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

(11) **EP 1 978 315 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
08.10.2008 Bulletin 2008/41

(51) Int Cl.:
F25B 13/00 *(2006.01)*

(21) Application number: **07120875.5**

(22) Date of filing: **16.11.2007**

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

(30) Priority: **06.04.2007 KR 20070034425**

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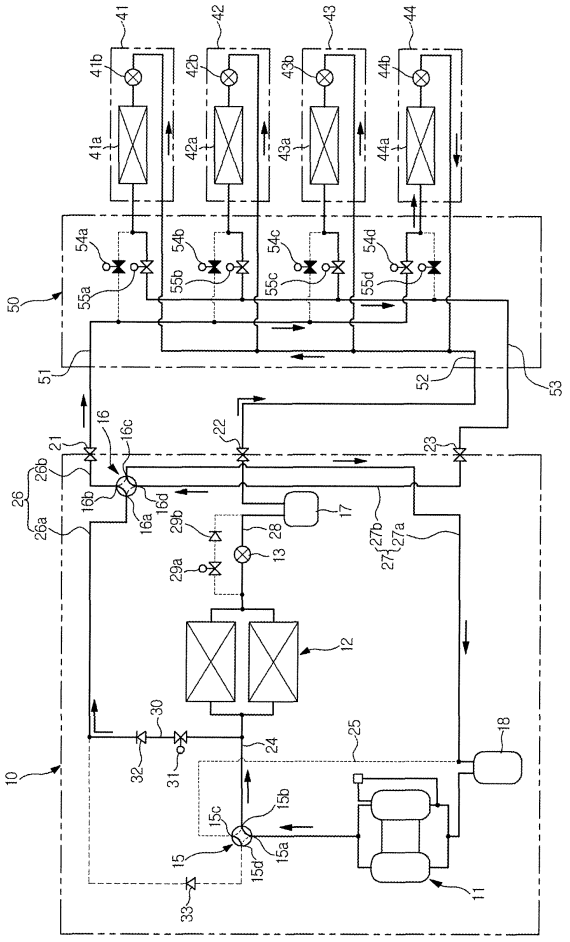
(54) **Outdoor Unit for Multi-Air Conditioner**

(57) An outdoor unit (10) applicable to not only a multi-air conditioner to perform heating and cooling operations simultaneously, but also a multi-air conditioner to perform a heating operation and a cooling operation separately. The outdoor unit (10) includes a compressor (11), an outdoor heat exchanger (12), first to third connecting valves (21-23) connected to pipes of a plurality of indoor units, respectively, a first 4-way valve (15) connected to a discharge side of the compressor for conversion of heating and cooling operations, a high-pressure gas pipe (26) to connect the first 4-way valve with the first connecting valve (21), a high-pressure liquid pipe (28) to connect the second connecting valve (22) with the outdoor heat exchanger (12), a first connecting pipe (24) to connect the outdoor heat exchanger (12) with the first 4-way valve (15), a second connecting pipe (25) to connect the first 4-way valve to a suction side of the compressor, and a low-pressure gas pipe (27) to guide a low-pressure gas refrigerant returned to the third connecting valve to the suction side of the compressor, and further includes a second 4-way valve (16) to convert a flow path so as to communicate the high-pressure gas pipe (26) with the third connecting valve (23) or to communicate the low-pressure gas pipe (27) with the third connecting valve (23).

Fig. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an outdoor unit for a multi-air conditioner, and, more particularly, to an outdoor unit for a multi-air conditioner, which is applicable to not only a multi-air conditioner to perform heating and cooling operations simultaneously, but also a multi-air conditioner to perform a heating operation and a cooling operation separately.

2. Description of the Related Art

[0002] Korean Patent Laid-Open Publication No. 2006-0065947 discloses a multi-air conditioner capable of performing heating and cooling operations simultaneously. The disclosed multi-air conditioner includes an outdoor unit having a compressor, an outdoor heat exchanger, a 4-way valve, and an expansion valve, a plurality of indoor units connected with the outdoor unit, and a heating/cooling switching device installed between the outdoor unit and the indoor units. The heating/cooling switching device includes a plurality of opening/closing valves to convert a flow path such that some of the plurality of indoor units performs a cooling operation and the remaining indoor units perform a heating operation.

[0003] The above described conventional air conditioner further includes a high-pressure gas pipe to connect the heating/cooling switching device with the outdoor unit, a high-pressure liquid pipe, and a low-pressure gas pipe. The high-pressure gas pipe is used to deliver a high-pressure gas-phase refrigerant from the compressor of the outdoor unit into at least one indoor unit performing a heating operation. The low-pressure gas pipe is used to deliver a low-pressure gas-phase refrigerant from at least one indoor unit performing a cooling operation into the compressor of the outdoor unit. Also, the high-pressure liquid pipe is used to deliver a high-pressure liquid-phase refrigerant toward the outdoor unit or indoor units.

[0004] As the opening/closing valves of the heating/cooling switching device are selectively opened or closed, the air conditioner can perform a "full heating operation" in which all the indoor units perform a heating operation, a "full cooling operation" in which all the indoor units perform a cooling operation, a "primary heating operation in which a minor part of the indoor units perform a cooling operation and a major part of the indoor units perform a heating operation, and a "primary cooling operation" in which a minor part of the indoor units perform a heating operation and a major part of the indoor units perform a cooling operation.

