(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 548 379 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.06.2005 Bulletin 2005/26

(51) Int Cl.[7]: **F25B 31/00**

(21) Application number: **04254258.9**

(22) Date of filing: **15.07.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK

(30) Priority: **24.12.2003 JP 2003427025**

(71) Applicant: **Samsung Electronics Co., Ltd.**
Suwon-si, Gyeonggi-do (KR)

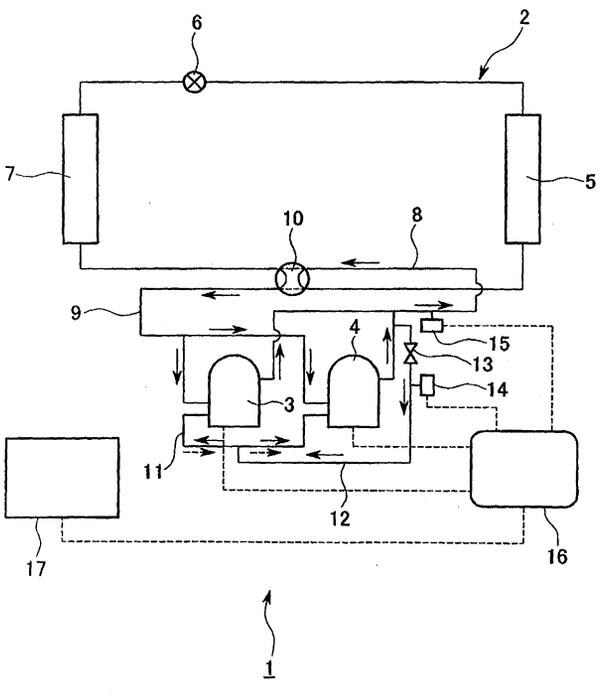
(72) Inventor: **Takashi, K.,**
Samsung Yokohama Res. Inst. Co. Ltd.
Yokohama-shi, Kanagawa-ken (JP)

(74) Representative: **Davies, Robert Ean et al**
Appleyard Lees,
15 Clare Road
Halifax HX1 2HY (GB)

(54) Refrigerating apparatus and control method thereof

(57) A refrigerating apparatus (1) and a control method thereof which can rapidly detect the fact that no high pressure refrigerant is introduced into an oil equalizing tube (11) due to failure of an opening/closing value (13), etc., thereby being capable of preventing the flow of oil mist, and thus, preventing damage to compressors (3, 4). The refrigerating apparatus includes a plurality of compressors (3, 4) connected in parallel in a refrigerant circuit (2), an oil equalizing tube (11) adapted to connect shells of the compressors, a bypass tube (12) adapted to connect the oil equalizing tube to a discharge refrigerant line (8) of the compressors, and an opening/closing valve (13) arranged at an intermediate portion of the bypass tube. The bypass tube, which is positioned between the opening/closing valve and the oil equalizing tube, is provided with a temperature sensor (14) adapted to detect a temperature of the bypass tube itself or an internal temperature of the bypass tube.

FIG. 1



EP 1 548 379 A1

Description

[0001] The present invention relates to a refrigerating apparatus in which oil equalization is carried out among a plurality of low pressure shell type compressors, and a method for controlling the refrigerating apparatus.

[0002] As an example of one type of air conditioner, there is a so-called "multi-type air conditioner in which a plurality of compressors are provided in one outdoor unit, in order to cope with a plurality of indoor units.

[0003] For the multiple compressors provided in the outdoor unit of such an air conditioner, variable capacity compressors may be used. In some cases, such compressors may have different capacities of compressor shells thereof.

[0004] In such cases, where compressors communicate via an oil equalization tube, oil may flow from the shell of the high pressure side compressor to the low pressure side compressor. In this case, the oil flows continuously, even when the level thereof in the shell of the high pressure side compressor is lowered below the position of oil equalizing tube connectors. This is because the oil is present in a mist state as it is stirred by rotating elements in the shell of the high pressure side compressor. As a result, shortage of oil in the high pressure side compressor may occur.

[0005] In order to prevent such a flow of oil mist, a proposal has been made, in which the shells of multiple compressors are communicated via an oil equalizing tube, and the oil equalizing tube is connected to a discharge side refrigerant line of the compressors via a bypass tube, as disclosed in Japanese Laid-open Publication No. Heisei 04-222354 (claims 3 to 5 and FIG. 1).

