



US 20130111943A1

(19) **United States**(12) **Patent Application Publication****Yoon et al.**(10) **Pub. No.: US 2013/0111943 A1**(43) **Pub. Date: May 9, 2013**(54) **NON-AZEOTROPIC MIXED REFRIGERANT CYCLE AND REFRIGERATOR EQUIPPED THEREWITH****Publication Classification**

(51) **Int. Cl.**
F25B 1/00 (2006.01)
(52) **U.S. Cl.**
USPC 62/498

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(21) Appl. No.: **13/661,662**

(22) Filed: **Oct. 26, 2012**

(30) **Foreign Application Priority Data**

Nov. 8, 2011 (KR) 10-2011-115819

(57) **ABSTRACT**

A non-azeotropic mixed refrigerant cycle and a refrigerator equipped with the same are disclosed. The non-azeotropic mixed refrigerant cycle includes a first refrigerant tube to guide a refrigerant from a condenser to a first evaporator, a second refrigerant tube to guide the refrigerant from the first evaporator to a second evaporator, a third refrigerant tube to guide the refrigerant from the second evaporator to a compressor. A downstream portion of the first refrigerant tube is arranged within the second refrigerant tube, to form a first heat exchanger having a double tube structure. An upstream portion of the first refrigerant tube is arranged within the third refrigerant tube, to form a second heat exchanger having a double tube structure. Thus, the first and second heat exchangers are simplified.

