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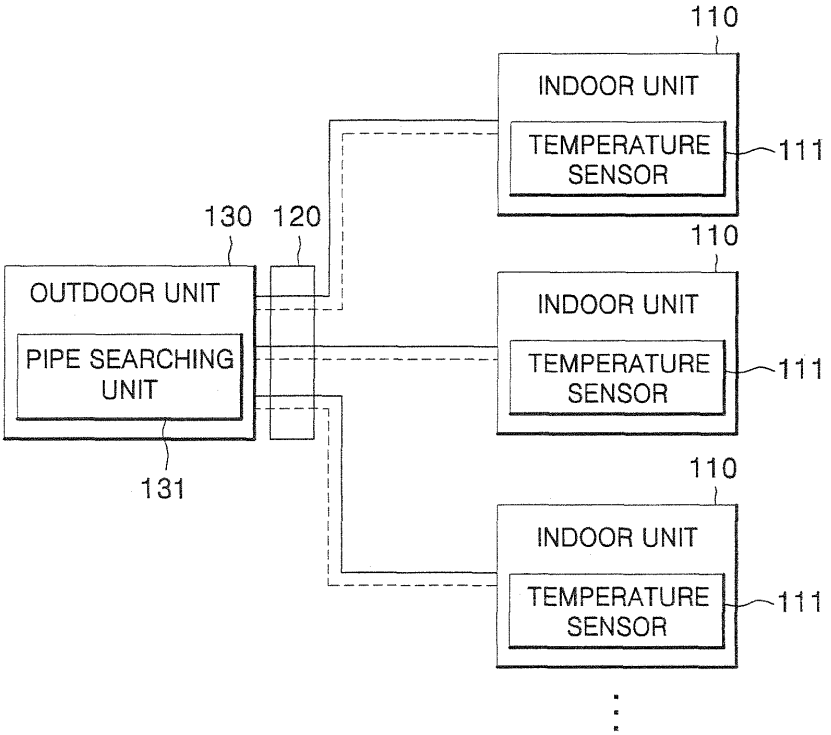
(54) Pipe-connection searching apparatus for multi-air conditioner

(57) A pipe-connection searching apparatus and method for a multiple air conditioner. The apparatus and method involving the identification of one of a plurality of indoor units, based on temperature criteria, and matching the one indoor unit to a corresponding one of a plurality of pipes that connect an outdoor unit to the plurality of indoor units, respectively.

FIG. 2



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Description

[0001] The present invention relates to a pipe-connection searching apparatus and method for a multi-air conditioner system, and more particularly, to a pipe-connection searching apparatus and method for a multi-air conditioner system provided with an outdoor unit and a plurality of indoor units connected to the outdoor unit, the apparatus and method capable of searching each one of the pipes of the indoor units connected to the outdoor unit.

[0002] The apparatus, regardless which embodiment, may include a pipe searching unit (selects pipes for open/close); temperature sensors at each indoor unit; a display unit (to identify which wire corresponds to open pipe based on one of four set criteria, *i.e.*, four embodiments); and a matching unit that may automatically configure wire to pipes.

[0003] Air conditioners are known for controlling the temperature and humidity of an enclosed space. In recent years, multiple air conditioner systems having one outdoor unit and a plurality of indoor units connected to the outdoor unit have been developed. Therefore, if a place to be cooled or heated has more than one enclosed space, the multi-air conditioner system eliminates the need to install independent air conditioning systems for each enclosed space.

[0004] FIG. 1 is a diagram schematically illustrating the structure of a multi-air conditioner system. As shown in FIG. 1, one outdoor unit 10 is connected to pipes 30 and wiring-lines 40 extending from a plurality of indoor units 20. The pipes 30 and the wiring-lines 40 are directly connected to the outdoor unit. However, a plurality of pipes are actually connected to the outdoor unit 10 with, for example, corresponding service ports interposed therebetween.

[0005] During installation, the installer needs to connect one end of each pipe and wiring-line to the outdoor unit and the other end of each pipe and wire to the corresponding indoor unit. Because each of the wiring-lines 40 is composed of a bundle of internal lines, such as a power line, a communication line, and a ground line, interference between the wiring-lines 40 rarely occurs. Nevertheless, when the internal lines are incorrectly connected, the indoor units and/or the outdoor unit may not operate. Therefore, the internal lines are typically color coded to enable the installer to easily recognize the internal lines. Because portions of the pipes and the wiring-lines unit are not visible or in view of the installer positioned in the vicinity of the outdoor unit the installer may have difficulty checking the connection between the pipes and the wiring-lines of the indoor units and the outdoor unit. As a result, the internal lines forming the wiring-line are often incorrectly connected, which results in turning on a wrong indoor unit instead of the one intended by the user.

[0006] This commonly causes user inconvenience and adversely affects the product reliability and performance. Therefore, in order to provide a more effective way of matching the pipe with the corresponding wiring-line of the corresponding indoor unit, an apparatus and a method of searching the connection between the pipe and wiring-line corresponding to each indoor unit is needed.

[0007] The present invention provides a pipe-connection searching apparatus for a multi-air conditioner system including an outdoor unit and a plurality of indoor units connected to the outdoor unit, which is capable of checking at the outdoor unit the connection between the pipe and the wiring-line of each indoor unit.

[0008] The present invention also provides a method of searching a pipe and a wiring-line associated with a corresponding one of a plurality of indoor units and automatically matching the pipe with the corresponding wiring-line to improve the effectiveness and efficiency of the installation of a multi-air conditioner system provided with an outdoor unit and a plurality of indoor units.

[0009] In general, the pipe-connection searching apparatus includes at least one temperature sensor provided in each of the plurality of indoor units; a pipe opening/closing unit capable of opening each of the plurality of pipes connected to an outdoor unit when the outdoor unit operates; and a pipe searching unit operating the outdoor unit and the pipe opening/closing unit and searching for the one indoor unit having the temperature sensor whose temperature reading first satisfies a predetermined set value before the other indoor units.

[0010] In one exemplary embodiment, the set value is the difference in temperature of before and after the outdoor unit begins operating.

[0011] In accordance with another exemplary embodiment, the set value is a predetermined temperature value different from the temperature before the outdoor unit begins operating.

[0012] In accordance with still another exemplary embodiment, the set value is the largest temperature difference among the plurality of temperature difference measurements associated with each of the plurality of indoor units when at least one of the indoor units satisfies a first predetermined temperature value, the first predetermined temperature value being a temperature value different from that of the temperature before the outdoor unit begins to operate.

[0013] In accordance with yet another exemplary embodiment, the set value is the largest temperature difference among the plurality of temperature difference measurements associated with each of the plurality of indoor units after a predetermined time period has elapsed after the outdoor unit begins to operate.

[0014] The outdoor unit may include a wiring-line display unit that displays a connection point between the outdoor unit and a wiring-line of the indoor unit that first satisfies the set value. The outdoor unit may further include a wiring-line matching unit that matches the opened pipe with a wiring-line of the indoor unit that first satisfies the set value. The pipe searching unit, in turn, sequentially searches each of the pipes.

[0015] The various aspects and embodiments of the present invention are not restricted to those described herein. The various aspects and embodiments described herein are exemplary. The above and other aspects of the present invention will become more apparent to one of ordinary skill in the art to which the present invention pertains by referencing the detailed description of the present invention given below.

