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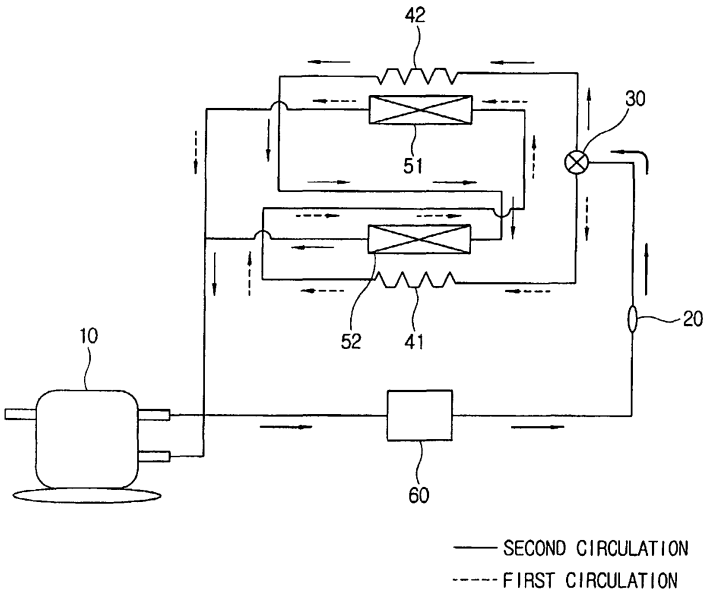
(54) Cooling System

(57) A cooling system including a compressor (10) compressing a refrigerant and a condenser (60) condensing the compressed refrigerant, includes: an evaporator section (51, 52) having a plurality of evaporators (51, 52) evaporating the refrigerant condensed in the condenser (60); a switching valve (30) on a refrigerant line between the condenser (60) and the evaporator, and selectively switching a refrigerant supply to the plurality of evaporators (51, 52); and a refrigerant expansion part (41, 42) adjacent to at least one of the evaporators, allowing refrigerant introduced into the plurality of evaporators (51, 52) through the switching valve (30) to expand. A refrigerant inlet of the refrigerant expansion part (41, 42) adjacent to any of the evaporators is connected to the switching valve (30), and a refrigerant outlet thereof is connected to an inlet of another evaporator.

FIG. 1



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Description

[0001] The present invention relates to a cooling system, and more particularly, to a cooling system efficiently defrosting an evaporator without an extra defrosting heater.

[0002] Generally, a cooling system (or a cooling cycle) includes a closed circuit having a compressor, a condenser, an evaporator and related devices. A refrigerant compressed in the compressor is condensed into a liquid by the condenser, and then evaporated in the evaporator. The evaporator generates cool air in the process of evaporating the refrigerant by using latent heat around the evaporator.

[0003] Because the temperature of the cooling air generated by the evaporator is below zero degrees, vapor in the air around the evaporator is condensed on a surface of the evaporator and turns into frost. Because the frost interferes with the transfer of heat to the evaporator and the generation of cooling air by the evaporator, a defrosting unit is generally placed in the cooling system to defrost the evaporator.

[0004] An example of a defrosting unit is disclosed in Korean Patent First Publication No. 1998-052950, wherein the defrosting unit includes: a defrosting heater at a lower part of an evaporator; a hot pipe between a compressor and a condenser; a defrosting pipe branched from the hot pipe, passing by the evaporator and connected to an entrance of the evaporator; and a control valve controlling a path of a refrigerant at a branching point of the hot pipe and the defrosting pipe.

[0005] However, in such a conventional defrosting unit, not only is electric power consumed for operating the defrosting heater, but also the rising temperature from the heat of the defrosting heater placed at the lower part of the evaporator causes low cooling performance of the cooling system in general.

[0006] Further, when the defrosting heater or the like malfunctions, it is troublesome to replace the defrosting unit and the replacement costs tend to be high.

[0007] According to the present invention there is provided an apparatus and method as set forth in the appended claims. Preferred features of the invention will be apparent from the dependent claims, and the description which follows.

[0008] An aspect of the present invention provides a cooling system efficiently defrosting an evaporator without an extra defrosting heater, thereby having an improved cooling efficiency and decreased power consumption.

