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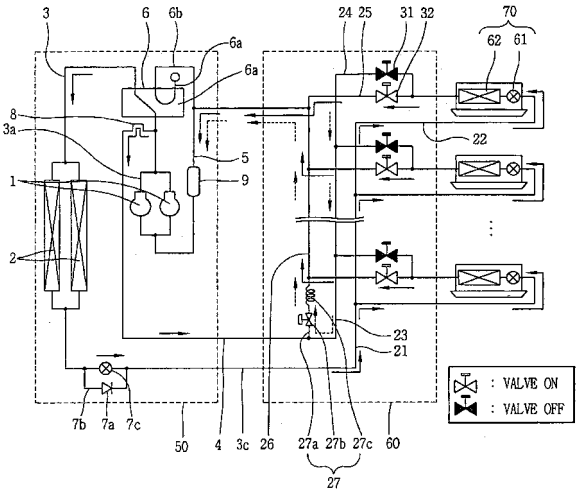
(54) Multi-air conditioner capable of performing simultaneous cooling and heating

(57) A multi-air conditioner capable of simultaneous cooling and heating, includes: a first duct (3) connected to a discharge side of a compressor (1), through which a refrigerant discharged from the compressor (1) passes at the time of cooling operation; a second duct (4) diverged from the first duct (3), through which a refrigerant discharged from the compressor passes at the time of heating operation; and an oil accumulation preventing portion (8) formed at a certain section of the second duct (4) to have a height difference, for preventing oil, which is introduced to the second duct (4) from the compressor (1) together with a refrigerant, from being accumulated in the second duct. Accordingly, the multi-air conditioner capable of simultaneous cooling and heating can prevent damage to the compressor due to a shortage of oil and thusly improve reliability of a compressor by preventing oil accumulation within a duct.

FIG. 2



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Description

[0001] The present invention relates to a multi-air conditioner capable of simultaneous cooling and heating, and particularly, to a multi-air conditioner capable of simultaneous cooling and heating configured to prevent damage to a compressor due to a shortage of oil by preventing oil accumulation within a duct which may occur during full cooling operation.

[0002] In general, an air conditioner is a device for cooling or heating an indoor space such as a living space, a restaurant or an office. In these days, in order to more efficiently cooling or heating an indoor space divided into a plurality of rooms, research on a multi-air conditioner cooling or heating each room is being continuously made. Particularly, such a multi-air conditioner is formed such that a plurality of indoor units are connected to one outdoor unit and each of the indoor units is installed to each room. The multi-air conditioner is operated in one of cooling and heating operation modes and performs air-conditioning of the room.

[0003] Figure 1 is a construction view of a general multi-air conditioner capable of simultaneous cooling and heating.

[0004] As shown in Figure 1, the general multi-air conditioner capable of simultaneous cooling and heating, includes an outdoor unit 50 having therein a compressor 1 and an outdoor heat exchanger 2, a plurality of indoor units (C), each having therein an electronic expansion valve 61 and an indoor heat exchanger 62, and a distributor 60 provided between the outdoor unit 50 and the indoor unit 70 and distributing to the plurality of indoor units, a refrigerant introduced from the outdoor unit.

[0005] The outdoor unit 50 includes a compressor 1, an outdoor heat exchanger 2, a duct unit having three ducts 3, 4 and 5 connected to the compressor 1, for guiding a refrigerant to the distributor 60 or guiding a refrigerant of the distributor 60 to the compressor 1, and a switching unit 6 switching a flow of a refrigerant so as to allow a refrigerant of a specific pressure and a specific phase to flow to each duct.

[0006] Also, the duct unit includes a first duct 3 connecting the distributor 60 with a discharge end of the compressor 1 and having the outdoor heat exchanger 2 in the middle, a second duct 4 connecting the distributor 60 with a front end 3a of the first duct (a discharge side of the compressor) and guiding only a high pressure gaseous refrigerant, and a third duct 5 connecting the distributor 60 to a suction end of the compressor 1.

[0007] The distributor includes a high pressure liquefied refrigerant connection duct 21 connected to a high pressure liquefied section 3c of the first duct 3 and guiding a high pressure liquefied refrigerant, a high pressure liquefied refrigerant divergence duct 22 diverged from the high pressure liquefied refrigerant connection duct 21 and guiding a high pressure liquefied refrigerant, a high pressure gaseous refrigerant connection duct 23 connected to the second duct 4 and guiding a high pressure gaseous refrigerant, a high pressure gaseous refrigerant divergence duct **24.** diverged from the high pressure gaseous refrigerant connection duct 23 and guiding a high pressure gaseous refrigerant, a low pressure gaseous refrigerant divergence duct 25 diverged from the high pressure gaseous refrigerant divergence duct 24, and a low pressure gaseous refrigerant connection duct 26 combining the low pressure gaseous refrigerant divergence ducts 25 and connected to the third duct 5.

