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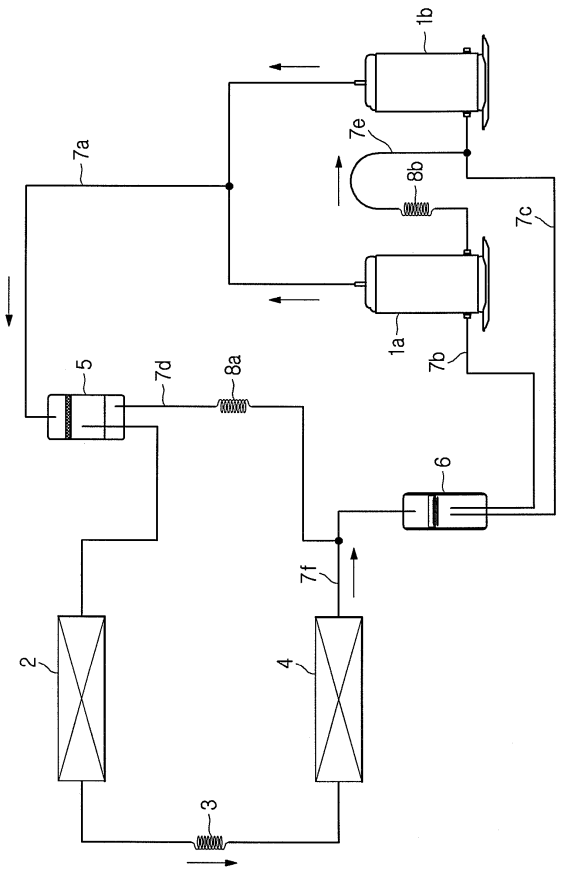
(54) Air conditioner

(57) A refrigerating cycle having compressors (1a, 1b) and flexibly adapting to refrigeration load is disclosed. The cycle includes a main compressor (1a) compressing refrigerant, an auxiliary compressor (1b) selectively operated based on refrigeration load to compress refrigerant, an accumulator (6) having a main suction pipe guiding refrigerant to the main compressor (1a) and an auxiliary suction pipe (7c) guiding refrigerant to the auxiliary compressor (1b), an oil introducing hole guiding oil to the main compressor (1a), and an oil delivery pipe (7e) guiding oil to the auxiliary compressor (1b). When only the main compressor (1a) operates, oil is returned to the main compressor (1a) to maintain a predetermined height of oil in the main compressor (1a). When both compressors (1a,1b) are operated, more oil is supplied to the main compressor (1a) and excess oil is delivered to the auxiliary compressor (1b) such that oil in the compressors can be maintained at the predetermined height. Thus, oil-shortage in the compressors (1a,1b) is prevented by a simple mechanical structure.

FIG 1



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Description

[0001] Air conditioning systems are installed in buildings to heat or cool the interior and include refrigerating devices such as a compressor for compressing refrigerant, a condenser for cooling high-pressure-and-high-temperature refrigerant compressed in the compressor, an expansion device for decompressing and expanding the cooled refrigerant, and an evaporator for performing heat exchange between refrigerant and air to evaporate the refrigerant.

[0002] Korean Patent Application No. 10-2002-0023990 discloses a refrigerating system including a plurality of compressors some or all of which operate depending on the refrigerating load.

[0003] Moreover, in order to cool and lubricate respective driving parts, oil is reserved in the respective compressors employed in the refrigerating system and each compressor is equipped with an oil-distribution pipe to uniformly distribute oil to plural compressors such that oil is delivered to or from neighbouring compressors.

[0004] However, in a conventional system, when only one of the plural compressors operates, since the operating compressor compresses refrigerant and interior pressure of the operating compressor is increased, oil reserved in the operating compressor flows to a compressor having relatively high inner pressure because of non-operation, oil in the operating compressor is insufficient.

[0005] Thus, in order to overcome the above problem, the conventional refrigerating system further includes an electronically controlled additional valve installed at the intermediate portion of the oil distribution pipe and oil-shortage is prevented by controlling the valve to close the oil-distribution pipe when any one of the compressors operates.