[0016] FIG. 1 is a diagram schematically illustrating the structure of a multiple air conditioner system;

[0017] FIG. 2 is a diagram schematically illustrating a pipe-connection searching apparatus according to an exemplary embodiment of the invention;

[0018] FIG. 3 is a diagram schematically illustrating a structure for searching a pipe using the pipe-connection searching apparatus shown in FIG. 2;

[0019] FIG. 4 is a diagram schematically illustrating another example of the structure shown in FIG. 3;

[0020] FIG. 5 is a flowchart illustrating an example of the operation of the pipe-connection searching apparatus according to the embodiment of the invention; and

[0021] FIGS. 6 to 8 are flowcharts illustrating other examples of the operation shown in FIG. 5.

[0022] The present invention will now be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. The invention may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the concept of the invention to those skilled in the art. Like reference numerals in the drawings indicate like elements, and thus their description will be omitted.

[0023] As mentioned, FIG. 2 is a diagram schematically illustrating a pipe-connection searching apparatus according to an exemplary embodiment of the invention.

[0024] Referring to FIG. 2, a pipe-connection searching apparatus for a multi-air conditioner system may include: temperature sensors 111, each provided in a corresponding one of plurality of indoor units 110; a pipe opening/closing unit 120 that opens, each of a plurality of pipes, one at a time, connected to an outdoor unit 130 when the outdoor unit 130 is in operation; and a pipe searching unit 131 that searches for and identifies the indoor unit with the temperature sensor whose temperature signal first satisfies a predetermined set value, after the outdoor unit 130 and the pipe opening/closing unit 120 begin to operate, as compared to the other indoor units and temperature sensors.

[0025] The temperature sensors 111 detect variations in temperature and in response, generate a corresponding output voltage that is indicative of the detected temperature variation. Here, it is preferable to use known temperature sensors conventionally provided in the indoor units.

[0026] The pipe opening/closing unit 120 includes valves which are used to selectively open and close the plurality of pipes connected to the outdoor unit 130. In order to achieve its intended function, the pipe opening/closing unit 120 opens only one pipe at a time when the outdoor unit 130 is operating. Therefore, it is preferable that the pipe searching unit 131 control the pipe searching process including the pipe opening/closing unit 120. However, one skilled in the art will readily appreciate alternative embodiments where such control is governed by other components.

[0027] In another embodiment, the installer of the multi-air conditioning system may manually operate the pipe opening/closing unit 120. However, it is preferable that the pipe opening/closing unit 120 automatically open and close the pipes, for example, under the control of the pipe searching unit 131, as stated above.

[0028] The pipe searching unit 131 may also control the operation of the outdoor unit 130. However, once again, one skilled in the art will readily appreciate alternative embodiments are possible, where control of the outdoor unit is governed by another component. The pipe searching unit 131 then searches for and identifies the one indoor unit 110 having the temperature sensor 111 whose signal first satisfies a predetermined set value. The search result may be displayed on a display unit for the installer. If necessary, the search result may be stored in a memory.

[0029] Again, the process of checking the connection between the pipes of each indoor unit 110 and the outdoor unit 130 is iterative in that each pipe is opened and closed in sequence, and the temperature and/or temperature change associated with the corresponding opened pipe is determined. Of course, the installer can manually check the temperature or temperature change at each indoor unit, but it is preferable that the installer receive information from the temperature sensor of each indoor unit through a corresponding wiring-line extending from the indoor unit connected to the outdoor to check the state of the indoor unit. In this way, the installer can perform the search from the position of the outdoor unit.

[0030] In one embodiment, the pipe searching unit is in the outdoor unit 130. Alternatively, the pipe searching unit may in any one of the indoor units.

[0031] Two exemplary configurations will be described herein below that allow the installer to determine whether the wires are properly connected. In accordance with the first exemplary configuration, a wiring-line display unit is provided so the installer can visually establish the connection point between the outdoor unit and the wiring-line associated within the indoor unit having the temperature sensor that first satisfies a set value. In accordance with the second exemplary configuration, a wiring-line matching unit is provided that matches the currently opened pipe with the corresponding indoor unit having the temperature sensor that first satisfies the set value.

[0032] In the first exemplary configuration, the wiring-line display unit, displays the connection point between the outdoor unit 130 and the wiring-line of the indoor unit 110 corresponding to the opened pipe. The wiring-line

display unit may be located at or in the outdoor unit 130 to display the connection state of the wiring-lines such that the installer can correctly connect the wires, as described now with reference to FIG. 3.

[0033] Referring to FIG. 3, a space 140 for installing the pipes and the wiring-lines is formed between the outdoor unit 130 and the plurality of indoor units 110a, b, c, which makes it difficult for the installer to check the arrangement of the pipes and the wiring-lines. Specifically, the space 140 for installing the pipes and the wiring-lines is not easily visible, below a floor, inside a pillar, or inside a ceiling. For the clarity of explanation, FIG. 3 does not show a pipe opening/closing portion that is provided in the outdoor unit or in the vicinity of the outdoor unit.

[0034] In order to search and identify the corresponding pipes, wires and indoor units, the pipes and the wiring-lines that are expected to correspond to each other are connected to the outdoor unit 130. Then, a first pipe, for example, pipe A is opened, and the other pipes B, C remain closed. Thereafter, when the outdoor unit 130 operates, the wiring-line display will indicate which wiring-line and corresponding indoor unit 110a-c first satisfies the set value. It is thus determined which indoor unit is connected to open pipe A.

[0035] In the exemplary configuration of Fig. 3, the wiring-line display unit 133 is provided at or in the outdoor unit 130. The wiring-line display unit 133 is connected to the corresponding indoor units 110 through the wiring-lines, as shown. The wiring-line display unit 133 can display the temperature of indoor units 110, or it may display the identity of the wiring-line associated with the indoor unit that satisfies the set value, for instance, with a flashing light. That is, the wiring-line display unit 133 displays the position at or on the outdoor unit of the wiring-line that corresponds to the indoor unit that first satisfies the set value. In Fig. 3, if the wiring-line display unit 133a corresponding to opened pipe A lights up, the wiring-line is correctly connected. However, if wiring-line display unit 133b or 133c light up, the wiring-line is incorrectly connected. The installer can then change the wiring-line connection accordingly. Although the installer could change the pipe connections, this is likely to be more complicated and involved compared to changing the wire connections. Furthermore, when the pipe connections are changed, connection strength is likely to be degraded. Therefore, it is preferable to change the wiring-line connections rather than the pipe connections.

[0036] The process of sequentially opening and closing the plurality of pipes, as shown in the configuration of Fig. 3, is repeated for each of the pipes. Thus, it is possible to verify and, if necessary, correctly connect the wiring-lines corresponding to all of the pipes.

[0037] In the second exemplary configuration, a wiring-line matching unit is employed. Here, the installer does not have to change the wiring-line connections. The wiring-lines are instead automatically connected to match the corresponding pipes. This makes the installation process far more efficient. FIG. 4 illustrates a wiring-line matching unit 135. The wiring-line matching unit 135 is directly connected to the wiring-lines extending from the indoor units or with the wiring-line display units 133 interposed therebetween.

[0038] In the example of Fig. 4, when pipe A is opened, and the pipe searching process is performed, and the wiring-line matching unit matches pipe A with the wiring-line connected to the wiring-line display unit c. That is because the indoor unit corresponding to the wiring-line and wiring-line display unit c is the first indoor unit to satisfy the set value. More specifically, when the opened pipe is checked, and the search process is performed, the wiring-line matching unit switches the wiring-lines such that the wiring-line connected to another pipe, for example, pipe C is now reconnected to the opened pipe, for example, pipe A.

