(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 818 809 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
31.12.2014 Bulletin 2015/01

(51) Int Cl.:
F25B 39/04 *(2006.01)*

(21) Application number: **14169553.6**

(22) Date of filing: **23.05.2014**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **26.06.2013 KR 20130073601**

(71) Applicant: **Samsung Electronics Co., Ltd**
Gyeonggi-do 443-742 (KR)

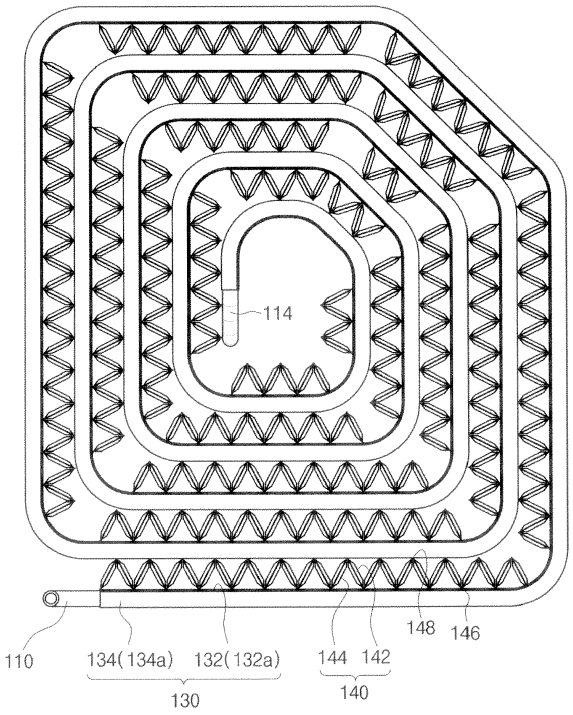
(72) Inventors:
- **KIM, Ki Hyun**
  Gwangju (KR)
- **KIM, Myoung Hun**
  Gwangju (KR)
- **YOON, Sinn Bong**
  Gwangju (KR)

(74) Representative: **Grünecker, Kinkeldey,**
Stockmair & Schwanhäusser
Leopoldstrasse 4
80802 München (DE)

(54) Condenser and refrigerator having the same

(57) A condenser and a refrigerator having the same, the condenser includes a refrigerant pipe, a plate fin coupled to one side portion of the refrigerant pipe, and a wave fin making contact with a rear surface of the plate fin. Through the structure as such, the condensation efficiency of the condenser may be enhanced, and furthermore, the condenser may be miniaturized, and thus is effective in utilizing space.

FIG. 7



EP 2 818 809 A2

Description

BACKGROUND

1. Field

[0001] The following description relates to a condenser and a refrigerator having the same, and more particularly, a condenser provided with an improved heat radiation structure and a refrigerator having the same.

2. Description of the Related Art

[0002] In general, a refrigerator represents a household appliance configured to store food in a fresh manner while provided with a storage compartment to store food, and a freezing apparatus to supply cool air to the storage compartment through a freezing cycle. The storage compartment is divided into a refrigerating compartment to store food in a refrigerated state and a freezing compartment to store food in a frozen state.

[0003] The freezing apparatus includes a compressor to compress refrigerant at high temperature and high pressure, a condenser to condense the compressed refrigerant in a liquid state, an expansion valve to expand the condensed refrigerant, and an evaporator to generate cool air by evaporating the refrigerant in a liquid state.

[0004] The condenser may release heat in a limited space, and thus an improvement of the structure of the condenser is desired.

SUMMARY

[0005] Therefore, it is an aspect of the present disclosure to provide a condenser having an enhanced condensing efficiency and having a compact size thereof, and a refrigerator having the same.

[0006] 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.

[0007] In accordance with an aspect of the present disclosure, a condenser includes a refrigerant pipe, a plate fin and a wave fin. The refrigerant pipe may have at least a portion thereof disposed along a first direction, and configured in a way that a refrigerant flows therethrough. The plate fin may be coupled to one side portion of the refrigerant pipe. The wave fin may be provided in a way to make contact with a rear surface of the plate fin, and formed along the first direction in a bent manner.

[0008] The first direction may include a direction having a spiral shape on a plurality of virtual surfaces provided in parallel to each other.

[0009] The refrigerant pipe may include an inlet part and an outlet part through which the refrigerant is introduced and discharged, and a main refrigerant pipe having both end portions thereof connected to the inlet part and the outlet part, respectively, and coupled to the plate fin.

[0010] The main refrigerant pipe may include heat radiating pipes formed along the first direction and a bent pipe connecting end portions of the heat radiating pipes.

[0011] The plate fin may include a lower plate provided with a groove formed along a path of the refrigerating pipe in a way that the refrigerant pipe is inserted thereinto, and an upper plate provided in a way to cover one surface of the lower plate into which the refrigerant pipe is inserted.

[0012] The heat radiating pipe may be inserted into the groove.

[0013] The wave fin may include a trough part and a crest part that are formed in a second direction perpendicular to the virtual surfaces, and disposed in a repeated manner along the first direction.

[0014] The plate fin may be provided with the shape of a barrel wound up in a direction that surrounds the wave fin.

[0015] The refrigerant pipe and the plate fin may include aluminum.

[0016] The plate fin and the wave fin may be coupled to each other through a brazing method.

[0017] In accordance with another aspect of the present disclosure, a refrigerator includes a body, a storage compartment and a freezing apparatus. The storage compartment may be formed inside the body. The freezing apparatus may have a compressor to compress refrigerant, a condenser to condense the refrigerant, an expansion valve to expand the refrigerant, and an evaporator to evaporate the refrigerant, and configured to supply cool air to the storage compartment. The condenser may include a refrigerant pipe through which the refrigerant flows, a plate fin coupled to one side portion of the refrigerant pipe, and a wave fin making contact with a rear surface of the plate fin, the condenser provided in the shape of a barrel formed in a wound-up manner to condense the refrigerant.

[0018] The refrigerant pipe may include an inlet part connected to the compressor and allowing the refrigerant to be introduced therethrough, an outlet part connected to the expansion valve and allowing the refrigerant to be discharged therethrough, and a main refrigerant pipe. The main refrigerant pipe may include heat radiating pipes provided in the form wound up in one direction with a gap of a first interval; and a bent pipe connecting end portions of each of the heat radiating pipes, the main refrigerant pipe having both end portions thereof connected to the inlet part and the outlet part, respectively, and coupled to the plate fin.

[0019] The plate fin and the wave fin may be formed between the gap of the first interval.

[0020] The plate fin may include an outer plate part having a groove in a way to surround at least a portion of the main refrigerant pipe, and an inner plate part making contact with the outer plate part and provided in a way to cover the groove.