[0006] However, since the conventional refrigerating system has to use an electronically controlled valve, costs for manufacturing the refrigerating system are increased. Moreover, since the valve must be controlled, control of the conventional refrigerating system is complicated.

[0007] The present invention has been made in view of the above-mentioned problems, and the invention seeks to provide an air conditioning system having a simple structure without additional devices or control and preventing oil-shortage in respective compressors.

[0008] According to the invention, there is provided an air conditioning system including a main compressor, at least one auxiliary compressor and an accumulator disposed in a refrigeration circuit, the main and auxiliary compressors being connected by an oil transfer conduit through which oil may be supplied from the main to the auxiliary compressor, wherein the accumulator is operable to supply refrigerant to the main and auxiliary compressors, respectively, and is configured to collect oil contained in the refrigerant and supply it, together with refrigerant, to the main compressor only.

[0009] In a preferred embodiment, refrigerant and oil is supplied to the main compressor from the accumulator via a main suction pipe having a portion which extends through an oil reservoir in the accumulator, said portion including an oil overflow aperture spaced from the end of the pipe through which refrigerant is introduced for the flow of oil into the pipe from the reservoir when the oil in the reservoir exceeds a predetermined level.

[0010] Preferably, refrigerant is supplied to the auxiliary compressor from the accumulator via an auxiliary suction pipe having a portion that extends through the oil reservoir in the accumulator, said portion having an end through which refrigerant is introduced into the auxiliary suction pipe and which is disposed above the oil overflow aperture in the main suction pipe.

[0011] In one embodiment, the oil transfer conduit communicates with the main compressor so that, when the amount of oil in the main compressor reaches a predetermined level, it flows into the auxiliary compressor via the oil transfer conduit.

[0012] Preferably, the air conditioning system further includes a first capillary tube installed at an intermediate portion of the oil return pipe to increase flow resistance of the oil return pipe.

[0013] Preferably, the air conditioning system further includes a second capillary tube installed at an intermediate portion of the oil delivery pipe to increase flow resistance of the oil delivery pipe.

[0014] In accordance with another aspect of the present invention, the present invention provides a refrigerating system including a plurality of compressors, and an accumulator for reducing introduction of liquid refrigerant to the compressors, wherein the compressors includes a main compressor for receiving oil from the accumulator, and at least one auxiliary compressor for receiving oil from the main compressor.

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

[0016] Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic view illustrating a refrigerating system according to a preferred embodiment of the present invention when both a main compressor and an auxiliary compressor are operated;

Figure 2 is a schematic view illustrating the refrigerating system according to the preferred embodiment of the present invention when only the main compressor is operated; and

Figure 3 is a sectional view illustrating an accumulator employed in the refrigerating system according to the preferred embodiment of the present invention.

[0017] A refrigerating system according to the pre-

ferred embodiment of the present invention, as shown in Figure 1, includes devices, such as compressors 1a and 1b for compressing refrigerant at high pressure and high temperature and for reserving oil to cool and lubricate inner driving parts of the compressors 1a and 1b, a condenser 2 for performing heat exchange between refrigerant and air to cool refrigerant, an expansion device 3 for decompressing and expanding refrigerant, and an evaporator 4 in which heat exchange between refrigerant and air is performed and refrigerant is evaporated. These devices are connected to each other by means of refrigerant pipes to form a closed circuit. In the preferred embodiment of the present invention, the expansion device 3 includes a capillary tube.

[0018] Moreover, the refrigerating system further includes an oil separator 5 installed at the intermediate portion of a discharge pipe 7a for guiding refrigerant discharged from the compressor 1a and 1b to separate oil discharged with refrigerant from the compressors 1a and 1b from refrigerant, and an accumulator 6 installed at the intermediate portions of suction pipes 7b and 7c for guiding refrigerant to the compressors 1a and 1b to prevent liquid refrigerant from entering the compressors 1a and 1b.