[0009] According to an aspect of the present invention, there is provided a cooling system including a compressor compressing a refrigerant and a condenser condensing the compressed refrigerant. The cooling system includes: an evaporator section having a plurality of evaporators evaporating the refrigerant condensed in the condenser; a switching valve on a refrigerant line between the condenser and the evaporator, and selectively switching a refrigerant supply to the plurality of evaporators; and a refrigerant expansion part adjacent to at least one of the evaporators, allowing refrigerant introduced into the plurality of evaporators through the switching valve to expand. A refrigerant inlet of the refrigerant expansion part adjacent to any of the evaporators is connected to the switching valve, and a refrigerant outlet thereof is connected to an inlet of another evaporator.

[0010] According to an aspect of the present invention, each of the evaporating parts may include a refrigerant pipe and a plurality of fins provided transversely to the lengthwise direction of the refrigerant pipe, and the refrigerant expansion part is provided along each of the refrigerant pipes.

[0011] According to an aspect of the present invention, each of the evaporating parts may include a refrigerant pipe and a plurality of fins provided transversely to the lengthwise direction of the refrigerant pipe, and the refrigerant expansion part is provided in parallel with each of the refrigerant pipes.

[0012] According to an aspect of the present invention, the refrigerant expansion part may be a capillary tube.

[0013] According to an aspect of the present invention, the switching valve may include a solenoid valve.

[0014] According to another aspect of the present invention, there is provided a cooling system including a compressor compressing a refrigerant and a condenser condensing the compressed refrigerant. The cooling system includes: an evaporator having a first evaporating part and a second evaporating part evaporating the condensed refrigerant; a switching valve on a refrigerant line between the condenser and the evaporator, and selectively supplying refrigerant to the first evaporating part and the second evaporating part; a first refrigerant expansion part in at least a portion of the second evaporating part, and allowing the refrigerant introduced into the first evaporating part through the switching valve to expand; and a second refrigerant expansion part provided in at least a portion of the first evaporating part, and allowing the refrigerant introduced into the second evaporating part through the switching valve to expand. A first circulation in which the condensed refrigerant is supplied to the first evaporating part through the first refrigerant expansion part, and a second circulation in which the refrigerant from the condenser is introduced into the second evaporating part through the second refrigerant expansion part, are selectively provided. The second evaporating part is defrosted during the first circulation by heat from the first refrigerant expansion part, and the first evaporating part is defrosted during the second circulation by heat from the second refrigerant expansion part.

[0015] According to an aspect of the present invention, the first evaporating part and the second evaporating part may respectively include a refrigerant pipe and a plurality of fins arranged transversely to the lengthwise direction of the refrigerant pipe, and the first and second refrigerant expansion parts may be respectively provided along a surface of the refrigerant pipe of the first and second

evaporating parts.

[0016] According to an aspect of the present invention, the first and second refrigerant expansion parts may be a capillary tube.

[0017] According to an aspect of the present invention, the switching valve may include a solenoid valve.

[0018] According to another aspect of the present invention, there is provided a cooling system, including: a first loop including a first refrigerant expansion section allowing compressed refrigerant flowing therethrough to expand and a first evaporator downstream of the first refrigerant expansion section; and a second loop including a second refrigerant expansion section allowing compressed refrigerant flowing therethrough to expand and a second evaporator downstream of the second refrigerant expansion section. When compressed refrigerant flows through the first loop, the first refrigerant expansion section is heated by the expansion of the refrigerant. When the compressed refrigerant flows through the second loop, the second refrigerant expansion section is heated by the expansion of the refrigerant. The first refrigerant expansion section is proximate to the second evaporator and the second refrigerant expansion section is proximate to the first evaporator.

[0019] According to another aspect of the present invention, there is provided a method of preventing frost on evaporators of a cooling system, including: supplying compressed refrigerant to a first expansion section allowing the compressed refrigerant to expand and heat the first expansion section and then to a first evaporator downstream of the first expansion section; and supplying compressed refrigerant to a second expansion section allowing the compressed refrigerant to expand and heat the second expansion section and then to a second evaporator downstream of the second expansion section. The first expansion section is proximate to the second evaporator and the second expansion section is proximate to the first evaporator.

[0020] Additional and/or other aspects and advantages of the present 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.

[0021] The above and/or other aspects and advantages of the present invention will become apparent and more readily appreciated from the following detailed description, taken in conjunction with the accompanying drawings of which:

Figure 1 is a schematic view of a cooling system according to an embodiment of the present invention;

Figure 2 is a front view of an evaporator shown in Figure 1; and

Figure 3 is a side view of an evaporator shown in Figure 2.