[0008] Undescribed reference numeral 9 is an accumulator.

[0009] A multi-air conditioner capable of simultaneous cooling heating having such a structure performs the following operation at the time of full cooling operation related to the present invention.

[0010] As shown in Figure 1, a high-pressure gaseous refrigerant discharged from the compressor 1 flows along a front end side 3a of the first duct and is introduced to a rear end side 3b of the first duct by switching of the switching unit 6. Then, the refrigerant is introduced to the outdoor heat exchanger 2, is condensed while passing through the outdoor heat exchanger 2, and is changed into a high temperature high pressure liquefied refrigerant. The high temperature high pressure liquefied refrigerant coming out of the outdoor heat exchanger 2 passes through a check valve 7a and is introduced to the high pressure liquefied refrigerant connection duct 21 of the distributor 60 along a high pressure liquefied refrigerant section 3c of the first duct 1. The high pressure liquefied refrigerant introduced to the high pressure liquefied refrigerant connection duct 21 is divided to each high pressure liquefied refrigerant divergence duct 22 and is expanded while passing through an electronic expansion valve 61 of each indoor side. Then, the refrigerant is evaporated while passing through each indoor heat exchanger 62, thereby cooling each room.

[0011] A portion of the high pressure liquefied refrigerant discharged from the compressor 1 is introduced to a second duct 4 which is not used at the time full cooling operation. In order to improve reliability and operation efficiency of the compressor, oil circulates together with the refrigerant. Thusly, if the full cooling operation is made for a long time, oil mixed with the refrigerant is accumulated within the second duct 4, and consequently, a shortage of refrigerant and oil occurs, which causes degradation in cooling performance and damage to a component such as a compressor 1.

[0012] To solve such problems, a structure in which the accumulated refrigerant is decompressed and expanded and then returns to the low pressure gaseous refrigerant connection duct is provided. Namely, refrigerant and oil introduced into the second duct 4 are introduced to a bypass duct 27a because of blockage of a two way valve 31 of a high pressure gaseous refrigerant divergence duct 24 side, then, passes through a blocking valve 27b and a capillary duct 27c, being converted into a low pressure gaseous refrigerant, and is introduced to the low pressure gaseous refrigerant connection duct 26

of the distributor 60.

[0013] Even though such a return structure is advantageous in that the return of a refrigerant is normally made, oil cannot normally returns because of its great viscosity and the very small amount of refrigerant flowing but remains in the second duct 4 and causes a shortage of oil of the system. Consequently, damage to the compressor 1 is caused. Such a phenomenon is more severely occurs if a duct is long or if a difference of height is generated because an outdoor unit is disposed at a high place and an indoor unit is disposed at a low place.

[0014] Therefore, an object of the present invention is to provide a multi-air conditioner capable of simultaneous cooling and heating, configured to improve reliability of a compressor by preventing oil accumulation within a duct and damage to a compressor which may occurs at the time of full cooling operation.

[0015] To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, there is provided a multi-air conditioner capable of simultaneous cooling and heating, comprising: a first duct connected to a discharge side of a compressor, through which a refrigerant discharged from the compressor passes at the time of cooling operation; a second duct diverged from the first duct, through which a refrigerant discharged from the compressor passes at the time of heating operation; and an oil accumulation preventing portion formed at a certain section of the second duct to have a height difference, for preventing oil, which is introduced to the second duct from the compressor together with a refrigerant, from being accumulated within the second duct.

[0016] The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

[0017] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a unit of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

[0018] In the drawings:

Figure 1 is a construction view of a general multi-air conditioner capable of simultaneous cooling and heating;

Figure 2 is a construction view of a multi-air conditioner capable of simultaneous cooling and heating according to the present invention;

Figure 3 is a perspective view of a main part of Figure 2;

Figure 4 is a sectional view taken along line IV-IV of Figure 3;

Figure 5 is a perspective view that illustrates another embodiment of an oil accumulation preventing portion according to the present invention; and

Figure 6 is a sectional view taken along line VI-VI of Figure 5.

[0019] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[0020] Here, the same reference numerals are designated to the same parts of the aforedescribed conventional multi-air conditioner, and the detailed description thereon will be omitted.

[0021] Figure 2 is a construction view of a multi-air conditioner capable of simultaneous cooling and heating according to the present invention, Figure 3 is a perspective view of a main part of Figure 2, and Figure 4 is a sectional view taken along line IV-IV of Figure 3.