[0019] Between the oil separator 5 and the accumulator 6, an oil return pipe 7d is installed to guide oil separated by the oil separator 5 to enter the accumulator 6. One end of the oil return pipe 7d is connected to the lower side of the oil separator 5 and the other end of the oil return pipe 7d is connected to a refrigerant pipe 7f for guiding refrigerant to the accumulator 6. In addition, at the intermediate portion of the oil return pipe 7d, a first capillary tube 8a is installed to increase flow resistance of the oil return pipe 7d such that flow rate of oil flowing through the oil return pipe 7d can be controlled by the first capillary tube 8a.

[0020] In order to flexibly adapt to refrigeration load, the refrigerating system according to the preferred embodiment of the present invention further includes a plurality of compressors 1a and 1b. One of the compressors 1a and 1b is a main compressor 1a for receiving refrigerant and oil from the accumulator 6 and the other of the compressors 1a and 1b is an auxiliary compressor 1b for receiving refrigerant from the accumulator 6 and receiving oil from the main compressor 1a. In the preferred embodiment of the present invention, a refrigerating system having only one auxiliary compressor 1b will be described for convenience's sake.

[0021] A main suction pipe 7b is connected between the main compressor 1a and the accumulator 6 such that refrigerant and oil are delivered from the accumulator 6 to the main compressor 1a, and an auxiliary suction pipe 7c is connected between the auxiliary compressor 1b and the accumulator 6 such that refrigerant is delivered from the accumulator 6 to the auxiliary compressor 1b, and thus the main compressor 1a and the auxiliary compressor 1b can receive refrigerant from one accumulator 6.

[0022] One end of the main suction pipe 7b and one end of the auxiliary suction pipe 7c, which are connected to the accumulator 6, as shown in FIG. 3, penetrate a bottom surface of the accumulator 6 and protrude at a predetermined height in the accumulator 6, while the main suction pipe 7b installed in the accumulator 6 has an oil introducing hole 9 formed at the lower side of the main suction pipe 7b to introduce oil reserved in the lower side of the accumulator 6. Thus, refrigerant is delivered to the main compressor 1a and the auxiliary compressor 1b through the main suction pipe 7b and the auxiliary suction pipe 7c, while oil reserved in the accumulator 6 is delivered only to the main compressor 1a through the main suction pipe 7b having the oil introducing hole 9.

[0023] Moreover, the refrigerating system according to the preferred embodiment of the present invention further includes an oil delivery pipe 7e for delivering excess oil to the auxiliary compressor 1b when the main compressor 1a reserves oil more than a predetermined quantity of oil.

[0024] The oil delivery pipe 7e is installed such that one end of the oil delivery pipe 7e is installed at a predetermined height to correspond to a predetermined height of oil in the main compressor 1a and the other end of the oil delivery pipe 7e is connected to the intermediate portion of the auxiliary suction pipe 7c. When more quantity of oil than the predetermined quantity is supplied to the main compressor 1a, the excess oil is delivered to the auxiliary suction pipe 7c via the oil delivery pipe 7e to be supplied to the auxiliary compressor 1b. Thus, oil in the main compressor 1a can be maintained at the predetermine height. The oil delivery pipe 7e is provided with a second capillary tube 8b installed at the intermediate portion of the oil delivery pipe 7e to increase flow resistance of the oil delivery pipe 7e such that flow rate of oil flowing to the auxiliary compressor 1b is adjusted by the second capillary tube 8b.

[0025] Operation of the refrigerating system according to the preferred embodiment of the present invention will be described as follows.

[0026] In the case that only the main compressor 1a operates to compress refrigerant, when the main compressor 1a compresses refrigerant, some of oil reserved in the main compressor 1a is discharged together with refrigerant to the discharge pipe 7a. Oil discharged through the discharge pipe 7a is withdrawn by the oil separator 5 and the accumulator 6. Since oil accumulated in the accumulator 6 is delivered only to the main compressor 1a through the main suction pipe 7b having the oil introducing hole 9, the majority of oil discharged from the main compressor 1a is returned to the main compressor 1a as it is. Thus, oil in the main compressor 1a can be continuously maintained at the predetermined height.