[0021] The wave fin may be provided with a plurality

of trough parts and a plurality of crest parts that are repeatedly formed with respect to a direction along which the heat radiating pipes are wound up.

[0022] The wave fin may include a plurality of first wave surfaces and a plurality of second wave surfaces correspondingly disposed in a bent manner to form a zigzag in a direction along which the heat radiating pipes are wound up, and a plurality of trough parts and a plurality of crest part that are formed as the first wave surface and the second wave surface make contact with each other.

[0023] The trough part and the crest part may be provided to make contact with the plate fin.

[0024] A condenser in accordance with the present disclosure and a refrigerator having the same are provided with improved heat radiating efficiency, and thus a miniaturization thereof may be achieved while enhancing space efficiency.

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 embodiments, taken in conjunction with the accompanying drawings of which:

FIG. 1 is a drawing illustrating a refrigerator in accordance with an embodiment of the present disclosure.

FIG. 2 is a perspective view illustrating a condenser in accordance with an embodiment of the present disclosure.

FIG. 3 is a partially enlarged view of the condenser in accordance with an embodiment of the present disclosure.

FIG. 4 is an exploded perspective view of the condenser in accordance with an embodiment of the present disclosure.

FIG. 5 is a perspective view of a refrigerant pipe in accordance with an embodiment of the present disclosure.

FIG. 6 is a side view of the condenser in accordance with an embodiment of the present disclosure.

FIG. 7 is a cross-sectional view of the condenser taken with respect to a first virtual surface of FIG. 6 in accordance with an embodiment of the present disclosure.

FIG. 8 is a drawing showing a flow of refrigerant of the condenser in accordance with an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0026] Reference will now be made in detail to the embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like components throughout.

[0027] FIG. 1 is a drawing illustrating a refrigerator in accordance with an embodiment of the present disclosure.

[0028] Referring to FIG. 1, a refrigerator 1 in accordance with an embodiment of the present disclosure includes a body 2, a storage compartment 3 formed at an inside the body 2 to store food, and a freezing apparatus to supply cool air to the storage compartment 3.

[0029] The body 2 as such is provided with the approximate shape of a box having a front surface portion thereof open. The body 2 is provided with an upper wall 4, a bottom wall 5, a rear wall 6, and side walls 7.

[0030] The storage compartment 3 is provided in a way to have a front surface portion thereof open, and the open front surface portion of the storage compartment 3 is open/closed by a door 8. The door 8 is hinge-coupled to the body 2, and is able to rotate.

[0031] The freezing apparatus includes a compressor 10 configured to compress refrigerant at high temperature and high pressure, a condenser 100 configured to condense the refrigerant in a gas state into a liquid state, an expansion valve 30 configured to expand the refrigerant at low temperature and low pressure, an evaporator 40 configured to evaporate the refrigerant in a liquid state into a gas state, and a connecting pipe 20 to guide the refrigerant to pass through the above described components of the freezing apparatus.

[0032] The compressor 10 is configured to release heat to an outside as the temperature thereof is increased to a high level in the process of compressing refrigerant at high temperature and high pressure. In addition, the condenser 100 as well is configured to release condensed heat that is taken from the refrigerant to an outside.

[0033] The compressor 10 and the condenser 100 as such are disposed at a machinery compartment 50 formed at a lower portion at a rear portion of the body 2. In addition, at the machinery compartment 50, a blower fan 56 is disposed as the blower fan 56 is configured to cool the compressor 10 and the condenser 100 by forcedly circulating air.

[0034] The machinery compartment 50 is provided to be open at a rear surface portion thereof, and a cover 52 is coupled to the open rear surface portion to cover the open rear surface portion. At the cover 52, a ventilating port 54 is formed as the ventilating port 54 is configured in a way for air to flow by communicating an inside and an outside the machinery compartment 50 even after the cover 52 is coupled to the open rear surface portion of the machinery compartment 50.

[0035] Thus, as the blower fan 56 is rotated, air is in-

troduced to an inside the machinery compartment 50 through the ventilating port 54 of the cover 52, and the introduced air is discharged to an outside the machinery compartment 50 through the ventilating port 54 of the cover 52 again after cooling the compressor 10 and the condenser 100.

[0036] By the structure as the above, the compressor 10 and the condenser 100 at an inside the machinery compartment 50 are cooled, and the maintenance of the performance of the compressor 10 and the heat exchanging efficiency of the condenser 100 are improved .

[0037] However, as the size of the machinery compartment 50 is small, the size of the compressor 10 and the condenser 100 are limited, and thus the sufficient condensation of refrigerant is not performed as much as a freezing cycle is operated, and accordingly, a condenser having improved heat radiating efficiency may be needed.

[0038] FIG. 2 is a perspective view illustrating the condenser 100 in accordance with an embodiment of the present disclosure, FIG. 3 is a partially enlarged view of the condenser 100 in accordance with an embodiment of the present disclosure, FIG. 4 is an exploded perspective view of the condenser 100 in accordance with an embodiment of the present disclosure, FIG. 5 is a perspective view of a refrigerant pipe in accordance with an embodiment of the present disclosure, FIG. 6 is a side view of the condenser 100 in accordance with an embodiment of the present disclosure, and FIG. 7 is a cross-sectional view of the condenser 100 with respect to a first virtual surface on FIG. 6 in accordance with an embodiment of the present disclosure.

[0039] The condenser 100 is provided with a refrigerant pipe 110 having at least a portion disposed along a first direction 'W1', and allowing refrigerant to flow therethrough, a plate fin 130 coupled to one side portion of the refrigerant pipe 110, and a wave fin 140 making contact with a rear surface portion of the plate fin 130 and formed along the first direction 'W1' in a bent manner.

[0040] The condenser 100 includes the refrigerant pipe 110 and a heat radiating part 120.

[0041] The refrigerant pipe 110 is referred to as a pipe of the condenser 100 through which the refrigerant compressed at high temperature and high pressure is passed. The shape of the refrigerant pipe 110 is not limited hereto, but in the present disclosure, the refrigerant pipe 110 is implemented in bent shape in multiple times.

[0042] The refrigerant pipe 110 includes a main refrigerant pipe 112 referred to as a section coupled to the heat radiating part 120, which is to be described later, and allowing the heat of the refrigerant to be discharged while passing through the heat radiating part 120, and an inlet part 116 and an outlet part 118 configured for inlet/outlet of refrigerant to/from the main refrigerant pipe 112. The inlet part 116 and the outlet part 118 are connected to both end portions of the main refrigerant pipe 112, respectively, to allow the refrigerant flowing through the main refrigerant 112 to be introduced and discharged therethrough.