[0006] An oil equalizing system, which is provided in a refrigerating apparatus disclosed in the above publication, will be described in brief. In a refrigerant circuit, a plurality of compressors are connected to a discharge side refrigerant line and a suction side refrigerant line such that the compressors are connected in parallel. Respective compressors include shells, adjacent ones of which are communicated via an oil equalizing tube. The discharge side refrigerant line of the compressors is connected to the oil equalizing tubes via a bypass tube, which is provided with an opening/closing valve at an intermediate portion thereof.

[0007] In accordance with this oil equalizing system, the opening/closing valve is open during normal cooling/heating operation so that high pressure refrigerant gas is introduced into the oil equalizing tubes via the bypass tube. Accordingly, it is possible to prevent oil mist from flowing between adjacent compressor shells through the associated oil equalizing tube, and thus, to prevent shortage of oil in the high pressure compressor.

[0008] Where there is an oil amount difference among the compressor shells due to a prolonged compressor operation, a so-called "oil equalizing operation" is carried out. That is, the compressors are sequentially operated one by one with the opening/closing valve closed, thereby causing surplus oil in each of the compressors to be sequentially fed. Thus, the amount of oil in each of the compressor shells is returned to a proper value.

[0009] However, when the opening/closing valve is maintained in a closed state due to a failure thereof, etc. during a normal cooling/heating operation in the above-mentioned conventional refrigerating apparatus, it is impossible to introduce high pressure refrigerant gas into the oil equalizing tubes. Where the compressor operation is continued under the condition in which no high pressure refrigerant gas is introduced into the oil equalizing tubes, as mentioned above, oil mist present in the high pressure side compressor may flow into the other compressor via the associated oil equalizing tube. As a result, failure may occur in the high pressure side compressor due to shortage of oil. That is, the failure of the inexpensive opening/closing valve may cause failure of the expensive compressors, in spite of the fact that a normal operation is inexpensively and simply achieved in this case by simply replacing the failed opening/closing valve with a new one. In this case, it may be necessary to replace the compressors with new ones, so that considerable costs and labor may be required.

[0010] The present invention addresses the above-mentioned problems, and an aim of embodiments of the invention is to provide a refrigerating apparatus and a control method thereof which can rapidly detect the fact that no high pressure refrigerant is introduced into an oil equalizing tube due to failure of an opening/closing value, etc., thereby being capable of preventing flow of oil mist, and thus, preventing damage to compressors.

[0011] In accordance with one aspect, the present invention provides a refrigerating apparatus comprising a plurality of compressors connected in parallel in a refrigerant circuit, an oil equalizing tube adapted to connect shells of the compressors, a bypass tube adapted to connect the oil equalizing tube to a discharge refrigerant line of the compressors, and an opening/closing valve arranged at an intermediate portion of the bypass tube, wherein the bypass tube, which is positioned between the opening/closing valve and the oil equalizing tube, is provided with a temperature sensor adapted to detect a temperature of the bypass tube itself or an internal temperature of the bypass tube.

[0012] In accordance with another aspect, the present invention provides a method for controlling a refrigerating apparatus including a plurality of compressors connected in parallel in a refrigerant circuit, an oil equalizing tube adapted to connect shells of the compressors, a bypass tube adapted to connect the oil equalizing tube to a discharge refrigerant line of the compressors, and an opening/closing valve arranged at an intermediate portion of the bypass tube, the method comprising: driving the compressors, thereby circulating a refrigerant through the refrigerant circuit while introducing the refrigerant, which is discharged from the compressors in a high pressure state, into the bypass tube via the re-

frigerant line; and detecting an internal temperature of the bypass tube, which is positioned between the opening/closing valve and the oil equalizing tube, or a temperature of the bypass tube itself, and stopping the compressors when the detected temperature is lower than a value obtained by deducting a predetermined value from a temperature of the refrigerant discharged from the compressors.

[0013] In the refrigerating apparatus according to embodiments of the present invention, the temperature sensor is positioned at the bypass tube arranged between the opening/closing valve and the oil equalizing tube to detect the temperature of the bypass tube itself and the internal temperature of the bypass tube. Accordingly, when high pressure refrigerant gas, which is discharged from the second compressor, and is then introduced into the bypass tube via the refrigerant line, is introduced into the oil equalizing tube after passing through the opening/closing valve, the temperature detected by the temperature sensor corresponds to high temperature. On the other hand, when the high pressure refrigerant gas introduced into the bypass tube does not pass through the opening/closing valve, the temperature detected by the temperature sensor corresponds to room temperature (low temperature). Thus, it is possible to check whether or not the high temperature refrigerant gas is introduced into the oil equalizing tube after passing through the opening/closing valve. Based on the result of the checking, it is possible to reliably prevent flow of oil mist, and thus, to prevent the compressors from being damaged due to shortage of oil.