[0022] Reference will now be made in detail to an embodiment of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiment is described below in order to explain the present invention by referring to the figures.

[0023] As shown in Figure 1, a cooling system according to an embodiment of the present invention includes a compressor 10 compressing a refrigerant to a high temperature and a high pressure; a condenser 60 condensing the compressed refrigerant into a liquid; and respective first and second evaporators 51, 52 evaporating the condensed refrigerant.

[0024] As shown in Figures 2 and 3, the first evaporator 51 includes a refrigerant pipe 51a through which the refrigerant flows and a plurality of plate-shaped fins 51b arranged in parallel at specified intervals to be crossed with the refrigerant pipe 51a.

[0025] The second evaporator 52, has the same construction as the first evaporator 51 shown in Figures 2 and 3, and includes a refrigerant pipe through which the refrigerant flows and a plurality of plate-shaped fins arranged in parallel at specified intervals to be crossed with the refrigerant pipe. Here, a drawing of the second evaporating part 52 is omitted since the drawing thereof is the same as the drawing of the first evaporating part 51.

[0026] On a refrigerant line between the evaporators 51, 52 and the condenser 60 is a switching valve 30 controlling a flowing direction of the refrigerant.

[0027] On a refrigerant line connecting the switching valve 30 and the first evaporator 51 is a first capillary tube 41 as a first refrigerant expansion part decompressing the high-pressure refrigerant from the condenser 60.

[0028] On a refrigerant line connecting the switching valve 30 and the second evaporator 52 is a second capillary tube 42 as a second refrigerant expansion part decompressing the high-pressure refrigerant from the condenser 60.

[0029] The switching valve 30 may include a solenoid valve (not shown) and switches a flowing direction of the refrigerant from the condenser 60.

[0030] That is, the switching valve 30 allows the refrigerant from the condenser 60 to flow either into the first evaporator 51 through the first capillary tube 41, or into the second evaporator 52 through the second capillary tube 42.

[0031] The first capillary tube 41 provided on the refrigerant line between the switching valve 30 and the first evaporator 51 allows the high-pressure refrigerant received from the condenser 60 to expand into a low temperature and low pressure refrigerant.

[0032] The second capillary tube 42 provided on the refrigerant line between the switching valve 30 and the second evaporator 52 allows the high-pressure refrigerant received from the condenser 60 to expand into a low temperature and low pressure refrigerant.

[0033] A dryer 20 is provided between the condenser 60 and the switching valve 30 to remove water and dirt

included in the refrigerant introduced into the first capillary tube 41 or the second capillary tube 42, thereby preventing the first capillary tube 41 or the second capillary tube 42 from clogging.

[0034] Turning to Figure 1, a first side of the second capillary tube 42 is connected to the switching valve 30, and the second side thereof is connected to the second evaporator 52 to transfer the refrigerant from the switching valve 30 to the second evaporator 52 through the second capillary tube 42.

[0035] The second capillary tube 42 is, as shown in Figures 2 and 3, provided on a surface of the refrigerant pipe 51a included in the first evaporator 51. That is, the second capillary tube 42 is welded along the surface of the refrigerant pipe 51a of the first evaporator 51.

[0036] As shown in Figure 1, a first side of the first capillary tube 41 is connected to the switching valve 30, and the second side thereof is connected to the first evaporator 51 to transfer the refrigerant introduced from the switching valve 30 to the first evaporator 51 through the first capillary tube 41.

[0037] The first capillary tube 41 is provided on the surface of the refrigerant pipe included in the second evaporator 52. The first capillary tube 41 is the same as the second capillary tube 42 in Figures 2 and 3. Also, the refrigerant pipe of the second evaporator 52 is same as the refrigerant pipe 51a in Figures 2 and 3. As the first capillary tube 41 is welded along the surface of the refrigerant pipe of the second evaporator 52 in the shape same as the second capillary tube 42 shown in Figures 2 and 3, a drawing thereof is not provided.

[0038] In the cooling system having the above-described configuration, the description of a circulating process of the refrigerant is as follows.

[0039] First, a first circulation will be described. After being compressed into the high temperature and high pressure refrigerant in the compressor 10, the refrigerant is introduced into the condenser 60 to be condensed as a liquid.