[0027] In the case that both the main compressor 1a and the auxiliary compressor 1b operate to compress refrigerant, when the main compressor 1a and the auxiliary compressor 1b compress refrigerant, some of oil reserved in the main compressor 1a and the auxiliary

compressor 1b is discharged together with refrigerant to the discharge pipe 7a. Oil discharged through the discharge pipe 7a is withdrawn by the oil separator 5 and the accumulator 6, and is delivered to the main compressor 1a through the main suction pipe 7b having the oil introducing hole 9.

[0028] Since the main compressor 1a is delivered with oil discharged from the main compressor 1a and the auxiliary compressor 1b, the main compressor 1a is supplied with more oil than the predetermined quantity. Since the main compressor 1a is provided with one end of the oil delivery pipe 7e installed to correspond to the predetermined height of oil such that excess oil more than the predetermined quantity of oil in the main compressor 1a is delivered to the auxiliary compressor 1b through the oil delivery pipe 7e, oil in the main compressor 1a and the auxiliary compressor 1b can be maintained at the predetermined height, respectively.

[0029] As described above, in the refrigerating system according to the present invention, all of oil reserved in the accumulator is delivered to the main compressor and oil more than the predetermined quantity supplied to the main compressor is delivered to the auxiliary compressor through the oil delivery pipe. Thus, when only the main compressor operates, since oil discharged from the main compressor is supplied to the main compressor as it is, oil in the main compressor can be maintained at the predetermined height. When both the main compressor and the auxiliary compressor operate, oil more than the predetermined quantity is supplied to the main compressor and excess oil is delivered to the auxiliary compressor such that oil in the main compressor and the auxiliary compressor can be maintained at the predetermined height. Thus, a simple mechanical structure without a separate control prevents oil-shortage in the main compressor and the auxiliary compressor.

[0030] Although a few 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 air conditioning system including a main compressor, at least one auxiliary compressor and an accumulator disposed in a refrigeration circuit, the main and auxiliary compressors being connected by an oil transfer conduit through which oil may be supplied from the main to the auxiliary compressor, wherein the accumulator is operable to supply refrigerant to the main and auxiliary compressors, respectively, and is configured to collect oil contained in the refrigerant and supply it, together with refrigerant, to the main compressor only.

2. An air conditioning system according to claim 1 wherein refrigerant and oil is supplied to the main compressor from the accumulator via a main suction pipe having a portion which extends through an oil reservoir in the accumulator, said portion including an oil overflow aperture spaced from the end of the pipe through which refrigerant is introduced for the flow of oil into the pipe from the reservoir when the oil in the reservoir exceeds a predetermined level.

3. An air conditioning system according to claim 2 wherein refrigerant is supplied to the auxiliary compressor from the accumulator via an auxiliary suction pipe having a portion that extends through the oil reservoir in the accumulator, said portion having an end through which refrigerant is introduced into the auxiliary suction pipe and which is disposed above the oil overflow aperture in the main suction pipe.

4. An air conditioning system according to any preceding claim, wherein the oil transfer conduit communicates with the main compressor so that, when the amount of oil in the main compressor reaches a predetermined level, it flows into the auxiliary compressor via the oil transfer conduit.

5. An air conditioning system according to claim 4 wherein the end of the oil transfer conduit remote from the main compressor communicates with the auxiliary suction pipe to supply oil from the main compressor to the auxiliary compressor together with the refrigerant supplied to the auxiliary compressor through the auxiliary suction pipe.

6. An air conditioner according to any preceding claim wherein the refrigeration circuit includes an oil separator for separating oil from the refrigerant and for supplying the separated oil to the accumulator.

7. An air conditioner according to claim 6 wherein the refrigeration circuit includes a condenser, an evaporator, an expansion device and an oil bypass conduit, the oil bypass conduit extending between the oil separator and the accumulator to allow oil to flow therethrough and bypass the condenser, expansion device and evaporator.