[0005] In the above described air conditioner, the high-pressure gas pipe and the heating/cooling switching device are required for simultaneous heating and cooling operations, and more particularly, for the above mentioned "primary heating operation" or "primary cooling operation". Accordingly, multi-air conditioners to perform the "full heating operation" or "full cooling operation" do not essentially require the high-pressure gas pipe and the heating/cooling switching device.

[0006] The outdoor unit manufactured for simultaneous heating and cooling operations, however, is usable only when the heating/cooling switching device is installed, and thus, has a problem in that it cannot be applied to a system having no heating/cooking switching device to perform the "full heating operation" or "full cooling operation". This is because a user requiring only the "full heating operation" or "full cooling operation" has no need to employ the heating/cooling switching device with additional costs.

[0007] Therefore, for the user requiring only the "full heating operation" or "full cooling operation", manufacturers must manufacture an outdoor unit for a multi-air conditioner (having no high-pressure gas pipe), which is intended to realize the "primary heating operation" or "primary cooling operation" without the heating/cooling switching device. However, this causes a difficulty in the manufacture and maintenance of constituent elements of the outdoor unit, and increases manufacturing costs of the air conditioner.

SUMMARY OF THE INVENTION

[0008] Accordingly, it is an aspect of the invention to provide an outdoor unit for a multi-air conditioner, which is applicable to not only a multi-air conditioner to perform heating and cooling operations simultaneously, but also a multi-air conditioner to perform a heating operation and a cooling operation separately.

[0009] 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.

[0010] In accordance with the invention, the above and/or other aspects can be achieved by the provision of an outdoor unit for a multi-air conditioner comprising: a compressor; an outdoor heat exchanger; first to third connecting valves connected to pipes of a plurality of indoor units, respectively; a first 4-way valve connected to a discharge side of the compressor for conversion of heating and cooling operations; a high-pressure gas pipe to connect the first 4-way valve with the first connecting valve; a high-pressure liquid pipe to connect the second connecting valve with the outdoor heat exchanger; a first connecting pipe to connect the outdoor heat exchanger with the first 4-way valve; a second connecting pipe to connect the first 4-way valve to a suction side of the compressor; and a low-pressure gas pipe to guide a low-pressure gas refrigerant returned to the third connecting valve to the suction side of the compressor, further comprising: a second 4-way valve to convert a flow path so as to communicate the high-pressure gas pipe with the

third connecting valve or to communicate the low-pressure gas pipe with the third connecting valve.

[0011] The high-pressure gas pipe may comprise a first high-pressure gas pipe to connect the first 4-way valve with the second 4-way valve and a second high-pressure gas pipe to connect the second 4-way valve with the first connecting valve, and the low-pressure gas pipe may comprise a first low-pressure gas pipe to connect the second 4-way valve with the suction side of the compressor, and a second low-pressure gas pipe to connect the second 4-way valve with the third connecting valve.

[0012] The outdoor unit may further comprise a bypass pipe diverged from the first connecting pipe and connected to the first high-pressure gas pipe, and a bypass valve installed on the bypass pipe.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] These and/or other aspects and advantages of the exemplary embodiments of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings, of which:

FIG. 1 is a circuit diagram of a simultaneous heating and cooling type multi-air conditioner having an outdoor unit according to the present invention, illustrating a primary cooling operation;

FIG. 2 is a circuit diagram of the simultaneous heating and cooling type multi-air conditioner having the outdoor unit according to the present invention, illustrating a primary heating operation;

FIG. 3 is a circuit diagram of the multi-air conditioner having the outdoor unit according to the present invention, illustrating a cooling operation; and

FIG. 4 is a circuit diagram of the multi-air conditioner having the outdoor unit according to the present invention, illustrating a heating operation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] Reference will now be made in detail to exemplary embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. The embodiments are described below to explain the present invention by referring to the figures.

[0015] FIGS. 1 and 2 illustrate a simultaneous heating and cooling type multi-air conditioner according to the present invention. As shown in FIG. 1, the simultaneous heating and cooling type multi-air conditioner includes an outdoor unit 10, a plurality of indoor units 41, 42, 43, and 44, and a heating/cooling switching device 50.

[0016] The outdoor unit 10 includes a compressor 11 to compress a refrigerant, an outdoor heat exchanger 12 to heat exchange the refrigerant with outside air, an outdoor expansion valve 13 to depress and expand the refrigerant, a first 4-way valve 15 to convert a flow path, a second 4-way valve 16 to covert a flow path, a receiver 17 to receive the circulating refrigerant, and an accumulator 18 to receive the circulating refrigerant and to supply the gas-phase refrigerant to the compressor 11. The outdoor unit 10 further includes a first connecting valve 21, a second connecting valve 22, and a third connecting valve 23, for the connection of the heating/cooling switching device 50 and the outdoor unit 10.

[0017] The 4-way valve 15 has first to fourth ports 15a, 15b, 15c, and 15d. The first port 15a of the first 4-way valve 15 is connected to a discharge side of the compressor 11 through a pipe, and the second port 15b is connected to the outdoor heat exchanger 12 through a first connecting pipe 24. The third port 15c of the first 4-way valve 15 is connected to a suction side of the compressor 11 through a second connecting pipe 25, and the fourth port 15d is connected to the first connecting valve 21 through a high-pressure gas pipe 26. The first 4-way valve 15 converts a flow path to selectively communicate the first connecting pipe 24 and the high-pressure gas pipe 26 with the discharge side of the compressor 11, for the switching of cooling and heating operations.

