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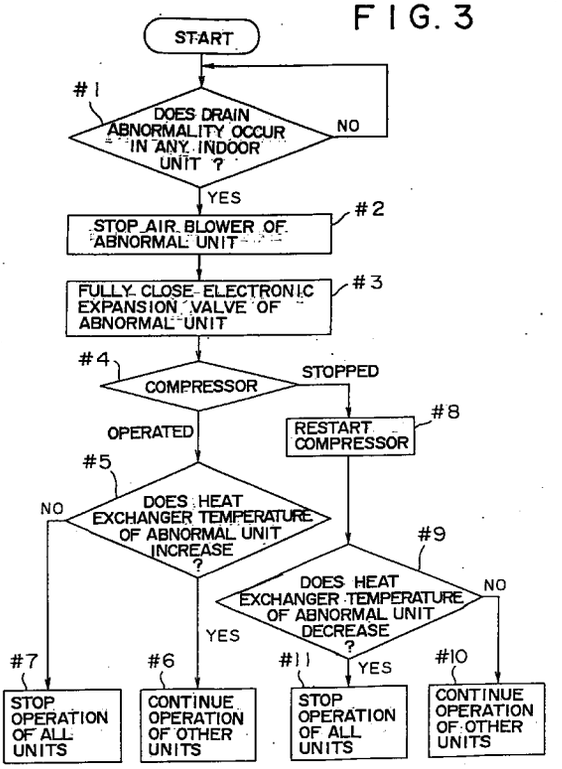
(54) MULTI-TYPE AIR-CONDITIONER

(57) If drain abnormality occurs, for example, an air blower 24a of an indoor unit 2 in which abnormality occurs is stopped, an electronic expansion valve 21a is fully closed, and the temperature of a heat exchanger 23a of the indoor unit 2 in which abnormality occurs is detected by a thermisor 30a. If this temperature increases, the operation of an indoor unit 3 having no drain abnormality is continued, and if this temperature does not increase, the operation of all the indoor units 2 and 3 is stopped. When a compressor 5, which has been stopped by the occurrence of abnormality, is restarted, it is determined whether or not the temperature of the indoor heat exchanger 23a decreases. If this temperature does not decrease, the operation of the other indoor unit 3 is continued, and if this temperature decreases, the operation of all the indoor units 2 and 3 is stopped.

FIG. 3



EP 0 834 708 A1

Description

Technical Field

The present invention relates to a multiple-type air conditioner in which a plurality of indoor units are connected to one outdoor unit via refrigerant pipes.

Background Art

FIG. 4 is a schematic view of such a multiple-type air conditioner.

In this air conditioner, a plurality of, for example, two indoor units 2 and 3 are connected to one outdoor unit 1 via refrigerant pipes 4a and 4b.

The outdoor unit 1 is provided with a compressor 5, and a four-way directional control valve 7 is connected to a refrigerant gas output end of the compressor 5 via an oil separator 6. The oil separator 6 is used for separating refrigerant gas into refrigerant gas and oil. The refrigerant gas is sent to the four-way directional control valve 7 and the oil is sent to a suction pipe 8 connected to the suction end of the compressor 5.

To one end of the four-way directional control valve 7 are connected two outdoor heat exchangers 9 and 10 in parallel. To these outdoor heat exchangers 9 and 10 are connected distributors 11 and 12, check valves 13 and 14, or electronic expansion valves 15 and 16, respectively.

These check valves 13 and 14 or electronic expansion valves 15 and 16 are connected to a receiver 17 in common. To this receiver 17 are connected the two indoor units 2 and 3 via the refrigerant pipe 4a.

The other end of the four-way directional control valve 7 is connected to the compressor 5 through an accumulator 18 and the suction pipe 8.

On the other hand, the two indoor units 2 and 3 are configured so that a strainer 20a, 20b is connected to the refrigerant pipe 4a, to the strainer 20a, 20b are connected an electronic expansion valve 21a, 21b, a distributor 22a, 22b, and an indoor heat exchanger 23a, 23b, and the indoor heat exchanger 23a, 23b is connected to the refrigerant pipe 4b.

The indoor unit 2, 3 is provided with an air blower (air blowing fan) 24a, 24b, and at the bottom thereof is provided a drain pan 25a, 25b for accumulating water separated by air cooling. The water accumulated in this drain pan 25a, 25b is discharged by using a drain pump 26a, 26b, or discharged naturally.

In the drain pan 25a, 25b, a float switch 27a, 27b is arranged. When the drain water accumulated in either or both of the drain pans 25a and 25b overflows, the float switch 27a, 27b detects the overflow to stop all units.

In such a configuration, for example, when cooling operation is performed, the refrigerant gas discharged from the compressor 5 is separated into refrigerant gas and oil by the oil separator 6, and the oil is returned to the suction pipe 8.