[0014] Also, in accordance with embodiments of the method for controlling the refrigerating apparatus, the compressors are driven to circulate refrigerant through the refrigerant circuit. Also, high pressure refrigerant gas discharged from the compressors is introduced into the bypass tube via the refrigerant line. Under this condition, the internal temperature of the bypass tube arranged between the opening/closing valve and the oil equalizing tube or the temperature of the bypass tube itself is detected. When the internal temperature of the bypass tube is lower than the value obtained by deducting the predetermined value from the temperature of the high pressure refrigerant gas discharged from the compressors, the compressors are stopped. That is, when no high pressure refrigerant gas passes through the opening/closing valve due to failure of the opening/closing valve, etc., the compressors are stopped. Accordingly, it is possible to prevent flow of oil mist, and thus, to prevent the first and second compressors from being damaged.

[0015] Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

[0016] For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings in which:

FIG. 1 is a circuit diagram illustrating an embodiment of a refrigerating apparatus according to the present invention; and

FIG. 2 is a flow chart illustrating an embodiment of a control method for the refrigerating apparatus according to the present invention.

[0017] Reference will now be made in detail to the embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below to explain the present invention by referring to the figures.

[0018] FIG. 1 illustrates a refrigerant circuit 2 in a refrigerating apparatus 1 according to embodiments of the present invention. In the illustrated case, the refrigerating apparatus 1 is an air conditioner. In the refrigerant circuit 2, first and second compressors 3 and 4, which are of a low pressure shell type, a first heat exchanger 5, an expansion valve 6, and a second heat exchanger 7 are sequentially arranged, as shown in FIG. 1. The two compressors 3 and 4 are connected to a discharge line 8 and a suction line 9 such that the compressors are connected in parallel. Each of the discharge and suction lines 8 and 9 is connected, at one end thereof, to the refrigerant circuit 2 through a four-directional valve 10. Each of the discharge and suction lines 8 and 9 is also branched, at the other end thereof, into two lines, which is in turn connected to the first and second compressors 3 and 4, respectively.

[0019] An oil equalizing tube 11 is arranged between the first and second compressors 3 and 4 to connect the shells of the first and second compressors 3 and 4. Thus, the shells of the first and second compressors 3 and 4 are communicated through the oil equalizing tube 11. The oil equalizing tube 11 is connected to respective lower portions of the side walls of the first and second compressors 3 and 4. Oil present in the shells of the first and second compressors 3 and 4 flows between the shells of the first and second compressors 3 and 4 after passing through the oil equalizing tube 11, so as to equalize the amounts of oil present in respective shells of the first and second compressors 3 and 4.

[0020] A bypass tube 12 is arranged between a portion of the discharge line 8, which is connected to the second compressor 4, and the oil equalizing tube 11, to connect the discharge line 8 and the oil equalizing tube 11. Thus, the discharge line 8 and oil equalizing tube 11 are communicated through the bypass tube 12. The bypass tube 12 is made of a tube having a diameter smaller than those of the discharge line 8 and oil equalizing tube 11. An opening/closing valve 13, which may be an electromagnetic valve or a motor-driven valve, is arranged at an intermediate portion of the bypass tube 12.

In accordance with an opening/closing operation thereof, the opening/closing valve 13 controls refrigerant gas, which flows through the bypass tube 12. When the opening/closing valve 13 is in a closed state, it prevents the refrigerant gas from passing therethrough. In an open state of the opening/closing valve 13, the refrigerant gas can pass through the opening/closing valve 13.

[0021] A first temperature sensor 14 is also provided at the intermediate portion of the bypass tube 12 to detect the internal temperature of the bypass tube 12. The first temperature sensor 14 may comprise a thermocouple, thermistor, infrared radiation thermometer, or resistance temperature detector. The first temperature sensor 14 is positioned at the bypass tube 12 arranged between the opening/closing valve 13 and the oil equalizing tube 11. When no refrigerant gas flows through the bypass tube 12 arranged between the opening/closing valve 13 and the oil equalizing tube 11, the temperature detected by the first temperature sensor 14 corresponds to room temperature. On the other hand, when refrigerant gas flows through the bypass tube 12, the temperature detected by the first temperature sensor 14 corresponds to a high temperature. Here, the room temperature is approximately equal to ambient temperature, and is typically about 0 to 35°C. Also, the high temperature is approximately equal to the temperature of the refrigerant gas, and is typically 60 to 130°C.