[0018] The outdoor heat exchanger 12 is connected to the second connecting valve 22 through a high-pressure liquid pipe 28. The high-pressure liquid pipe 28 is installed with the receiver 17 and the outdoor expansion valve 13. The outdoor expansion valve 13 is installed between the outdoor heat exchanger 12 and the receiver 17. A pipe bypassing the outdoor expansion valve 13 is installed with a flow-rate regulating valve 29a and a check valve 29b.

[0019] The third connecting valve 23 is connected to the suction side of the compressor 11 through a low-pressure gas pipe 27, and the accumulator 18 is installed to the low-pressure gas pipe 27 at a position adjacent to the compressor 11. The second 4-way valve 16 converts a flow path to communicate the high-pressure gas pipe 26 with the third connecting valve 23, or to communicate the low-pressure gas pipe 27 with the third connecting valve 23. To enable this connection, the high-pressure gas pipe 26 includes a first high-pressure gas pipe 26a to connect the first 4-way valve 15 with a first port 16a of the second 4-way valve 16, and a second high-pressure gas pipe 26b to connect a second port 16b of the second 4-way valve 16 with the first connecting valve 21. Similarly, the low-pressure gas pipe 27 includes a first low-pressure gas pipe 27a to connect the suction side of the compressor 11 with a third port 16c of the second 4-way valve 16, and a second low-pressure gas pipe 27b to connect a fourth port 16d of the second 4-way valve 16 with the third connecting valve 23.

[0020] The outdoor unit 10 further includes a bypass pipe 30 diverged from the first connecting pipe 24, which connects the first 4-way valve 15 with the outdoor heat exchanger 12, and connected to the first high-pressure

gas pipe 26a, and a bypass valve 31 and a check valve 32 installed on the bypass pipe 30. When the bypass valve 31 is opened, a high-pressure gas-phase refrigerant to be supplied to the outdoor heat exchanger 12 can be bypassed to the first high-pressure gas pipe 26a. The first high-pressure gas pipe 26a is installed with a check valve 33 to prevent the high-pressure gas-phase refrigerant, which is bypassed through the bypass pipe 30, from flowing backward toward the first 4-way valve 15.

[0021] Each of the plurality of indoor units 41, 42, 43, and 44 includes an indoor heat exchanger 41 a, 42a, 43a, or 44a, and an indoor expansion valve 41 b, 42b, 43b, or 44b. Hereinafter, for the convenience of explanation, the indoor units are designated by reference numerals 41, 42, 43, and 44 from the top of FIG. 1.

[0022] The heating/cooling switching device 50 includes a first pipe 51 connected to the first connecting valve 21 of the outdoor unit 10, a second pipe 52 connected to the second connecting valve 22 of the outdoor unit 10, and a third pipe 53 connected to the third connecting valve 23 of the outdoor unit 10. In this case, the second pipe 52 is connected to the indoor expansion valves 41 b, 42b, 43b, and 44b of the respective indoor units 41, 42, 43, and 44, and the first and third pipes 51 and 53 are connected to the indoor heat exchangers 41 a, 42a, 43a, and 44a of the respective indoor units 41, 42, 43, and 44.

[0023] The heating/cooling switching device 50 includes first to fourth heating opening/closing valves 54a, 54b, 54c, and 54d to selectively open or close pipes, which are diverged from the first pipe 51 and connected to the respective indoor heat exchangers 41 a, 42a, 43a, and 44a, and first to fourth cooling opening/closing valves 55a, 55b, 55c, and 55d to selectively open or close pipes, which are diverged from the third pipe 53 and connected to the respective indoor heat exchangers 41a, 42a, 43a, and 44a. The heating/cooling switching device 50 selectively opens or closes the opening/closing valves, to allow some of the indoor units to perform a cooling operation and the remaining indoor units to perform a heating operation.

[0024] Now, the operation of the above described simultaneous heating and cooling type multi-air conditioner will be described.

[0025] FIG. 1 illustrates a primary cooling operation in which a minor part of indoor units perform a heating operation, and a major part of indoor units perform a cooling operation. In this case, the first 4-way valve 15, as shown in FIG. 1, operates to deliver a high-pressure gas-phase refrigerant discharged from the compressor 11 to the outdoor heat exchanger 12. The second 4-way valve 16 operates to communicate the first high-pressure gas pipe 26a with the second high-pressure gas pipe 26b and the first low-pressure gas pipe 27a with the second low-pressure gas pipe 27b. The bypass valve 31 is opened to allow a part of the high-pressure gas-phase refrigerant to be delivered to the first high-pressure gas pipe 26a. The outdoor expansion valve 13 is also opened to allow the refrigerant, having passed through the outdoor heat exchanger 12, to be delivered to the second pipe 52 of the heating/cooling switching device 50 through the high-pressure liquid pipe 28. The first to third heating opening/closing valves 54a, 54b, and 54c of the heating/cooling switching device 50 are closed, and the fourth heating opening/closing valve 54d is opened. Also, the first to third cooling opening/closing valves 55a, 55b, and 55c are opened, and the fourth cooling opening/closing valve 55d is closed.