On the other hand, the refrigerant gas is introduced to the outdoor heat exchangers 9 and 10 through the four-way directional control valve 7, and condensed in the outdoor heat exchangers 9 and 10. The refrigerant liquid condensed in the outdoor heat exchangers 9 and 10 passes through the distributors 11 and 12, the check valves 13 and 14, and the receiver 17, respectively, and is introduced to the two indoor units 2 and 3 through the refrigerant pipe 4a.

Since the electronic expansion valves 15 and 16 are closed, the refrigerant liquid passes through the check valves 13 and 14.

In the indoor units 2 and 3, the refrigerant liquid passes through the strainer 20a, 20b, electronic expansion valve 21a, 21b, and distributor 22a, 22b, and is introduced to the indoor heat exchanger 23a, 23b, where the refrigerant liquid is evaporated into a gaseous form.

The refrigerant gas returns to the outdoor unit 1 through the refrigerant pipe 4b. It passes through the four-way directional control valve 7, accumulator 18, and suction pipe 8, and is sucked by the compressor 5 again.

During the cooling operation, the indoor heat exchanger 23a, 23b in the indoor unit 2, 3 cools air, so that water in the air is separated from air and accumulates as drain water in the drain pan 25a, 25b.

The water accumulated in this drain pan 25a, 25b is discharged by using the drain pump 26a, 26b, or discharged naturally.

If the drain water accumulates in the drain pan 25a, 25b, and is going to overflow from the drain pan 25a, 25b, the drain abnormality is detected by the float switch 27a, 27b.

Such control of drain abnormality is carried out in accordance with an abnormality control flowchart shown in FIG. 5.

If, in either of the indoor units 2 and 3, for example, in the indoor unit 2, the drain water overflows from the drain pan 25a and the float switch 27a is actuated, all the indoor units 2 and 3 are stopped and the abnormality is displayed on a remote control panel.

In the above-described multiple-type air conditioner, however, if a plurality of indoor units, that is, two indoor units 2 and 3 are in operation and, for example, the float switch 27a of one indoor unit 2 is actuated, all the indoor units are stopped although the operation of the other indoor unit 3 can be continued.

Disclosure of Invention

Accordingly, an object of the present invention is to provide a multiple-type air conditioner in which of the plural indoor units, the indoor units having no abnormality caused by the overflow of drain water can continue to be operated.

According to claim 1, there is provided a multiple-

type air conditioner in which a plurality of indoor units each having a heat exchanger, air blowing fan, and electronic expansion valve are connected to one outdoor unit, and there are provided in each of the indoor units a drain pan which receives and discharges drain generated in the heat exchanger and a water level detection switch which generates an abnormality signal when the water level in the drain pan reaches a predetermined level, comprising:

a temperature sensor provided on the heat exchanger;
abnormality stop means which determines whether or not the water level detection switch generates an abnormality signal, and, if abnormality occurs, stops the air blowing fan of the indoor unit in which abnormality occurs, and fully closes the electronic expansion valve; and
operability determination means which determines whether or not the detection temperature of the temperature sensor of the indoor unit in which abnormality occurs increases when abnormality occurs, and, if this temperature increases (e.g. if this temperature gets over a predetermined level or range), continues the operation of other indoor units and, if this temperature does not increase (e.g. if this temperature is kept under a predetermined level or range), stops the operation of all the indoor units.

In such a multiple-type air conditioner, when the water level in the drain pan reaches the predetermined level, the water level detection switch detects this fact and generates an abnormality signal. When abnormality occurs, the air blowing fan of the indoor unit in which abnormality occurs is stopped, the electronic expansion valve is fully closed, and it is determined whether or not the detection temperature of the temperature sensor of the indoor unit in which abnormality occurs increases. If this temperature increases, the operation of other indoor units is continued, and if this temperature does not increase, the operation of all the indoor units is stopped.

Thereupon, the indoor units having no abnormality caused by the overflow of drain water can continue to be operated.

According to claim 2, in the multiple-type air conditioner defined in claim 1, to the operability determination means is added restart determination means which determines whether or not the detection temperature of the temperature sensor of the indoor unit in which abnormality occurs when a compressor, which has been stopped by the occurrence of abnormality, is restarted, and, if this temperature does not decrease (e.g. if this temperature is not under a pre-determined level or range), continues the operation of other indoor units and, if this temperature decreases (e.g. if this temperature is kept under a predetermined level or range), stops the operation of all the indoor units.

Brief Description of Drawings

FIG. 1 is a schematic view showing one embodiment of a multiple-type air conditioner in accordance with the present invention.

FIG. 2 is a block diagram of a control system for the air conditioner.

FIG. 3 is an abnormality control flowchart for the air conditioner.

FIG. 4 is a schematic view of a conventional multiple-type air conditioner.

FIG. 5 is an abnormality control flowchart for the conventional air conditioner.

Best Mode for Carrying Out the Invention

One embodiment of the present invention will be described below with reference to the accompanying drawings. The same reference numerals are applied to the same elements as those in FIG. 4, and the detailed description thereof is omitted.

FIG. 1 is a schematic view of a multiple-type air conditioner.