[0022] The multi-air conditioner capable of simultaneous cooling and heating includes a first duct 3 connected to a discharge side of a compressor 1, through which a refrigerant discharged from the compressor 1 passes at the time of cooling operation, a second duct 4 diverged from the first duct 3, through which a refrigerant discharged from the compressor 1 passes at the time of heating operation, and an oil accumulation preventing portion 8 formed in a certain section of the second duct 4 to have a height difference for the purpose of preventing oil, which is introduced to the second duct 4 together with a refrigerant, from being accumulated within the second duct 4.

[0023] The second duct 4 is installed such that its one side communicates with a front end 3a of the first duct (a discharge side of the compressor) and its other side communicates with a distributor 60. Here, the portion communicating with the front end 3a of the first duct becomes an inlet side of the second duct 4.

[0024] Here, in order to facilitate return of oil by reducing a path that oil returns, the oil accumulation preventing portion 8 is placed in the vicinity of an inlet portion of the second duct.

[0025] Preferably, a section from the inlet portion 10 of the second duct to a starting point 11 of the oil accumulation preventing portion has the same height at both ends so that oil flow is prevented by the oil accumulation preventing portion 8 and return of the oil accumulated at the front end side of the second duct 4 can be facilitated. Furthermore, more preferably, the section may be inclined at a predetermined angle (θ) such that its height is lowered toward the inlet portion 10 of the second duct.

[0026] Meanwhile, the section from the inlet portion 10 of the second duct to the starting point 11 of the oil accumulation preventing portion is formed in a straight line in order to reduce an oil return path and a cost for a duct.

[0027] Also, the oil accumulation preventing portion 8 includes the highest spot 12 which is the highest point in the section forming the oil accumulation preventing portion 8, and a downward section continued from the highest spot. This is because the most preferred embodiment should be able to prevent the accumulation of the oil within the second duct 4 without installing a special returning

device and thusly to block the flow of the oil by gravity.

[0028] Here, preferably, the height (H) between the starting point 11 of the oil accumulation preventing portion and the highest spot 12 of the oil accumulation preventing portion is the same as or greater than a diameter of the second duct 4.

[0029] Also, in order to improve convenience in duct manufacturing and reducing a cost for manufacturing the duct, the oil accumulation preventing portion 8 preferably includes at least one curved section.

[0030] To consider the preferred embodiments synthetically, it is most preferable that the oil accumulation preventing portion 8 has a reverse trap.

[0031] Figure 5 shows another embodiment of the oil accumulation preventing portion in accordance with the present invention.

[0032] A method of forming a path of a certain section between the inlet portion 10 of the second duct and the starting point 11 of the oil accumulation preventing portion as described above is possible, but a method of forming a starting point 13 of the oil accumulation preventing portion corresponding to the inlet portion of the second duct is also possible.

[0033] Also, even when the flow to the distributor is in a horizontal direction after the installation of the oil accumulation preventing portion 8, the oil-flow preventing effect by the oil accumulation preventing portion 8 is the same. Therefore, an object of the present invention can be still achieved.

[0034] Preferably, the distributor 60 further includes a liquefaction preventing unit 27 between the second duct 4 and the low pressure refrigerant connection duct 26 in order to prevent a high pressure gaseous refrigerant accumulated in the second duct 4 from being liquefied. This is because if the high pressure gaseous refrigerant is liquefied and stays in the second duct 4, a shortage of refrigerant may occur in the compressor. Here, as shown in Figure 1, the liquefaction preventing unit 27 includes a bypass duct 27a connecting the low pressure gaseous refrigerant connection duct 26 with the second duct 4, a blocking valve 27b provided on the bypass duct 27a and opening and closing the bypass duct 27a so as to allow the refrigerant accumulated in the second duct to flow to the low pressure gaseous refrigerant connection duct 26, and a capillary duct 27c decompressing and expanding a high pressure refrigerant accumulated in the second duct 4 and converting the refrigerant into a low pressure gaseous refrigerant.

[0035] The operation of the multi-air conditioner capable of simultaneous cooling and heating according to the present invention and a flow of a refrigerant will now be described in detail with the full cooling operation related to the present invention as a central case.

[0036] As shown in Figure 2, in the full cooling operation, while flowing along a front end side 3a of the first duct, most of a high pressure gaseous refrigerant discharged from the compressor 1 is introduced to the outdoor heat exchanger 2 along a rear end side 3b of the first duct by the switching of the switching unit 6 and then is condensed therein. Then, the refrigerant passes through the check valve 7a and is introduced to the high pressure liquefied refrigerant connection duct 21 of the distributor 60 along a high pressure liquefied refrigerant section 3c of the first duct.