8. An air conditioner according to claim 7 wherein a capillary tube is disposed in the oil bypass conduit to control the flow of oil from the oil separator into the accumulator.

9. A refrigerating system comprising a main compressor for compressing refrigerant, at least one auxiliary compressor selectively operated based on refrigeration load to compress refrigerant, an accumulator to which a main suction pipe is connected to guide refrigerant sucked into the main compressor and an

auxiliary suction pipe is connected to guide refrigerant sucked into the auxiliary compressor, an oil introducing hole formed in the main suction pipe to guide oil reserved in the accumulator to the main compressor through the main suction pipe and an oil delivery pipe having one end installed in the main compressor to guide oil in the main compressor to the auxiliary compressor.

10. The refrigerating system according to claim 9 wherein one end of the main suction pipe and one end of the auxiliary pipe are opened to receive refrigerant from the accumulator and penetrate a bottom surface of the accumulator to protrude upwardly, and the oil introducing hole is formed at a position lower than an opened end of the auxiliary pipe.

11. The refrigerating system according to claim 9 wherein an end of the oil delivery pipe is installed to a side of the main compressor corresponding to a predetermined height of oil in the main compressor, and the other end of the oil delivery pipe is installed at an intermediate portion of the auxiliary pipe.

12. The refrigerating system according to claim 9 further comprising an oil separator installed at an intermediate portion of a discharge pipe for guiding refrigerant discharged from the main compressor and the auxiliary compressor and separating oil contained in refrigerant and an oil return pipe having an end connected to the oil separator and the other end connected to a refrigerant pipe for guiding refrigerant to the accumulator, and delivering oil from the oil separator to the accumulator.

13. The refrigerating system according to claim 12 further comprising a first capillary tube installed at an intermediate portion of the oil return pipe to increase flow resistance of the oil return pipe.

14. The refrigerant cycle according to claim 9 further comprising a second capillary tube installed at an intermediate portion of the oil delivery pipe to increase flow resistance of the oil delivery pipe.

15. A refrigerating system comprising a plurality of compressors; and an accumulator for reducing introduction of liquid refrigerant to the compressors, the compressors comprising a main compressor for receiving oil from the accumulator and at least one auxiliary compressor for receiving oil from the main compressor.

16. The refrigerant cycle according to claim 15 wherein the accumulator is connected to a main suction pipe for guiding refrigerant to the main compressor and to an auxiliary suction pipe for delivering refrigerant to the auxiliary compressor, the main suction pipe is formed with an oil introducing hole for sucking oil reserved in the accumulator.

17. The refrigerant cycle according to claim 16 further comprising an oil delivery pipe having one end installed to a side of the main compressor and the other end installed to the auxiliary suction pipe to guide oil in the main compressor to the auxiliary compressor.

18. The refrigerant cycle according to claim 17 wherein the one end of the oil delivery pipe is installed at a height corresponding to a predetermined height of oil in the main compressor.

19. The refrigerant cycle according to claim 16 wherein one end of the main suction pipe and one end of the auxiliary pipe are opened to receive refrigerant from the accumulator and penetrate a bottom surface of the accumulator to protrude upwardly, and the oil introducing hole is formed at a position lower than an opened end of the auxiliary pipe.

20. The refrigerating system according to claim 15 further comprising an oil separator installed at an intermediate portion of a discharge pipe for guiding refrigerant discharged from the main compressor and the auxiliary compressor and separating oil contained in refrigerant and an oil return pipe having an end connected to the oil separator and the other end connected to a refrigerant pipe for guiding refrigerant to the accumulator, and delivering oil from the oil separator to the accumulator.

21. The refrigerating system according to claim 20 further comprising a first capillary tube installed at an intermediate portion of the oil return pipe to increase flow resistance of the oil return pipe.

22. The refrigerant cycle according to claim 17 further comprising a second capillary tube installed at an intermediate portion of the oil delivery pipe to increase flow resistance of the oil delivery pipe.