In the two indoor units 2 an 3, the indoor heat exchanger 23a, 23b is provided with a thermistor 30a, 30b as a temperature sensor.

The thermistor 30a, 30b senses the temperature of the indoor heat exchanger 23a, 23b, and generates a signal according to the temperature of the indoor heat exchanger 23a, 23b.

On the other hand, FIG. 2 is a block diagram of a control system.

This control system is provided with an abnormality stop means 31, which receives an abnormality signal generated from the float switch 27a, 27b serving as a water level detection switch.

This abnormality stop means 31 has the following function: It is determined whether or not an abnormality signal is generated from the float switches 27a and 27b. If drain water overflow abnormality occurs, this means 31 stops the air blower 24a, 24b of the indoor unit 2, 3 in which abnormality occurs, and fully closes the electronic expansion valve 21a, 21b.

An operability determination means 32 has the following function: When receiving information about the occurrence of drain water overflow abnormality from the abnormality stop means 31, the operability determination means 32 judges the operation state of the compressor 5 of the outdoor unit 1 through an output means 33. If the compressor 5 is in operation, it is determined whether or not the detection temperature of the thermistor 30a, 30b of the indoor unit 2, 3, that is, the temperature of the indoor heat exchanger 23a, 23b increases. If the detection temperature increases, the operation of the other indoor unit 3, 2 is continued. If the temperature of the indoor heat exchanger 23a, 23b does not

increase, the operation of all the indoor units 2 and 3 is stopped.

Also, this operability determination means 32 has a restart determination means 34. This restart determination means 34 has the following function: When the compressor 5, which has been stopped by the occurrence of drain water overflow abnormality, is restarted, this restart determination means 34 determines whether or not the temperature of the indoor heat exchanger 23a, 23b detected by the thermistor 30a, 30b decreases. If the temperature of the indoor heat exchanger 23a, 23b does not decrease, the operation of the other indoor unit 3, 2 is continued. If the temperature of the indoor heat exchanger 23a, 23b decreases, the operation of all the indoor units 2 and 3 is stopped.

Next, the operation of the air conditioner configured as described above will be described in accordance with an abnormality control flowchart shown in FIG. 3.

For example, when cooling operation is performed, the refrigerant gas discharged from the compressor 5 is separated into refrigerant gas and oil by the oil separator 6, as mentioned before, and the separated refrigerant gas is introduced to the outdoor heat exchangers 9 and 10 through the four-way directional control valve 7, and condensed in the outdoor heat exchangers 9 and 10.

The condensed refrigerant liquid passes through the distributors 11 and 12, the check valves 13 and 14, and the receiver 17, respectively, and is introduced to the two indoor units 2 and 3 through the refrigerant pipe 4a.

In the indoor units 2 and 3, the refrigerant liquid passes through the strainer 20a, 20b, electronic expansion valve 21a, 21b, and distributor 22a, 22b, and is introduced to the indoor heat exchanger 23a, 23b, where the refrigerant liquid is evaporated into a gaseous form.

The refrigerant gas returns to the outdoor unit 1 through the refrigerant pipe 4b. It passes through the four-way directional control valve 7, accumulator 18, and suction pipe 8, and is sucked by the compressor 5 again.

During the cooling operation, the indoor heat exchanger 23a, 23b in the indoor unit 2, 3 cools air, so that water in the air is separated from air and accumulates as drain water in the drain pan 25a, 25b.

The water accumulated in this drain pan 25a, 25b is discharged by using the drain pump 26a, 26b, or discharged naturally.

If the drain water accumulates in the drain pan 25a, 25b, and is going to overflow from the drain pan 25a, 25b, the float switch 27a, 27b is actuated, and a drain water overflow abnormality signal is generated.

At this time, the abnormality stop means 31 determines in Step #1 whether or not an abnormality signal is generated from the float switches 27a and 27b each.

As the result of this determination, if drain abnormality occurs, the abnormality stop means 31 stops, in Step #2, the operation of the air blower 24a, 24b of the indoor unit 2, 3 in which the abnormality occurs. For example, if an abnormality signal is generated from the float switch 27a, the abnormality stop means 31 stops the operation of the air blower 24a of the indoor unit 2, and, in the next step #3, fully closes the electronic expansion valve 21a. (Hereinafter, the case where drain water overflow abnormality occurs in the indoor unit 2 will be explained.)

Next, when receiving information about the occurrence of drain water overflow abnormality from the abnormality stop means 31, the operability determination means 32 judges, in Step #4, the operation state of the compressor 5 of the outdoor unit 1 through an output means 33.

As the result of this determination, if the compressor 5 is operated, the operability determination means 32 proceeds to Step #5, where, receiving the detection temperature of the thermistor 30a of the indoor unit 2 in which abnormality occurs, it determines whether or not the temperature of the indoor heat exchanger 23a increases.