[0039] When employing this configuration and corresponding method, the installer does not need to change the connection between the wiring-lines subsequent to the pipe searching process. Thus, the closing and opening of the pipes, the pipe searching process, and the reconnection of any wiring-lines are automatically performed.

[0040] Further, once a pipe has been opened and closed, and the corresponding wire line matched the subsequent testing of other pipes need not include pipes that have already been tested.

[0041] The temperature sensor value is used to perform the pipe searching process. Even when a refrigerant is not supplied to the searched indoor unit, the temperature of the indoor unit having the refrigerant supplied thereinto does not rapidly vary. Therefore, the temperature sensor of the searched indoor unit is likely to sense a predetermined set value first, during the search of other pipes. For this reason, it is preferable that the search pipe and indoor unit be excluded during the search of other pipes.

[0042] Indoor fans circulate the air in the space where an indoor unit may be installed. When the fan operates, the temperature of the space, not the internal temperature of the indoor unit, is measured. Thus, it is preferable that indoor fans be not operated while the pipe searching process is performed, that is, while the pipe searching unit operates. In this case, the temperature sensor in the indoor unit can accurately measure the variation in the internal temperature of the indoor unit without being affected by an external environment.

[0043] Measuring the temperature of the space associated with a given indoor unit makes it possible to search for the corresponding pipe, but it is not preferable because it would require a lot of time to satisfy the set value. It is more preferable to perform the searching process without operating the indoor fan and measuring the internal temperature of the indoor unit itself. Furthermore, it is preferable to close the vent of the indoor unit in order to more accurately measure the internal temperature of the indoor unit.

[0044] Various set values may be used during the pipe

searching process.

[0045] In accordance with a first exemplary implementation, the change in temperature of the indoor unit may be employed as the set value.

[0046] More specifically, the pipe opening/closing unit 120 opens one of the pipes connected to the outdoor unit 130. The outdoor unit 130 then begins operating. Before the outdoor unit 130 begins operating, the temperature sensors 111 associated with each of the indoor units 110 measure the internal temperatures of the corresponding indoor units 110. After the outdoor unit 130 begins operating, the temperature sensors 111 are used to now determine which indoor unit first reaches a predetermined change in temperature. This indoor unit is identified as the unit connected to the open pipe.

[0047] The predetermined temperature difference may be stored in the pipe searching unit, or the installer may manually set the predetermined temperature difference according to the installation environment. The predetermined temperature difference may be in the range of 5°C to 15°C. If the predetermined temperature difference is lower than 5°C, a search error is more likely to occur. That is because another indoor unit, not the indoor unit corresponding to the opened pipe, may reach the temperature difference first. For this reason, it may be preferable to set the temperature difference to be greater than 5°C.

[0048] The aforementioned error may occur because a very small amount of refrigerant typically flows through all of the pipes even when one pipe is opened and the other pipes are closed. In order to avoid this error, it is preferable that the temperature difference be equal to or higher than 5°C, wherein the result of the pipe searching process is more reliable.

[0049] If the predetermined temperature difference is excessively large, the time required to perform the pipe searching process is likewise, excessively large. Therefore, it is preferable that the predetermined temperature difference be no greater than 15°C.

[0050] The temperature difference for a given indoor unit may be measured by comparing the temperature before the opening of the pipe with real time temperature measurements after the opening of the pipe. The temperature difference may be measured in real time at predetermined time intervals. This would be particularly useful when a temperature difference of 15°C is employed as the predetermined set value.

[0051] It does not matter whether the outdoor unit operates in a cooling mode or a heating mode during the search of the pipe.

[0052] Next, the pipe-connection searching processes will be described with reference to FIG. 5. First, one of a plurality of pipes is opened, while the other pipes remain closed (S110). An initial temperature measurement is then taken for each indoor unit and, thereafter, the outdoor unit begin operating (S120). The initial temperature for each indoor unit is then stored in a predetermined storage unit until the comparing process is completed. The initial temperatures may be measured before the outdoor unit begins operating, as stated above or at the beginning of the operation of the outdoor unit.

[0053] Then, subsequent temperature measurements are taken, in real time, for each of the indoor units, for example, at predetermine time intervals (S 130). The temperature difference between the initial temperature and subsequent real time temperatures for each indoor unit is calculated, and based on these temperature difference calculations, it is determined whether there is an indoor unit that satisfies the predetermined temperature difference (S140). If it is determined that no indoor unit satisfies the predetermined temperature difference, the two previous steps are repeated.

[0054] When it is determined that one of the indoor units satisfies the predetermined temperature difference, the wire line associated with that indoor unit is manually or automatically connected to the opened pipe (S150).

[0055] If all of the pipes have not been examined (S160), only one of the remaining pipes is opened, while the other pipes are closed (S 170). The entire process is repeated, stating from the process of measuring the initial temperature.

[0056] For reference, the last pipe to be matched need not be examined because only one indoor unit remains. At this point, the last remaining pipe is matched with the wire line associated with the remaining indoor unit. In addition, and as described above, it is preferable that previously matched pipes and indoor units are excluded during subsequent iterations of the pipe searching process.

[0057] In accordance with a second exemplary implementation, a predefined, absolute temperature value, different from the temperature value before the outdoor unit begins operating, may be used as the set value. In this implementation, the temperature is measured in each of the indoor units, or remaining indoor units, by the corresponding temperature sensor. By taking these measurements, a determination can be made as to which indoor unit first reaches the predetermined temperature value. The pipe searching unit then establishes that the indoor unit that first reaches the predetermined temperature value is the indoor unit connected to the opened pipe. The wire line associated with this indoor unit can then be manually or automatically matched with the opened pipe. This implementation has the following advantages. When the installer manually changes the wire line connections using the wiring-line display unit, wherein display units for displaying the temperatures associated with each of the indoor units, the installer can more easily check the temperatures associated with each of the indoor units, and more easily determine the connection state of the indoor units. In accordance with this implementation, it is not necessary to take a temperature measurement prior to turning on the outdoor unit. It is only necessary to determine which indoor unit first reaches the predetermined temperature value. As soon as the installer sees, on the display, which indoor unit first reaches the predetermined

temperature, the installer can easily make the wire line connection.

[0058] Further in accordance with this second exemplary implementation, it may be necessary to first determine the operation mode of the outdoor unit, that is, determine whether the outdoor unit is in cooling mode or heating mode, before the pipe searching process begins. If the pipe searching process is performed such that the predetermined temperature value is higher than the current room temperature (i.e., the temperature value at the temperature sensor before the outdoor unit begins operating), the outdoor unit needs to operate in the heating mode. On the other hand, if the predetermined temperature value is lower than the current room temperature, the outdoor unit needs to operate in the cooling mode.

[0059] Further, since the temperature value should vary according to the current temperature, it is preferable to establish a database storing predetermined temperature values associated with the current temperature.

[0060] Again, as in the previous exemplary implementation, it is preferable that the pipe searching unit exclude the previously searched pipes during the current iteration of the pipe searching process. Doing so simplifies each subsequent iteration, as fewer temperatures need to be checked. In addition, the temperature of the indoor units connected to pipes that have already been matched may still be at the predetermined temperature value, thus making determinations difficult during subsequent iterations of the process.

[0061] Similar to the exemplary embodiment shown in FIG. 2, the outdoor unit may include a wiring-line display unit that displays to the installer the connection point between the outdoor unit and the wiring-line associated with of the indoor unit that first reaches the predetermined temperature value. Alternatively, it may include a wiring-line matching unit that automatically matches the opened pipe with the wiring-line associated with the indoor unit that first reaches the predetermined temperature.

