heating valve-cooling valve set out of the plural heating valve-cooling valve sets during the operation of the system;
detecting the indoor unit having a heat exchanger, the temperature of which varies correspond-

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ing to the change of the opened and closed states of the heating valve-cooling valve set; and determining, when the indoor unit having the heat exchanger, the temperature of which varies, matches with the heating valve-cooling valve set having the changed opened and closed states thereof, that the connection between the indoor unit having the heat exchanger, the temperature of which varies, and the heating valve-cooling valve set, having the changed the opened and closed states thereof, is normal.

4. The method according to claim 1, further comprising:

determining, when the indoor unit having the heat exchanger, the temperature of which varies, does not match with the heating valve-cooling valve set having the changed the opened and closed states thereof, that the connection between the indoor unit having the heat exchanger, the temperature of which varies, and the heating valve-cooling valve set, having the changed the opened and closed states thereof, fails.

5. A method for inspecting pipe connection of a multi air conditioning system, which comprises a plurality of indoor units, a plurality of refrigerant pipes for supplying refrigerant, transmitted from an outdoor unit, to the indoor units or for supplying refrigerant, discharged from the indoor units, to the outdoor unit, and a mode converter including a plurality of cooling valves, opened in cooling modes of the indoor units, and a plurality of heating valves, opened in heating modes of the indoor units, for controlling the flow of the refrigerant pipes, comprising:

operating compressors under the condition that all of the plural heating valves are closed and all of the plural cooling valves are opened; opening one heating valve of the plural heating valves and closing one cooling valve matching with the heating valve in a set; and determining, when the indoor unit having a heat exchanger, the variation of measured temperature of which is more than a reference range, matches with the heating valve-cooling valve set having the changed opened and closed states thereof, that the connection between the indoor unit and the heating valve-cooling valve set is normal.

6. The method according to claim 5, further comprising:

determining, when the indoor unit having the heat exchanger, the variation of temperature of which is more than the reference range, does not match with the heating valve-cooling valve

set having the changed opened and closed states thereof, that the connection between the indoor unit and the heating valve-cooling valve set fails.

7. The method according to claim 5, wherein the temperatures of the heat exchangers are respectively measured by temperature sensors installed in pipes connecting the plural indoor units to the mode converter.

8. The method according to claim 7, wherein the temperatures of the heat exchangers are respectively measured before and after the opened and closed states of the heating valve-cooling valve set are changed.

9. The method according to claim 5, wherein the variations of the temperatures of the heat exchangers are increased variables of the measured temperatures of the heat exchangers.

10. The method according to claim 5, wherein the inspections of the pipe connections between the indoor units and the plural heating valve-cooling valve sets are sequentially performed.

11. A method for inspecting pipe connection of a multi air conditioning system, which comprises a plurality of indoor units, a plurality of refrigerant pipes for supplying refrigerant, transmitted from an outdoor unit, to the indoor units or for supplying refrigerant, discharged from the indoor units, to the outdoor unit, and a mode converter including a plurality of cooling valves, opened in cooling modes of the indoor units, and a plurality of heating valves, opened in heating modes of the indoor units, for controlling the flow of the refrigerant pipes, comprising:

operating compressors under the condition that all of the plural cooling valves are closed and all of the plural heating valves are opened; opening one cooling valve of the plural cooling valves and closing one heating valve matching with the cooling valve in a set; and determining, when the indoor unit having a heat exchanger, the variation of measured temperature of which is more than a reference range, matches with the heating valve-cooling valve set having the changed opened and closed states thereof, that the connection between the indoor unit and the heating valve-cooling valve set is normal.

12. The method according to claim 11, further comprising:

determining, when the indoor unit having the

heat exchanger, the variation of temperature of which is more than the reference range, does not match with the heating valve-cooling valve set having the changed opened and closed states thereof, that the connection between the indoor unit and the heating valve-cooling valve set fails. 5

13. The method according to claim 11, wherein the temperatures of the heat exchangers are respectively measured by temperature sensors installed in pipes connecting the plural indoor units to the mode converter. 10

14. The method according to claim 13, wherein the temperatures of the heat exchangers are respectively measured before and after the opened and closed states of the heating valve-cooling valve set are changed. 15

