



(11)

EP 1 677 057 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
05.07.2006 Bulletin 2006/27

(51) Int Cl.:
F25B 31/00 (2006.01)

(21) Application number: **05103535.0**

(22) Date of filing: **28.04.2005**

(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 MC NL PL PT RO SE SI SK TR**
Designated Extension States:
AL BA HR LV MK YU

- **Kim, Jong-moon**
Hwaseong-si, Gyeonggi-do (KR)
- **Shin, Jong-jin**
Gyeonggi-do (KR)
- **Lee, Hee-sool**
Yeongtong-gu, Suwon-si, Gyeonggi-do (KR)

(30) Priority: **28.12.2004 KR 2004113915**
28.12.2004 KR 2004113916

(71) Applicant: **SAMSUNG ELECTRONICS CO., LTD.**
Suwon-si, Gyeonggi-Do 442-742 (KR)

(74) Representative: **Geary, Stuart Lloyd et al**
Venner Shipley LLP
20 Little Britain
London EC1A 7DH (GB)

(72) Inventors:
• **Kim, Sung-goo**
Seoul (KR)

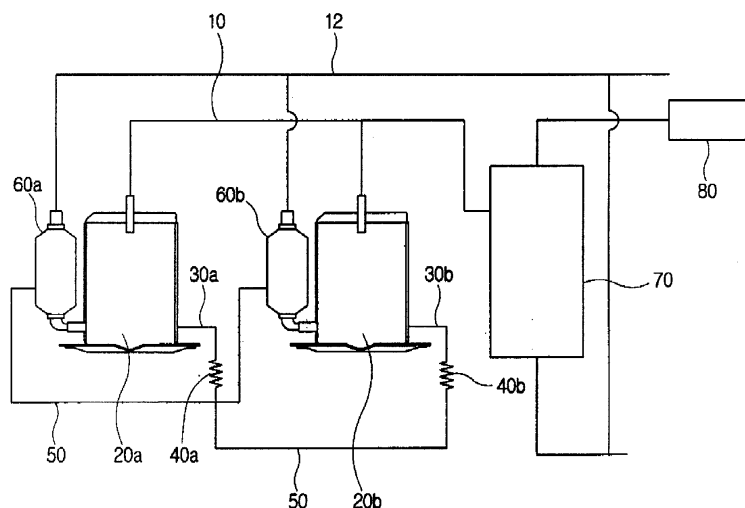
(54) Heat pump with compressor oil distribution

(57) The present invention relates to an air conditioner comprising: a plurality of compressors (20A, 20B) disposed in parallel with each other; an oil outlet pipe (30A, 30B) provided in the plurality of compressors respectively and discharging a surplus oil; a capillary tube (40A, 40B) connected to the oil outlet pipe; and an oil equalizing pipe

connected to the capillary tube and selectively supplying the surplus oil discharged through the oil outlet pipe to the plurality of compressors.

Thus, the adequate oil level of the oil in the plurality of compressors may be maintained stably and also the oil equalizing function may be simplified.

FIG. 1



Description

[0001] The present invention relates to heat pump comprising a plurality of refrigerant compressors disposed in parallel with each other and each having an outlet for discharging surplus oil.

[0002] Generally, an air conditioner is a device for cooling or heating air by using a heat pump which comprises a refrigerant cycling through a compressor, a condenser, an expansion valve and an evaporator.

[0003] Split type air conditioners comprise a plurality of compressors so that the compressor volume can be changed to correspond to changes in the space subject to the air conditioning. Thus, only one of compressors operates when a relatively low air-cooling capacity is required, e.g. when there are no large difference in temperature between the indoors and the outdoors. Also, the plurality of compressors operate to increase the efficiency of the air conditioner when a relatively high air-cooling capacity is required, e.g. when there is large a thermal difference between the indoors and the outdoors or a room temperature is required to be lowered.

[0004] Compressors do not work well and can be damaged when there is the wrong amount of oil in an air conditioner with a plurality of compressors disposed in parallel. Accordingly, it is necessary to maintain an adequate level of oil.