[0062] Also, as in the first exemplary implementation, it is preferable that the vents and fans associated with each of the indoor units be closed or turned off during the process in order to minimize any effect on the temperature sensors due to external temperature conditions (i.e., external to the indoor units).

[0063] This operation associated with the second exemplary implementation will be briefly described with reference to FIG. 6. First, the pipes are selectively opened (S210), that is, one pipe is opened while the remaining pipes are closed. The outdoor unit begins operating (S220). Then, the internal temperatures associated with each of the indoor units or remaining indoor units are measured (S230). A determination is then made as to whether any of the remaining indoor units satisfies the predetermined temperature (S240). If not, additional temperature measurements are taken (S230). When one of the indoor units satisfies the predetermined temperature, it is determined that this indoor unit is connected to the opened pipe (S250), and the wire line associated with that indoor unit can be manually or automatically matched with the opened pipe, as previously described. The above-mentioned processes then repeat for the remaining pipes (S260 and S270), until all pipes have been matched.

[0064] In accordance with a third exemplary implementation, both absolute temperature and temperature difference may be employed. For example, when at least one indoor unit first satisfies a predetermine temperature value, different from the temperature value before the outdoor unit began operating, the largest temperature difference among the temperature differences measured at the indoor units may be used as the set value. Therefore, the set value is not a fixed value, but is the largest temperature difference among the measured temperature differences at the remaining indoor units.

[0065] More, specifically, the outdoor unit is turned on. Just before, or approximately at the same time the outdoor unit is turned on, each of the temperature sensors measure an initial temperature for the corresponding indoor unit. Thereafter, the temperature sensors continue to measure the temperature of the corresponding indoor units. When the first indoor unit reaches a predetermined temperature value (first set value), the temperature measurements taken by the temperature sensors are compared with the corresponding initial temperature measured before the pipe was opened. The indoor unit having the largest temperature difference is established as the one connected to the opened pipe.

[0066] This operation of the third exemplary implementation will now be described with reference to FIG. 7. First, the pipes are selectively opened (S310) as in the previous implementations. Then, the initial temperature of each indoor unit is measured and, at approximately the same time or soon thereafter, the outdoor unit begins operating (S320). Then, subsequent temperature measurements are made for each of the indoor units (S330). Eventually, one of the indoor units satisfies the predetermined temperature value (first set value) (S340). When an indoor unit satisfies the predetermined temperature value, the difference between the initial temperature and the subsequent temperature measurements of each of the indoor units is analyzed, and a determination is made as to which indoor unit has experienced the largest change in temperature (i.e., largest temperature difference). This indoor unit is then established as the one connected to the opened pipe (S350). This information can then be used to manually or automatically match the wire line associated with this indoor unit and the opened pipe. The above-mentioned processes repeats until the remaining pipes (S360 and S370) are matched.

[0067] Again, the outdoor unit may include a wiring-line display unit that displays to the installer the connection point between the outdoor unit and the wiring-line of the indoor unit having the largest temperature difference. the installer can then manually match the wire line to the corresponding pipe. Alternatively, the outdoor unit may include a wiring matching unit that automatically matches

the opened pipe and the wiring-line of the indoor unit that has the largest temperature difference. Also, as previously stated, it is preferable that the vents and fans associated with the indoor units to be closed or turned off during the pipe searching process. Further, as previously stated, it is preferable to exclude pipes and indoor units that have already been matched.

[0068] In accordance with a fourth exemplary implementation, the largest temperature difference among the temperature differences measured by the temperature sensors for each of the indoor units may be used as the set value. Specifically, once the outdoor unit operates for a predetermined period of time (first set value), the difference between the temperatures measured by each of the temperature sensors before and after the outdoor unit begins operating is determined. The indoor unit having the largest change in temperature (i.e., the largest temperature difference) is established as the indoor unit connected to the opened pipe.

[0069] This operation will now be described in more detail with reference to FIG. 8. First, the pipes are selectively opened (S410), as in the previously described implementations. Then, an initial temperature for each indoor unit is measured, and at approximately the same time, the outdoor unit begins operating (S420). The outdoor unit is then permitted to operate for a predetermined period of time (first set value) (S440), and subsequent temperature each of the indoor units are taken (S430). When the predetermined time period has elapsed, the initial temperature for each indoor unit is compared with the corresponding, current subsequent temperature measurement, and a determination is made as to which indoor unit has the largest temperature difference. This indoor unit is established as the one connected to the opened pipe (S450). The above-mentioned process is repeated until all of the pipes have been matched (S460 and S470).

[0070] In this exemplary implementation, the subsequent temperature is continuously measured for a predetermined period of time, but the invention is not limited thereto. Measuring subsequent temperatures (S430) for each of the indoor units may instead be performed once after the predetermined period of time (S440) has elapsed. In this case, it is not necessary to continuously measure subsequent temperatures.

[0071] Again, as in the previously described implementations, the outdoor unit may include a wiring-line display unit that displays to the installer the connection point between the outdoor unit and a wiring-line of the indoor unit having the largest temperature difference after the predetermined period of time has elapsed. This allows the installer to manually match the opened pipe with the wire line associated with this indoor unit. Alternatively, a wiring matching unit that automatically matches the opened pipe and the wiring-line of the indoor unit that has the largest temperature difference. In addition, it is preferable that the vents and fan associated with each of the indoor units be closed or turned off during the pipe searching process. It is also preferable to exclude previously matched pipes and indoor units during subsequent iterations of the pipe searching process.

[0072] The present invention can be applied to a multiple air conditioning system having one outdoor unit and a plurality of indoor units connected thereto.

Claims

1. A pipe-connection searching apparatus for a multiple air conditioner system comprising an outdoor unit and a plurality of indoor units, the apparatus comprising:

   a plurality of temperature sensors (111) each associated with a corresponding of the plurality of indoor units (110);
   a pipe opening/closing unit (120) selectively opening one of a plurality of pipes, wherein each of the plurality of pipes connecting the outdoor unit (130) to a corresponding one of the plurality of indoor units; and
   a pipe searching unit (131) configured to identify one of the plurality of indoor units (110) that is connected to the one opened pipe based on a temperature criteria.

2. The pipe-connection searching apparatus of claim 1, wherein the temperature criteria is a change in temperature measured at each of the plurality of indoor units (110).

3. The pipe-connection searching apparatus of claim 2, wherein the identified one of the plurality of indoor units (110) is first to reach a predefined change in temperature as compared to the other indoor units.

4. The pipe-connection searching apparatus of claim 1, wherein the temperature criteria is a predefined temperature value.

5. The pipe-connection searching apparatus of claim 4, wherein the identified one of the plurality of indoor units (110) is first to reach the predefined temperature value, as compared to the other indoor units.

6. The pipe-connection searching apparatus of claim 1, wherein the temperature criteria is a change in temperature when at least one of the indoor units (110) satisfies a predefined temperature.

7. The pipe-connection searching apparatus of claim 6, wherein the identified one of the plurality of indoor units (110) experiences the greatest change in temperature, as compared to the other indoor units, reaches the predetermined temperature.

8. The pipe-connection searching apparatus of claim 1, wherein the temperature criteria is a change in temperature after a predetermined period of time has elapsed.

9. The pipe-connection searching apparatus of claim 8, wherein the identified one of the plurality of indoor units (110) experiences the greatest change in temperature, compared to the other indoor units, after the predetermined period of time elapses.