[0026] Upon implementation of the primary cooling operation, the high-pressure gas-phase refrigerant, discharged from the compressor 11, is heat exchanged by passing through the outdoor heat exchanger 12, and thereafter, is delivered to the respective indoor expansion valves 41 b, 42b, and 43b of the first to third indoor units 41, 42, and 43 through the high-pressure liquid pipe 28 and the second pipe 52 of the heating/cooling switching device 50. Accordingly, the first to third indoor units 41, 42, and 43 perform a cooling operation. The resulting low-pressure gas-phase refrigerant, having passed through the first to third indoor units 41, 42, and 43, is delivered to the suction side of the compressor 11 through the third pipe 53 of the heating/cooling switching device 50 and the low-pressure gas pipe 27 of the outdoor unit 10.

[0027] Simultaneously with the above described operation, a part of the high-pressure gas-phase refrigerant, which was delivered to the high-pressure gas pipe 26 through the bypass pipe 30 of the outdoor unit 10, is supplied to the fourth indoor unit 44 through the first pipe 51 of the heating/cooling switching device 50. Accordingly, the fourth indoor unit 44 perform a heating operation. Of course, in this case, the indoor expansion valve 44b of the fourth indoor unit 44 is kept in an opened state. The resulting high-pressure liquid-phase refrigerant, having passed through the fourth indoor unit 44, is supplied into the first to third indoor units 41, 42, and 43 after being joined with the refrigerant passing through the second pipe 52 of the heating/cooling switching device 50. With the above described primary cooling operation, the first to third indoor units 41, 42, and 43 perform a cooling operation, and the fourth indoor unit 44 performs a heating operation.

[0028] FIG. 2 illustrates a primary heating operation in which a minor part of indoor units perform a cooling operation, and a major part of indoor units perform a heating operation. In this case, the first 4-way valve 15, as shown in FIG. 2, operates to deliver the high-pressure gas-phase refrigerant discharged from the compressor 11 to the high-pressure gas pipe 26. The second 4-way valve 16 operates to communicate the first high-pressure gas pipe 26a with the second high-pressure gas pipe 26b and the first low-pressure gas pipe 27a with the second low-pressure gas pipe 27b. The bypass valve 31 is closed, and an opening rate of the outdoor expansion valve 13 is reduced. The first heating opening/closing valve 54a is closed, and the second to fourth heating opening/clos-

ing valves 54b, 54c, and 54d are opened. Also, the first cooling opening/closing valve 55a is opened, and the second to fourth cooling opening/closing valves 55b, 55c, and 55d are closed.

[0029] Upon implementation of the primary hating operation, the high-pressure gas-phase refrigerant discharged from the compressor 11 is delivered to the first pipe 51 of the heating/cooling switching device 50 through the high-pressure gas pipe 26, so as to be supplied to the second to fourth indoor units 42, 43, and 44. Accordingly, the second to fourth indoor units 42 to 44 perform a heating operation. Of course, in this case, the indoor expansion valves 42b, 43b, and 44b of the second to fourth indoor units 42, 43, and 44 are opened. The resulting high-pressure liquid-phase refrigerant, having passed through the second to fourth indoor units 42, 43, and 44, are delivered to the outdoor expansion valve 13 through the second pipe 52 of the heating/cooling switching device 50. After being depressed and expanded in the outdoor expansion valve 13, the refrigerant is delivered to the outdoor heat exchanger 12. The resulting low-pressure gas-phase refrigerant, having passed through the outdoor heat exchanger 12, is delivered to the suction side of the compressor 11 through the first and second connecting pipes 24 and 25.

[0030] Simultaneously with the above described operation, a part of the high-pressure liquid-phase refrigerant, which was delivered to the second pipe 52 of the heating/cooling switching device 50 through the second to fourth indoor units 42, 42, and 44, is delivered to the indoor expansion valve 41 b of the first indoor unit 41. Accordingly, the first indoor unit 41 performs a cooling operation. Also, the low-pressure gas-phase refrigerant, having passed through the first indoor unit 41, is delivered to the suction side of the compressor 11 through the third pipe 53 of the heating/cooling switching device 50 and the low-pressure gas pipe 27 of the outdoor unit 10. With the above described primary heating operation, only the first indoor unit 41 performs a cooling operation, and the second to fourth indoor units 42, 43, and 44 perform a heating operation.

[0031] Although FIGS. 1 and 2 illustrate the primary cooling operation and the primary heating operation, the above described simultaneous heating and cooling type multi-air conditioner also can perform a full cooling operation in which all indoor units perform a cooling operation and a full heating operation in which all indoor units perform a heating operation, by operating the first 4-way valve 15 and the opening/closing valves of the heating/cooling switching device 50.

[0032] FIGS. 3 and 4 illustrate embodiments in which the above described outdoor unit 10 is applied to a multi-air conditioner for performing a heating operation and a cooling operation separately. The multi-air conditioner is designed such that all indoor units perform a cooling operation or a heating operation. This kind of air conditioner cannot perform heating and cooling operations simultaneously because of the absence of the heating/cooling switching device.

[0033] As shown in FIG. 3, when the outdoor unit 10 is applied to the multi-air conditioner for performing a heating operation and a cooling operation separately, it is unnecessary to connect a pipe to the first connecting valve 21 of the outdoor unit 10. Therefore, the first connecting valve 21 is closed. Indoor expansion valves 61 b, 62b, 63b, and 64b of indoor units 61, 62, 63, and 64 are connected to the second connecting valve 22 of the outdoor unit 10 through a first pipe 71. Also, indoor heat exchangers 61a, 62a, 63a, and 64a of the indoor units 61, 62, 63, and 64 are connected, at their ends opposite to the indoor expansion valves 61b, 62b, 63b, and 64b, to the third connecting valve 23 of the outdoor unit 10 through a second pipe 72.

