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(72) Inventors:
• **Hamachiyo, Takashi**
MINATO-KU, TOKYO, 108-8215 (JP)
• **Isozumi, Shinichi**
MINATO-KU, TOKYO, 108-8215 (JP)

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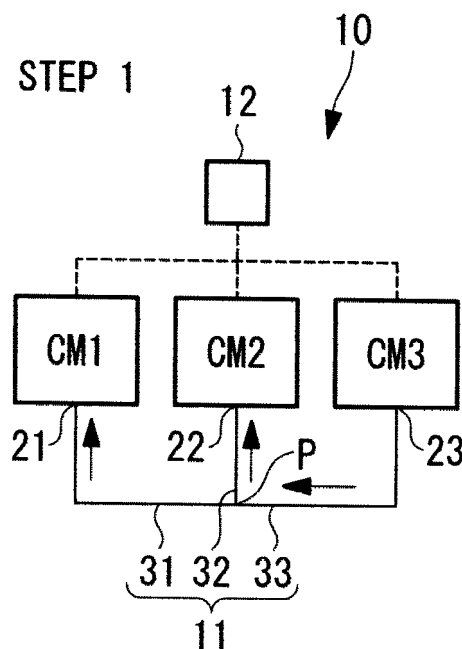
(74) Representative: **Intès, Didier Gérard André et al**
Cabinet Beau de Loménie
158, rue de l'Université
75340 Paris Cedex 07 (FR)

(71) Applicant: **Mitsubishi Heavy Industries**
Tokyo 108-8215 (JP)

(54) **Outdoor unit with at least three compressors for use with air conditioners**

(57) A capacity shortfall in an indoor unit at a high load is prevented. An outdoor unit (10) includes at least three compressors (CM1, CM2, CM3) and has an oil equalization mode function for maintaining a proper oil level in each of the compressors (CM1, CM2, CM3). The outdoor unit (10) includes a controller (12) that controls starting and stopping of the compressors (CM1, CM2, CM3) in the oil equalization mode such that one of the compressors (CM1, CM2, CM3) at a time is stopped or operated at a low load while the other compressors (CM1, CM2, CM3) are operated.

FIG. 2A



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Description

{Technical Field}

[0001] The present invention relates to outdoor units for use with air conditioners, and particularly to an outdoor unit including at least three compressors and having an oil equalization mode function for maintaining the proper oil level in each of the compressors. {Background Art}

[0002] PTL 1 discloses an example of a known outdoor unit including at least three compressors and having an oil equalization mode function for maintaining the proper oil level in each of the compressors.

{Citation List}

[0003]

{PTL 1} Japanese Unexamined Patent Application, Publication No. 2005-188365

{Summary of Invention}

{Technical Problem}

[0004] The outdoor unit disclosed in PTL 1 above, however, has a step of stopping a first compressor and a second compressor and operating only a third compressor and a step of operating only the first compressor and stopping the second compressor and the third compressor. Therefore, when the outdoor unit disclosed in PTL 1 above is at a high load (when many indoor units are operating), the indoor units may face a capacity shortfall.

[0005] An object of the present invention, which has been made in light of such circumstances, is to provide an outdoor unit that can prevent a capacity shortfall in indoor units at a high load.

{Solution to Problem}

[0006] To solve the above problem, the present invention employs the following solutions.

An outdoor unit according an aspect of the present invention includes at least three compressors and has an oil equalization mode function for maintaining a proper oil level in each of the compressors. The outdoor unit includes a controller that controls starting and stopping of the compressors in the oil equalization mode such that one of the compressors at a time is stopped or operated at a low load while the other compressors are operated.

[0007] In the oil equalization mode of the outdoor unit according to the aspect of the present invention, one of the compressors is stopped or operated at a low load while the other compressors (at least two compressors) are operating normally.

This prevents a capacity shortfall in an indoor unit at a high load.

[0008] In the above outdoor unit, the controller prefer-

ably controls the starting and stopping of the compressors in the oil equalization mode such that the compressors are each started before another compressor is stopped or transitions to low-load operation so that the operation of the started compressor is established at the same time as when the other compressor is stopped or completes the transition to low-load operation.

[0009] In this type of outdoor unit, the inner pressures of oil-equalizing branch pipes at (near) oil-equalizing-pipe connection ports of the compressors operating normally are (substantially) equal when the operation of the started compressor is established.

This allows the oil to be (substantially) evenly distributed over the compressors operating normally.

[0010] A multi-type air conditioner according to an aspect of the present invention includes one of the above types of outdoor units.

[0011] In the oil equalization mode of the outdoor unit included in the above multi-type air conditioner, one of the compressors is stopped or operated at a low load while the other compressors (at least two compressors) are operating normally.

This prevents a capacity shortfall in an indoor unit at a high load, thus constantly maintaining a comfortable indoor environment.