[0043] The main refrigerant pipe 112 includes a plurality of heat radiating pipes 113 provided along the first direction 'W1', and a bent pipe 114 extendedly formed from the heat radiating pipe 113 in a way to connect end portions of the heat radiating pipe 113.

[0044] As to be described hereinafter, in a case when the refrigerant pipe 110, the plate fin 130, and the wave fin 140 are provided in the shape of a wound-up barrel while having the refrigerant pipe 110, the plate fin 130, and for example the wave fin 140 disposed on top of one another, the heat radiating pipe 113 is provided with the shape of a spiral with respect to a first virtual surface 'P1', a second virtual surface 'P2', a third virtual surface 'P3', and a fourth virtual surface 'P4', while end portions of the heat radiating pipe 113 are connected by the bent pipe 114 so that refrigerant flows.

[0045] That is, the first virtual surface 'P1', the second virtual surface 'P2', the third virtual surface 'P3', and the fourth virtual surface 'P4' may be provided to be parallel to each other also while spaced apart with each other, and at each of the first virtual surface 'P1', the second virtual surface 'P2', the third virtual surface 'P3', and the fourth virtual surface 'P4', the heat radiating pipe 113 is disposed in the first direction 'W1'. The first direction 'W1' includes a direction having a spiral shape. Although as a non-limiting example, four virtual surfaces have been shown in FIG. 6, the present disclosure is not limited thereto. For example, one or more virtual surfaces may be used.

[0046] In a case when the heat radiating pipe 113 is wound in one direction, the heat radiating pipe 113 may be wound while having an interval of a first gap 'G1' with respect to each other. That is, the interval at which the heat radiating pipe 113 is wound in the shape of a spiral may be the first gap 'G1'.

[0047] The first gap 'G1' is not limited hereto, the plate fin 130 and the wave fin 140 are disposed between the interval of the first gap G1.

[0048] At end portions of the main refrigerant pipe 112, the inlet part 116 and the outlet part 118 are implemented, so that the refrigerant compressed by the compressor 10 is introduced through the inlet part 116 and is discharged to the expansion valve 30 through the outlet part 118. For the above, the inlet part 116 may be connected to the compressor 10 and the outlet part 118 may be connected to the expansion valve 30.

[0049] The heat radiating part 120 includes the plate fin 130 and the wave fin 140.

[0050] The plate fin 130 is structured in a way to be directly connected to the refrigerant pipe 110 to absorb the heat of the refrigerant that is passed through the refrigerant pipe 110.

[0051] The plate fin 130 includes an upper plate fin 134 and a lower plate fin 132.

[0052] The lower plate fin 132 includes a groove 133 corresponding to an outer circumferential surface portion of the refrigerant pipe 110, so that the refrigerant pipe

110 is inserted into the groove along a path of the refrigerant pipe 110.

[0053] The groove 133 may be implemented to correspond both of the heat radiating pipe 113 and the bent pipe 114, but in the present disclosure, the groove 133 is provided to correspond to the heat radiating pipe 113. Therefore, the groove 133 may be provided in at least two units thereof along the first direction 'W1' while corresponding to the heat radiating pipes 113.

[0054] As the main refrigerant pipe 112 is inserted into the groove 133, an upper portion thereof may be covered by the upper plate fin 134. One surface portion of the upper plate fin 134 may be provided to cover the lower plate fin 132 together with the groove 133 into which the main refrigerant pipe 112 is inserted.

[0055] An inner plate part 134a and an outer plate part 132a may be provided with structures identical to the upper plate fin 134 and the lower plate fin 132, respectively.

[0056] As described above, the outer plate part 132a corresponding to the lower plate fin 132 is provided with a groove 133 as to cover at least a portion of the main refrigerant pipe 112, and the inner plate part 134a corresponding to the upper plate fin 134 may be provided in a way to cover the groove 133 while making contact with the outer plate part 132a.

[0057] At a bottom surface portion of the upper plate fin 134, the wave fin 140 may be provided.

[0058] The wave fin 140 may have a plurality of first wave surfaces 142 and a plurality of second wave surfaces 144 that are correspondingly disposed in a bent manner to form a zigzag, and edge portions of the first wave surfaces 142 making contact with edge portion of the second wave surfaces 144 may form a crest part 148 and a trough part 146.

[0059] The first wave surface 14 and the second wave surface 144 may be formed in the shape of, for example a plane surface, but as to increase the heat radiating surface, as in an embodiment of the present disclosure, the first wave surface 14 and the second wave surface 144 are preferred to be formed in a bent manner.

[0060] The wave fin 140 is provided in a way to be bent so that the crest part 148 and the trough part 146 are repeated, and the crest part 148 may make contact with a lower portion of the lower plate fin 132 and the trough part 146 may make contact with an upper surface portion of the upper plate fin 134.

[0061] In detail, the crest part 148 and the trough part 146 may be provided to be disposed in a repeated manner in a plurality of times along the first direction 'W1', that is, the direction along which the heat radiating pipe 113 is wound. That is, the crest part 148 and the trough part 146 may be provided in a second direction 'W2' that is perpendicular to the first direction 'W1'.

[0062] The crest part 148 and the trough part 146 of the wave fin 140 are provided in the second direction 'W2' that is perpendicular to the first direction 'W1' so that the wave fin 140 may be wound while maintaining the crest part 148 and the trough part 146 when the refrigerant pipe 110 provided in the first direction 'W1' is wound up in the direction perpendicular to the plate fin 130.

[0063] In addition, through the structure as such, the air that passes through the wave fin 140 through the blower fan 56 may be guided through the crest part 148 and the trough part 146, and the structure as such may be able to enhance draft efficiency as the air is passed through in a direction perpendicular to the lengthways of the heat radiating pipe 113, and since the air being drafted may be concentrated in between the wave fin 140 and the plate fin 130, heat radiating efficiency may be enhanced.

[0064] The condenser 100 may be formed of material having superior heat conductivity to enhance heat radiating efficiency. The refrigerating pipe 110 and the plate fin 130 may be formed of aluminum material.

[0065] The above described components of the condenser 100 may be assembled through a brazing method as to prevent leaking of refrigerant. That is, the refrigerant pipe 110, the plate fin 130, and the wave fin 140 each may be coated with clad material for a brazing method.

[0066] Thus, the refrigerant pipe 110 is settled at the groove 133 of the lower plate fin 132, the upper plate fin 134 is covered on the lower plate fin 132, and the wave fin 140 is disposed at one surface of the upper plate fin 134 to be inserted into a brazing furnace, so that the condenser 100 may be assembled.

[0067] As the temporarily assembled condenser 100 is heated at the temperature of about 600□ and 700□ in the brazing furnace, the clad material coated on the each component is melt as the melted clad material seals the joint portions the each component and firmly places the components together. Thus, the joint portions of the each component may be formed while having a certain gap as to seal the gap by use of the melted clad material.