[0022] A second temperature sensor 15 is positioned at the discharge line 8, which is connected to the first and second compressors 3 and 4 to join flows of refrigerant discharged from the first and second compressors 3 and 4. The second temperature sensor 15 detects the internal temperature of the discharge line 8. The second temperature sensor 15 is made of the same element as that of the first temperature sensor 14. The refrigerating apparatus 1 is also provided with a control unit 16 adapted to control driving of the first and second compressors 3 and 4. The control unit 16 is electrically connected to an operating panel 17 adapted to operate the refrigerating apparatus 1. The operating panel 17 is provided with a touch panel (not shown). In accordance with an operation of the touch panel, the refrigerating apparatus 1 can perform cooling/heating, oil equalizing, and stopping operations.

[0023] The first and second temperature sensors 14 and 15 and the first and second compressors 3 and 4 are electrically connected to the control unit 16. Information of respective temperatures detected by the first and second temperature sensors 14 and 15 is sent to the control unit 16, which in turn controls the first and second compressors 3 and 4, based on the information. Specifically, where the internal temperature T of the bypass tube detected by the first temperature sensor 14 is lower than a value obtained by deducting a predetermined value A from the refrigerant temperature To detected by the second temperature sensor 15, a stop signal is sent from the control unit 16 to the first and second compressors 3 and 4, thereby causing the first and second compressors 3 and 4 to be stopped. Simultaneously, an error signal is sent from the control unit 16 to the operating panel 17, so that the error is displayed. Meanwhile, the value A is determined, taking into consideration a decrease in temperature or generation of errors caused by loss of heat occurring during a procedure in which high pressure refrigerant gas flows, for example, 10°C. In this case, the value A may be 0 to 20°C.

[0024] Now, methods of using and controlling the above-described refrigerating apparatus 1 will be described.

[0025] First, the following description will be given in conjunction with a cooling/heating operation. Refrigerant is circulated through the refrigerant circuit 2 by driving the first and second compressors 3 and 4. At this time, the opening/closing valve 13 is maintained in an open state. Accordingly, high pressure refrigerant gas, which is discharged from the second compressor 4 into the discharge line 8, flows into the bypass tube 12. The high pressure refrigerant gas is then introduced into the oil equalizing tube 11 after passing through the bypass tube 12 via the opening/closing valve 13 in a direction indicated by a solid line in FIG. 1. The high pressure refrigerant gas introduced into the oil equalizing tube 11 then enters the first and second compressors 3 and 4 in the direction indicated by the solid arrow in FIG. 1. Accordingly, the interior of the oil equalizing tube 11 is maintained in a high pressure state. As a result, it is possible to prevent oil mist, which is generated in the shells of the first and second compressors 3 and 4 maintained in a low pressure state, from being introduced into the oil equalizing tube 11.

[0026] Also, it is checked during a cooling/heating operation whether or not the opening/closing valve 13 is in an appropriately opened state. Based on the result of the checking, the refrigerating apparatus 1 is controlled. This will be described in more detail with reference to FIG. 2. First, the internal temperature T of the bypass tube 12 arranged between the opening/closing valve 13 and the oil equalizing tube 11 is detected by the first temperature sensor 14. Also, the internal temperature of the discharge line 8 is measured by the second temperature sensor 15. Thus, the temperature To of the high pressure refrigerant gas discharged from the first and second compressors 3 and 4 is detected. Information of the detected temperatures T and To is sent to the control unit 16, which in turn determines whether or not the internal temperature T of the bypass tube 12 is lower than a value obtained by deducting the predetermined value A from the temperature To of the high pressure refrigerant gas. When it is determined that the temperature T is lower than the value obtained by deducting the predetermined value A from the temperature To, the control unit 16 stops the first and second compressors 3 and 4. On the other hand, when the temperature T is lower than the value obtained by deducting the predetermined value A from the temperature To, the first and second compressors 3 and 4 are continuously operated to perform

the cooling/heating operation.