10. The pipe-connection searching apparatus of claim 1, wherein the outdoor unit (130) comprises a wiring-line display unit (133) that displays information identifying one of a plurality of wiring-lines, wherein the identified one of the plurality of wiring-lines corresponds to the identified one of the plurality of indoor units (110).

11. The pipe-connection searching apparatus of claim 1, wherein the outdoor unit (130) comprises a wiring-line matching unit (135) that matches the opened pipe with one of a plurality of wiring-lines, wherein the identified one of the plurality of wiring-lines corresponds to the identified one of the plurality of indoor units (110).

12. A method of associating each of a plurality of indoor air conditioning units with a corresponding one of a plurality of pipes in a multiple air conditioner system, each of the plurality of pipes connecting a corresponding one of the plurality of indoor units to an outdoor unit, the method comprising:

selectively opening one of the plurality of pipes;
activating the outdoor unit; and
identifying one of the plurality of indoor units as corresponding to the opened pipe based on predefined temperature criteria.

13. The method of claim 12, wherein the predefined temperature criteria is a change in temperature.

14. The method of claim 12, wherein the predefined temperature criteria is a predefined temperature.

15. The method of claim 12 further comprising:

measuring an initial temperature associated with each of the plurality of indoor units prior to or substantially at the same time the outdoor unit is activated;
measuring the temperature associated with each of the plurality of indoor units after the operation of the outdoor unit is initiated; and
determining a change in temperature for each of the plurality of indoor units.

FIG. 1

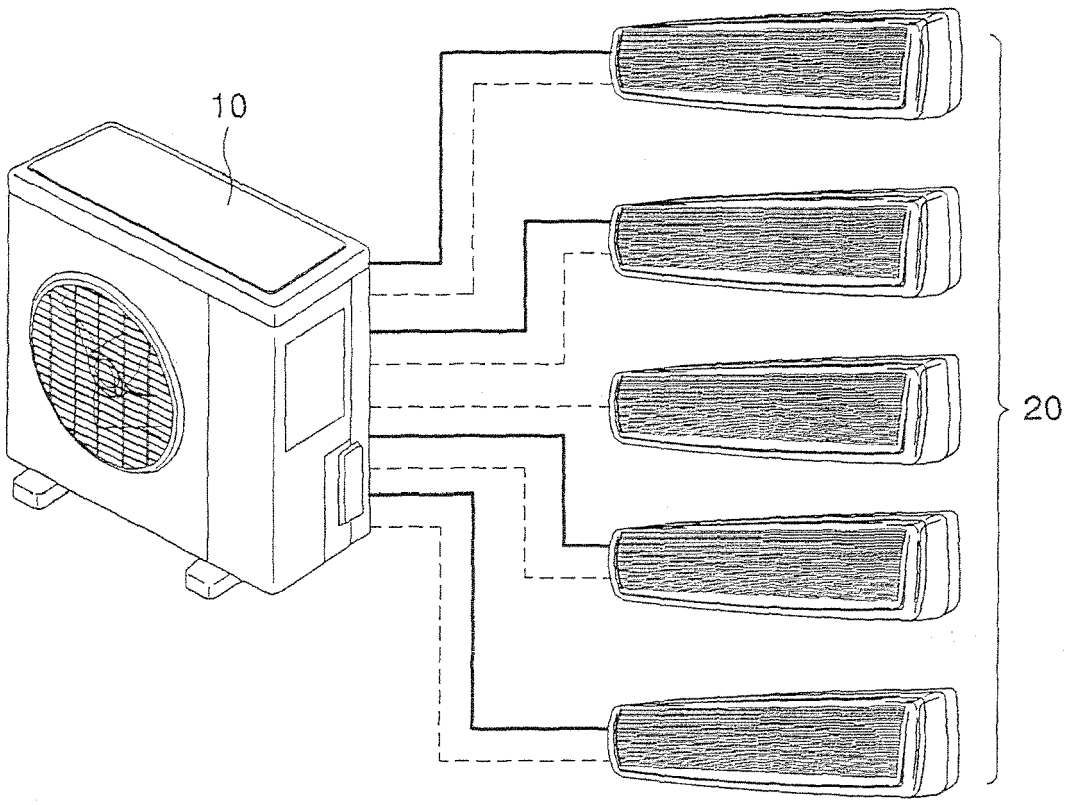


FIG. 2

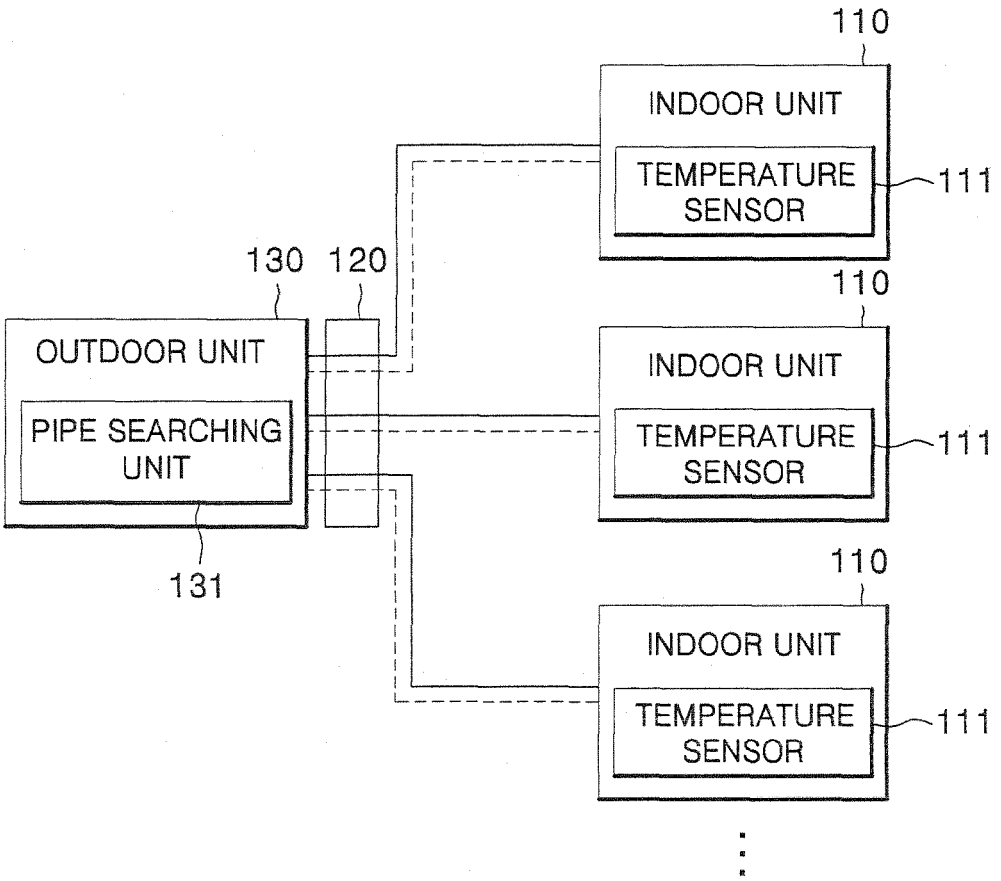

110
INDOOR UNIT
TEMPERATURE SENSOR
111
130
120
110
OUTDOOR UNIT
PIPE SEARCHING UNIT
INDOOR UNIT
TEMPERATURE SENSOR
111
131
110
INDOOR UNIT
TEMPERATURE SENSOR
111