[0034] When the above described multi-air conditioner performs a cooling operation, the first 4-way valve 15, as shown in FIG. 3, operates to deliver the high-pressure gas-phase refrigerant discharged from the compressor 11 to the outdoor heat exchanger 12. The second 4-way valve 16 operates to communicate the first high-pressure gas pipe 26a with the second high-pressure gas pipe 26b and the first low-pressure gas pipe 27a with the second low-pressure gas pipe 27b. In this case, also, the outdoor expansion valve 13 is opened to deliver the refrigerant, having passed through the outdoor heat exchanger 12, to the first pipe 71 through the high-pressure liquid pipe 28.

[0035] Upon implementation of the cooling operation under the above described condition, the high-pressure gas-phase refrigerant discharged from the compressor 11 is heat exchanged by passing through the outdoor heat exchanger 12, and thereafter, is delivered to the indoor expansion valves 61b, 62b, 63b, and 64b of the first to fourth indoor units 61, 62, 63, and 64 through the high-pressure liquid pipe 28 and the first pipe 71. Accordingly, all the indoor units 61, 62, 63, and 64 perform a cooling operation. The resulting low-pressure gas-phase refrigerant, having passed through the first to fourth indoor units 61, 62, 63, and 64, is delivered to the suction side of the compressor 11 through the second pipe 72 and the low-pressure gas pipe 27 of the outdoor unit 10. During the cooling operation, no refrigerant passes through the high-pressure gas pipe 26.

[0036] On the other hand, upon implementation of a heating operation, as shown in FIG. 4, the connection of a flow path is changed by the first 4-way valve 15 and the second 4-way valve 16. Specifically, the first 4-way valve 15 operates to deliver the high-pressure gas-phase refrigerant, discharged from the compressor 11, to the first high-pressure gas pipe 26a. The second 4-way valve 16 operates to communicate the first high-pressure gas pipe 26a with the second low-pressure gas pipe 27b and the first low-pressure gas pipe 27a with the second high-pressure gas pipe 26b. That is, in this case, the high-pressure gas-phase refrigerant, passing through the first high-pressure gas pipe 26a, is delivered to the third connecting valve 23 and the indoor second pipe 72 toward

the indoor units. Also, the opening rate of the outdoor expansion valve 13 is reduced, and the flow paths of the indoor expansion valves 61 b, 62b, 63b, and 64b of the indoor units 61, 62, 63, and 64 are expanded. The bypass valve 31 is closed.

[0037] Upon implementation of the heating operation under the above described condition, the high-pressure gas-phase refrigerant discharged from the compressor 11 is introduced into the indoor heat exchangers 61 a, 62a, 63a, and 64a of the indoor units 61, 62, 63, and 64 through the first high-pressure gas pipe 26a, the second low-pressure gas pipe 27b, the third connecting valve 23, and the indoor second pipe 72. Accordingly, in this case, all the indoor units 61, 62, 63, and 64 perform a heating operation. The resulting high-pressure liquid-phase refrigerant, having passed through the indoor units 61, 62, 63, and 64, is delivered to the outdoor expansion valve 13 through the indoor first pipe 71, the second connecting valve 22, and the high-pressure liquid pipe 28. After being depressed and expanded in the outdoor expansion valve 13 so as to be changed to a low-pressure gas-phase refrigerant by passing through the outdoor heat exchanger 12, the resulting low-pressure gas refrigerant is delivered to the suction side of the compressor 11 through the first and second connecting pipes 24 and 25. No refrigerant passes through the first low-pressure gas pipe 27a.

[0038] As apparent from the above description, according to the present invention, an outdoor unit for a multi-air conditioner according to the present invention includes a second 4-way valve to convert a flow path so as to selectively communicate a high-pressure gas pipe or a low-pressure gas pipe with a third connecting valve. With the use of the second 4-way valve, the outdoor unit of the present invention is applicable to not only a multi-air conditioner for performing heating and cooling operations simultaneously, but also a multi-air conditioner for performing heating and cooling operations separately.

[0039] Although embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

Claims

1. An outdoor unit for a multi-air conditioner comprising: a compressor; an outdoor heat exchanger; first to third connecting valves connected to pipes of a plurality of indoor units, respectively; a first 4-way valve connected to a discharge side of the compressor for conversion of heating and cooling operations; a high-pressure gas pipe to connect the first 4-way valve with the first connecting valve; a high-pressure liquid pipe to connect the second connecting valve with the outdoor heat exchanger; a first connecting pipe to connect the outdoor heat exchanger with the first 4-way valve; a second connecting pipe to connect the first 4-way valve to a suction side of the compressor; and a low-pressure gas pipe to guide a low-pressure gas refrigerant returned to the third connecting valve to the suction side of the compressor, further comprising:

a second 4-way valve to convert a flow path so as to communicate the high-pressure gas pipe with the third connecting valve or to communicate the low-pressure gas pipe with the third connecting valve.

2. The outdoor unit according to claim 1, wherein:

the high-pressure gas pipe comprises a first high-pressure gas pipe to connect the first 4-way valve with the second 4-way valve and a second high-pressure gas pipe to connect the second 4-way valve with the first connecting valve; and
the low-pressure gas pipe comprises a first low-pressure gas pipe to connect the second 4-way valve with the suction side of the compressor, and a second low-pressure gas pipe to connect the second 4-way valve with the third connecting valve.