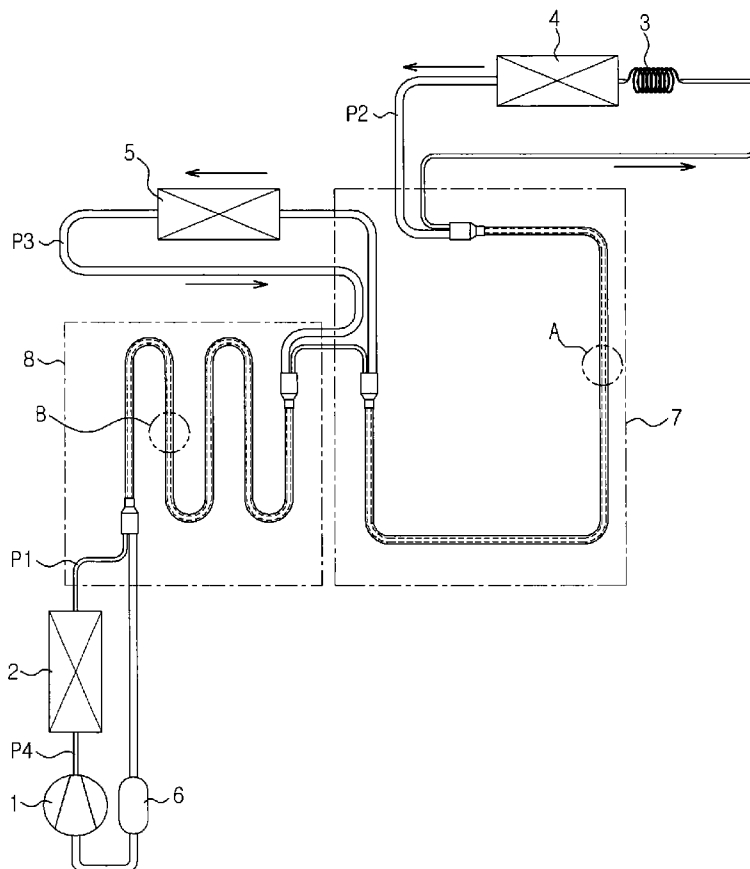


FIG. 1

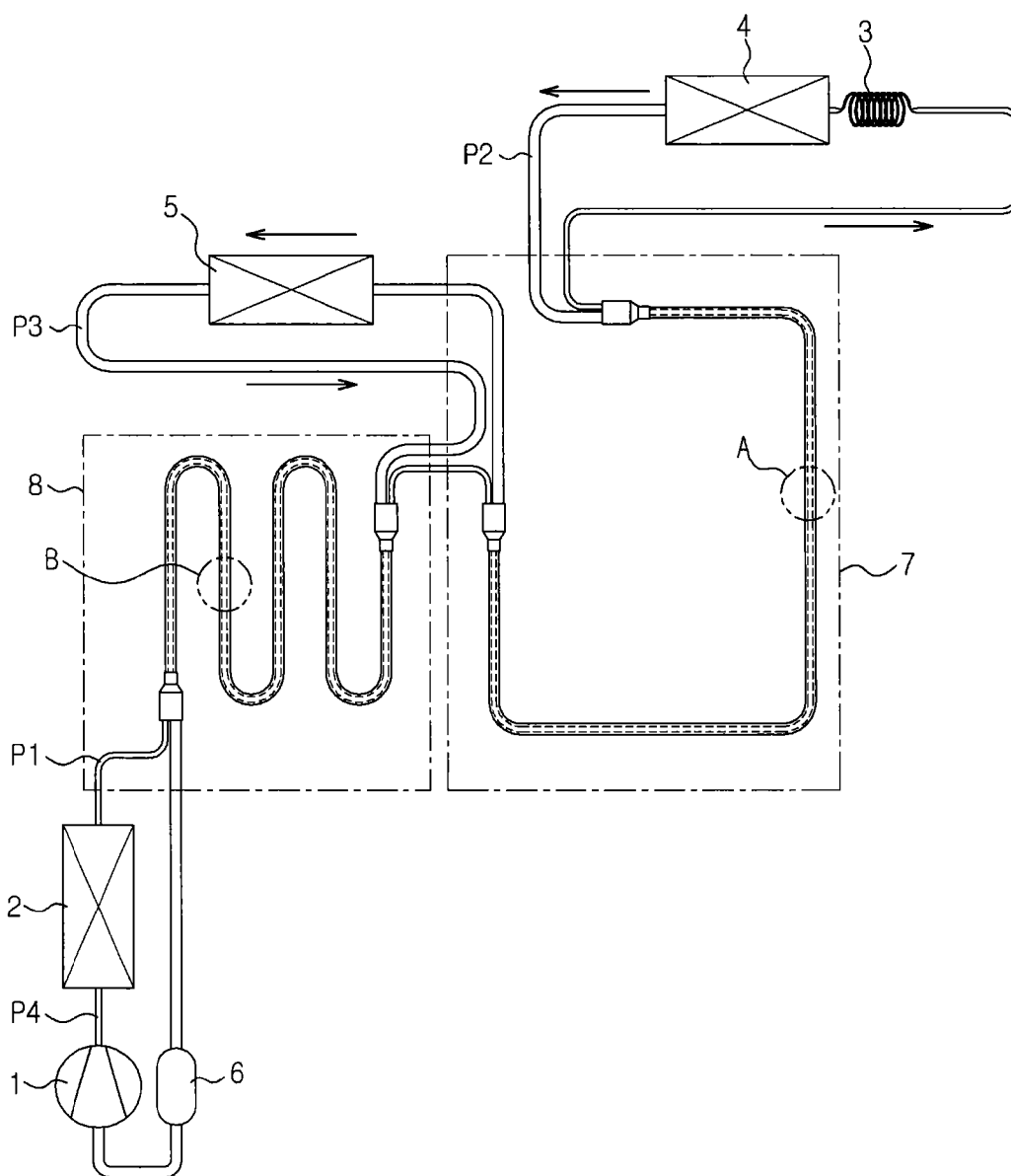


FIG. 2

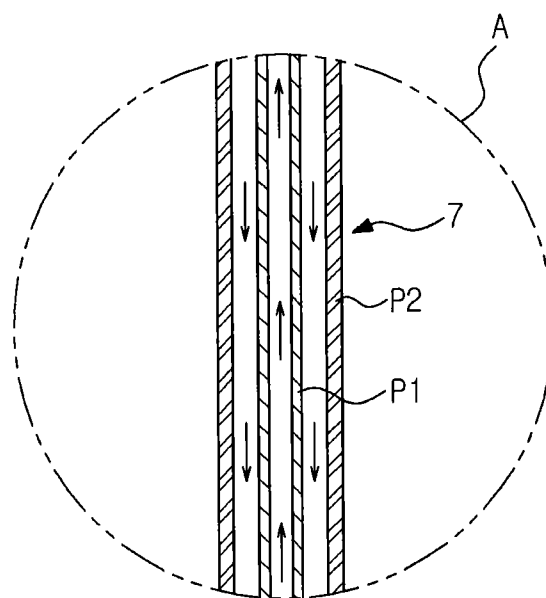
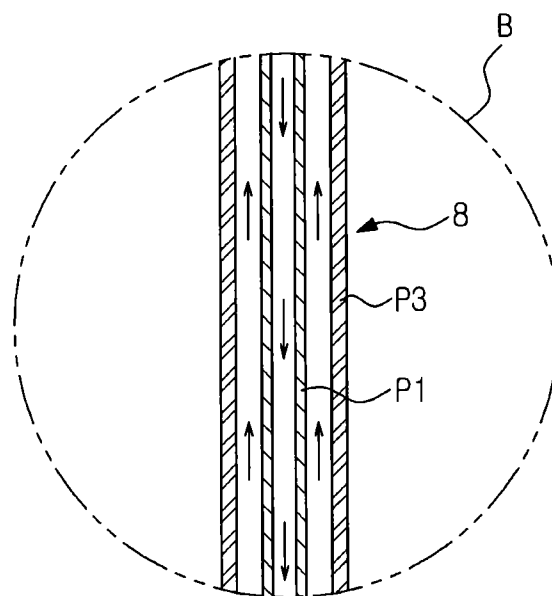