As the result of this determination, if the temperature of the indoor heat exchanger 23a of the indoor unit 2 in which abnormality occurs increases, the operability determination means 32 judges that there is no possibility of an increase in drain water of the indoor heat exchanger 23a since the cooling operation is stopped because the electronic expansion valve 21a of the indoor unit 2 in which abnormality occurs is closed. Then, the operability determination means 32 proceeds to Step #6 to stop the operation of only the indoor unit 2 in which abnormality occurs, and continue the operation of the other indoor unit 3.

If it is decided in the above step #5 that the temperature of the indoor heat exchanger 23a of the indoor unit 2 in which abnormality occurs does not increase, the operability determination means 32 proceeds to Step #7 to stop all the indoor units 2 and 3, since the electronic expansion valve 21a is not fully closed, so that there is a possibility that the drain water increases and overflows if the operation is continued.

On the other hand, as the result of determination of the operation state of the compressor 5 of the outdoor unit 1, if the compressor 5 is stopped, the restart determination means 34 waits for the next restart of the compressor 5 in Step #8. In the next step #9, the restart determination means 34 takes in the detection temperature of the thermistor 30a, and determines whether or not the temperature of the indoor heat exchanger 23a of the indoor unit 2 in which abnormality occurs decreases.

As the result of this determination, if the temperature of the indoor heat exchanger 23a of the indoor unit 2 in which abnormality occurs does not decrease, judging that cooling operation is not performed because the electronic expansion valve 21a of the indoor unit 2 in which abnormality occurs is closed and further the drain

water does not increase, the restart determination means 34 proceeds to Step #10 to stop the operation of the indoor unit 2 in which abnormality occurs and continue the operation of the other indoor unit 3.

If the temperature of the indoor heat exchanger 23a of the indoor unit 2 in which abnormality occurs decreases, judging that the electronic expansion valve 21a is not fully closed, so that there is a possibility that the drain water increases and overflows if the operation is continued, the operability determination means 32 proceeds to Step #11 to stop the operation of all the indoor units 2 and 3.

Thus, in the above embodiment, when the water level in the drain pan reaches a predetermined level and drain abnormality occurs, the air blower 24a of the indoor unit 2 in which abnormality occurs is stopped, the electronic expansion switch 21a is fully closed, and it is determined from the detection temperature of the thermistor 30a of the indoor unit 2 in which abnormality occurs whether or not the temperature of the indoor heat exchanger 23a increases. If this temperature increases, the operation of the other indoor unit 3 is continued, and if this temperature does not increase, the operation of all the indoor units 2 and 3 is stopped. When the compressor 5, which has been stopped by the occurrence of abnormality, is restarted, it is determined whether or not the temperature of the indoor heat exchanger 23a decreases. If this temperature does not decrease, the operation of the other indoor unit 3 is continued, and if this temperature decreases, the operation of all the indoor units 2 and 3 is stopped. Therefore, judging that there is no possibility of an increase in drain water in the indoor unit 2 in which drain abnormality occurs, of the plural indoor units 2 and 3, the operation of only the indoor unit 2 in which drain abnormality occurs is stopped, and the operation of the other indoor unit 3 is continued.

Also, by determining whether the compressor 5 is operated or stopped, it can be decided whether the operation of only the indoor unit 2 in which drain abnormality occurs is stopped or the operation of all the indoor units 2 and 3 is stopped.

In addition, the indoor unit 3 having no drain abnormality display can be used.

Although the case where abnormality occurs in the indoor unit 2 has been explained above, the operation is the same in the case where abnormality occurs in the indoor unit 3 or in the case where three or more indoor units are provided.

If drain abnormality occurs in two or more indoor units, the operation is the same except that the operation of all the indoor units in which drain abnormality occurs is stopped and the operation of the remaining indoor units is continued.

The present invention is not limited to the above-described embodiment, and modifications may be made as follows.

For example, the temperature sensor for detecting the temperature of the indoor heat exchanger 23a, 23b is not limited to the thermistor 30a, 30b, and other temperature detecting elements may be used.

Industrial Applicability

As described in detail above, according to claims 1 and 2 of the present invention, there can be provided a multiple-type air conditioner in which, of a plurality of indoor units, the indoor units which have no abnormality caused by the overflow of drain water can continue to be operated.