[0005] An air conditioner having a plurality of compressors is disclosed in KR-A-2003-0075197. The disclosed air conditioner comprises first and second thermostatic sensors, provided at the top and the bottom of a decompressor. The oil amount of each compressor is controlled with respect to the thermal difference detected by the first and second thermostatic sensors.

[0006] However, the above air conditioner has a problem in that the oil equalizing function for maintaining stably adequate oil levels in the compressors and the control method thereof are complicated.

[0007] Therefore, it has a defect that the economic cost as well the parts cost and the installation cost increases largely.

[0008] A heat pump, according to the present invention, is characterised in that the first end of respective capillary tube is connected to each of said outlets and the second ends of the capillary tubes are interconnected.

[0009] Preferred and optional features are set forth in claims 2 to 13 appended hereto.

[0010] Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic representation of a first air conditioner according to the present invention;
Figure 2 illustrates the flow of oil when a compressor operates by itself in the air conditioner in Figure 1;
Figure 3 illustrates the flow of oil when the compressors operate simultaneously in the air conditioner in

Figure 1;

Figure 4 a schematic representation of a second air conditioner according to the present invention;; and
Figure 5 illustrates the flow of oil when a compressor operates in the air conditioner in Figure 2.

[0011] Referring to Figures 1 to 3, a first air conditioner comprises a first compressor 20a and a second compressor 20b, a first oil outlet pipe 30a and a second oil outlet pipe 30b provided respectively in the first and second compressors 20a, 20b for discharging surplus oil, a first capillary tube 40a and a second capillary tube 40b respectively connected to the first and second oil outlet pipes 30a, 30b, and an oil equalizing pipe 50 connected to the first and second capillary tubes 40a, 40b. The oil equalizing pipe 50 selectively supplies the surplus oil, discharged through the first and second oil outlet pipes 30a, 30b, to the first and second compressors 20a, 20b.

[0012] The first and second compressors 20a, 20b are disposed in parallel, have different air-cooling capacities from each other and compress refrigerant flowing from an evaporator (not shown) to a high pressure. A discharge pipe 10 is connected to the tops of the first and second compressors 20a, 20b for discharging the compressed refrigerant. The refrigerant discharged through the discharge pipe 10 is supplied to the condenser 80 via an oil separator 70.

[0013] A first accumulator 60a and a second accumulator 60b are connected to the first and second compressors 20a, 20b respectively and separate the refrigerant and the oil flowing via a refrigerant pipe 12.

[0014] The oil separator 70 connected to the discharge pipe 10 and the refrigerant pipe 12 separates the oil discharged in a refrigerant discharge process from the first and second compressors 20a, 20b with the refrigerant, so that the separated oil returns to the first and second compressors 20a, 20b.

[0015] The first and second oil outlet pipes 30a, 30b are provided adjacent to the adequate oil level of the first and second compressors 20a, 20b for discharging surplus oil to the outside.

[0016] The oil equalizing pipe 50 directly supplies the surplus oil from the first and second compressors 20a, 20b to the other which lacks oil as its refrigerant is relatively much discharged, thereby maintaining an adequate oil level in the first and second compressors 20a, 20b.

[0017] The oil equalizing pipe 50 forms a junction 50a for connecting the first and second compressors 20a, 20b with each other. The arrangement of the oil equalizing pipe 50 can be modified variously as necessary.

[0018] The oil equalizing pipe 50 directly supplies the surplus oil, discharged through the first and second oil outlet pipes 30a, 30b, to the first and second compressors 20a, 20b. Alternatively, the oil equalizing pipe 50 supplies the surplus oil discharged through the first and second accumulator 60a, 60b.

[0019] The diameter and the length of the first and sec-

ond capillary tubes 40a, 40b can be set in consideration of the first and second compressors 20a, 20b connected thereto and a suitable value can be determined by experiment. For example, if the pneumatic resistance is high, so that the diameter and the length of the first and second capillary tubes 40a, 40b are small and large respectively, oil cannot flow as it is. If the pneumatic resistance is low, the high pressure refrigerant and oil flow too much, thereby affecting the efficiency of the oil equalizing function.

[0020] Referring to Figure 2, if only the first compressor 20a is operated, the surplus oil in the first compressor 20a is discharged through the oil outlet pipe 30a and flows along the oil equalizing pipe 50 via the capillary tube 40a.