FIG. 3



NON-AZEOTROPIC MIXED REFRIGERANT CYCLE AND REFRIGERATOR EQUIPPED THEREWITH

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of Korean Patent Application No. 10-2011-115819, filed on Nov. 8, 2011 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND

[0002] 1. Field

[0003] Embodiments of the present disclosure relate to a non-azeotropic mixed refrigerant cycle using a non-azeotropic mixed refrigerant, and a refrigerator equipped with the same.

[0004] 2. Description of the Related Art

[0005] Generally, a refrigeration cycle includes a compressor to compress a refrigerant, a condenser to cool the refrigerant discharged from the compressor such that the refrigerant is condensed, an expansion valve to expand the refrigerant transferred from the condenser through pressure reduction, and an evaporator to cause the refrigerant expanded through pressure reduction to evaporate while absorbing heat.

[0006] When such a refrigeration cycle is applied to a refrigerator, cold air generated from the evaporator is supplied to freezing and refrigerating compartments of the refrigerator, to cool the freezing and refrigerating compartments. Since the freezing and refrigerating compartments are maintained at different temperatures, respectively, two evaporators are provided to separately cool the freezing and refrigerating compartments.

[0007] Of refrigeration cycles applicable to refrigerators, as mentioned above, there is a Lorenz-Meutzner (LM) cycle, which is a non-azeotropic mixed refrigerant cycle using a non-azeotropic mixed refrigerant. In addition to a configuration generally used in a general refrigeration cycle, namely, a compressor, a condenser, an expansion device, a first evaporator, and a second evaporator, the LM cycle includes a first heat exchanger to cause heat exchange between the refrigerant emerging from the condenser and the refrigerant emerging from the first evaporator, and a second heat exchanger to cause heat exchange between the refrigerant emerging from the condenser and the refrigerant emerging from the second evaporator. Thus, the LM cycle is a refrigeration cycle capable of achieving an enhancement in cooling performance. Meanwhile, the heat exchangers are provided as separate components in the LM cycle to be combined with various refrigerant tubes, and that causes the worsening of productivities and the increase of manufacturing costs.

SUMMARY

[0008] Therefore, it is an aspect of the present disclosure to provide a non-azeotropic mixed refrigerant cycle capable of simplifying configurations of first and second heat exchangers thereof, and a refrigerator equipped with the same.

[0009] Another aspect of the present disclosure is to provide a refrigerator capable of achieving more efficient heat exchange in first and second heat exchangers thereof.

[0010] Additional aspects of the disclosure will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the disclosure.

[0011] In accordance with one aspect of the present disclosure, a non-azeotropic mixed refrigerant cycle includes a compressor to compress a refrigerant, a condenser to cool the refrigerant discharged from the compressor after receiving the refrigerant, an expansion device to expand the refrigerant received from the condenser through pressure reduction, a first evaporator to evaporate the refrigerant emerging from the expansion device after receiving the refrigerant from the expansion device, a second evaporator to evaporate the refrigerant emerging from the first evaporator after receiving the refrigerant from the first evaporator, a first refrigerant tube to guide the refrigerant from the condenser to the first evaporator, a second refrigerant tube to guide the refrigerant from the first evaporator to the second evaporator, a third refrigerant tube to guide the refrigerant from the second evaporator to the compressor, and a first heat exchanger to cause heat exchange between a portion of the first refrigerant tube and the second refrigerant tube, wherein the first heat exchanger is formed as a single unit with the first refrigerant tube and the second refrigerant tube. The first heat exchanger may be formed with a double tube structure in which the first refrigerant tube is arranged within the second refrigerant tube.

[0012] The refrigerant, which passes through the first refrigerant tube, and the refrigerant, which passes through the second refrigerant tube, may pass through the first heat exchanger in opposite directions, respectively.