FIG. 3

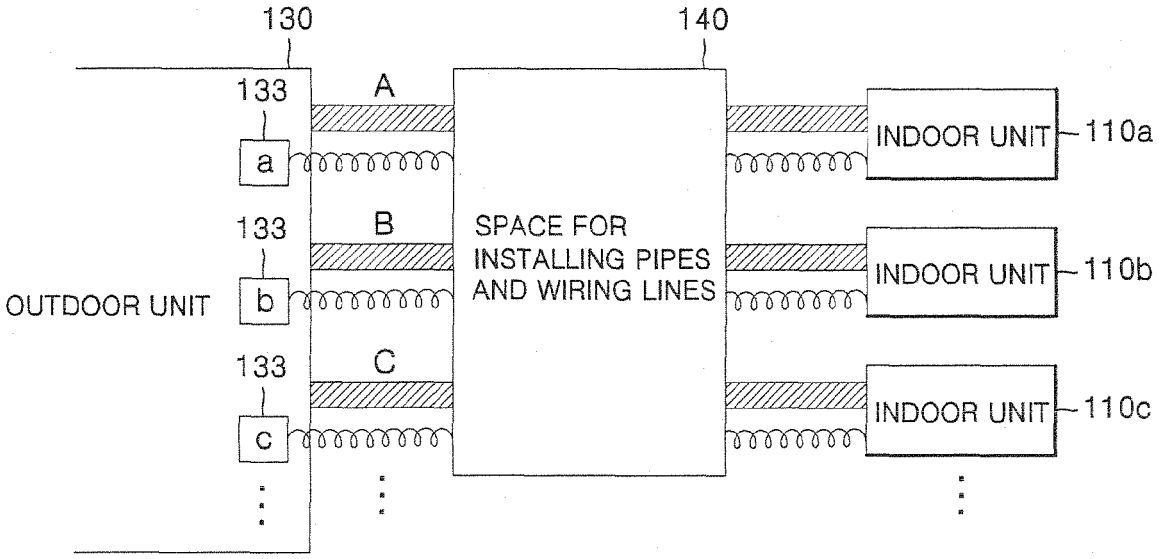

130
140
133
A
a
INDOOR UNIT
110a
133
B
SPACE FOR INSTALLING PIPES AND WIRING LINES
OUTDOOR UNIT
b
INDOOR UNIT
110b
133
C
c
INDOOR UNIT
110c

FIG. 4

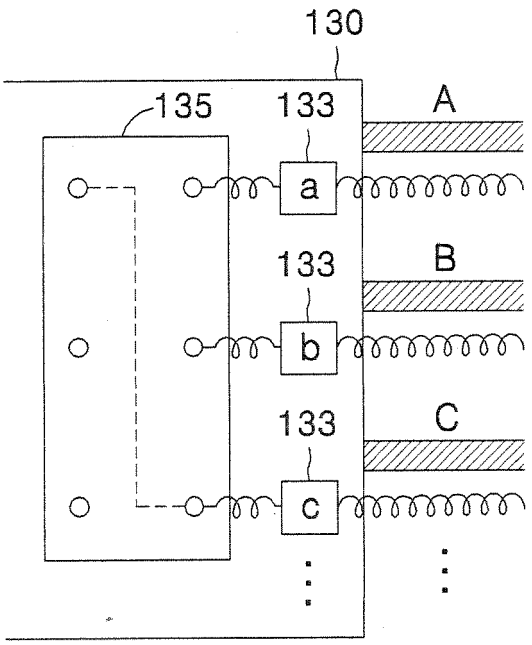


FIG. 5

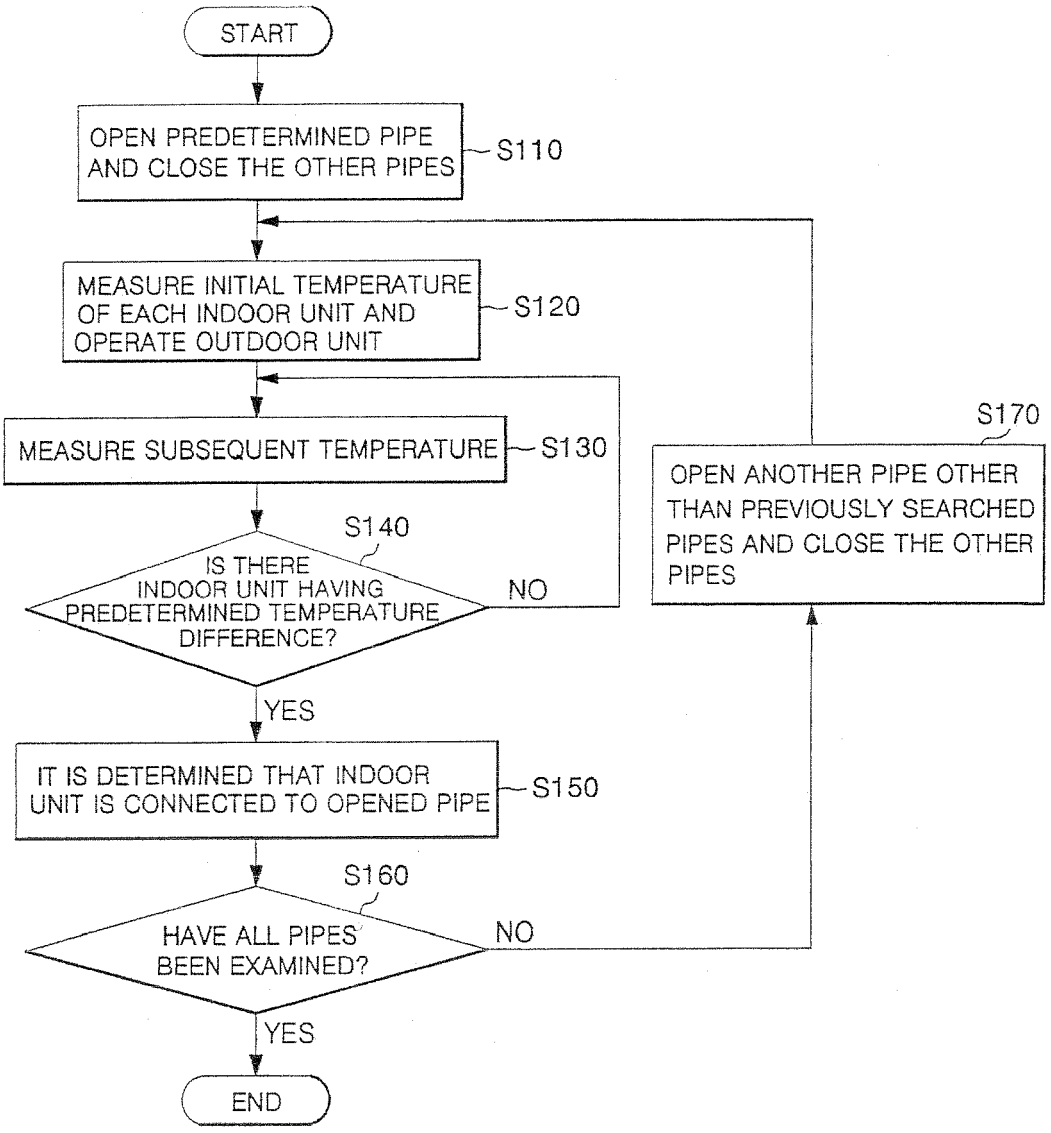

START
OPEN PREDETERMINED PIPE AND CLOSE THE OTHER PIPES
S110
MEASURE INITIAL TEMPERATURE OF EACH INDOOR UNIT AND OPERATE OUTDOOR UNIT
S120
MEASURE SUBSEQUENT TEMPERATURE
S130
S140
IS THERE INDOOR UNIT HAVING PREDETERMINED TEMPERATURE DIFFERENCE?
NO
YES
IT IS DETERMINED THAT INDOOR UNIT IS CONNECTED TO OPENED PIPE
S150
S160
HAVE ALL PIPES BEEN EXAMINED?
NO
YES
END
S170
OPEN ANOTHER PIPE OTHER THAN PREVIOUSLY SEARCHED PIPES AND CLOSE THE OTHER PIPES