[0068] The structure of the condenser 100 in accordance with an embodiment of the present disclosure is not only applied to the condenser 100, but may be applied to the evaporator 40 as a heat exchanger, as well as to an air conditioner and a refrigerator.

[0069] Through the above, within the limited space of the machinery compartment 50, the heat radiating efficiency of the plurality of freezing cycles may be improved, and the energy that is consumed in heat radiation may be reduced.

[0070] Through the structure as such, the condenser 100 that includes the refrigerant pipe 110 and the heat radiating part 120 may be provided with the shape of, for example a barrel as the plate fin 130 is wound up in a direction that surrounds the wave fin 140.

[0071] That is, the plate fin 130 may be wound up in a perpendicular direction with respect to the first direction 'W1' at which the heat radiating pipe 113 is disposed, and in detail, the lower plate fin 132 may be wound up in a way that the lower plate fin 132 is disposed at an outside that surrounds the condenser 100.

[0072] The shape of a barrel may be formed in the shape of a body that is wound up in various shapes, such as the rectangular pillar shape as well as a cylindrical shape.

[0073] Within the limited space of the machinery compartment 50, the heat radiating efficiency of the condenser 100 may be needed to be improved as to dispose the miniaturized condenser 100.

[0074] While using the pipe-type refrigerant pipe 110 other than the tube-type refrigerant pipe 110 for the condenser 100 in the wound-up shape of a barrel, the structure is provided in a way that the wave fin 140 is disposed at a space in between the plate fins 130. Through the structure as such, by using the pipe-type refrigerant pipe 110, the controlling of the flow of refrigerant is convenient, and in addition, the refrigerant may be made to be evenly distributed, while the improved heat radiating effect may be achieved as the heat radiation is taken place by the wave fin 140 even in the space in between the plate fins 130.

[0075] Hereinafter, the condenser 100 having the structure as the above and the flow of refrigerant of a refrigerator having the condenser 100 as such will be described.

[0076] FIG. 8 is a drawing showing the flow of a refrigerant of the condenser 100 in accordance with an embodiment of the present disclosure.

[0077] The flow of refrigerant by the structures of the compressor 10, the condenser 100, the expansion valve 30, and the evaporator 40 is already described above and thus will be omitted, and the flow of the refrigerant at an inside the condenser 100 will be described.

[0078] First, the refrigerant introduced through the inlet part 116 is passed through the refrigerant pipe 113 disposed on the first virtual surface 'P1'. Then, after passing through the bent pipe 114 that connects the refrigerant pipe 113 on the first virtual surface 'P1' to the refrigerant pipe 113 on the second virtual surface 'P2', the refrigerant flows through the refrigerant pipe 113 disposed on the second virtual surface 'P2', and after passing through the bent pipe 114 connected to the refrigerant pipe 113 on the second virtual surface 'P2', the refrigerant flows through the refrigerant pipe 113 on the third virtual surface 'P3', Through the above the refrigerant that flows to the refrigerant pipe 113 on the fourth virtual surface 'P4' is released through the outlet part 118 and is communicated to the expansion valve 30.

[0079] During the process as the above, the refrigerant pipe 113 primarily delivers heat to the lower plate fin 132 and the upper plate fin 134 that surrounds the refrigerant pipe 113, and secondarily, the heat is delivered to the wave fin 140 making contact with the upper plate fin 134. During the heat-delivering process as such, by the flow of the air that passes by the side surface of the condenser 100, the heat may be discharged to an outside the condenser 100.

[0080] By having the wave fin 140 disposed in between the plate fins 130, the heat radiating surface is increased, and thus the heat radiating efficiency is enhanced, and even in a case of having the identical amount of heat radiation, the miniaturization of the condenser may be possible.

[0081] 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.

Claims

1. A condenser comprising:

a refrigerant pipe having at least a portion thereof disposed along a first direction, and configured so that a refrigerant flows therethrough;
a plate fin coupled to one side portion of the refrigerant pipe; and
a wave fin provided to make contact with a rear surface portion of the plate fin, and formed along the first direction in a bent manner,
wherein the refrigerant pipe comprises:

an inlet part and an outlet part through which the refrigerant is introduced and discharged; and
a main refrigerant pipe comprising heat radiating pipes formed along the first direction and a bent pipe connecting end portions of the heat radiating pipes, the main refrigerant pipe having both end portions thereof connected to the inlet part and the outlet part, respectively, and coupled to the plate fin.

2. The condenser of claim 1, wherein:

the first direction comprises a direction having a spiral shape on a plurality of virtual surfaces provided in parallel to each other.

3. The condenser of claim 1, wherein:

the plate fin comprises:

a lower plate provided with a groove formed along a path of the refrigerating pipe so that the refrigerant pipe is inserted thereinto; and
an upper plate provided to cover one surface portion of the lower plate into which the refrigerant pipe is inserted.

4. The condenser of claim 3, wherein:

the heat radiating pipe is inserted into the groove.

5. The condenser of claim 1, wherein:

the wave fin comprises a trough part and a crest part that are formed in a second direction perpendicular to the virtual surfaces, and disposed in a repeated manner along the first direction.

6. The condenser of claim 1, wherein:

the plate fin is provided with the shape of a barrel wound up in a direction that surrounds the wave fin.

7. The condenser of claim 1, wherein:

the refrigerant pipe and the plate fin include aluminum.

8. The condenser of claim 1, wherein:

the plate fin and the wave fin are coupled to each other through a brazing method.

9. A refrigerator, comprising:

a body;
a storage compartment formed inside the body; and
a freezing apparatus having a compressor to compress refrigerant, a condenser to condense the refrigerant, an expansion valve to expand the refrigerant, and an evaporator to evaporate the refrigerant, and configured to supply cool air to the storage compartment,
wherein the condenser comprises a refrigerant pipe through which the refrigerant flows, a plate fin coupled to one side portion of the refrigerant pipe, and a wave fin provided to make contact with a rear surface of the plate fin, the condenser provided in the shape of a barrel formed in a wound-up manner to condense the refrigerant, and
the refrigerant pipe comprises an inlet part connected to the compressor and allowing the refrigerant to be introduced therethrough; an outlet part connected to the expansion valve and allowing the refrigerant to be discharged therethrough; and a main refrigerant pipe comprising heat radiating pipes provided in the form wound up in one direction with a gap of a first interval; and a bent pipe to connect end portions of the heat radiating pipes, the main refrigerant pipe having both end portions thereof connected to the inlet part and the outlet part, respectively, and coupled to the plate fin.