[0012] A method for operating an outdoor unit according to an aspect of the present invention is a method for operating an outdoor unit including at least three compressors and having an oil equalization mode function for maintaining a proper oil level in each of the compressors. The compressors are started and stopped in the oil equalization mode such that one of the compressors at a time is stopped or operated at a low load while the other compressors are operated.

[0013] In the oil equalization mode of the above method for operating the outdoor unit, one of the compressors at a time is stopped or operated at a low load while the other compressors (at least two compressors) are operating normally.

This prevents a capacity shortfall in an indoor unit at a high load.

[0014] In the above method for operating the outdoor unit, the compressors are preferably started and stopped in the oil equalization mode such that the compressors are each started before another compressor is stopped or transitions to low-load operation so that the operation of the started compressor is established at the same time as when the other compressor is stopped or completes the transition to low-load operation.

[0015] In this method for operating the outdoor unit, the inner pressures of oil-equalizing branch pipes at (near) oil-equalizing-pipe connection ports of the compressors operating normally are (substantially) equal when the operation of the started compressor is established.

This allows the oil to be (substantially) evenly distributed over the compressors operating normally.

{Advantageous Effects of Invention}

[0016] The outdoor unit according to the aspect of the present invention provides the advantage of preventing a capacity shortfall in an indoor unit at a high load.

{Brief Description of Drawings}

[0017]

{Fig. 1}

Fig. 1 is a table showing the operational status of each compressor according to an embodiment of the present invention.

{Fig. 2A}

Fig. 2A is a diagram showing oil flow in a step shown in Fig. 1.

{Fig. 2B}

Fig. 2B is a diagram showing oil flow in a step shown in Fig. 1.

{Fig. 2C}

Fig. 2C is a diagram showing oil flow in a step shown in Fig. 1.

{Fig. 3}

Fig. 3 is a timing chart showing the relationship between the ON/OFF state of each compressor and operating time in the embodiment of the present invention.

{Description of Embodiments}

[0018] An outdoor unit according to an embodiment of the present invention will now be described with reference to Figs. 1 to 3.

Fig. 1 is a table showing the operational status of each compressor according to this embodiment. Figs. 2A to 2C are diagrams showing oil flow in the respective steps shown in Fig. 1. Fig. 3 is a timing chart showing the relationship between the ON/OFF state of each compressor and operating time in this embodiment.

[0019] As shown in Figs. 2A to 2C, an outdoor unit 10 according to this embodiment includes at least three (in this embodiment, three) compressors CM1, CM2, and CM3, an oil-equalizing pipe 11, and a controller 12 and is connected to a plurality of indoor units (not shown) via refrigerant piping (not shown).

[0020] The oil-equalizing pipe 11 includes a first oil-equalizing branch pipe 31 through which an oil-equalizing pipe node P communicates with (connects to) an oil-equalizing-pipe connection port 21 of the (first) compressor CM1, a second oil-equalizing branch pipe 32 through which the oil-equalizing pipe node P communicates with (connects to) an oil-equalizing-pipe connection port 22 of the (second) compressor CM2, and a third oil-equalizing branch pipe 33 through which the oil-equalizing pipe node P communicates with (connects to) an oil-equalizing-pipe connection port 23 of the (third) compressor CM3.

[0021] The controller 12 controls starting and stopping (start/stop) of the compressors CM1, CM2, and CM3 according to the table shown in Fig. 1 and the chart shown in Fig. 3. That is, the compressors CM1, CM2, and CM3 are each started (ON) and stopped (OFF) in response to an instruction signal (control signal) transmitted by the controller 12.

[0022] In the outdoor unit 10 according to this embodiment, the controller 12 controls the starting and stopping of the compressors CM1, CM2, and CM3 in an oil equalization mode (i.e., step 1 to step 3) such that one of the compressors CM1, CM2, and CM3 at a time is stopped (in the order CM3 → CM1 → CM2) while the other compressors are operated (in the order CM1, CM2 → CM2, CM3 → CM1, CM3). That is, the compressors CM1, CM2, and CM3 are each started and stopped in response to an instruction signal (control signal) transmitted by the controller 12 in the oil equalization mode such that the compressors CM1 and CM2 operate while the compressor CM3 is stopped, that the compressors CM2 and CM3 operate while the compressor CM1 is stopped, and that the compressors CM1 and CM3 operate while the compressor CM2 is stopped.

[0023] In the oil equalization mode of the outdoor unit 10 according to this embodiment, the starting (rise) of the compressors CM1, CM2, and CM3 does not occur at the same time as the stopping (fall) of the compressors CM1, CM2, and CM3. That is, as indicated by the lines rising to the right in Fig. 3, the compressors CM1, CM2, and CM3 are each started slightly before another compressor CM1, CM2, or CM3 is stopped so that the operation of the started compressor CM1, CM2, or CM3 is established at the same time as when the other compressor CM1, CM2, or CM3 is stopped.