3. The outdoor unit according to claim 1, further comprising:

a bypass pipe diverged from the first connecting pipe and connected to the first high-pressure gas pipe; and
a bypass valve installed on the bypass pipe.

Fig. 1

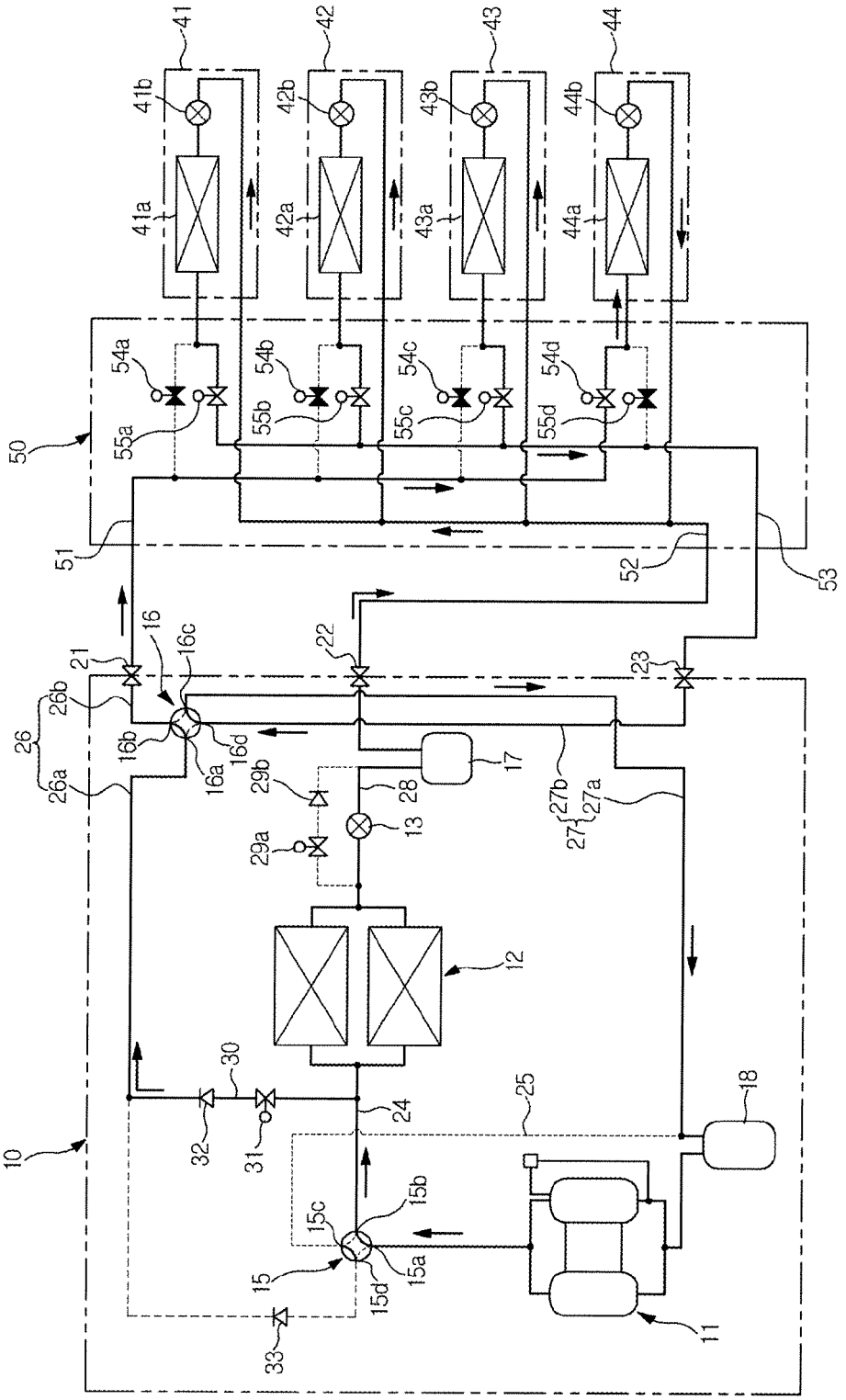
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Fig. 2