[0040] The refrigerant condensed in the condenser 60 is introduced into the first capillary tube 41 through the dryer 20 by the switching valve 30. The refrigerant is decompressed, flowing inside of the first capillary tube 41. At this time, the first capillary tube 41 having temperature generally higher than the surface temperature of the second evaporator 52 generates heat, and the frost formed on the second evaporator 52 is removed by the heat since the first capillary tube 41 generating heat is attached to the refrigerant pipe of the second evaporator 52.

[0041] The refrigerant decompressed in the first capillary tube 41 is introduced into the first evaporator 51, and then evaporated. At this time, cooling air is generated in the vicinity of the first evaporator 51 by the absorption of the latent heat, and the gaseous refrigerant evaporated in the first evaporator 51 returns to the compressor 10.

[0042] Hereinbelow, a second circulation will be described. After being compressed into the high temperature and high pressure refrigerant in the compressor 10, the refrigerant is introduced to the condenser 60 to be condensed as a liquid.

[0043] The refrigerant condensed in the condenser 60 is introduced into the second capillary tube 42 through the dryer 20 by the switching valve 30. The refrigerant is decompressed, flowing inside of the second capillary tube 42. At this time, the second capillary tube 42 generates heat, and the frost formed on the first evaporator 51 is removed by the heat since the second capillary tube 42 generating such heat is attached to the refrigerant pipe 51a of the first evaporator 51 as shown in Figures 2 and 3.

[0044] The refrigerant decompressed in the second capillary tube 42 is introduced into the second evaporator 52, and then evaporated. At this time, cool air is generated in the vicinity of the second evaporator 52 by the absorption of the latent heat, and the gaseous refrigerant evaporated in the second evaporator 52 returns to the compressor 10.

[0045] In the cooling system according to the present embodiment, the first circulation and the second circulation take turns circulating as the flowing direction of the refrigerant is controlled by the switching valve 30.

[0046] Further, the heat of the first capillary tube 41 generated during the first circulation defrosts the second evaporator 52, and the heat of the second capillary tube 42 generated during the second circulation defrosts the first evaporator 51.

[0047] According to the above-described embodiment of the present invention, because the evaporators 51, 52 are defrosted without an extra defrosting heater during the first and the second circulation, loss of general efficiency of the cooling system and increase of electric power consumption by the heat of the defrosting heater can be minimized. Also, the cooling system according to the described embodiment of the present invention may be employed in various sectors including a refrigerator, an air conditioner, etc.

[0048] In the foregoing embodiment, the first and second refrigerant expansion parts are described as the capillary tubes, and the solenoid valve is described as one example for the switching valve 30. However, it is to be understood that these are intended merely as non-limiting

examples.

[0049] In the foregoing embodiment, the refrigerant expansion parts and the evaporators are provided as a pair, respectively, but not limited thereto. Alternatively, the number of the refrigerant expansion parts and the evaporators may vary. Also, in the foregoing embodiment, each of the evaporators is provided with the refrigerant expansion parts. Alternatively, the refrigerant expansion parts may be provided in only one of a pair of evaporators.

[0050] Although a few preferred embodiments have been shown and described, it will be appreciated by those skilled in the art that various changes and modifications

might be made without departing from the scope of the invention, as defined in the appended claims.

[0051] Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0052] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0053] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0054] The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. A cooling system including a compressor (10) compressing a refrigerant and a condenser (60) condensing the compressed refrigerant, comprising:

   an evaporator section (51, 52) having a plurality of evaporators (51, 52) evaporating the refrigerant condensed in the condenser (60);
   a switching valve (30) on a refrigerant line between the condenser (60) and the evaporator, and selectively switching a refrigerant supply to the plurality of evaporators (51, 52); and
   a refrigerant expansion part (41, 42) adjacent to at least one of the evaporators (51, 52), allowing refrigerant introduced into the plurality of evaporators (51, 52) through the switching valve (30) to expand,
   wherein a refrigerant inlet of the refrigerant expansion part (41, 42) adjacent to any of the evaporators (51, 52) is connected to the switching valve (30), and a refrigerant outlet thereof is connected to an inlet of another evaporator (51, 52).

2. The cooling system according to claim 1, wherein each of the evaporators (51, 52) includes a refrigerant pipe (51a) and a plurality of fins (51b) disposed transversely to a lengthwise direction of the refrigerant pipe (51a), and the refrigerant expansion part (41, 42) is disposed along each of the refrigerant pipes (51a).