[0021] When the oil flowing along the oil equalizing pipe 50 reaches the junction 50a of the oil equalizing pipe 50, it is supplied to the first accumulator 60a, connected to the first compressor 20a, while being operated by the pressure difference of the first and second compressors 20a, 20b, thereby supplying stably the oil to the first compressor 20a and maintaining an adequate oil level.

[0022] When, as shown in Figure 3, the first and second compressors 20a, 20b are operated simultaneously, it is difficult for the first compressor 20a to maintain an adequate oil level using only the oil returned from the oil separator 70 because it discharges relatively much oil (refer to Figure 1), while the second compressor 20b, from which a small amount of oil is discharged, has surplus oil.

[0023] However, the surplus oil is discharged through the second oil outlet pipe 30b and the discharged oil flows along the oil equalizing pipe 50 via the capillary tube 40b. When the oil flowing along the oil equalizing pipe 50 reaches the junction 50a of the oil equalizing pipe 50, it is supplied to the first accumulator 60a, connected to the first compressor 20a, in which the oil is discharged much due to the pressure difference between the first and second compressors 20a, 20b, thereby maintaining an adequate oil level in both the first and second compressors 20a, 20b.

[0024] When the surplus oil from the second compressor 20b, from which a small amount of the oil is discharged, flows to the second compressor 20b, an adequate oil level of the oil in the second compressor 20b is maintained and only the high pressure refrigerant gas flows along the oil equalizing pipe 50. The flux of the refrigerant gas is limited by the capillary tube 40b to a predetermined amount or below

[0025] Referring to Figures 4 and 5, a second air conditioner comprises a first compressor 20a and a second compressor 20b, a first oil outlet pipe 30a and a second oil outlet pipe 30b, provided respectively in the first and second compressors 20a, 20b, a first opening and closing valve 90a and a second opening and closing valve 90b, opening and closing the first and second oil outlet pipes 30a, 30b, a first capillary tube 40a and a second capillary tube 40b, connected to the first and second oil

outlet pipes 30a, 30b, and an oil equalizing pipe 50, connected to the first and second capillary tubes 40a, 40b.

[0026] Each of the compressors 20a, 20b is provided with a first thermal sensor 22, 24 and a second thermal sensor 26, 28 for measuring the temperature of the refrigerant gas and the oil. The first thermal sensors 22, 24 are disposed at a position where the temperature of the refrigerant gas can be measured. The second thermal sensors 26, 28 are disposed adjacent to the adequate oil level for measuring selectively the temperature of the oil and the temperature of the refrigerant gas according to changes in the oil level.

[0027] The first and second opening and closing valves 90a, 90b open and close according to the thermal differences between the first thermal sensors 22, 24 on the one hand and the second thermal sensor 26, 28 on the other.

[0028] Therefore, when the oil in each of the compressors 20a, 20b rises above the adequate oil level, the first thermal sensor 22, 24 detects the temperature of the refrigerant gas and the second thermal sensor 26, 28 detects the temperature of the oil, thereby generating the thermal difference. The first and second opening and closing valve 90a, 90b is opened by the thermal difference which is recognized as an oil surplus state.

[0029] When the oil in each compressor 20a, 20b falls below the adequate oil level, the first thermal sensor 22, 24 and the second thermal sensor 26, 28 both detect the temperature of the refrigerant gas, thereby not detecting a thermal difference. Therefore, the first and second opening and closing valves 90a, 90b are closed.

[0030] When the first and second opening and closing valves 90a, 90b are opened by the thermal differences between the first thermal sensors 22, 24 and the second thermal sensors 26, 28, the oil equalizing pipe 50 supplies the oil, discharged through the first and second oil outlet pipes 30a, 30b, to each of the compressors 20a, 20b equally, thereby maintaining stably the adequate oil levels. The oil equalizing pipe 50 may be disposed to supply the oil discharged through the first and second oil outlet pipes 30a, 30b to each of the compressors 20a, 20b. The arrangement of the oil equalizing pipe 50 can be modified variously according to need.

[0031] The first and second capillary tubes 40a, 40b properly control the flow of the oil using a pneumatic resistance.