FIG 1

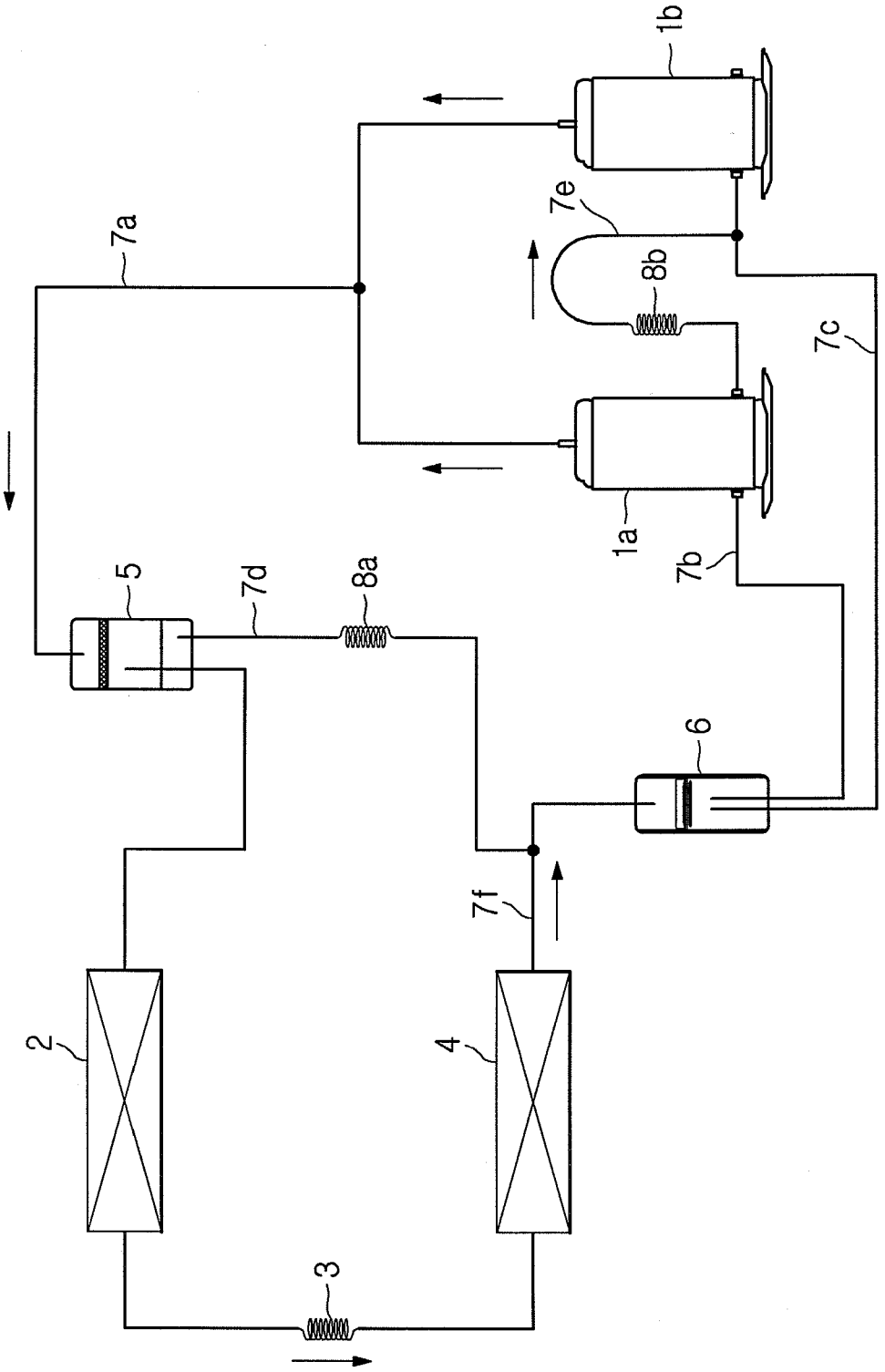