[0024] According to the outdoor unit 10 and the method for operating the outdoor unit 10 according to this embodiment, in the oil equalization mode, any one of the compressors CM1, CM2, and CM3 is stopped while the other compressors (at least two compressors) CM1, CM2, and CM3 are operating normally. This prevents a capacity shortfall in the indoor units at a high load.

[0025] In the outdoor unit 10 and the method for operating the outdoor unit 10 according to this embodiment, the inner pressures of the oil-equalizing branch pipes 31, 32, and 33 at (near) the oil-equalizing-pipe connection ports 21, 22, and 23 of the compressors CM1, CM2, and CM3 operating normally are (substantially) equal when the operation of the started compressor CM1, CM2, or CM3 is established.

This allows the oil to be (substantially) evenly distributed over the compressors CM1, CM2, and CM3 operating normally.

[0026] In the oil equalization mode of a multi-type air conditioner (not shown) including the outdoor unit 10 according to this embodiment, any one of the compressors CM1, CM2, and CM3 is stopped while the other compressors (at least two compressors) CM1, CM2, and CM3

are operating normally.

This prevents a capacity shortfall in the indoor units at a high load.

[0027] The present invention is not limited to the embodiment described above; various modifications and variations are permitted as needed.

For example, while the above embodiment has been illustrated with the example in which any one of the compressors CM1, CM2, and CM3 is stopped in the oil equalization mode, the present invention is not limited thereto; any one of the compressors CM1, CM2, and CM3 may be operated at a lower load than the other compressors CM1, CM2, and CM3 operating normally, or at a lower rotational speed than the other compressors CM1, CM2, and CM3 operating normally.

{Reference Signs List}

[0028]

10	outdoor unit	
11	oil-equalizing pipe	
12	controller	
21	oil-equalizing-pipe connection port	
22	oil-equalizing-pipe connection port	
23	oil-equalizing-pipe connection port	
31	oil-equalizing branch pipe	
32	oil-equalizing branch pipe	
33	oil-equalizing branch pipe	
CM1	compressor	30
CM2	compressor	
CM3	compressor	

Claims

1. An outdoor unit (10) comprising at least three compressors (CM1, CM2, CM3) and having an oil equalization mode function for maintaining a proper oil level in each of the compressors (CM1, CM2, CM3), the outdoor unit (10) **characterized in that** it comprises a controller (12) that controls the starting and stopping of the compressors (CM1, CM2, CM3) in the oil equalization mode such that one of the at least three compressors (CM1, CM2, CM3) at a time is stopped or operated at a low load while the other of the at least three compressors (CM1, CM2, CM3) are operated.
2. The outdoor unit (10) according to Claim 1, wherein the controller (12) controls the starting and stopping of the at least three compressors (CM1, CM2, CM3) in the oil equalization mode such that the at least three compressors (CM1, CM2, CM3) are each started before another compressor (CM1, CM2, CM3) is stopped or transitions to low-load operation so that the operation of the started compressor is established at the same time as when the other compressor

is stopped or completes the transition to low-load operation.

3. A multi-type air conditioner comprising the outdoor unit (10) according to Claim 1 or 2.
4. A method for operating an outdoor unit (10) including at least three compressors (CM1, CM2, CM3) and having an oil equalization mode function for maintaining a proper oil level in each of the compressors (CM1, CM2, CM3), wherein the at least three compressors (CM1, CM2, CM3) are started and stopped in the oil equalization mode such that one of the at least three compressors (CM1, CM2, CM3) at a time is stopped or operated at a low load while the others of the at least three compressors (CM1, CM2, CM3) are operated.
5. The method for operating the outdoor unit (10) according to Claim 4, wherein the at least three compressors are started and stopped in the oil equalization mode such that the at least three compressors are each started before another of the at least three compressors is stopped or transitions to low-load operation so that the operation of the started compressor is established at the same time as when the other compressor is stopped or completes the transition to low-load operation.

FIG. 1

OPERATIONAL STATUS OF COMPRESSORS

COMPRESSOR	CM1	CM2	CM3
BEFORE STARTING OF OIL EQUALIZATION	ON	ON	ON
STEP 1	ON	ON	OFF
STEP 2	OFF	ON	ON
STEP 3	ON	OFF	ON
NORMAL OPERATION	ON	ON	ON