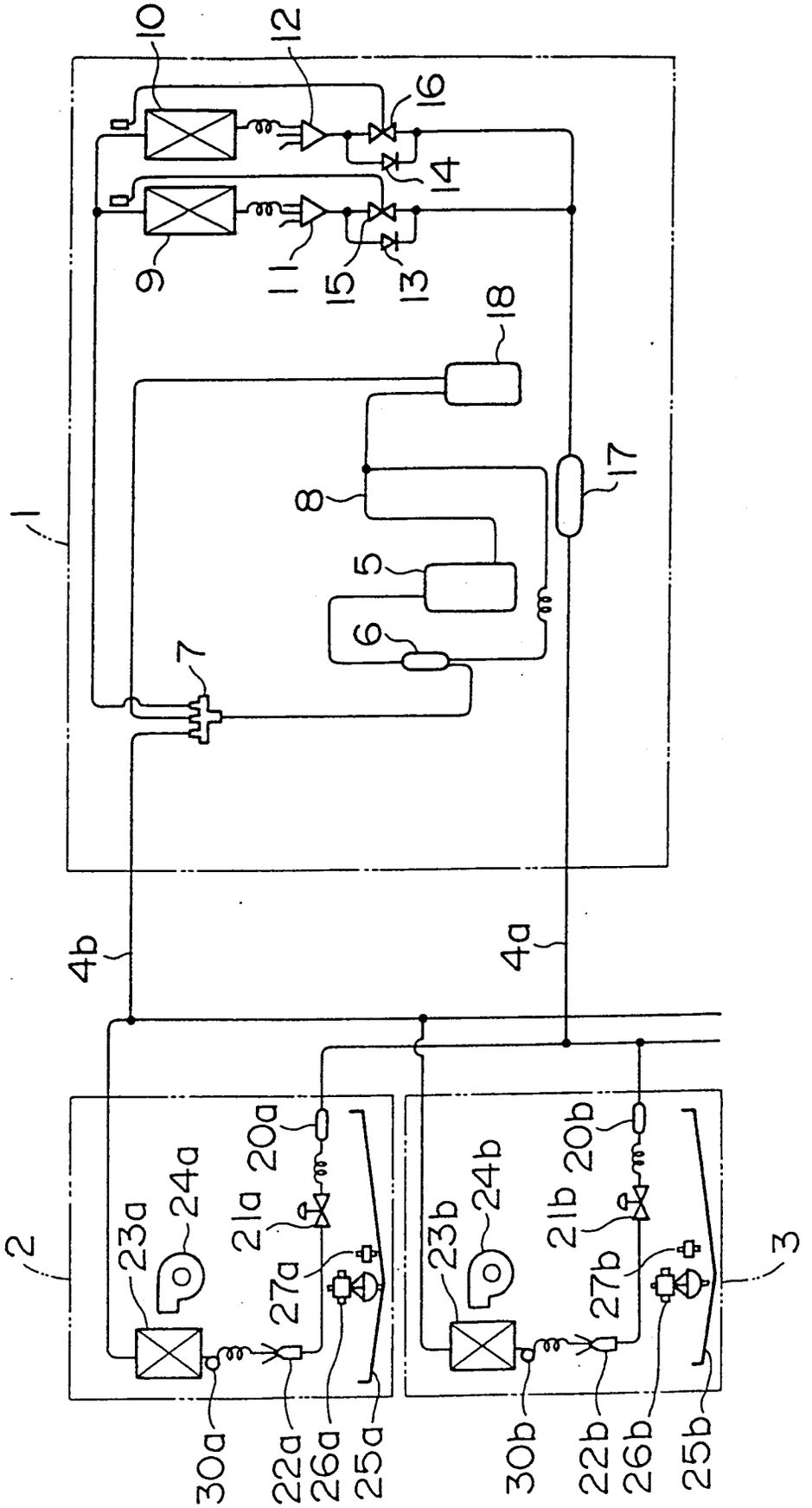
Claims

1. A multiple-type air conditioner in which a plurality of indoor units each having a heat exchanger, air blowing fan, and electronic expansion valve are connected to one outdoor unit, and there are provided in each of the indoor units a drain pan which receives and discharges drain generated in said heat exchanger and a water level detection switch which generates an abnormality signal when the water level in said drain pan reaches a predetermined level, comprising:

   a temperature sensor provided on said heat exchanger;
   abnormality stop means which determines whether or not said water level detection switch generates an abnormality signal, and, if abnormality occurs, stops said air blowing fan of the indoor unit in which abnormality occurs, and fully closes said electronic expansion valve; and
   operability determination means which determines whether or not the detection temperature of said temperature sensor of the indoor unit in which abnormality occurs increases when abnormality occurs, and, if this temperature increases, continues the operation of other indoor units and, if this temperature does not increase, stops the operation of all the indoor units.

2. A multiple-type air conditioner according to claim 1, wherein to said operability determination means is added restart determination means which determines whether or not the detection temperature of said temperature sensor of the indoor unit in which abnormality occurs when a compressor, which has been stopped by the occurrence of abnormality, is restarted, and, if this temperature does not decrease, continues the operation of other indoor units and, if this temperature decreases, stops the operation of all the indoor units.

FIG. 1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14
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11
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18
17
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5
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7
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4b
4a
2
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23a
24a
21a
20a
27a
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24b
21b
20b
27b
30b
22b
26b
25b