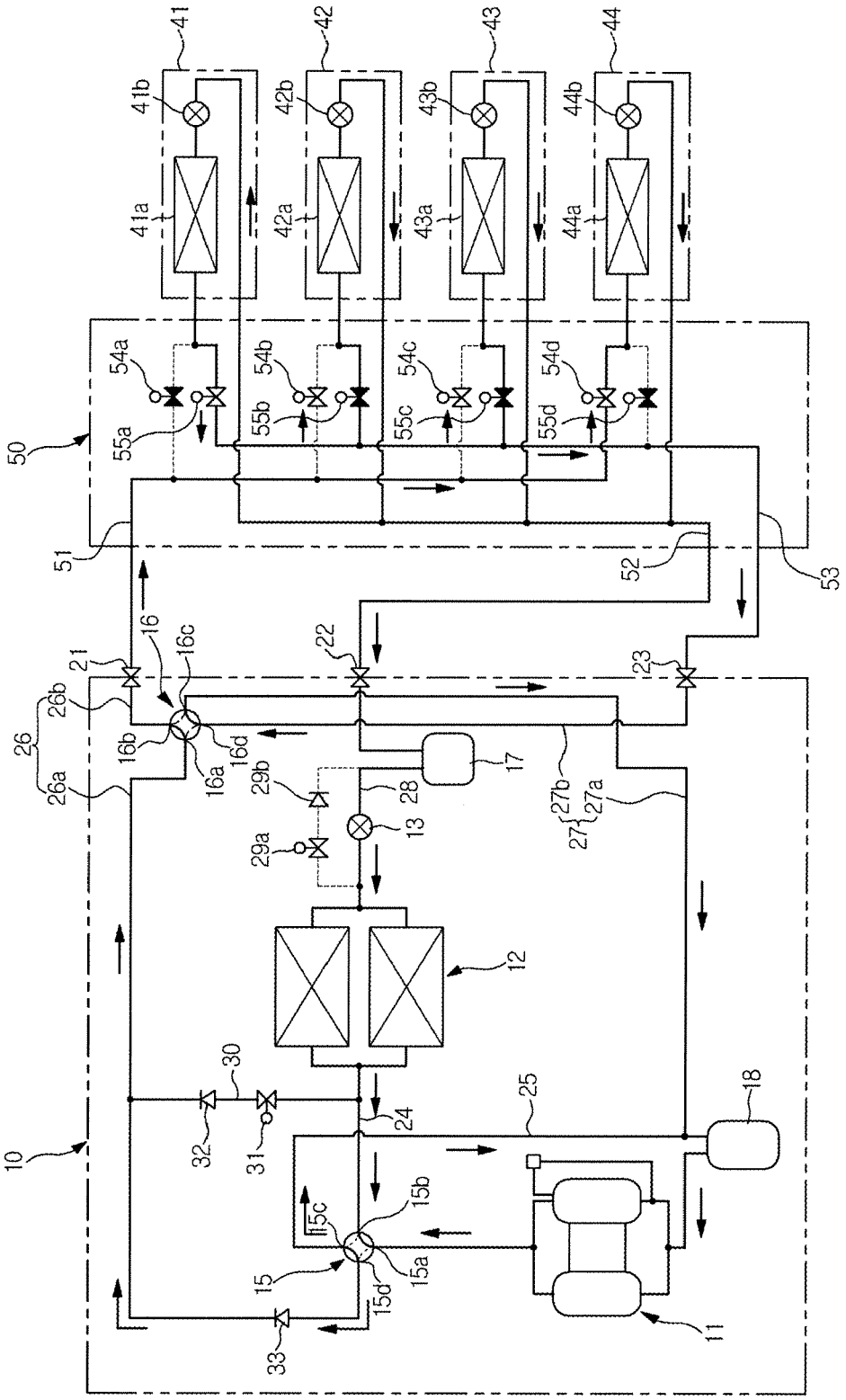
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Fig. 3