[0037] The remaining portion of the high pressure gaseous refrigerant is introduced to the second duct 4. Here, the refrigerant introduced to the second duct and oil mixed therewith flow along a flow path of a certain section, and the refrigerant keep flowing toward the distributor 60 as illustrated as a dotted arrow in Figure 4. However, as illustrated as a solid line in Figure 4, once entering the oil accumulation preventing portion 8 of a reverse trap structure having a predetermined height difference (H), the oil cannot flow upwardly by itself due to gravity and thusly can no more flow. The oil whose flow has been blocked is accumulated in a section of an upstream area within the second duct 4. If the accumulation occurs, the oil returns to the compressor 1 by way of the inlet portion 10 of the second duct and the front end side 3a of the first duct. Here, as shown in Figure 3, the section between the inlet portion 10 of the second duct and the starting point 11 of the oil accumulation preventing portion is inclined at a predetermined angle (θ) such that its height is lowered toward a discharge side of the compressor 1, which facilitates the return of oil. Also, the return path can be shortened by forming a section between the inlet portion 10 of the second duct and the starting point 11 of the oil accumulation preventing portion as a straight line.

[0038] A refrigerant introduced into the second duct 4 radiates heat, is condensed, and is accumulated therein. If the accumulation occurs, the blocking valve 27b is opened, and the refrigerant is decompressed and expanded while passing through the capillary duct 27c, and is converted into a low pressure gaseous refrigerant. Then, the refrigerant is introduced to the low pressure gaseous refrigerant connection duct 26 of the distributor 60.

[0039] The high pressure liquefied refrigerant introduced to the high pressure liquefied refrigerant connection duct 21 of the distributor is divided into each high pressure liquefied refrigerant divergence duct 22 and is expanded while passing through an electronic expansion valve 61 of each room. Then, the refrigerant is evaporated while passing through the indoor heat exchanger 72 and cools each room. Thereafter, the evaporated refrigerant is introduce to each low pressure gaseous refrigerant divergence duct 26 by blockage of a two way valve 31 of each high pressure gaseous refrigerant divergence duct 24, then, passes through the low pressure gaseous refrigerant connection duct 26 and the low pressure gaseous refrigerant duct 3d, and then is introduced to the compressor 1 together with the low pressure gaseous refrigerant having entered the low pressure gaseous refrigerant connection duct 26. Here, a portion of the refrigerant is drawn into a closing duct 6c for pressurization

along an auxiliary connection duct 6b by a four way valve 7a which has already been switched.

[0040] As described so far, an oil accumulation preventing portion 8 having a height difference is formed at a certain section of the second duct 4, so that oil accumulation within a duct which may occurs at the time of full cooling operation and a shortage of oil can be prevented. Accordingly, damage to the compressor 1 is prevented, and the reliability of the compressor can be improved.

[0041] As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the metes and bounds of the claims, or equivalence of such metes and bounds are therefore intended to be embraced by the appended claims.

Claims

1. A multi-air conditioner capable of simultaneous cooling and heating, comprising:

   a first duct connected to a discharge side of a compressor, through which a refrigerant discharged from the compressor passes at the time of cooling operation;
   a second duct diverged from the first duct, through which a refrigerant discharged from the compressor passes at the time of heating operation; and
   an oil accumulation preventing portion formed at a certain section of the second duct to have a height difference, for preventing oil, which is introduced to the second duct from the compressor together with a refrigerant, from being accumulated within the second duct.

2. A multi-air conditioner capable of simultaneous cooling and heating, comprising:

   an outdoor unit having therein a compressor and an outdoor heat exchanger;
   a plurality of indoor units, each having therein an electronic expansion valve and an indoor heat exchanger;
   a distributor provided between the outdoor unit and the indoor unit and distributing a refrigerant introduced from the outdoor unit to the plurality of indoor units;
   a duct unit including a first duct connecting the distributor to a discharge side of the compressor, having the outdoor heat exchanger in the middle and guiding a refrigerant discharged from the compressor toward the indoor heat exchanger, and a second duct diverged from the first duct, connected to the distributor and guiding a refrigerant discharged from the compressor toward the indoor heat exchanger; and
   an oil accumulation portion formed to have a height difference at a certain section of the second duct in order to prevent oil, which is introduced to the second duct from the compressor together with a refrigerant, from being accumulated within the second duct.

3. The multi-air conditioner of claim 1 or 2, wherein the oil accumulation preventing portion is placed in the vicinity of an inlet portion of the second duct.