FIG. 2

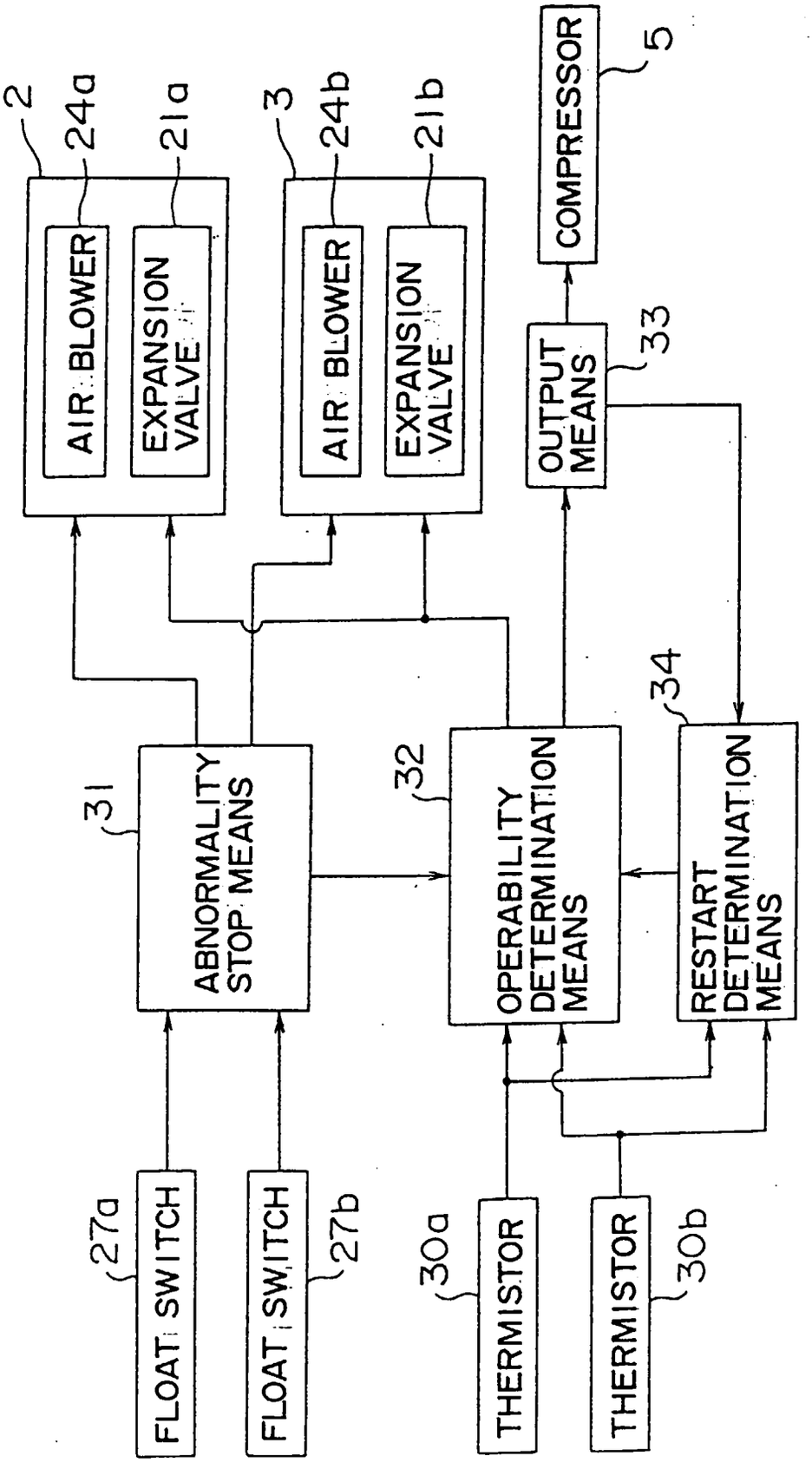

2
24a
21a
AIR BLOWER
EXPANSION VALVE
3
24b
21b
AIR BLOWER
EXPANSION VALVE
COMPRESSOR
5
OUTPUT MEANS
33
31
ABNORMALITY STOP MEANS
32
OPERABILITY DETERMINATION MEANS
34
RESTART DETERMINATION MEANS
27a
FLOAT SWITCH
27b
FLOAT SWITCH
30a
THERMISTOR
30b
THERMISTOR