3. The cooling system according to claim 1, wherein each of the evaporators (51, 52) includes a refrigerant pipe (51a) and a plurality of fins (51b) disposed transversely to a lengthwise direction of the refrigerant pipe (51a), and the refrigerant expansion part (41, 42) is disposed in parallel with each of the refrigerant pipes (51a) .

4. The cooling system according to claim 1, 2 or 3, wherein the refrigerant expansion part (41, 42) is a capillary tube.

5. The cooling system according to any preceding claim, wherein the switching valve (30) is a solenoid valve.

6. A cooling system including a compressor (10) compressing a refrigerant and a condenser (60) condensing the compressed refrigerant, comprising:

   an evaporator (51, 52) having a first evaporating part (51) and a second evaporating part (52) evaporating the condensed refrigerant;
   a switching valve (30) on a refrigerant line between the condenser (60) and the evaporator (51, 52), and selectively supplying refrigerant to the first evaporating part (51) and the second evaporating part (52);
   a first refrigerant expansion part (41) in at least a portion of the second evaporating part (52), and allowing the refrigerant introduced into the first evaporating part (51) through the switching valve (30) to expand; and
   a second refrigerant expansion part (42) provided in at least a portion of the first evaporating part (51), and allowing the refrigerant introduced into the second evaporating part (52) through the switching valve (30) to expand;
   wherein a first circulation in which the condensed refrigerant is supplied to the first evaporating part (51) through the first refrigerant expansion part (41), and a second circulation in which the refrigerant from the condenser (60) is introduced into the second evaporating part (52) through the second refrigerant expansion part (42), are selectively provided, and
   wherein the second evaporating part (52) is defrosted during the first circulation by heat from the first refrigerant expansion part (41), and the first evaporating part (51) is defrosted during the second circulation by heat from the second refrigerant expansion part (42).

7. The cooling system according to claim 6, wherein

the first and second evaporators (51, 52) each include a refrigerant pipe (51a) and a plurality of fins (51b) arranged transversely to a lengthwise direction of the refrigerant pipe (51a), and
the first and second refrigerant expansion parts (41, 42) are respectively provided along a surface of the refrigerant pipe (51a) of the first and second evaporators (51, 52).

8. The cooling system according to claim 6 or 7, wherein the first and second refrigerant expansion (41, 42) parts are capillary tubes.

9. The cooling system according to claim 6, 7 or 8, wherein the switching valve (30) is a solenoid valve.

10. A cooling system, comprising:

a first loop including a first refrigerant expansion section (41) allowing compressed refrigerant flowing therethrough to expand and a first evaporator (51) downstream of the first refrigerant expansion section (41) ; and
a second loop including a second refrigerant expansion section (42) allowing compressed refrigerant flowing therethrough to expand and a second evaporator (52) downstream of the second refrigerant expansion section (42),
wherein when compressed refrigerant flows through the first loop, the first refrigerant expansion section (41) is heated by the expansion of the refrigerant,
wherein when the compressed refrigerant flows through the second loop, the second refrigerant expansion section (42) is heated by the expansion of the refrigerant, and
wherein the first refrigerant expansion section (41) is proximate to the second evaporator (52) and the second refrigerant expansion section (42) is proximate to the first evaporator (51).

11. The cooling system of claim 10, wherein the compressed refrigerant is selectively and alternatingly supplied to the first and second loops.

12. A method of preventing frost on evaporators of a cooling system, comprising:

supplying compressed refrigerant to a first expansion section (41) allowing the compressed refrigerant to expand and heat the first expansion section (41) and then to a first evaporator (51) downstream of the first expansion section (41); and
supplying compressed refrigerant to a second expansion section (42) allowing the compressed refrigerant to expand and heat the second expansion section (42) and then to a second evaporator (52) downstream of the second expansion section (42),
wherein the first expansion section (41) is proximate to the second evaporator (52) and the second expansion section (42) is proximate to the first evaporator (51).