4. The multi-air conditioner of any of claims 1 to 3, wherein a section between an inlet portion of the second duct and a starting point of the oil accumulation preventing portion has the same height at both ends.

5. The multi-air conditioner of any of claims 1 to 4, wherein a section between an inlet portion of the second duct and a starting point of the oil accumulation preventing portion is inclined at a predetermined angle such that its height is lowered toward the inlet portion of the second duct.

6. The multi-air conditioner of claim 4 or 5, wherein a section between an inlet portion of the second duct and a starting point of the oil accumulation preventing portion is formed as a straight line.

7. The multi-air conditioner of any of claims 1 to 6, wherein the oil accumulation preventing portion includes a highest spot and a downward section continued from the highest spot.

8. The multi-air conditioner of any of claims 1 to 7, wherein a height from the starting point of the oil accumulation preventing portion to the highest spot of the oil accumulation preventing portion is the same as or greater than a diameter of the second duct.

9. The multi-air conditioner of any of claims 1 to 8, wherein the oil accumulation preventing portion includes at least one curved section.

10. The multi-air conditioner of any of claims 1 to 9, wherein the oil accumulation preventing portion has a reverse trap structure.

11. The multi-air conditioner of any of claims 1 to 10, wherein the oil accumulation preventing portion is formed such that a starting point of the oil accumulation preventing portion coincides with an inlet por-

tion of the second duct.

12. The multi-air conditioner of any of claims 2 to 11, wherein the distributor comprises:

a low pressure gaseous refrigerant duct for guiding a low pressure gaseous refrigerant discharged from the plurality of indoor units to the compressor at the time of cooling operation; and
a liquefaction preventing unit provided between the second duct and the low pressure gaseous refrigerant duct and preventing liquefaction of a high pressure gaseous refrigerant accumulated in the second duct at the time of full cooling operation.

13. The multi-air conditioner of claim 12, wherein the liquefaction preventing unit comprises:

a bypass duct connecting the low pressure gaseous refrigerant duct with the second duct;
a blocking valve provided on the bypass duct and allowing a refrigerant accumulated in the second duct at the time of full cooling operation to flow to the low pressure gaseous refrigerant duct; and
a capillary duct decompressing and expanding a high pressure gaseous refrigerant accumulated within the second duct and converting the refrigerant into a low pressure gaseous refrigerant.

14. A method of operating a multi-air conditioner according to any of claims 1 to 13.

FIG. 1

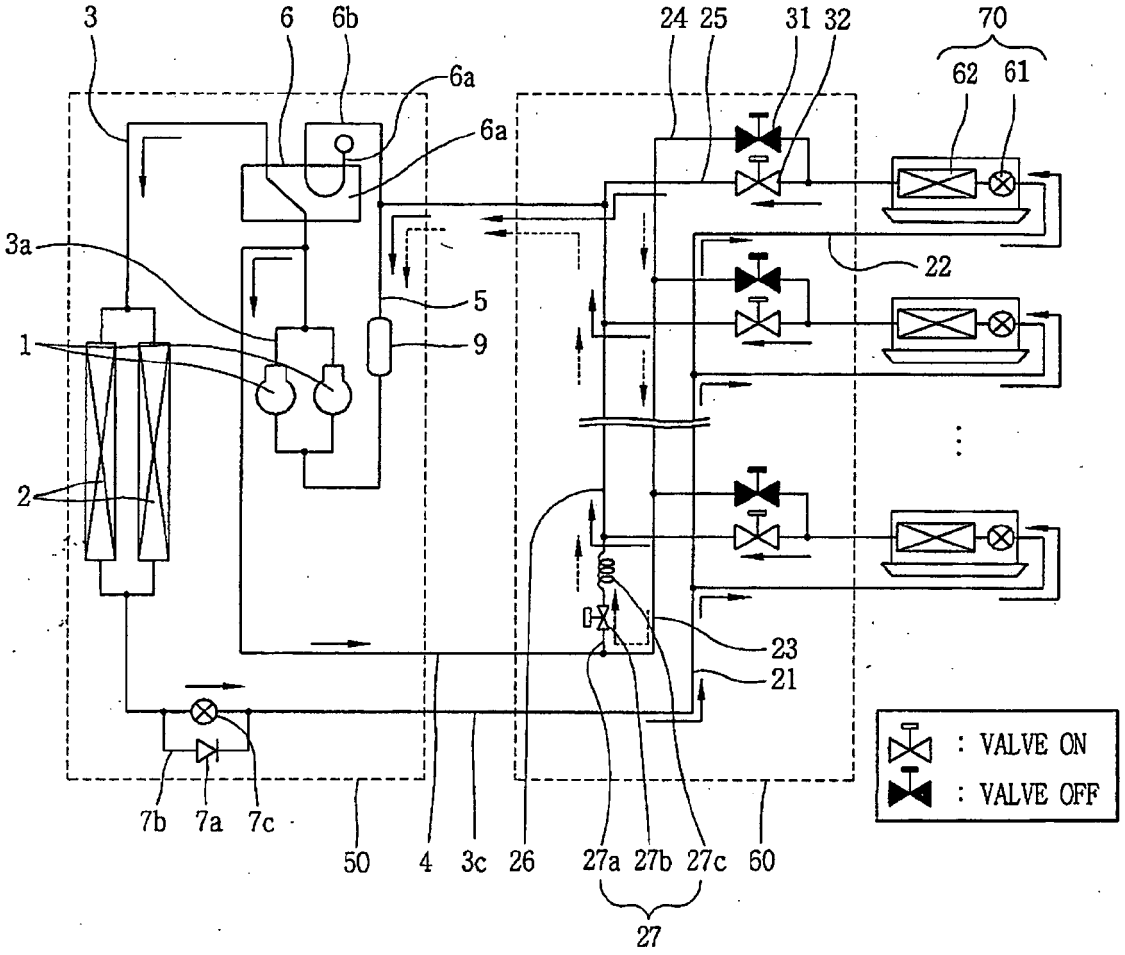
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FIG. 2