FIG. 2A

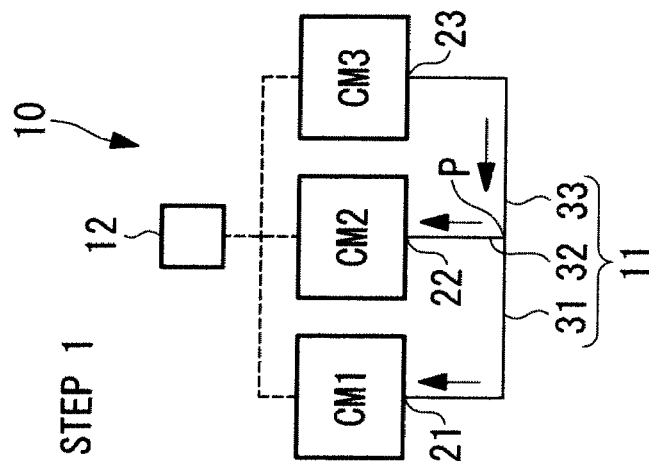


FIG. 2B

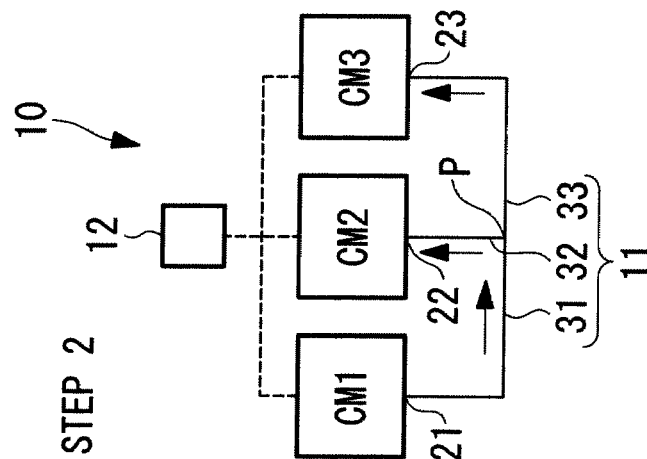


FIG. 2C

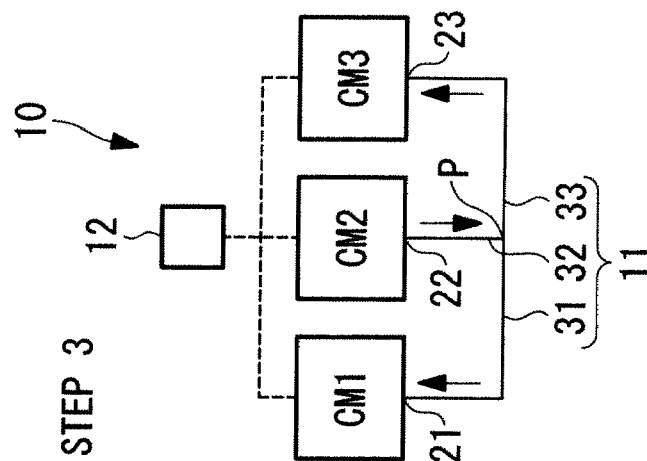
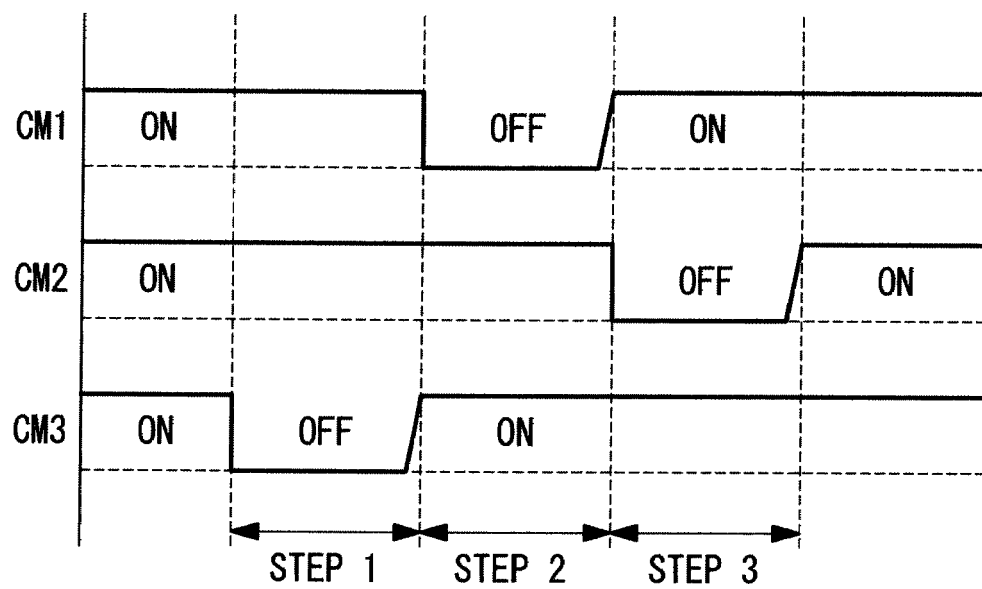


FIG. 3





EUROPEAN SEARCH REPORT

Application Number
EP 12 16 5384

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