[0013] The non-azeotropic mixed refrigerant cycle may further include a second heat exchanger to cause heat exchange between a portion of the first refrigerant tube and the third refrigerant tube, wherein the second heat exchanger is formed as a single unit with the first refrigerant tube and the third refrigerant tube. The second heat exchanger may be formed with a double tube structure in which the first refrigerant tube is arranged within the third refrigerant tube. The first heat exchanger and the second heat exchanger may be formed as a single unit with the first refrigerant tube, the second refrigerant tube, and the third refrigerant tube.

[0014] The refrigerant, which passes through the first refrigerant tube, and the refrigerant, which passes through the third refrigerant tube, may pass through the second heat exchanger in opposite directions, respectively.

[0015] The expansion device may be integrated with a portion of the first refrigerant tube arranged at a side of the evaporator.

[0016] The non-azeotropic mixed refrigerant cycle may further include an accumulator integrated with a portion of the third refrigerant tube arranged at a side of the compressor.

[0017] In accordance with one aspect of the present disclosure, a non-azeotropic mixed refrigerant cycle includes a compressor to compress a refrigerant, a condenser to cool the refrigerant discharged from the compressor after receiving the refrigerant, an expansion device to expand the refrigerant received from the condenser through pressure reduction, a first evaporator to evaporate the refrigerant emerging from the expansion device after receiving the refrigerant from the expansion device, a second evaporator to evaporate the refrigerant emerging from the first evaporator after receiving the refrigerant from the first evaporator, a first refrigerant tube to guide the refrigerant from the condenser to the first evaporator, a second refrigerant tube to guide the refrigerant from the

first evaporator to the second evaporator, a third refrigerant tube to guide the refrigerant from the second evaporator to the compressor, and a heat exchanger to cause heat exchange between a portion of the first refrigerant tube and the third refrigerant tube, wherein the heat exchanger is formed as a single unit with the first refrigerant tube and the third refrigerant tube. The first heat exchanger may be formed with a double tube structure in which the first refrigerant tube is arranged within the third refrigerant tube.

[0018] In accordance with another aspect of the present disclosure, a refrigerator includes freezing and refrigerating compartments, a compressor to compress a refrigerant, a condenser to cool the refrigerant discharged from the compressor after receiving the refrigerant, a first evaporator to cool the freezing compartment, a second evaporator to cool the refrigerating compartment, a first refrigerant tube to guide the refrigerant from the condenser to the first evaporator, a second refrigerant tube to guide the refrigerant from the first evaporator to the second evaporator, a third refrigerant tube to guide the refrigerant from the second evaporator to the compressor, a first heat exchanger to cause heat exchange between a downstream portion of the first refrigerant tube and the second refrigerant tube, a second heat exchanger to cause heat exchange between an upstream portion of the first refrigerant tube and the third refrigerant tube, wherein the first heat exchanger and the second heat exchanger are formed as a single unit with the first refrigerant tube, the second refrigerant tube, and the third refrigerant tube. The first heat exchanger may be formed with a double tube structure in which the first refrigerant tube is arranged within the second refrigerant tube.

[0019] The refrigerant, which passes through the first refrigerant tube, and the refrigerant, which passes through the second refrigerant tube, may pass through the first heat exchanger in opposite directions, respectively.

[0020] The second heat exchanger may be formed with a double tube structure in which the first refrigerant tube is arranged within the third refrigerant tube. The first heat exchanger and the second heat exchanger may be formed as a single unit with the first refrigerant tube, the second refrigerant tube, and the third refrigerant tube.

[0021] The refrigerant, which passes through the first refrigerant tube, and the refrigerant, which passes through the third refrigerant tube, may pass through the second heat exchanger in opposite directions, respectively.

[0022] The expansion device may be integrated with a portion of the first refrigerant tube arranged at a side of the evaporator.

[0023] The refrigerator may further include an accumulator integrated with a portion of the third refrigerant tube arranged at a side of the compressor.

[0024] In accordance with another aspect of the present disclosure, a refrigerator includes freezing and refrigerating compartments, a compressor to compress a refrigerant, a condenser to cool the refrigerant discharged from the compressor after receiving the refrigerant, a first evaporator to cool the freezing compartment, a second evaporator to cool the refrigerating compartment, a first refrigerant tube to guide the refrigerant from the condenser to the first evaporator, a second refrigerant tube to guide the refrigerant from the first evaporator to the second evaporator, a third refrigerant tube to guide the refrigerant from the second evaporator to the compressor, a first heat exchanger to cause heat exchange between a downstream portion of the first refrigerant tube and the

second refrigerant tube, a second heat exchanger to cause heat exchange between an upstream portion of the first refrigerant tube and the third refrigerant tube, wherein the refrigerant, which passes through the first refrigerant tube, and the refrigerant, which passes through second refrigerant tube, pass through the first heat exchanger in opposite directions, respectively, and wherein the refrigerant, which passes through the first refrigerant tube, and the refrigerant, which passes through third refrigerant tube, pass through the second heat exchanger in opposite directions, respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] These and/or other aspects of the disclosure will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

[0026] FIG. 1 is a schematic view illustrating a non-azeotropic mixed refrigerant cycle according to an exemplary embodiment of the present disclosure;

[0027] FIG. 2 is an enlarged view of a portion A of FIG. 1; and

[0028] FIG. 3 is an enlarged view of a portion B of FIG. 1.