[0027] Now, the oil equalizing operation will be described. First, the opening/closing valve 13 is closed, and the second compressor 4 is stopped. Under this condition, the first compressor 3 is driven. As the first compressor 3 is driven, the interior of the shell of the first compressor 3 is rendered to be in a low pressure state. Accordingly, surplus oil present in the shell of the first compressor 3 flows into the shell of the second compressor 4 through the oil equalizing tube 11. Subsequently, the opening/closing valve 13 is closed, and the first compressor 3 is then stopped. Under this condition, the second compressor 4 is driven. As the second compressor 4 is driven, the interior of the shell of the second compressor 4 is rendered to be in a low pressure state. Accordingly, surplus oil present in the shell of the second compressor 4 flows into the shell of the first compressor 3 through the oil equalizing tube 11. Thus, the amounts of oil in respective shells of the first and second compressors 3 and 4 can be equalized in accordance with the alternate driving of the first and second compressors 3 and 4 as described above.

[0028] In the above-described refrigerating apparatus 1, the first temperature sensor 14 is positioned at the bypass tube 12 arranged between the opening/closing valve 13 and the oil equalizing tube 11 to detect the internal temperature of the bypass tube 12. Accordingly, when high pressure refrigerant gas, which is discharged from the second compressor 4, and is then introduced into the bypass tube 12 via the discharge line 8, is introduced into the oil equalizing tube 11 after passing through the opening/closing valve 13, the temperature T detected by the first temperature sensor 14 corresponds to the high temperature. On the other hand, when the high pressure refrigerant gas introduced into the bypass tube 12 does not pass through the opening/closing valve 13, the temperature T detected by the first temperature sensor 14 corresponds to room temperature (low temperature). Thus, it is possible to check whether or not the high temperature refrigerant gas is introduced into the oil equalizing tube 11 after passing through the opening/closing valve 13. Based on the result of the checking, it is possible to reliably prevent flow of oil mist, and thus, to prevent the first and second compressors 3 and 4 from being damaged due to shortage of oil.

[0029] Also, the second temperature sensor 15 is positioned at the discharge line 8, so that it is possible to compare the temperature To of the high pressure refrigerant gas discharged from the first and second compressors 3 and 4 with the temperature T detected by the first temperature sensor 14. Accordingly, it is possible to detect a state in which a proper amount of high pressure refrigerant gas cannot pass through the opening/closing valve 13 due to inadequate opening of the opening/closing valve 13.

[0030] In accordance with the method for controlling the refrigerating apparatus 1, the first and second compressors 3 and 4 are driven to circulate refrigerant through the refrigerant circuit 2. Also, high pressure refrigerant gas discharged from the second compressor 4 is introduced into the bypass tube 12 via the discharge line 8. Under this condition, the internal temperature T of the bypass tube 12 arranged between the opening/closing valve 13 and the oil equalizing tube 11 is detected. When the internal temperature T of the bypass tube 12 is lower than the value obtained by deducting the predetermined value A from the temperature To of the high pressure refrigerant gas discharged from the first and second compressors 3 and 4, the first and second compressors 3 and 4 are stopped. That is, when no high pressure refrigerant gas passes through the opening/closing valve 13 due to failure of the opening/closing valve 13, etc., the first and second compressors 3 and 4 are stopped. Accordingly, it is possible to prevent flow of oil mist, and thus, to prevent the first and second compressors 3 and 4 from being damaged.

[0031] Although the refrigerating apparatus and control method thereof according to embodiments of the present invention have been shown and described with reference to a few embodiments thereof, they are not limited to these embodiments. It would be appreciated by those skilled in the art that changes may be made in the embodiments without departing from the principles and spirit of the invention. For example, although the internal temperature of the bypass tube 12 is detected by the first temperature sensor 14 in the illustrated embodiment, it is also possible to check whether or not high temperature refrigerant gas flows through the bypass tube 12, by detecting the temperature of the bypass tube 12 itself, and estimating the internal temperature of the bypass tube 12, based on the detected temperature, in accordance with the present invention.

[0032] Also, although it is checked whether or not high temperature refrigerant gas flows through the bypass tube 12, by comparing the internal temperature T of the bypass tube 12 with the temperature To of the refrigerant gas discharged from the first and second compressors 3 and 4 in the above described embodiment, it is also possible to check the flow of high temperature refrigerant gas by comparing the internal temperature T of the bypass tube 12 with a predetermined value in accordance with embodiments of the present invention. In this case, the predetermined value is a maximum temperature typically expected when no high temperature refrigerant gas flows. For example, this value may be set to 50°C. In this case, the compressors are stopped when the internal temperature T of the bypass tube 12 is less than 50°C during a normal cooling/heating operation.