10. The refrigerator of claim 9, wherein the plate fin and the wave fin are formed between the gap of the first interval.

11. The refrigerator of claim 9, wherein:

the plate fin comprises an outer plate part having a groove to surround at least a portion of the main refrigerant pipe; and an inner plate part making contact with the outer plate part and provided to cover the groove.

12. The refrigerator of claim 9, wherein:

the wave fin is provided with a plurality of trough parts and a plurality of crest parts repeatedly formed with respect to a direction along which the heat radiating pipes are wound up.

13. The refrigerator of claim 9, wherein:

the wave fin comprises a plurality of first wave surfaces and a plurality of second wave surfaces correspondingly disposed in a bent manner to form a zigzag in a direction along which the heat radiating pipes are wound up; and
a plurality of trough parts and a plurality of crest part formed as the first wave surface and the second wave surface make contact with each other.

14. The refrigerator of claim 13, wherein:

the trough part and the crest part are provided to make contact with the plate fin.

FIG. 1

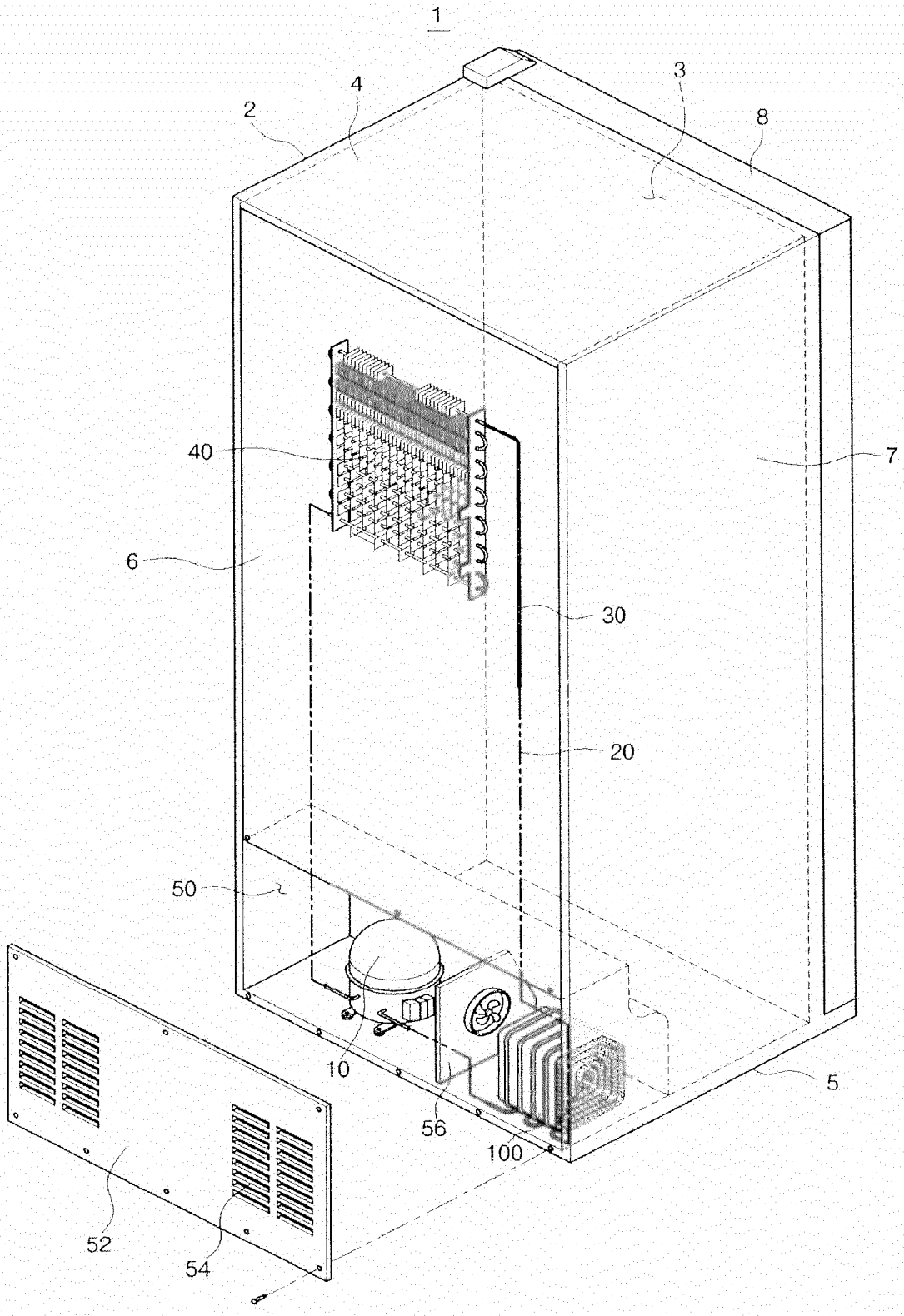


FIG. 2

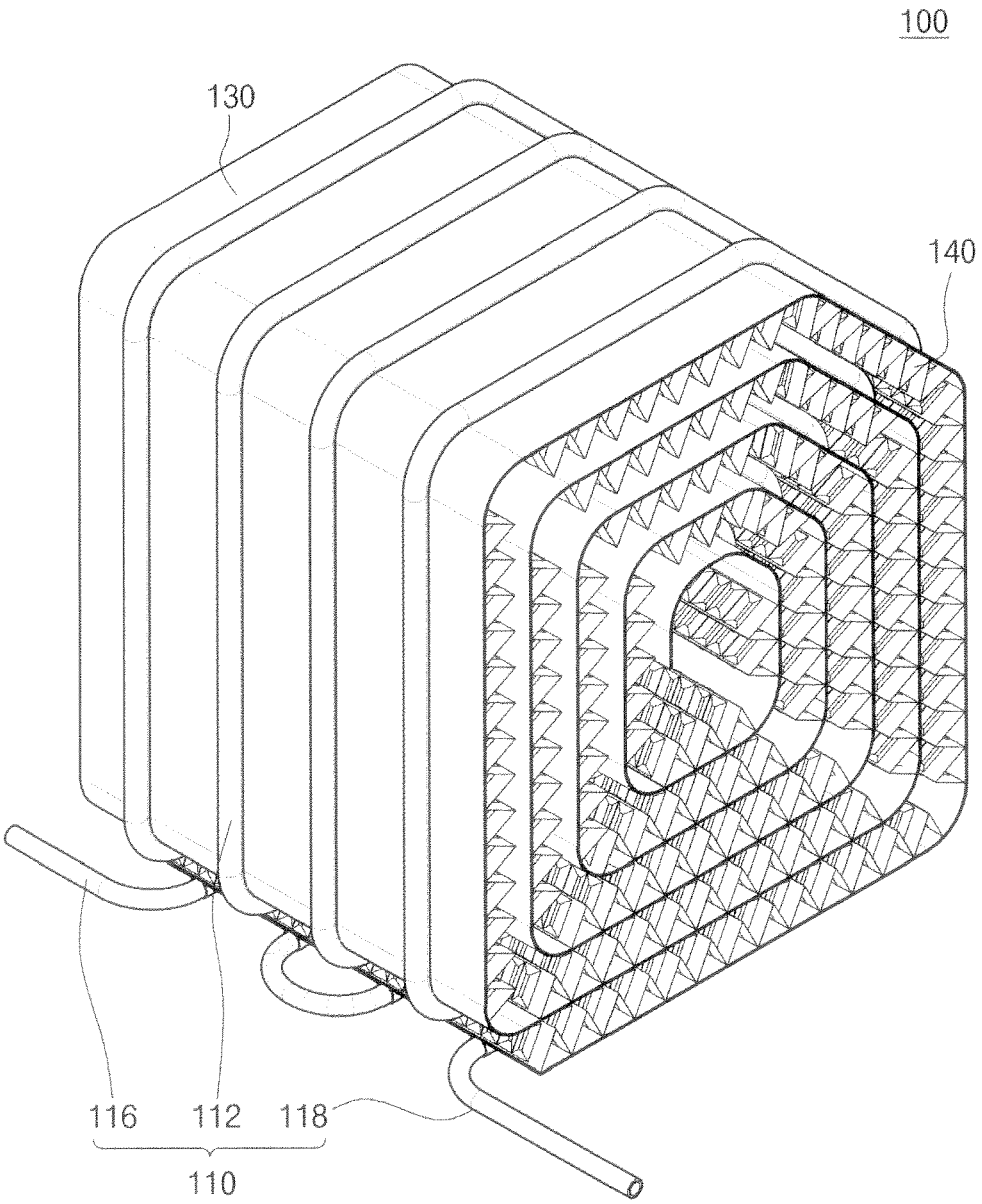


FIG. 3

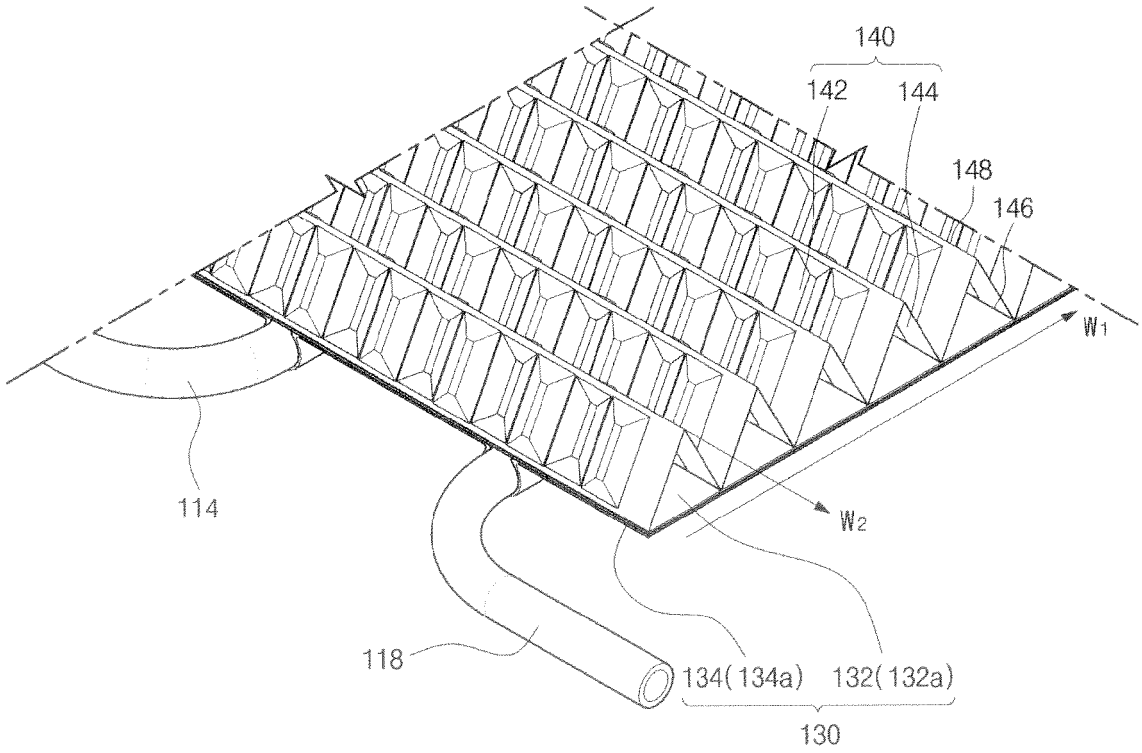


FIG. 4

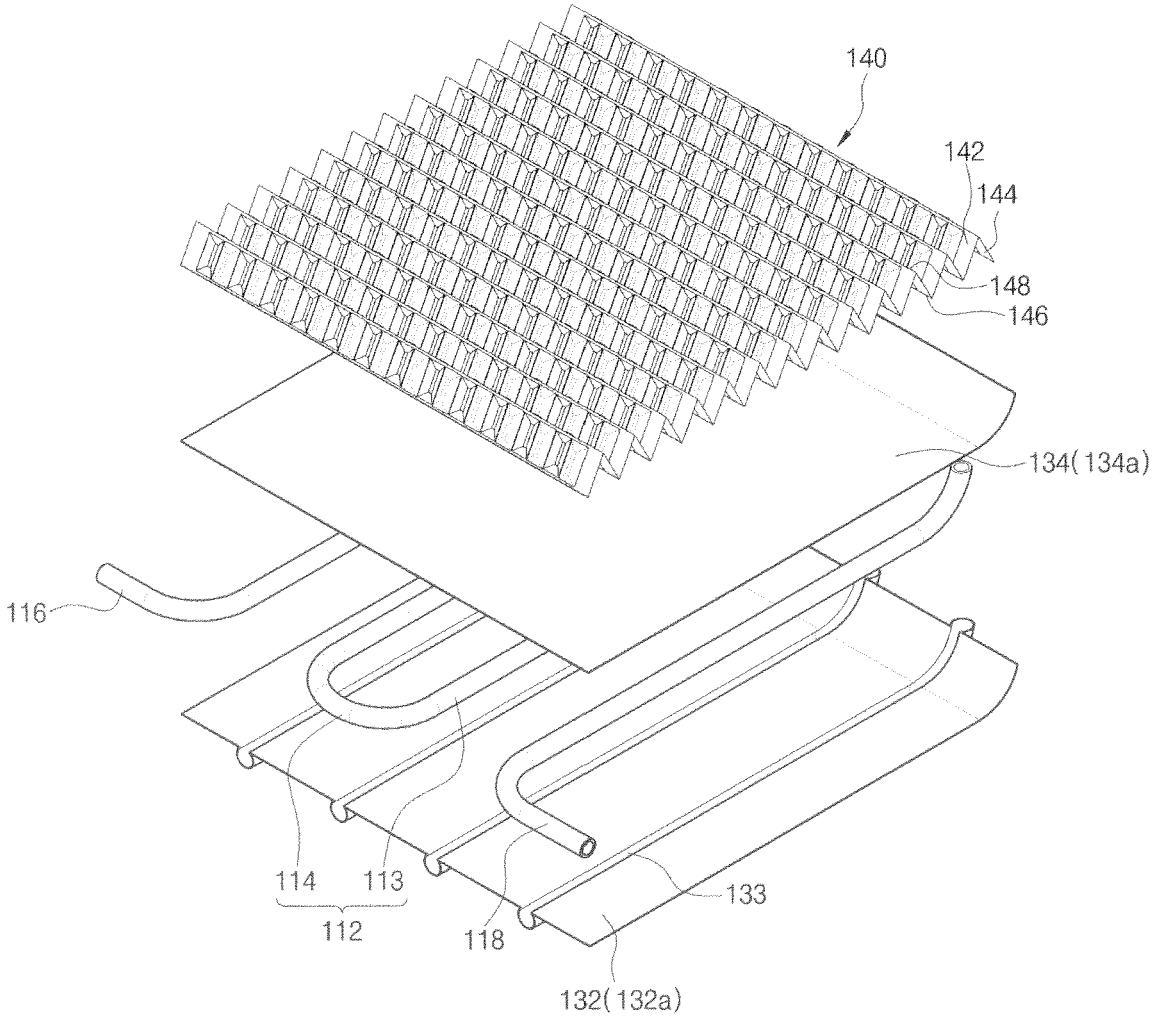


FIG. 5

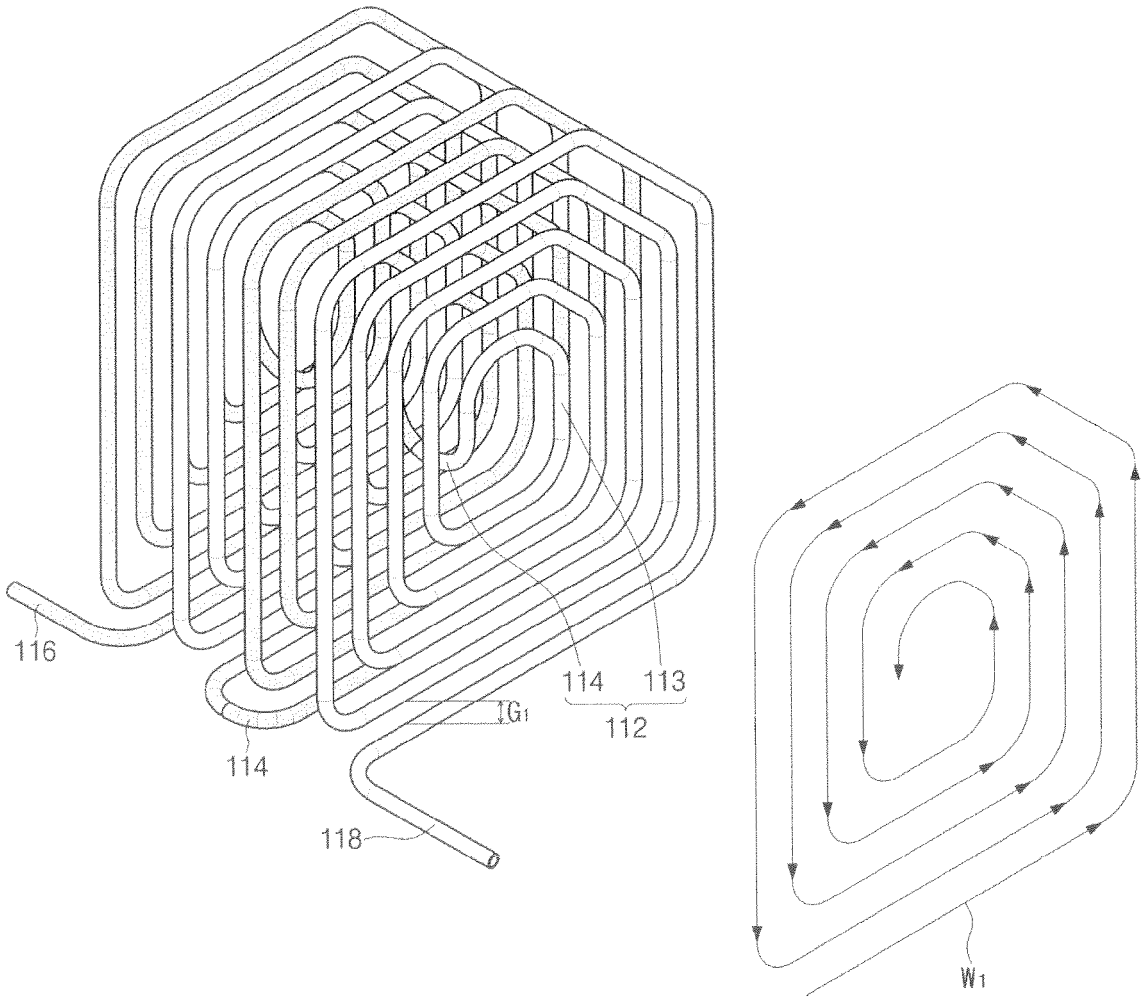


FIG. 6

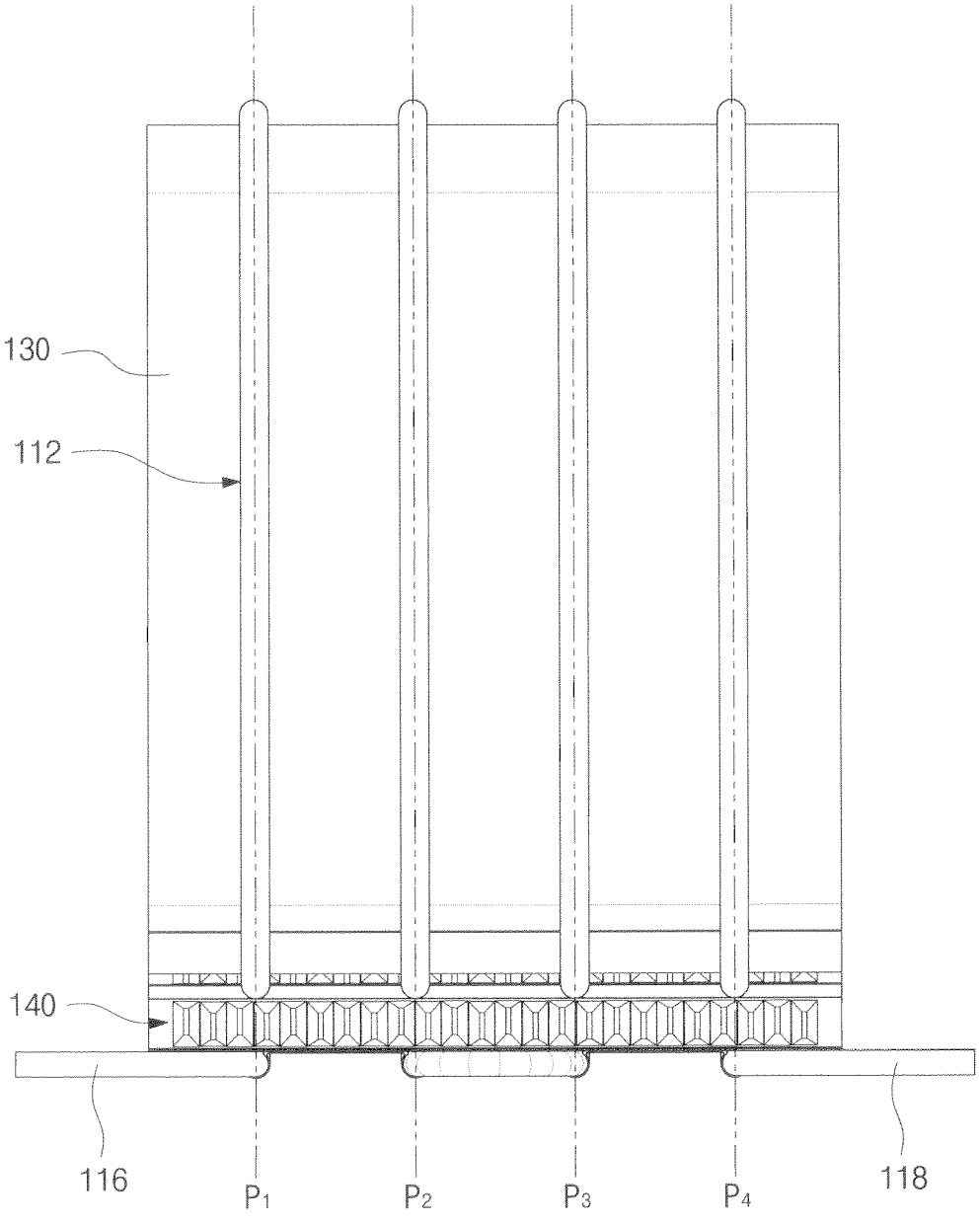


FIG. 7

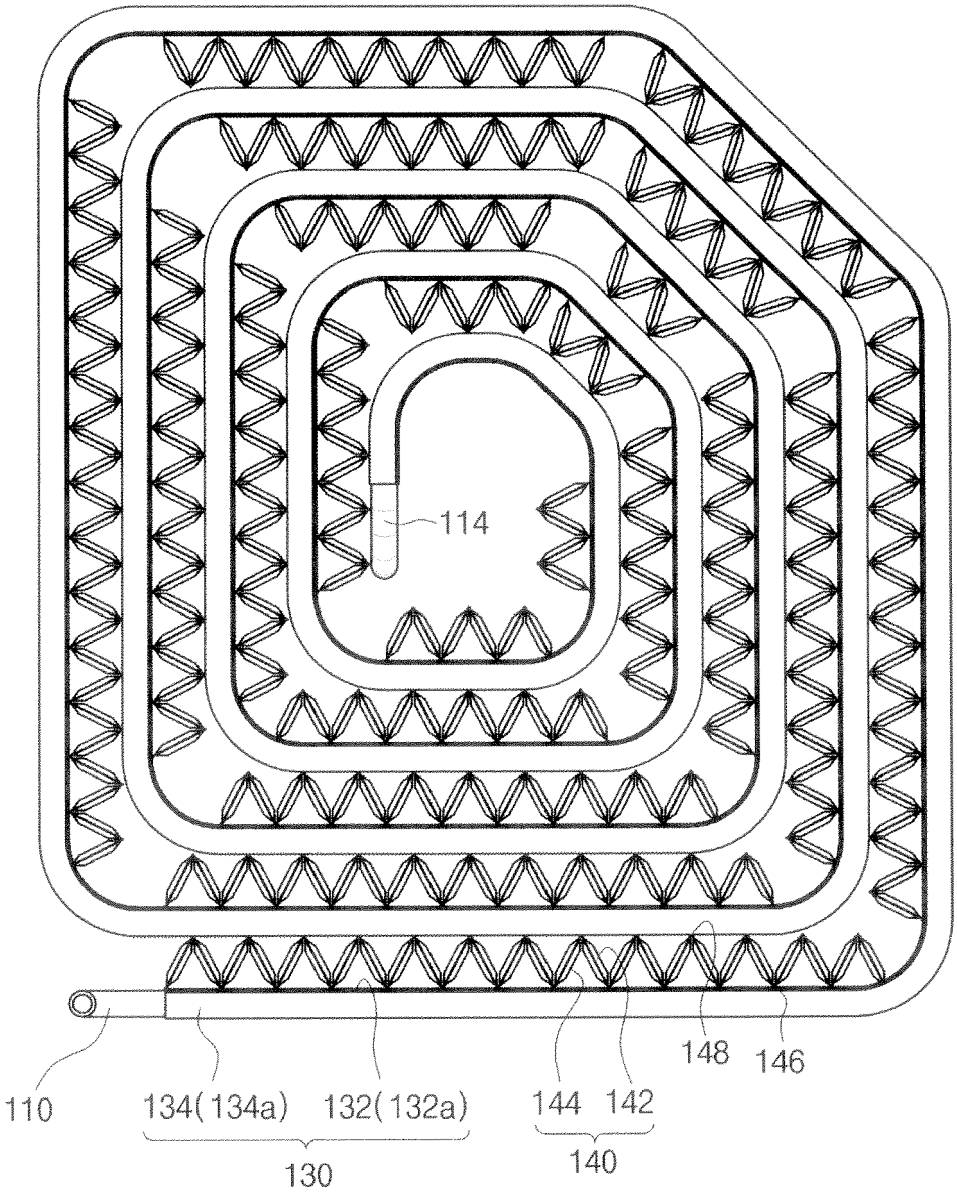


FIG. 8