FIG. 3

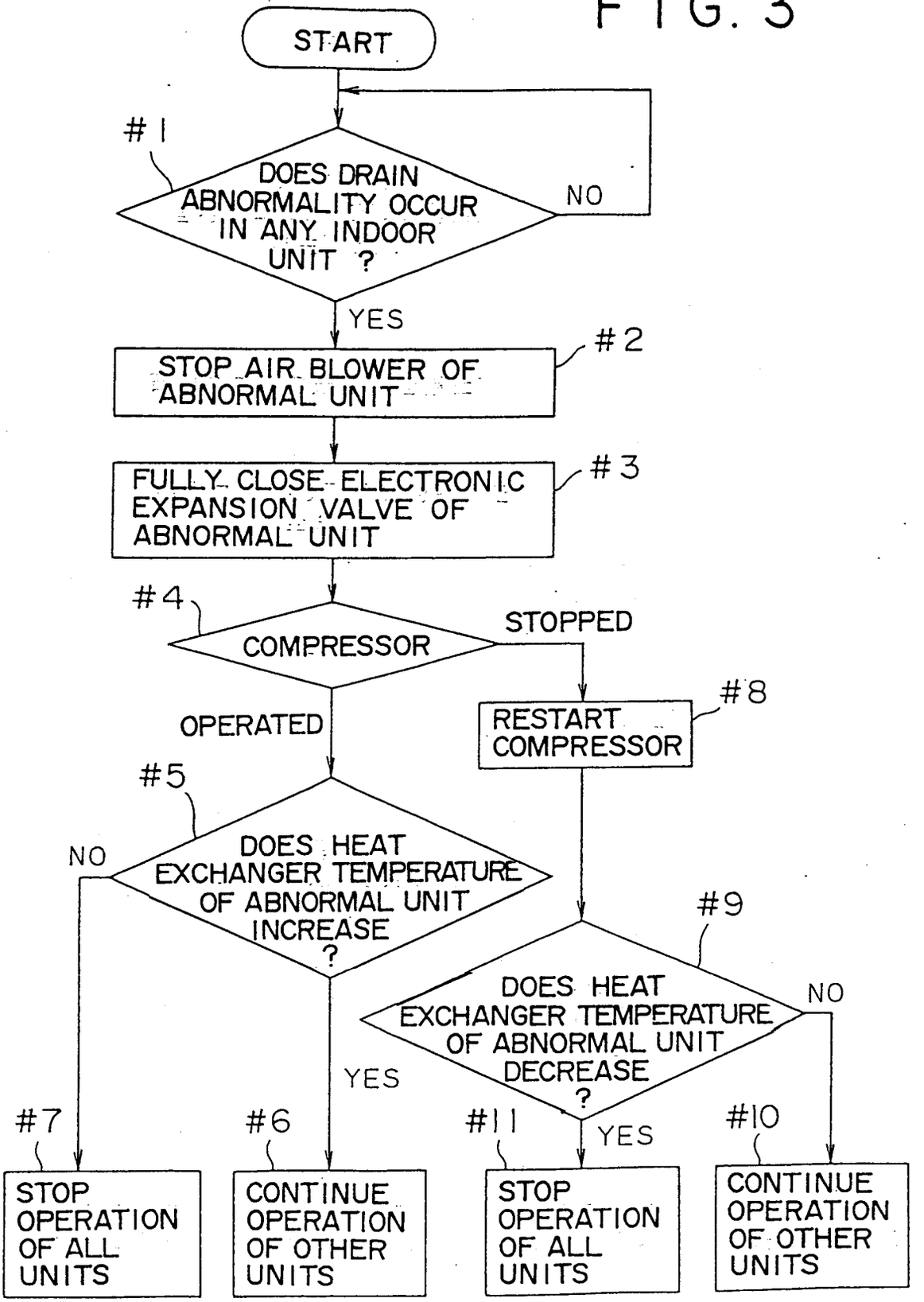
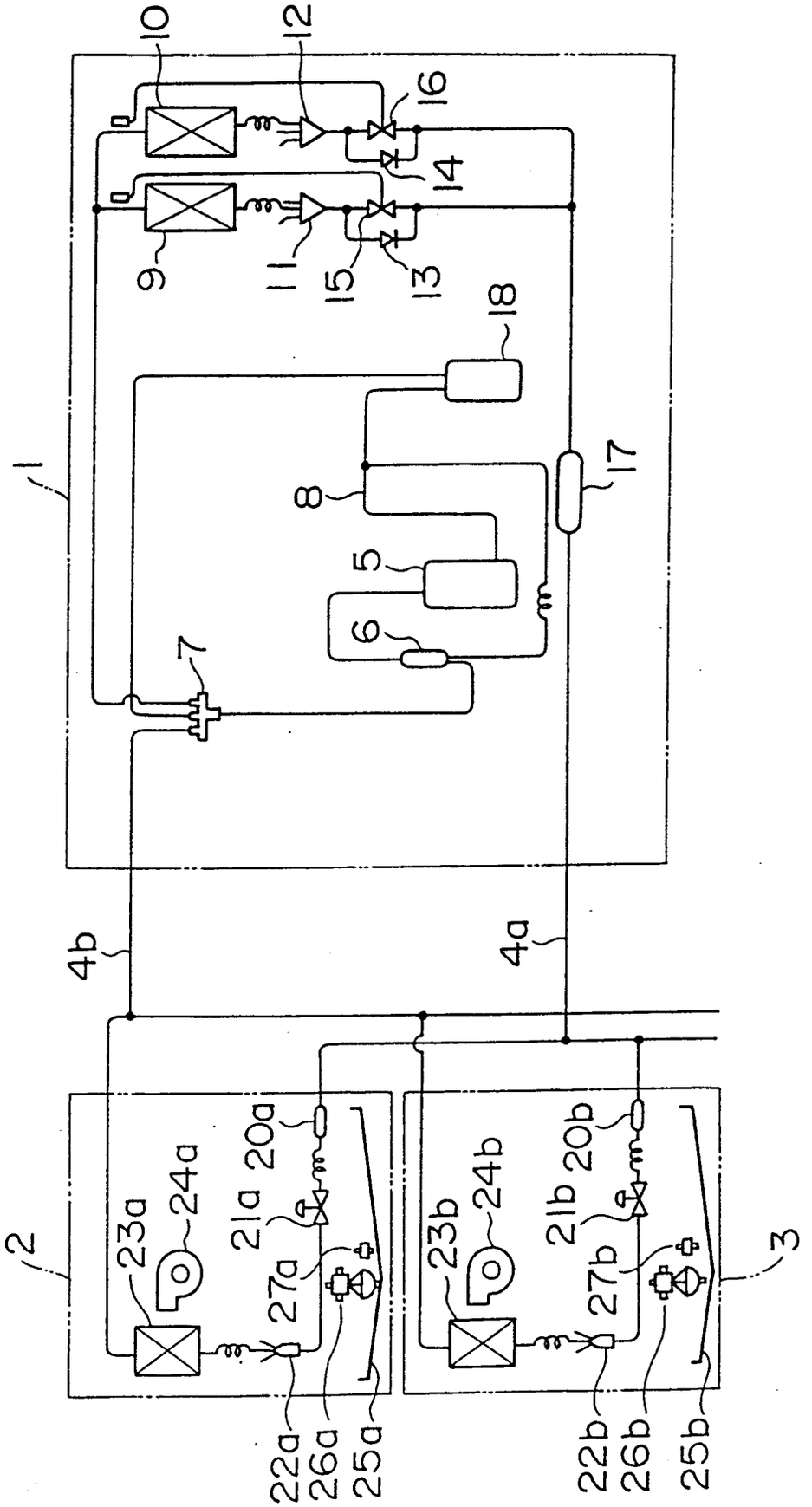