[0033] Although two compressors, that is, the compressors 3 and 4, are provided in the refrigerating apparatus 1 in the illustrated embodiment, the present invention may also be implemented in the case in which at least three compressors are provided. Also, although the present invention has been described in conjunction with the embodiment in which the refrigerating appara-

tus 1 is an air conditioner, it is also applicable to a refrigerator, a freezer, or other refrigerating devices.

[0034] Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0035] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0036] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0037] The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. A refrigerating apparatus (1) comprising a plurality of compressors (3, 4) connected in parallel in a refrigerant circuit (2), an oil equalizing tube (11) adapted to connect shells of the compressors, a bypass tube adapted to connect the oil equalizing tube to a discharge refrigerant line (8) of the compressors, and an opening/closing valve (13) arranged at an intermediate portion of the bypass tube,

wherein the bypass tube, which is positioned between the opening/closing valve and the oil equalizing tube, is provided with a temperature sensor (14) adapted to detect a temperature of the bypass tube itself or an internal temperature of the bypass tube.

2. A method for controlling a refrigerating apparatus (1) including a plurality of compressors (3, 4) connected in parallel in a refrigerant circuit (2), an oil equalizing tube (11) adapted to connect shells of the compressors, a bypass tube (12) adapted to connect the oil equalizing tube to a discharge refrigerant line (8) of the compressors, and an opening/closing valve (15) arranged at an intermediate portion of the bypass tube, the method comprising:

driving the compressors, thereby circulating a refrigerant through the refrigerant circuit while introducing the refrigerant, which is discharged from the compressors in a high pressure state, into the bypass tube via the refrigerant line; and

detecting an internal temperature of the bypass tube, which is positioned between the opening/closing valve and the oil equalizing tube, or a temperature of the bypass tube itself, and stopping the compressors when the detected temperature is lower than a value obtained by deducting a predetermined value from a temperature of the refrigerant discharged from the compressors.