DETAILED DESCRIPTION

[0029] Hereinafter, a non-azeotropic mixed refrigerant cycle using a non-azeotropic mixed refrigerant according to an exemplary embodiment of the present disclosure will be described in detail with reference to the accompanying drawings.

[0030] The non-azeotropic mixed refrigerant cycle according to the illustrated embodiment of the present disclosure uses a mixed refrigerant containing a plurality of refrigerant elements. As shown in FIG. 1, the non-azeotropic mixed refrigerant cycle includes a compressor 1 to compress a refrigerant, a condenser 2 to cool the compressed refrigerant after receiving the refrigerant from the compressor 1, an expansion device 3 to expand the refrigerant discharged from the condenser 2 through pressure reduction, a first evaporator 4 to evaporate the expanded refrigerant after receiving the refrigerant from the expansion device 3, a second evaporator 5 to again evaporate the evaporated refrigerant after receiving the refrigerant from the first evaporator 4, and an accumulator 6 to prevent a liquid component of the refrigerant from being sucked into the compressor 1.

[0031] In the above-described configuration, the refrigerant expanded through pressure reduction by the expansion device 3 is first transferred to the first evaporator 4. As the refrigerant passes through the first evaporator 4, a portion of the refrigerant is evaporated. The resultant refrigerant is then transferred to the second evaporator 5. Thus, the first evaporator 4 receives a liquid-phase refrigerant, whereas the second evaporator 5 receives a refrigerant, a portion of which has been evaporated during passage thereof through the first evaporator 4, namely, a mixed refrigerant containing a gas-phase refrigerant and a liquid-phase refrigerant. Accordingly, the first evaporator 4 may perform cooling at a lower temperature than the second evaporator 5. Using such a concept, it may be possible to use the first evaporator 4 for cooling of a freezing compartment of a refrigerator and the second evaporator 5 for cooling of a refrigerating compartment of the refrigerator, which is to be maintained at a higher temperature than the freezing compartment.

[0032] The non-azeotropic mixed refrigerant cycle also includes a plurality of refrigerant tubes to connect the above-described constituent elements such that the refrigerant is circulated through the constituent elements via the refrigerant tubes. The plurality of refrigerant tubes may include a first refrigerant tube P1 to guide the refrigerant from the condenser 2 to the first evaporator 4, a second refrigerant tube P2 to guide the refrigerant from the first evaporator 4 to the second evaporator 5, a third refrigerant tube P3 to guide the refrigerant from the second evaporator 5 to the compressor 1, and a fourth refrigerant tube P4 to guide the refrigerant from the compressor 1 to the condenser 2.

[0033] The non-azeotropic mixed refrigerant cycle further includes a first heat exchanger 7 to cause heat exchange between the refrigerant condensed by the condenser 2 and the refrigerant emerging from the first evaporator 4, and a second heat exchanger 8 to cause heat exchange between the refrigerant condensed by the condenser 2 and the refrigerant emerging from the second evaporator 5. The first heat exchanger 7 causes heat exchange between a downstream portion of the first refrigerant tube P1 and the second refrigerant tube P2. The second heat exchanger 9 causes heat exchange between an upstream portion of the first refrigerant tube P1 and the third refrigerant tube P3.