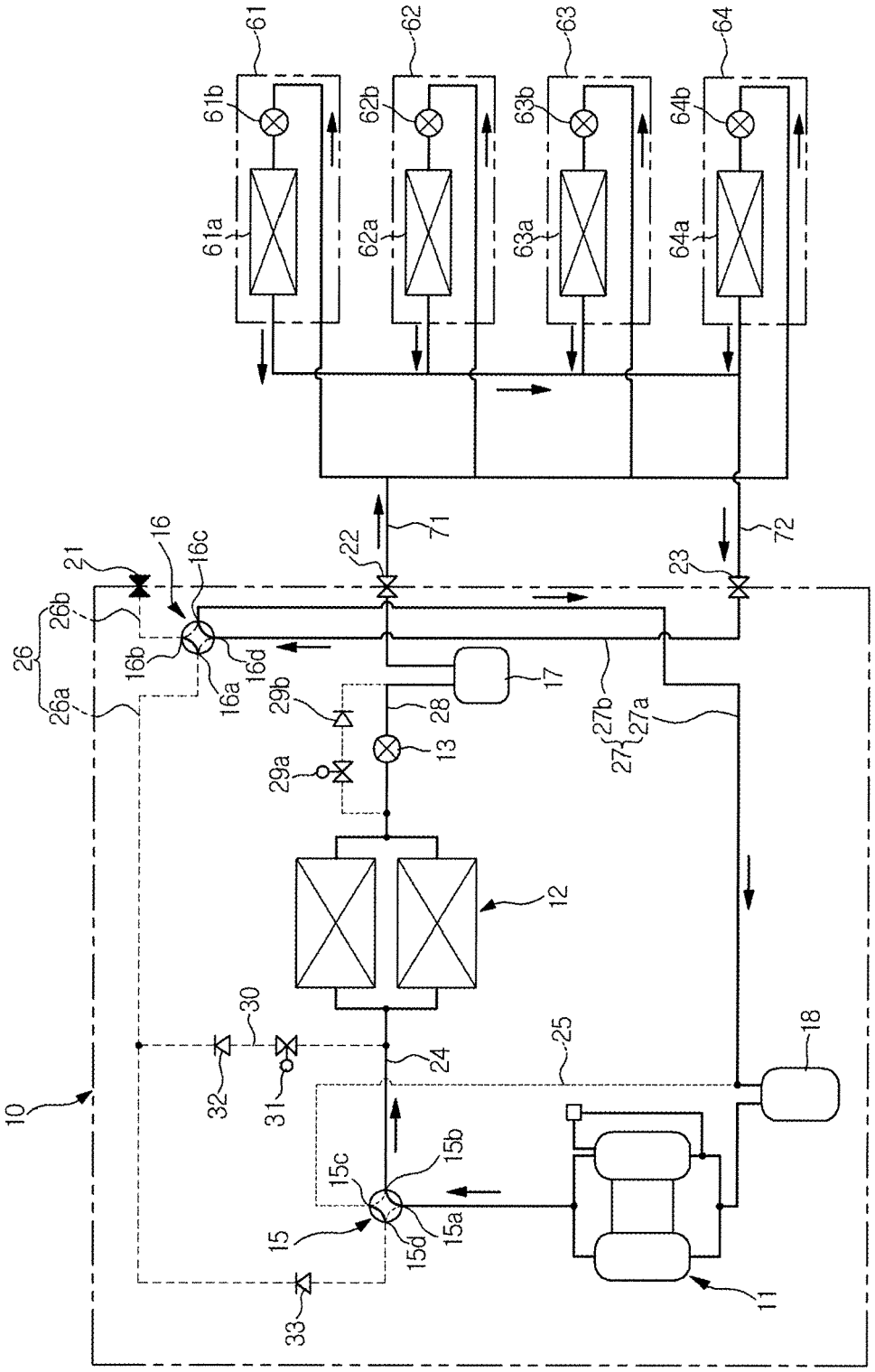
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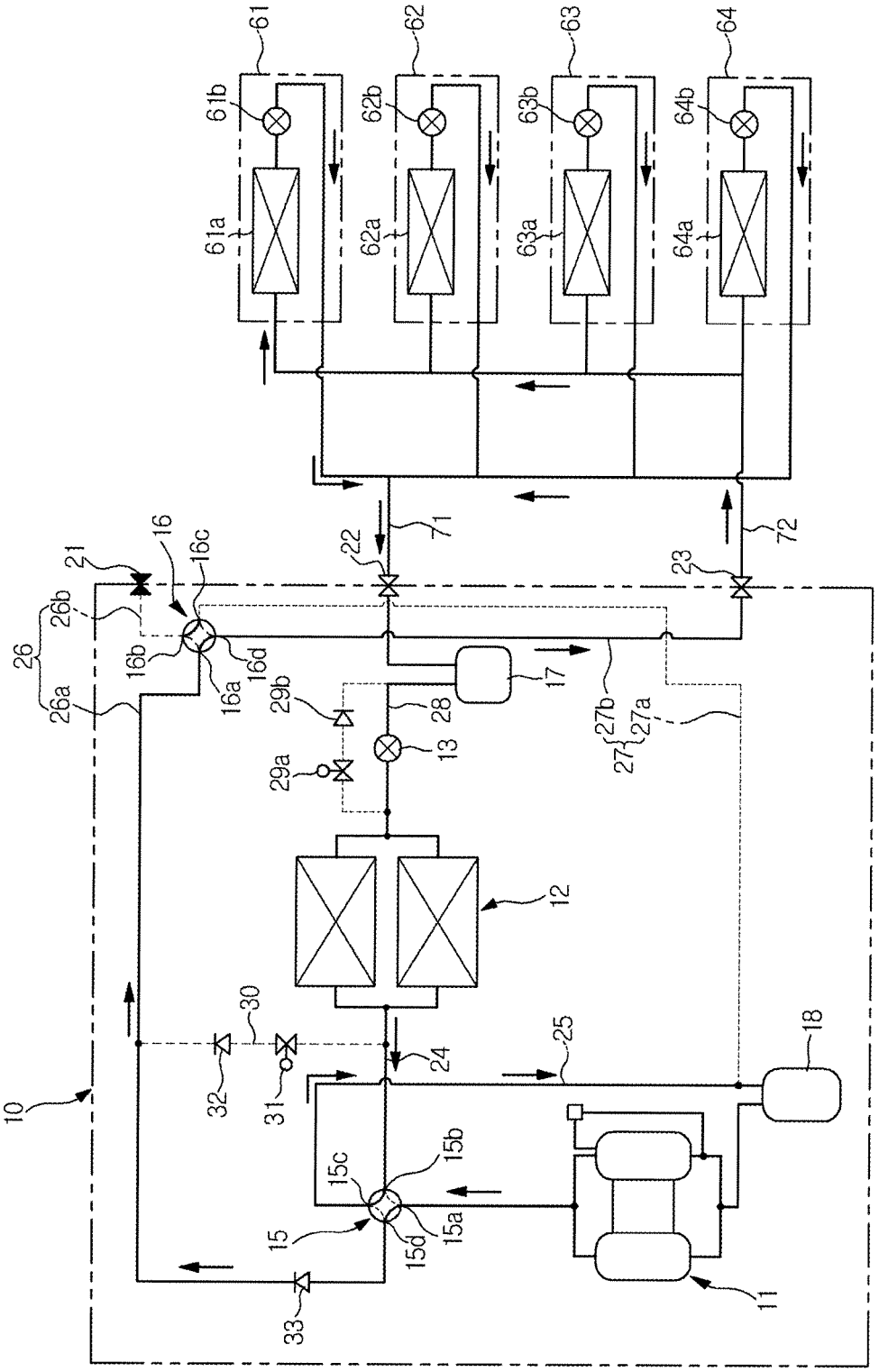
Fig. 4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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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