FIG. 1

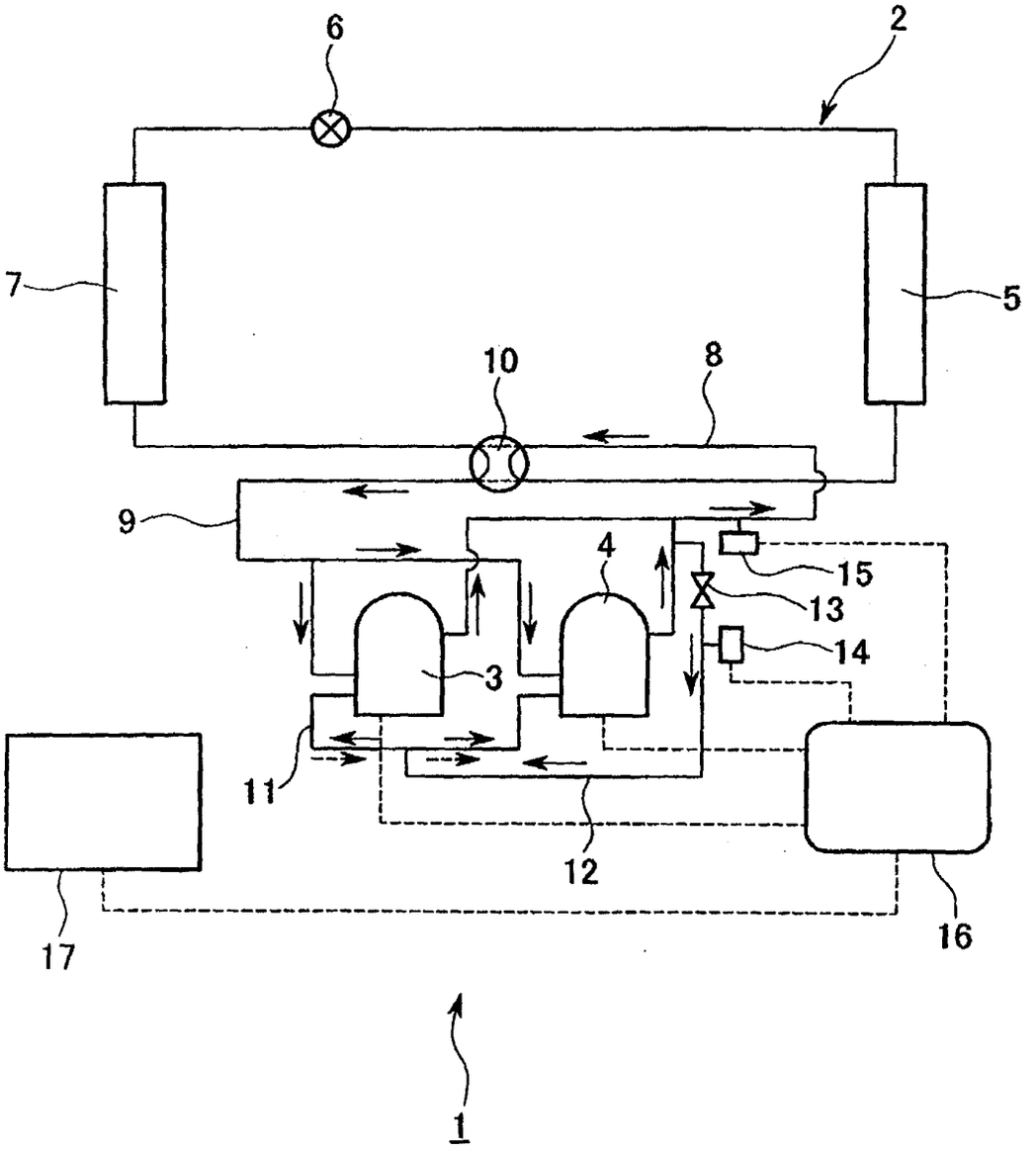
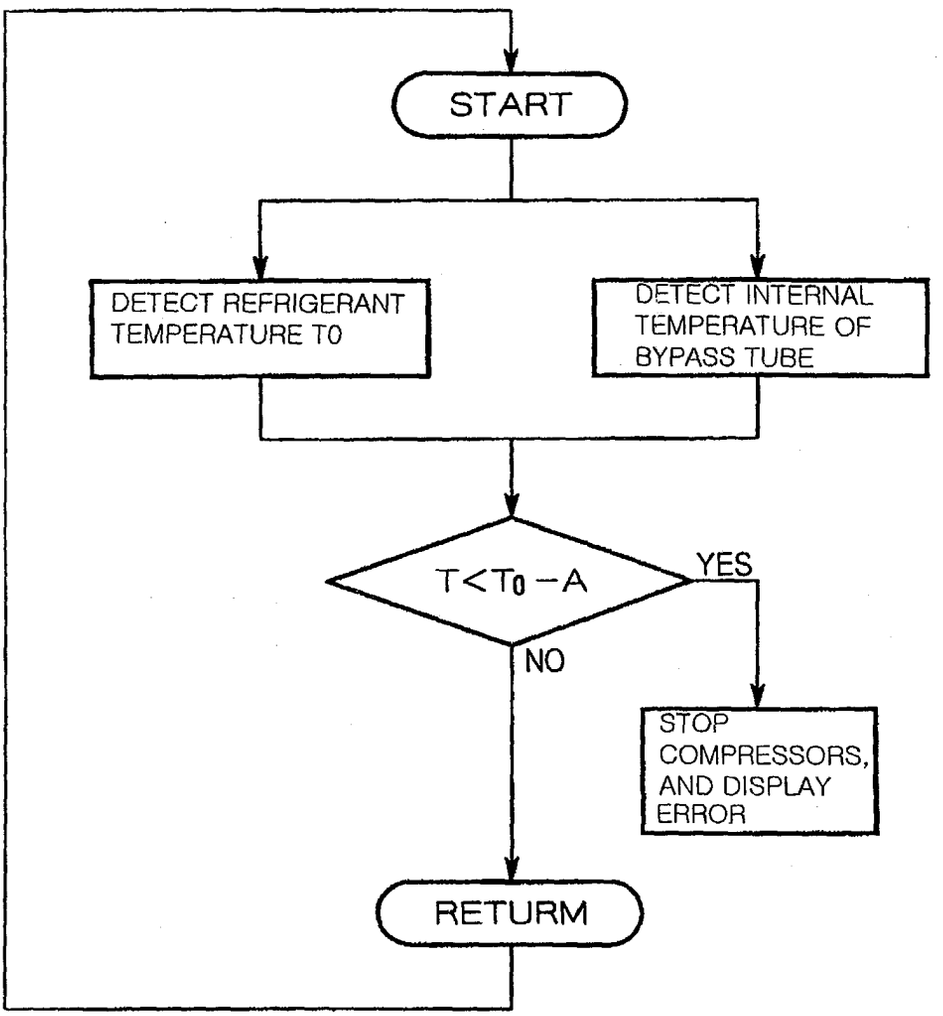