[0034] In the illustrated embodiment, the first heat exchanger 7 is not provided as a separate component which needs to be connected to the first refrigerant tube P1 and the second refrigerant tube P2 respectively. The first heat exchanger 7 is formed with a double tube structure such that the first refrigerant tube P1 is arranged within the second refrigerant tube P2. The second heat exchanger 8 is formed in similar way to the first heat exchanger 7. The second heat exchanger 8 is formed with a double tube structure such that the first refrigerant tube P1 is arranged within the third refrigerant tube P3. Accordingly, the refrigerant, which passes through the first refrigerant tube P1, exchanges heat with the refrigerant passing through the third refrigerant tube P3 arranged outside the first refrigerant tube P1 and the refrigerant passing through the second refrigerant tube P2 arranged outside the first refrigerant tube P1 in a sequential manner. Thus, when each of the first and second heat exchangers 7 and 8 is configured to be formed with the refrigerant tubes themselves such as a double tube structure in which the second refrigerant tube P2 or third refrigerant tube P3 is arranged outside the first refrigerant tube P1 without providing further components for exchanging the heat between two different temperature refrigerants, it may be possible to simplify the configurations of the first and second heat exchangers 7 and 8. As a result, it may be possible to greatly reduce the space occupied by the first and second heat exchangers 7 and 8. Further, the first heat exchanger 7 and the second heat exchanger 8 may be integrally formed as a single unit according to the above mentioned structure. Meanwhile, the construction of the heat exchangers 7 or 8 is not limited to the double tube structure of the refrigerant tubes. The first and second heat exchangers 7 or 8 may be formed as a single unit with the refrigerant tubes P1 and P2 or refrigerant tubes P1 and P3 in parallel. As long as the heat can be exchanged directly by the refrigerant tubes themselves, any structures of the heat exchangers 7 or 8 may be adopted.

[0035] The expansion device 3 may be constituted by a capillary tube integrated with a portion of the first refrigerant tube P1 arranged at the side of the first evaporator 4. Also, the accumulator 6 may be integrated with a portion of the third

refrigerant tube P3 arranged at the side of the compressor 1. In this case, it may be possible to unify the first heat exchanger 7, second heat exchanger 8, expansion device 3 and accumulator 6 through the first refrigerant tube P1, second refrigerant tube P2 and third refrigerant tube P3 in the form of a single unit. Accordingly, the configuration of the non-azeotropic mixed refrigerant cycle may be further simplified.

[0036] In the illustrated embodiment, the refrigerant passing through the first refrigerant tube P1 and the refrigerant passing through the second refrigerant tube P2 pass through the first heat exchanger 7 in opposite directions, respectively, as shown in FIG. 2. On the other hand, the refrigerant passing through the first refrigerant tube P1 and the refrigerant passing through the third refrigerant tube P3 pass through the first heat exchanger 7 in opposite directions, respectively, as shown in FIG. 3. Accordingly, the refrigerant passing through the first refrigerant tube P1 may more efficiently exchange heat with the refrigerant passing through the second refrigerant tube P2 in the first heat exchanger 7 and the refrigerant passing through the third refrigerant tube P2 in the second heat exchanger 8.

[0037] Hereinafter, operation of the non-azeotropic mixed refrigerant cycle configured as described above and operation of a refrigerator equipped with the non-azeotropic mixed refrigerant cycle will be described with reference to FIG. 1.

[0038] First, the refrigerant is compressed in accordance with operation of the compressor 1. The compressed refrigerant is transferred to the condenser 2 via the fourth refrigerant tube P4. In the condenser 2, the refrigerant is cooled such that it is condensed into a liquid phase. Thereafter, the refrigerant is transferred from the condenser 2 to the first evaporator 4 via the first refrigerant tube P1. During passage thereof through the first refrigerant tube P1, the refrigerant is expanded through pressure reduction while passing through the expansion device 3 provided at the first refrigerant tube P1. After expansion, the refrigerant is transferred to the first evaporator 4. When the refrigerant passes through the first evaporator 4, it absorbs heat, such that a portion thereof is evaporated. Since the first evaporator 4 is arranged in a freezing compartment of the refrigerator, as described above, the refrigerant absorbs heat from the freezing compartment.

[0039] Since the refrigerant is partially evaporated during passage thereof through the first evaporator 4, it is transferred to the second evaporator 5 in the form of a mixture of a liquid-phase refrigerant and a gas-phase refrigerant. In the second evaporator 5, the liquid component of the refrigerant is evaporated while absorbing heat. Since the second evaporator 5 is arranged in a refrigerating compartment of the refrigerator, as described above, the refrigerant absorbs heat from the refrigerating compartment.

[0040] The refrigerant emerging from the second evaporator 5 is transferred to the compressor 1 via the third refrigerant tube P3. Since the accumulator 6 is arranged in the third refrigerant tube P3, as described above, the liquid component of the refrigerant, which is sucked into the compressor 1, is separated from the refrigerant such that only the gas-phase refrigerant is sucked into the compressor 1.

[0041] During the above-described refrigerant circulation, the refrigerant, which passes through the first refrigerant tube P1, is cooled in a sequential manner while sequentially passing through the first and second heat exchangers 7 and 8. Accordingly, the refrigerant is transferred to the expansion device 3 in a state of being cooled to a further reduced temperature. As a result, the refrigerant expanded through pres-

sure reduction while passing through the expansion device 3 enters a state capable of absorbing a further increased amount of heat. Thus, it may be possible to enhance the cooling performances of the first and second evaporators 4 and 5.