START
#1
DOES DRAIN ABNORMALITY OCCUR IN ANY INDOOR UNIT ?
NO
YES
#2
STOP AIR BLOWER OF ABNORMAL UNIT
#3
FULLY CLOSE ELECTRONIC EXPANSION VALVE OF ABNORMAL UNIT
#4
COMPRESSOR
STOPPED
OPERATED
#8
RESTART COMPRESSOR
#5
NO
DOES HEAT EXCHANGER TEMPERATURE OF ABNORMAL UNIT INCREASE ?
#9
DOES HEAT EXCHANGER TEMPERATURE OF ABNORMAL UNIT DECREASE ?
NO
YES
YES
#7
#6
#11
#10
STOP OPERATION OF ALL UNITS
CONTINUE OPERATION OF OTHER UNITS
STOP OPERATION OF ALL UNITS
CONTINUE OPERATION OF OTHER UNITS

FIG. 4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23a
24a
21a
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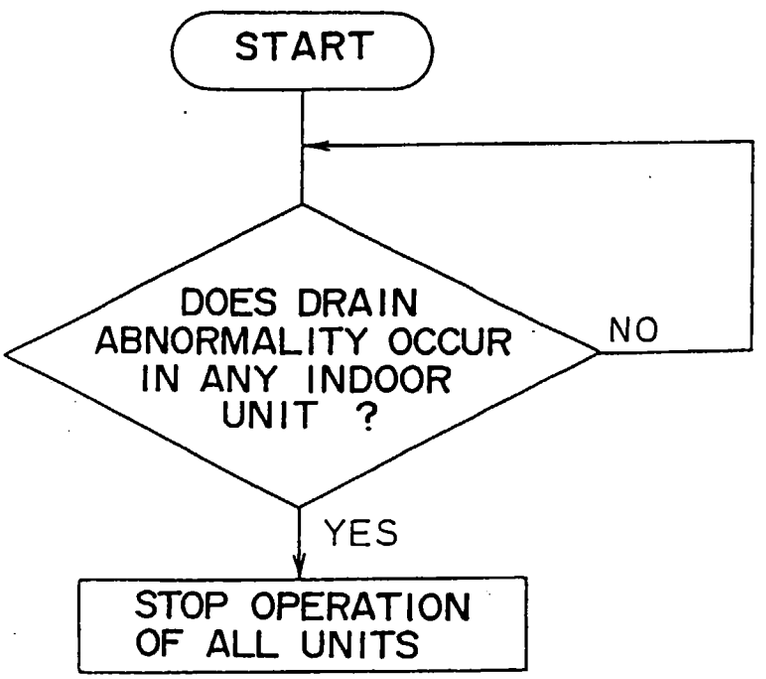
21b
20b
27b
22b
26b
25b

FIG. 5


START
DOES DRAIN ABNORMALITY OCCUR IN ANY INDOOR UNIT ?
NO
YES
STOP OPERATION OF ALL UNITS

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP97/01361

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl^6 F24F11/02

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)

Int. Cl^6 F24F11/02

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

Jitsuyo Shinan Koho 1926 - 1997
Kokai Jitsuyo Shinan Koho 1971 - 1997

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 63-101646, A (Sanyo Electric Co., Ltd.), May 6, 1988 (06. 05. 88) (Family: none)	1, 2

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
July 16, 1997 (16. 07. 97)	July 29, 1997 (29. 07. 97)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)