FIG. 2


START
DETECT REFRIGERANT TEMPERATURE T0
DETECT INTERNAL TEMPERATURE OF BYPASS TUBE
T<T0 −A
YES
NO
STOP COMPRESSORS, AND DISPLAY ERROR
RETURM

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 25 4258

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 1 367 259 A (TOSHIBA CARRIER CORPORATION) 3 December 2003 (2003-12-03) * paragraphs [0040] - [0134]; claims 9-16; figures 5,7,11-13 *	1,2	F25B31/00
A	WO 03/085332 A (DAIKIN INDUSTRIES, LTD; TAKEGAMI, MASAAKI; TANIMOTO, KENJI) 16 October 2003 (2003-10-16) * paragraphs [0065] - [0077]; figure 2 *	1,2	
A	EP 1 293 734 A (TEKO GESELLSCHAFT FUER KAELTETECHNIK MBH) 19 March 2003 (2003-03-19)	1,2	
A	US 2002/073721 A1 (SEO HYEONG-JOON ET AL) 20 June 2002 (2002-06-20) * paragraphs [0026] - [0035]; figures 3,4 *	1,2	
A	US 2003/010046 A1 (FREUND PETER W ET AL) 16 January 2003 (2003-01-16)	1,2	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	WO 02/46664 A (DAIKIN INDUSTRIES, LTD; TANIMOTO, KENJI; TAKEGAMI, MASAAKI; NOMURA, KA) 13 June 2002 (2002-06-13)	1,2	F25B
A	EP 1 170 558 A (SANYO ELECTRIC CO., LTD) 9 January 2002 (2002-01-09) * abstract *	1,2	
A	EP 0 838 640 A (MATSUSHITA REFRIGERATION COMPANY) 29 April 1998 (1998-04-29) * abstract *	1	
A	US 5 634 345 A (ALSENZ ET AL) 3 June 1997 (1997-06-03) * figure 2 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 April 2005	van Berlo, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 25 4258

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

28-04-2005

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1367259 A	03-12-2003	JP 2002242833 A	28-08-2002
		EP 1367259 A1	03-12-2003
		CN 1491321 A	21-04-2004
		WO 02064979 A1	22-08-2002
WO 03085332 A	16-10-2003	AU 2003221148 A1	20-10-2003
		CN 1547654 A	17-11-2004
		EP 1493978 A1	05-01-2005
		WO 03085332 A1	16-10-2003
		US 2004159111 A1	19-08-2004
EP 1293734 A	19-03-2003	DE 20115270 U1	22-11-2001
		EP 1293734 A1	19-03-2003
US 2002073721 A1	20-06-2002	KR 2002048699 A	24-06-2002
		CN 1358966 A ,C	17-07-2002
		JP 3556918 B2	25-08-2004
		JP 2002195626 A	10-07-2002
US 2003010046 A1	16-01-2003	DE 10216644 A1	30-01-2003
		JP 2003042573 A	13-02-2003
WO 0246664 A	13-06-2002	JP 2002174463 A	21-06-2002
		AU 2109402 A	18-06-2002
		WO 0246664 A1	13-06-2002
EP 1170558 A	09-01-2002	JP 2002022293 A	23-01-2002
		JP 2002022294 A	23-01-2002
		CN 1333450 A	30-01-2002
		CN 1510361 A	07-07-2004
		EP 1170558 A2	09-01-2002
		US 2002023459 A1	28-02-2002
EP 0838640 A	29-04-1998	JP 10132397 A	22-05-1998
		JP 10153355 A	09-06-1998
		CA 2217514 A1	28-04-1998
		EP 0838640 A2	29-04-1998
		KR 242810 B1	02-03-2000
		US 5996363 A	07-12-1999
US 5634345 A	03-06-1997	AU 5969096 A	24-12-1996
		WO 9639601 A1	12-12-1996

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82