[0032] Referring to Figure 5, if a thermal difference between the first and second thermal sensors 22, 26 is not generated in the first compressor 20a and a thermal difference between the first and second thermal sensors 24, 28 is generated in the second compressor 20b, the second opening and closing valve 90b of the second compressor 20b is opened and oil is supplied to the first and second accumulators 60a, 60b, connected to the first and second compressors 20a, 20b, flowing along the oil equalizing pipe 50 via the second oil outlet pipe 30b. At this time, the first opening and closing valve 90a of the first compressor 20a is maintained in the closed

state.

[0033] Accordingly, the adequate oil levels in the first and second compressors 20a, 20b can be maintained stably.

[0034] As described above, adequate oil levels in a plurality of compressors may be maintained stably and also the oil equalizing function may be simplified.

[0035] Accordingly, surplus oil is supplied to the compressor losing oil much, thereby reducing the time corresponding to the oil equalizing.

[0036] Although a few embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that changes may be made in these embodiments.

Claims

1. A heat pump comprising a plurality of refrigerant compressors (20a, 20b) disposed in parallel with each other and each having an outlet (30a, 30b) for discharging surplus oil, **characterised in that** the first end of respective capillary tube (40a, 40b) is connected to each of said outlets (30a, 30b) and the second ends of the capillary tubes (40a, 40b) are interconnected.

2. A heat pump according to claim 1, wherein each compressor (20a, 20b) has an oil accumulator (60a, 60b) associated therewith and the accumulators (60a, 60b) are connected to the second ends of said capillary tubes (40a, 40b).

3. A heat pump according to claim 1 or 2, wherein each compressor has:

upper and lower temperature sensors (22, 24, 26, 28), the upper sensor (22, 24) being in a position where only the temperature of refrigerant will be sensed during normal operation and the lower sensor (26, 28) being at a position where the temperature of oil or refrigerant will be sensed according to the oil level, an associated valve (90a, 90b) for selectively blocking and allowing the flow of surplus oil through the compressor's surplus oil discharge outlet (30a, 30b), and control means for controlling the associated valve (90a, 90b) in dependence on the difference between the temperatures sensed by the upper and lower temperature sensors (22, 24, 26, 28).

4. An air conditioner including a heat pump according to any preceding claim.

5. An air conditioner comprising:

a plurality of compressors disposed in parallel with each other;
an oil outlet pipe provided in the plurality of compressors respectively and discharging a surplus oil;
a capillary tube connected to the oil outlet pipe; and
an oil equalizing pipe connected to the capillary tube and selectively supplying the surplus oil discharged through the oil outlet pipe to the plurality of compressors.

6. The air conditioner according to claim 5, wherein the oil equalizing pipe forms a junction for connecting to the plurality of compressors with each other.

7. The air conditioner according to claim 5, wherein the oil outlet pipe is provided adjacent to an adequate oil level of the plurality of compressors respectively.

8. The air conditioner according to claim 6, wherein the oil outlet pipe is provided adjacent to an adequate oil level of the plurality of compressors respectively.

9. The air conditioner according to claim 6, further comprising an accumulator connected to the plurality of compressors respectively, wherein the oil equalizing pipe supplies the surplus oil discharged through the oil outlet pipe to the accumulator.

10. An air conditioner comprising:

a plurality of compressors disposed in parallel with each other;
an oil outlet pipe provided in the plurality of compressors respectively ;
a first thermostatic sensor and a second thermostatic sensor provided inside of the plurality of compressors, and measuring a temperature of a refrigerant gas and a temperature of an oil ;
a opening/closing valve opening and closing the oil outlet pipe by a thermostatic difference between the first thermostatic sensor and the second thermostatic sensor;
a capillary tube connected to the oil outlet pipe; and
an oil equalizing pipe connected to the capillary tube.

11. The air conditioner according to claim 10, wherein the first thermostatic sensor is located at a position for measuring the temperature of refrigerant gas and the second thermostatic sensor is located adjacent to an adequate oil level of an oil for measuring selectively the temperature of the refrigerant gas and the temperature of the oil corresponding to change of the oil level.