FIG. 1

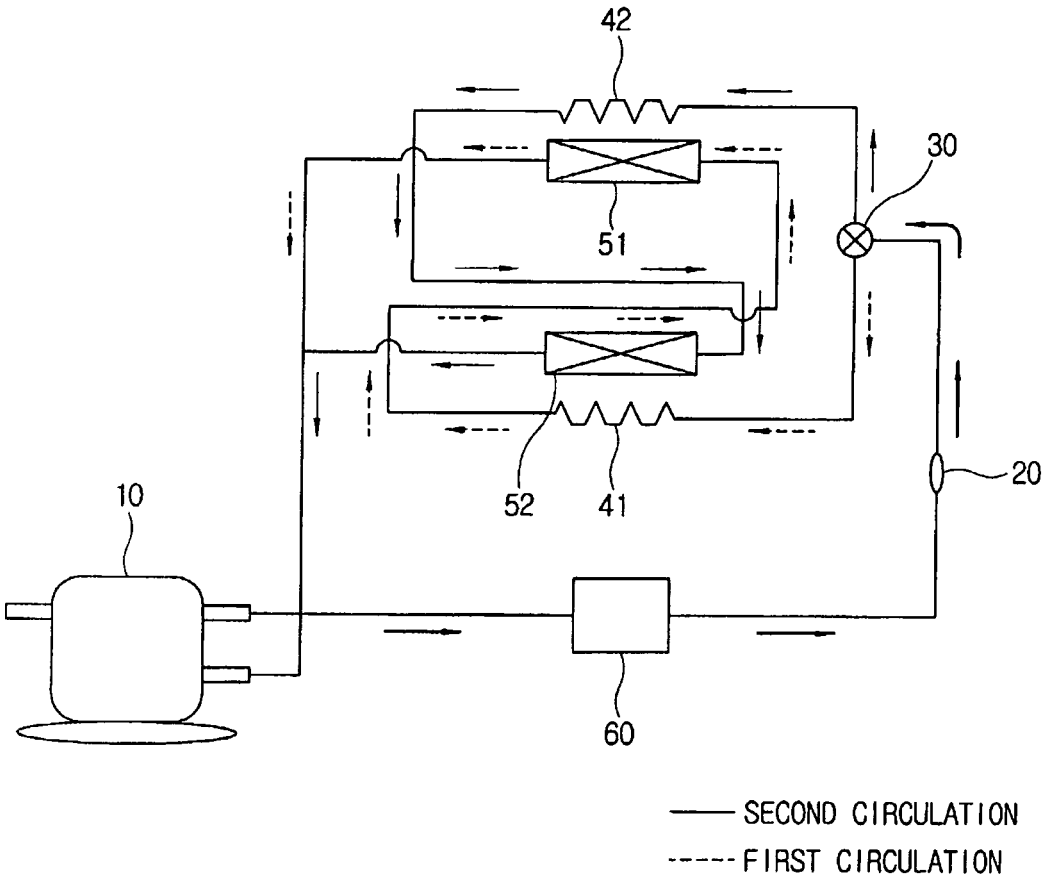

FIG. 2

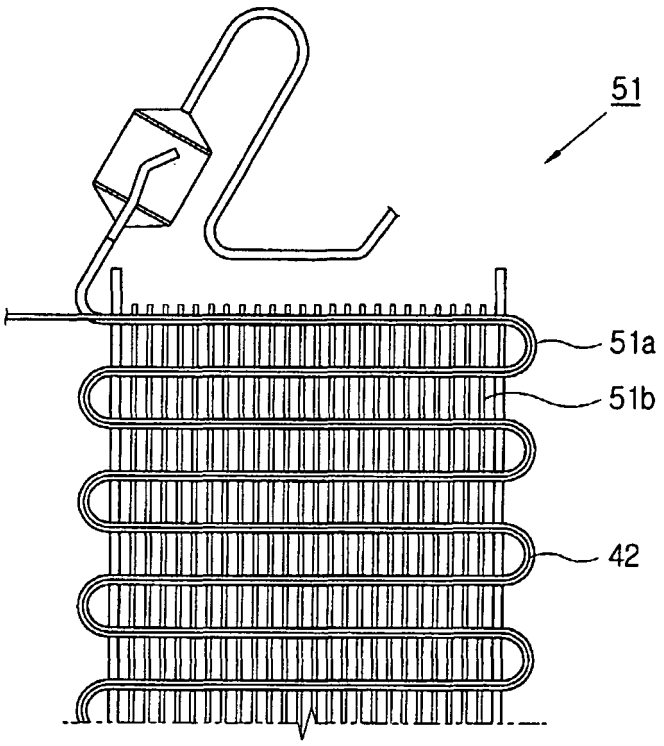

FIG. 3