FIG 2

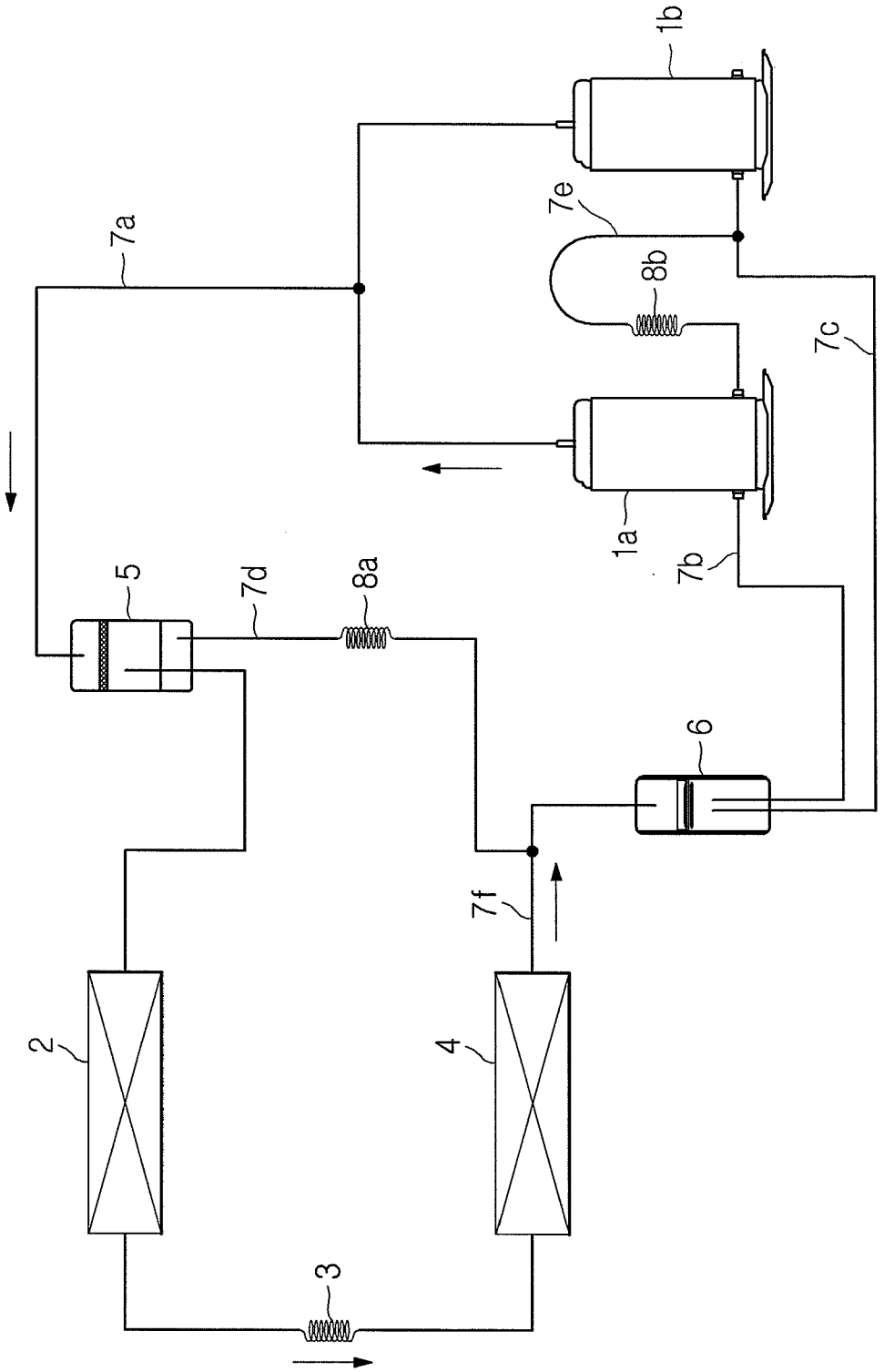

FIG 3