15. The method according to claim 11, wherein the variations of the temperatures of the heat exchangers are decreased variables of the measured temperatures of the heat exchangers. 20

16. The method according to claim 11, wherein the inspections of the pipe connections between the indoor units and the plural heating valve-cooling valve sets are sequentially performed. 25

17. A multi air conditioning system comprising: 30

a plurality of indoor units;
 a plurality of refrigerant pipes for supplying refrigerant, transmitted from an outdoor unit, to the indoor units, or for supplying refrigerant, discharged from the indoor units, to the outdoor unit; 35
 a mode converter including a plurality of cooling valves, opened in cooling modes of the indoor units, and a plurality of heating valves, opened in heating modes of the indoor units, for controlling the flow of the refrigerant pipes; 40
 a plurality of temperature sensors for measuring temperatures of heat exchangers of the indoor units; and 45
 a controller for detecting one indoor unit having the heat exchanger, the temperature of which varies according to the change of the opened and closed states of the heating valve-cooling valve set for controlling the refrigerant flowing into said indoor unit, thus inspecting pipe connection between said indoor unit and said heating valve-cooling valve set. 50

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FIG. 1

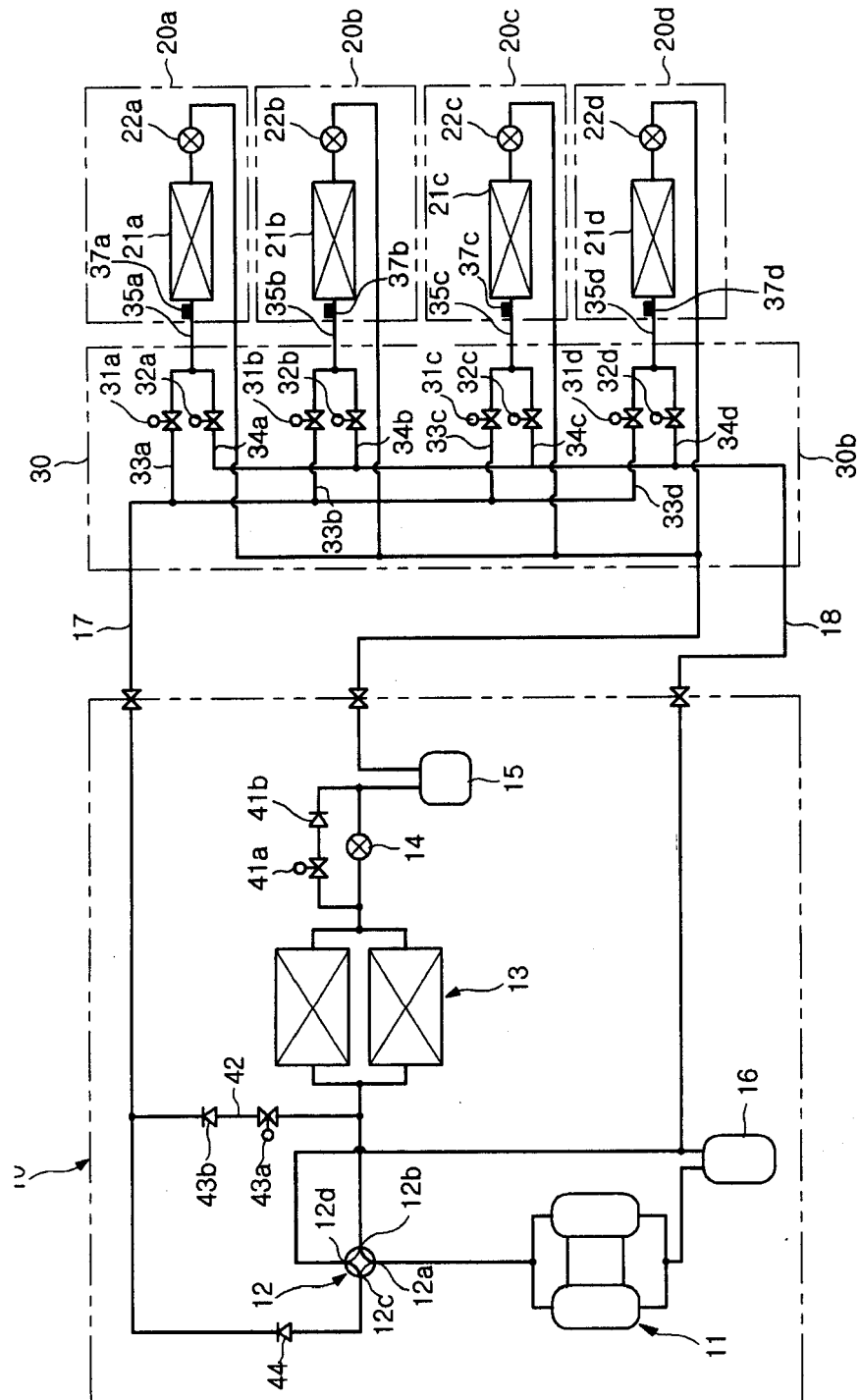


FIG. 2

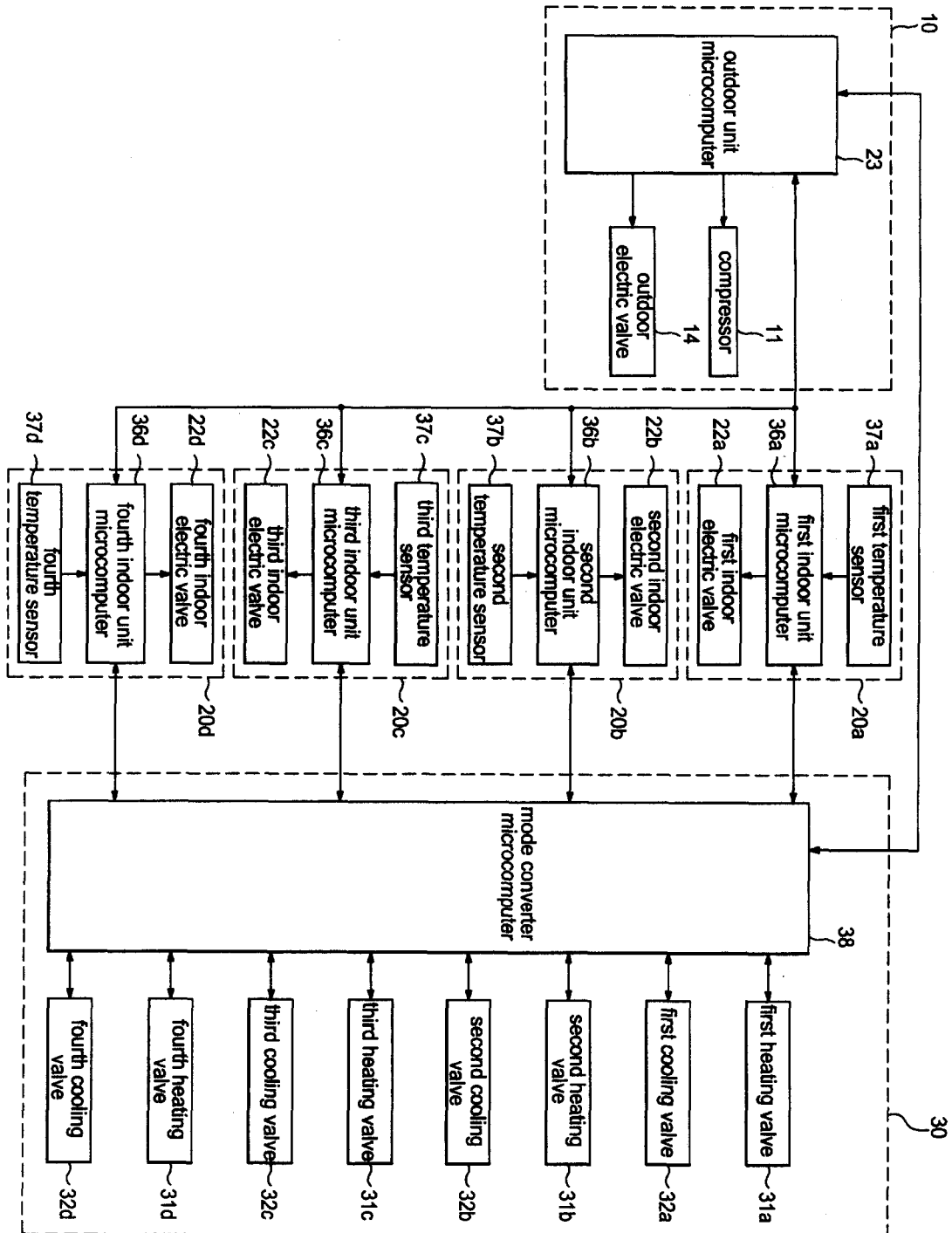


FIG. 3

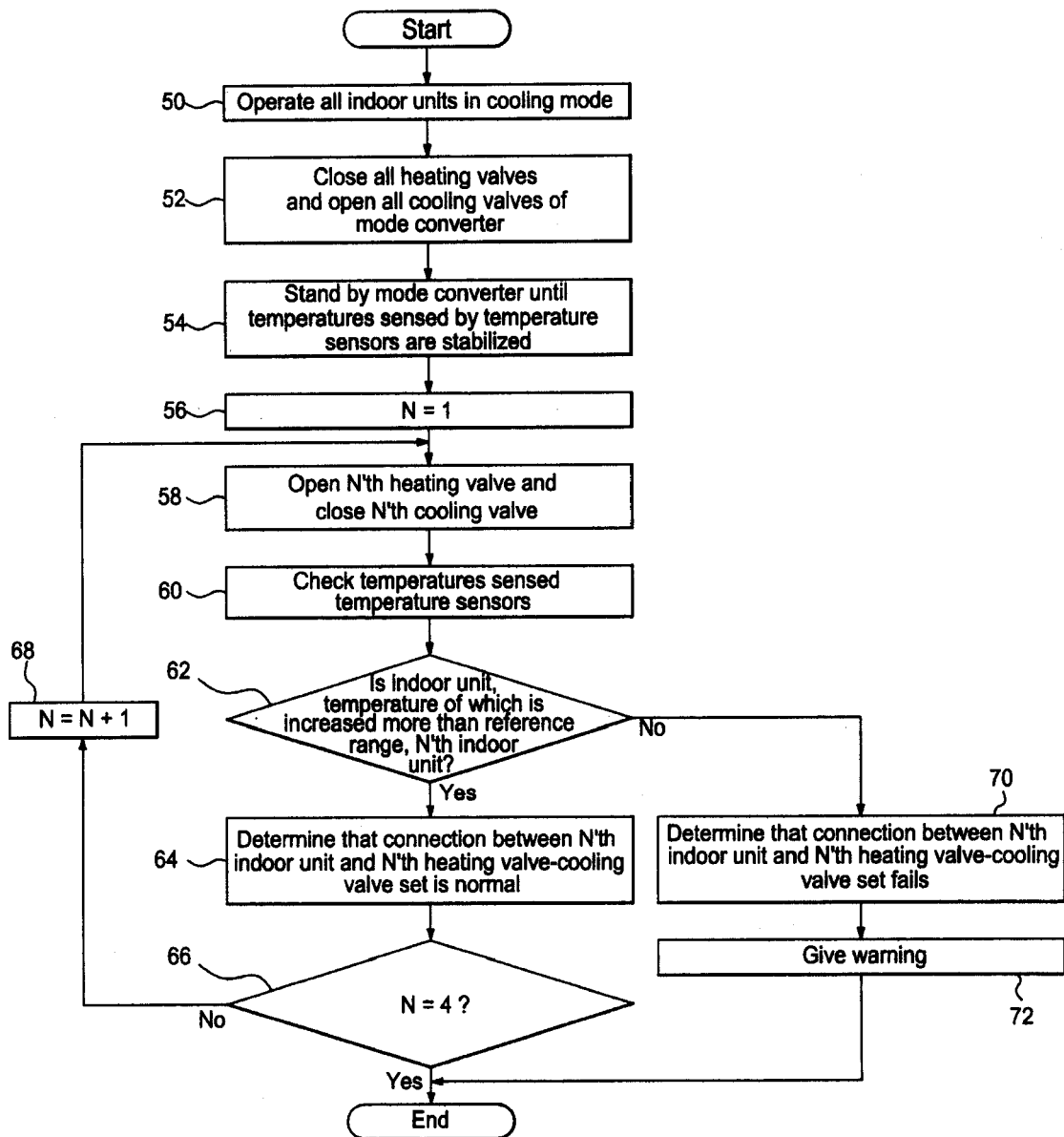


FIG. 4