FIG. 6

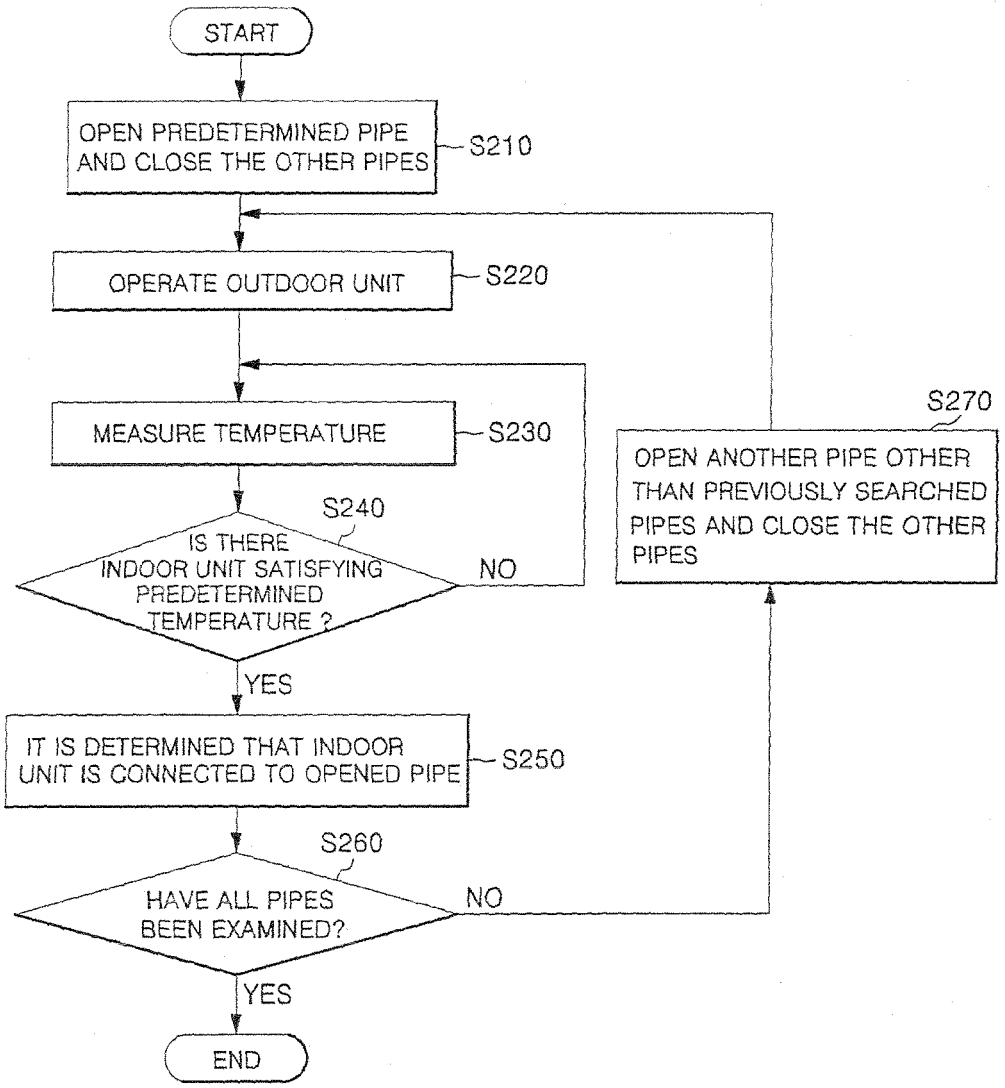

START
OPEN PREDETERMINED PIPE AND CLOSE THE OTHER PIPES
S210
OPERATE OUTDOOR UNIT
S220
MEASURE TEMPERATURE
S230
S240
IS THERE INDOOR UNIT SATISFYING PREDETERMINED TEMPERATURE ?
NO
YES
IT IS DETERMINED THAT INDOOR UNIT IS CONNECTED TO OPENED PIPE
S250
S260
HAVE ALL PIPES BEEN EXAMINED?
NO
YES
END
S270
OPEN ANOTHER PIPE OTHER THAN PREVIOUSLY SEARCHED PIPES AND CLOSE THE OTHER PIPES