[0042] During passage thereof through the first heat exchanger 7, the refrigerant, which passes through the second refrigerant tube P2, absorbs heat from the refrigerant passing through the first refrigerant tube P1. Accordingly, the temperature of the refrigerant introduced into the second evaporator 5 is increased. Thus, it may be possible to reduce irreversible loss that may occur when the refrigerant is supplied to the second evaporator 5 at low temperature.

[0043] During passage thereof through the second heat exchanger 8, the refrigerant, which passes through the third refrigerant tube P3, is heated while absorbing heat from the refrigerant passing through the first refrigerant tube P1. Accordingly, the liquid component of the refrigerant, which is still in a liquid phase without being evaporated even after passage thereof through the second evaporator 5, is evaporated while passing through the second heat exchanger 8. Thus, the amount of a liquid refrigerant transferred to the compressor 1 is reduced.

[0044] As apparent from the above description, in the non-azeotropic mixed refrigerant cycle according to the illustrated embodiment of the present disclosure and the refrigerator equipped with the non-azeotropic mixed refrigerant cycle, each of the first and second heat exchangers is constituted by refrigerant tubes having a double tube structure or being formed as a single unit. Accordingly, the configuration of the non-azeotropic mixed refrigerant cycle is simplified.

[0045] Meanwhile, the refrigerant passing through the first refrigerant tube and the refrigerant passing through the second refrigerant tube pass through the first heat exchanger in opposite directions, respectively. Also, the refrigerant passing through the first refrigerant tube and the refrigerant passing through the third refrigerant tube pass through the first heat exchanger in opposite directions, respectively. Accordingly, the refrigerant passing through the first refrigerant tube P1 may more efficiently exchange heat with the refrigerant passing through the second refrigerant tube P2 and the refrigerant passing through the third refrigerant tube P3.

[0046] Although a few embodiments of the present disclosure have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the disclosure, the scope of which is defined in the claims and their equivalents.

What is claimed is:

1. A non-azeotropic mixed refrigerant cycle comprising:
 - a compressor to compress a refrigerant;
 - a condenser to cool the refrigerant discharged from the compressor after receiving the refrigerant;
 - an expansion device to expand the refrigerant received from the condenser through pressure reduction;
 - a first evaporator to evaporate the refrigerant emerging from the expansion device after receiving the refrigerant from the expansion device;
 - a second evaporator to evaporate the refrigerant emerging from the first evaporator after receiving the refrigerant from the first evaporator;
 - a first refrigerant tube to guide the refrigerant from the condenser to the first evaporator;
 - a second refrigerant tube to guide the refrigerant from the first evaporator to the second evaporator;

a third refrigerant tube to guide the refrigerant from the second evaporator to the compressor; and

a first heat exchanger to cause heat exchange between a portion of the first refrigerant tube and the second refrigerant tube,

wherein the first heat exchanger is formed as a single unit with the first refrigerant tube and the second refrigerant tube.

2. The non-azeotropic mixed refrigerant cycle according to claim 1, wherein the refrigerant, which passes through the first refrigerant tube, and the refrigerant, which passes through the second refrigerant tube, pass through the first heat exchanger in opposite directions, respectively.

3. The non-azeotropic mixed refrigerant cycle according to claim 1, further comprising:

a second heat exchanger to cause heat exchange between a portion of the first refrigerant tube and the third refrigerant tube,

wherein the second heat exchanger is formed as a single unit with the first refrigerant tube and the third refrigerant tube.

4. The non-azeotropic mixed refrigerant cycle according to claim 3, wherein the refrigerant, which passes through the first refrigerant tube, and the refrigerant, which passes through the third refrigerant tube, pass through the second heat exchanger in opposite directions, respectively.

5. The non-azeotropic mixed refrigerant cycle according to claim 1, wherein the expansion device is integrated with a portion of the first refrigerant tube arranged at a side of the evaporator.

6. The non-azeotropic mixed refrigerant cycle according to claim 1, further comprising:

an accumulator integrated with a portion of the third refrigerant tube arranged at a side of the compressor.

7. The non-azeotropic mixed refrigerant cycle according to claim 1, the first heat exchanger is formed with a double tube structure in which the first refrigerant tube is arranged within the second refrigerant tube.

8. The non-azeotropic mixed refrigerant cycle according to claim 3, the second heat exchanger is formed with a double tube structure in which the first refrigerant tube is arranged within the third refrigerant tube.