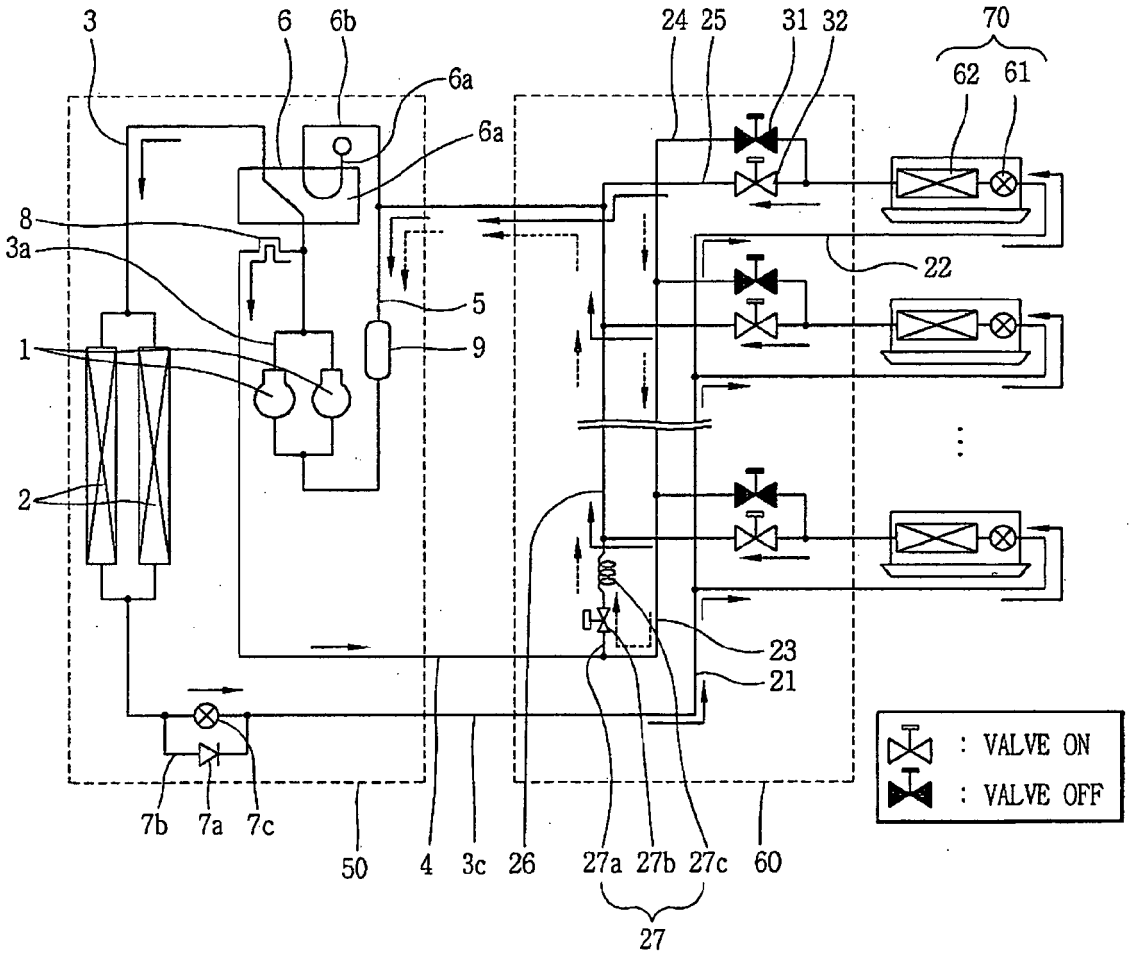
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FIG. 3