12. The air conditioner according to claim 11, wherein the opening/closing value is opened in the case that the oil ascends above the adequate oil level to generate a thermal difference between the first and second thermal sensors and is closed in the case that the oil descends below the adequate oil level not to generate the thermal difference therebetween. 5
13. The air conditioner according to claim 10, wherein the oil equalizing pipe is disposed to equally supply the surplus oil discharged through the oil outlet pipes to the plurality of compressors respectively. 10

15

20

25

30

35

40

45

50

55

FIG. 1

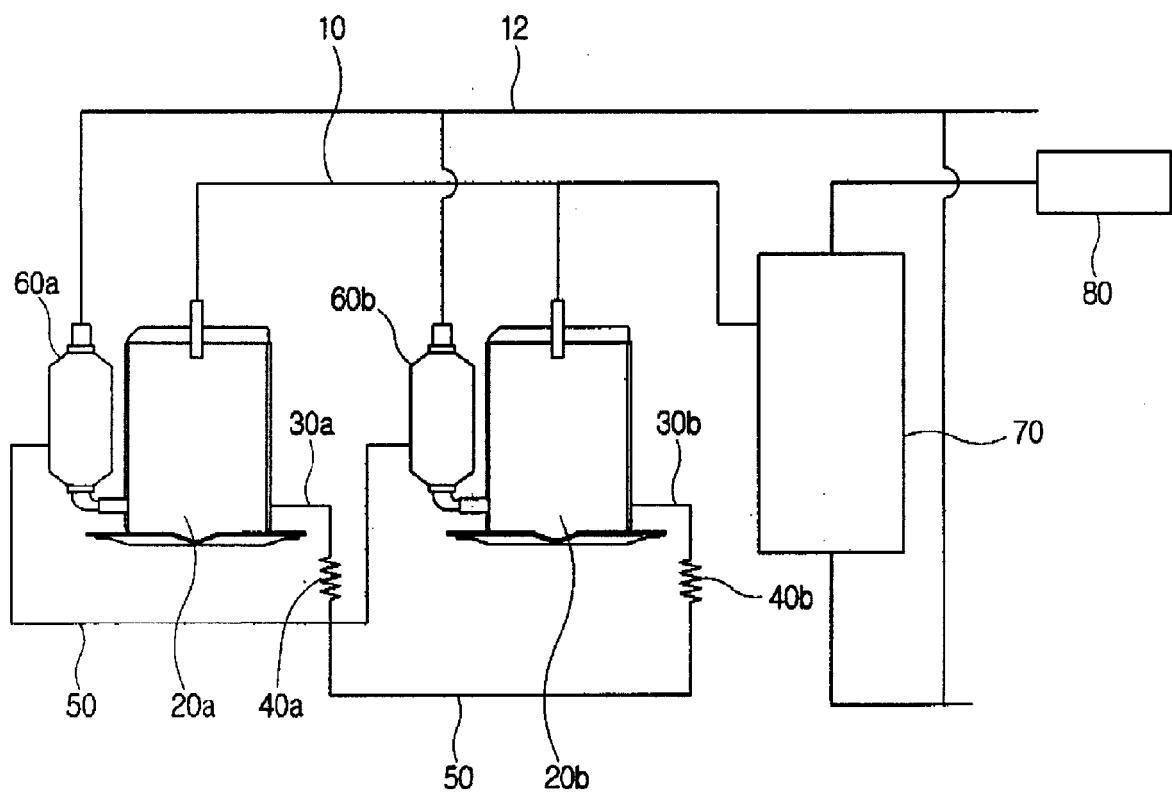


FIG. 2

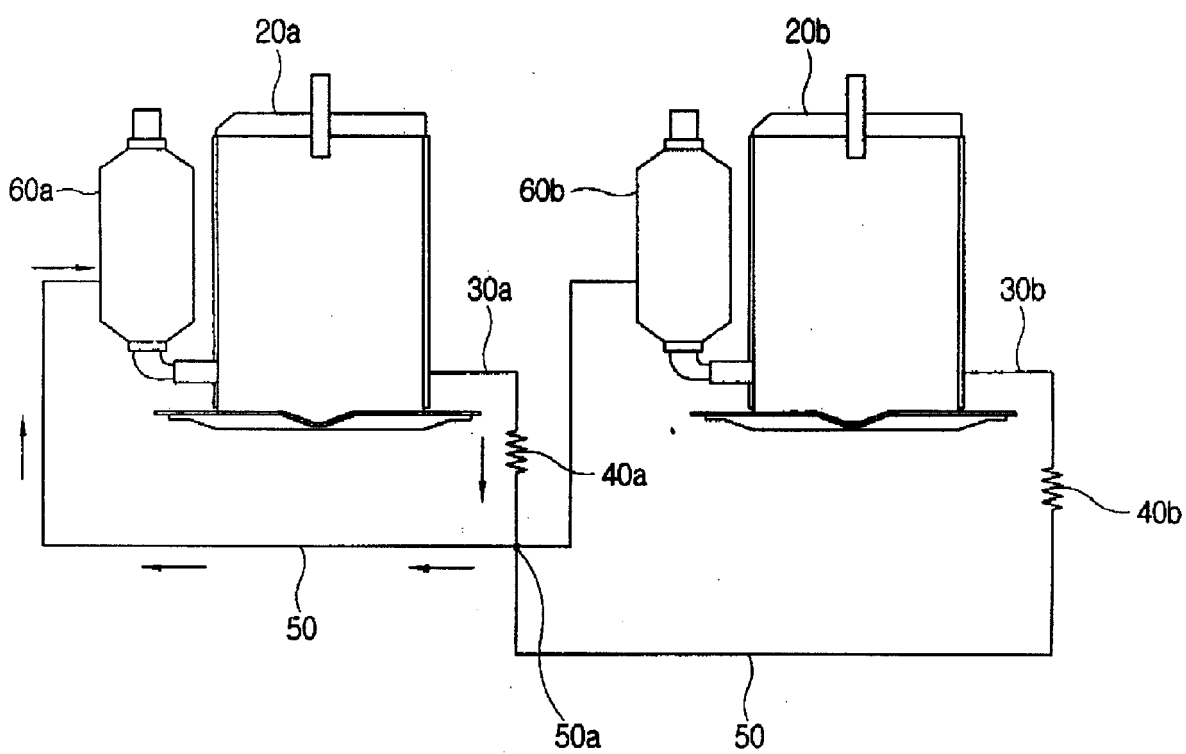


FIG. 3

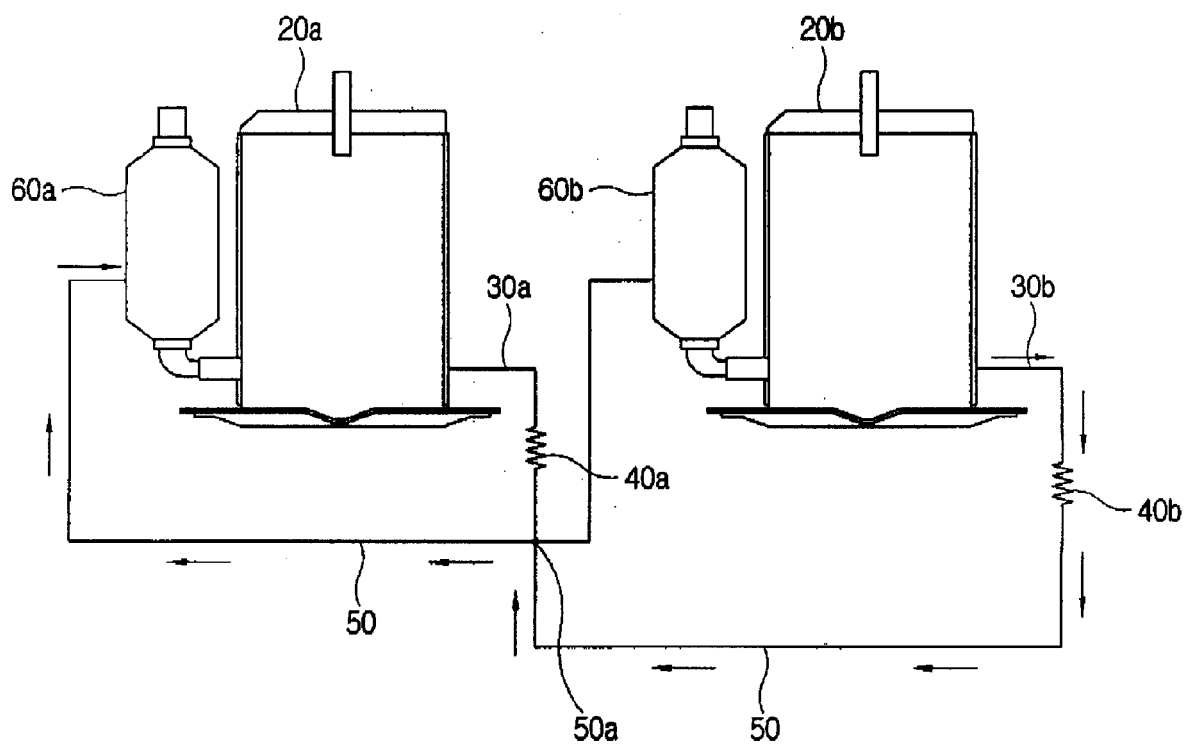


FIG. 4

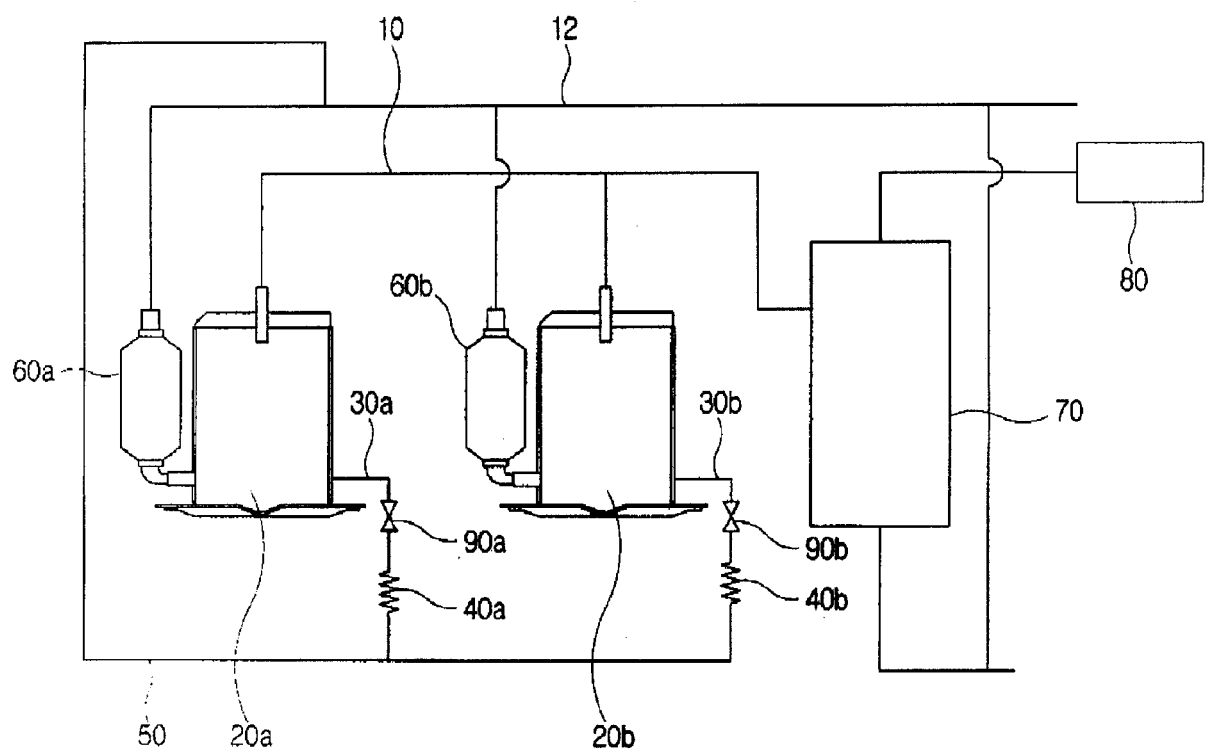


FIG. 5