9. The non-azeotropic mixed refrigerant cycle according to claim 3, wherein the first heat exchanger and the second heat exchanger are formed as a single unit with the first refrigerant tube, the second refrigerant tube, and the third refrigerant tube.

10. A non-azeotropic mixed refrigerant cycle comprising:

- a compressor to compress a refrigerant;

a condenser to cool the refrigerant discharged from the compressor after receiving the refrigerant;

an expansion device to expand the refrigerant received from the condenser through pressure reduction;

a first evaporator to evaporate the refrigerant emerging from the expansion device after receiving the refrigerant from the expansion device;

a second evaporator to evaporate the refrigerant emerging from the first evaporator after receiving the refrigerant from the first evaporator;

a first refrigerant tube to guide the refrigerant from the condenser to the first evaporator;

a second refrigerant tube to guide the refrigerant from the first evaporator to the second evaporator;

a third refrigerant tube to guide the refrigerant from the second evaporator to the compressor; and
 a heat exchanger to cause heat exchange between a portion of the first refrigerant tube and the third refrigerant tube, wherein the heat exchanger is formed as a single unit with the first refrigerant tube and the third refrigerant tube.

11. The non-azeotropic mixed refrigerant cycle according to claim **10**, the heat exchanger is formed with a double tube structure in which the first refrigerant tube is arranged within the third refrigerant tube.

12. A refrigerator comprising:

freezing and refrigerating compartments;
 a compressor to compress a refrigerant;
 a condenser to cool the refrigerant discharged from the compressor after receiving the refrigerant;
 a first evaporator to cool the freezing compartment;
 a second evaporator to cool the refrigerating compartment;
 a first refrigerant tube to guide the refrigerant from the condenser to the first evaporator;
 a second refrigerant tube to guide the refrigerant from the first evaporator to the second evaporator;
 a third refrigerant tube to guide the refrigerant from the second evaporator to the compressor;
 a first heat exchanger to cause heat exchange between a downstream portion of the first refrigerant tube and the second refrigerant tube;
 a second heat exchanger to cause heat exchange between an upstream portion of the first refrigerant tube and the third refrigerant tube,
 wherein the first heat exchanger and the second heat exchanger are formed as a single unit with the first refrigerant tube, the second refrigerant tube, and the third refrigerant tube.

13. The refrigerator according to claim **12**, wherein the refrigerant, which passes through the first refrigerant tube, and the refrigerant, which passes through the second refrigerant tube, pass through the first heat exchanger in opposite directions, respectively.

14. The refrigerator according to claim **12**, wherein the first heat exchanger is formed with a double tube structure in which the first refrigerant tube is arranged within the second refrigerant tube, and the second heat exchanger is formed with a double tube structure in which the first refrigerant tube is arranged within the third refrigerant tube.

15. The refrigerator according to claim **12**, wherein the refrigerant, which passes through the first refrigerant tube, and the refrigerant, which passes through the third refrigerant tube, pass through the second heat exchanger in opposite directions, respectively.

16. The refrigerator according to claim **12**, wherein the expansion device is integrated with a portion of the first refrigerant tube arranged at a side of the evaporator.

17. The refrigerator according to claim **12**, further comprising:

an accumulator integrated with a portion of the third refrigerant tube arranged at a side of the compressor.

18. The refrigerator according to claim **12**, wherein the first heat exchanger and the second heat exchanger are formed as a single unit with the first refrigerant tube, the second refrigerant tube, and the third refrigerant tube.

19. A refrigerator comprising:

freezing and refrigerating compartments;
 a compressor to compress a refrigerant;
 a condenser to cool the refrigerant discharged from the compressor after receiving the refrigerant;
 a first evaporator to cool the freezing compartment;
 a second evaporator to cool the refrigerating compartment;
 a first refrigerant tube to guide the refrigerant from the condenser to the first evaporator;
 a second refrigerant tube to guide the refrigerant from the first evaporator to the second evaporator;
 a third refrigerant tube to guide the refrigerant from the second evaporator to the compressor;
 a first heat exchanger to cause heat exchange between a downstream portion of the first refrigerant tube and the second refrigerant tube;
 a second heat exchanger to cause heat exchange between an upstream portion of the first refrigerant tube and the third refrigerant tube,

wherein the refrigerant, which passes through the first refrigerant tube, and the refrigerant, which passes through second refrigerant tube, pass through the first heat exchanger in opposite directions, respectively, and wherein the refrigerant, which passes through the first refrigerant tube, and the refrigerant, which passes through third refrigerant tube, pass through the second heat exchanger in opposite directions, respectively.

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