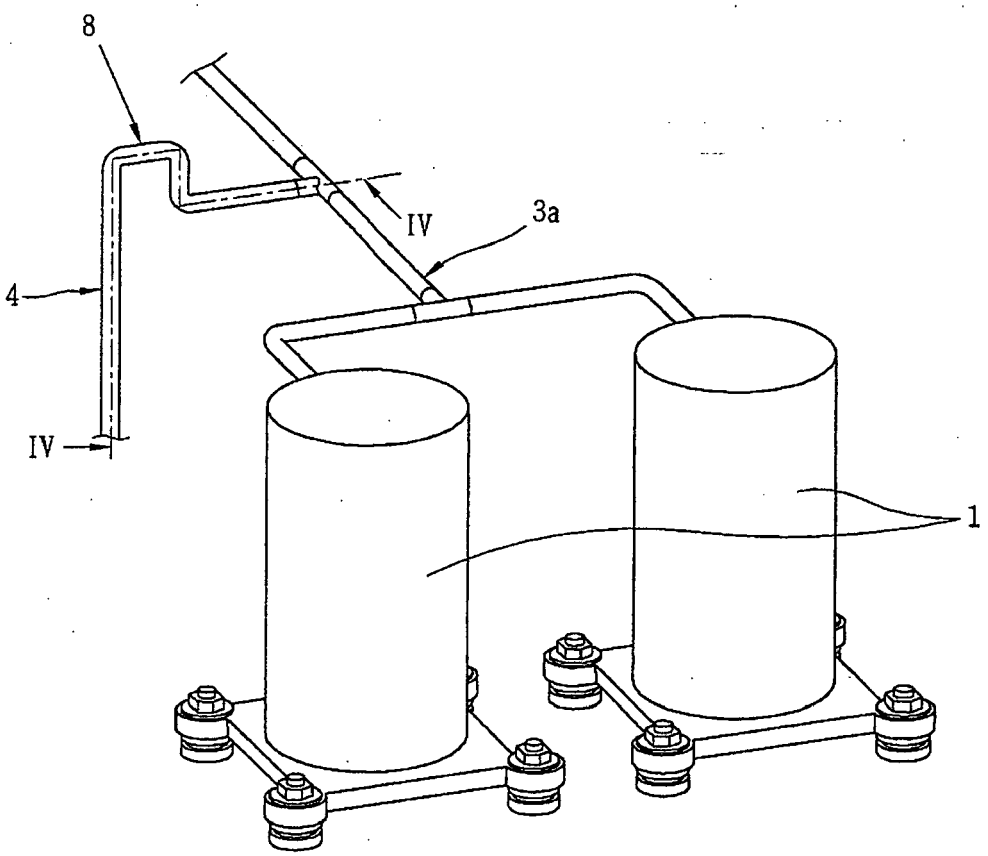


FIG. 4

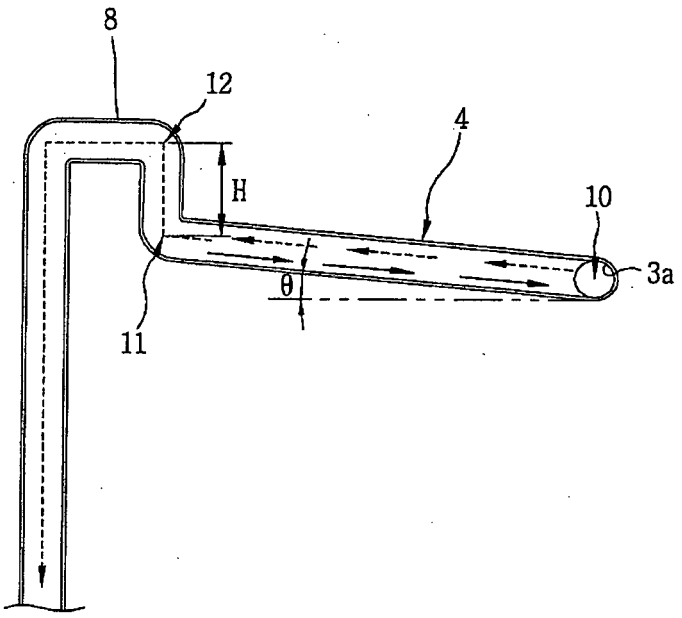


FIG. 5

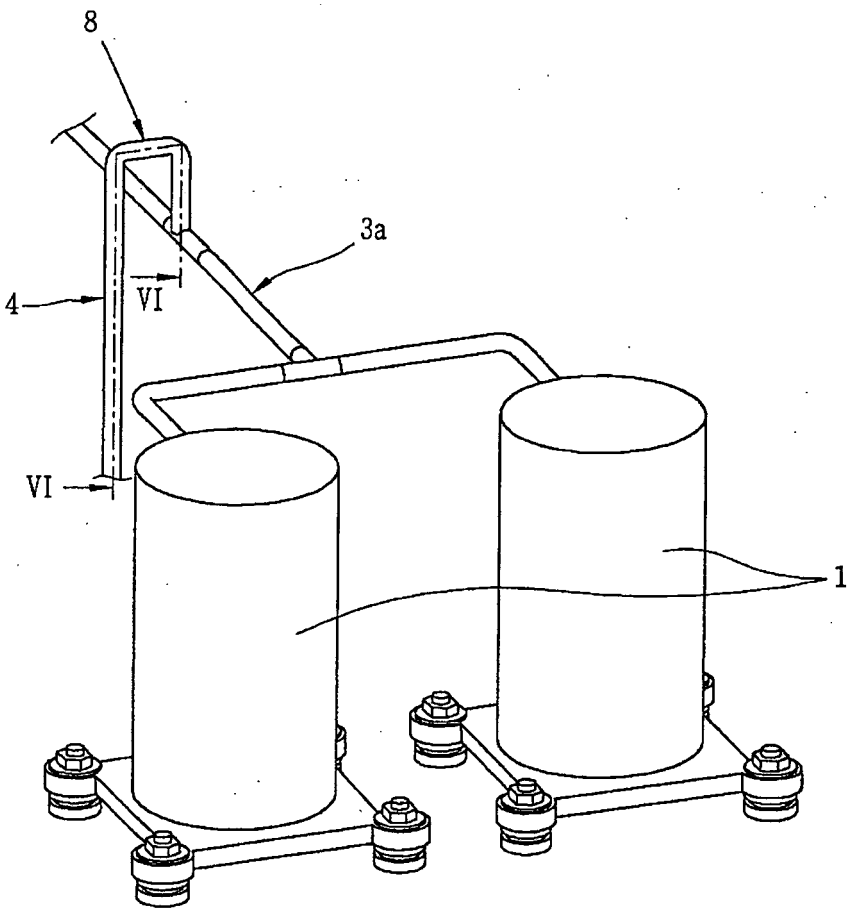
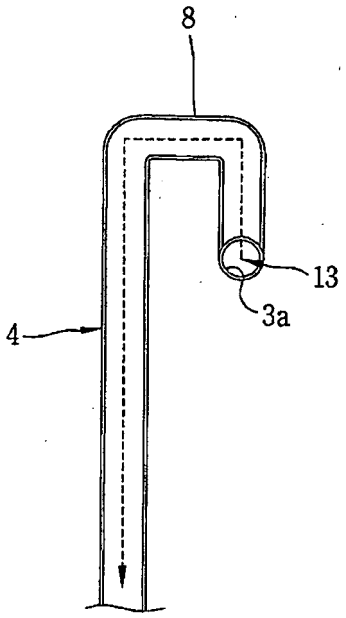


FIG. 6



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EUROPEAN SEARCH REPORT

Application Number
EP 06 00 2284

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 02, 31 March 1995 (1995-03-31) -& JP 06 307724 A (MATSUSHITA REFRIG CO LTD), 1 November 1994 (1994-11-01)	1,3-11, 14	INV. F25B13/00 F25B31/00 ADD. F25B43/02
Y	http://dossier1.ipdl.ncipi.go.jp/AIPN/aipn_call_transl.ipdl?N0000=7413&N0120=01&N2001=2&N3001=H06-307724 * abstract; figures 1,6 * -----	2,12,13	
Y	EP 1 437 557 A (LG ELECTRONICS INC) 14 July 2004 (2004-07-14) * abstract; figure 1 * * paragraphs [0055], [0064], [0067], [0068], [0074] * -----	2,12,13	

TECHNICAL FIELDS SEARCHED (IPC)
F25B F24F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 May 2006	Yousufi, S

CATEGORY OF CITED DOCUMENTS

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18-05-2006

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