FIG. 7

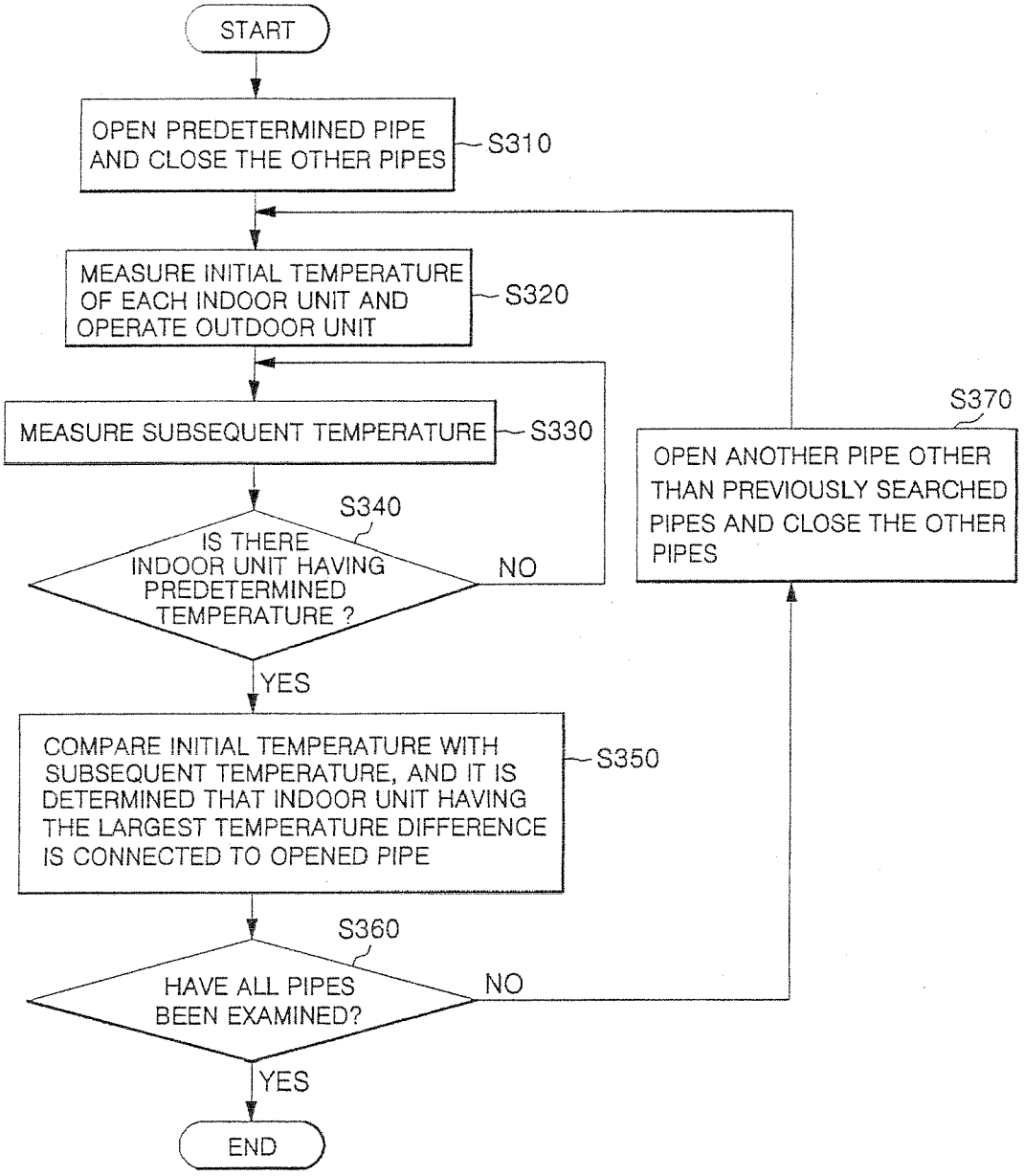
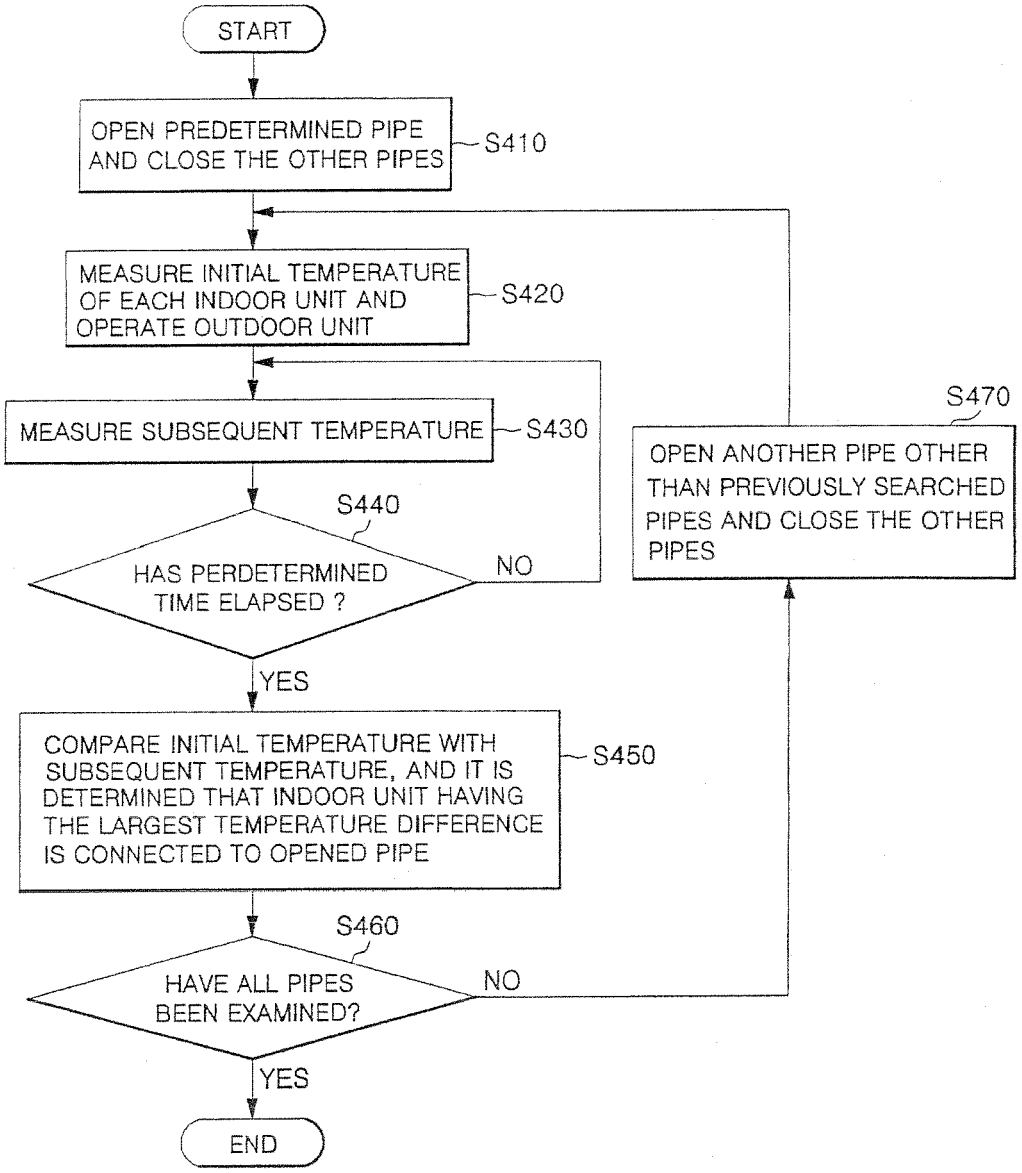

START
OPEN PREDETERMINED PIPE AND CLOSE THE OTHER PIPES
S310
MEASURE INITIAL TEMPERATURE OF EACH INDOOR UNIT AND OPERATE OUTDOOR UNIT
S320
MEASURE SUBSEQUENT TEMPERATURE
S330
S340
IS THERE INDOOR UNIT HAVING PREDETERMINED TEMPERATURE ?
NO
YES
COMPARE INITIAL TEMPERATURE WITH SUBSEQUENT TEMPERATURE, AND IT IS DETERMINED THAT INDOOR UNIT HAVING THE LARGEST TEMPERATURE DIFFERENCE IS CONNECTED TO OPENED PIPE
S350
S360
HAVE ALL PIPES BEEN EXAMINED?
NO
YES
END
S370
OPEN ANOTHER PIPE OTHER THAN PREVIOUSLY SEARCHED PIPES AND CLOSE THE OTHER PIPES

FIG. 8


START
OPEN PREDETERMINED PIPE AND CLOSE THE OTHER PIPES
S410
MEASURE INITIAL TEMPERATURE OF EACH INDOOR UNIT AND OPERATE OUTDOOR UNIT
S420
MEASURE SUBSEQUENT TEMPERATURE
S430
S440
HAS PERDETERMINED TIME ELAPSED ?
NO
YES
COMPARE INITIAL TEMPERATURE WITH SUBSEQUENT TEMPERATURE, AND IT IS DETERMINED THAT INDOOR UNIT HAVING THE LARGEST TEMPERATURE DIFFERENCE IS CONNECTED TO OPENED PIPE
S450
S460
HAVE ALL PIPES BEEN EXAMINED?
NO
YES
END
S470
OPEN ANOTHER PIPE OTHER THAN PREVIOUSLY SEARCHED PIPES AND CLOSE THE OTHER PIPES

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EUROPEAN SEARCH REPORT

Application Number
EP 08 16 2685

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	EP 0 426 450 A (TOKYO SHIBAURA ELECTRIC CO [JP]) 8 May 1991 (1991-05-08) * column 1 - column 2; claims 1-19; figures 1,2,4,5 *	1,2,8,12 3-7, 9-11, 13-15	INV. F24F11/00
Y	JP 09 112998 A (MITSUBISHI HEAVY IND LTD) 2 May 1997 (1997-05-02) * abstract *	3-7, 9-11, 13-15	
A	US 5 974 813 A (JEONG SANG-JIN [KR]) 2 November 1999 (1999-11-02) * abstract; claims 1,2; figure 2 *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

F24F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 December 2008	Decking, Oliver

CATEGORY OF CITED DOCUMENTS

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