



(11) **EP 1 852 668 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.11.2007 Bulletin 2007/45

(51) Int Cl.:
F28D 1/047 ^(2006.01) **F28F 13/12** ^(2006.01)
F25B 39/00 ^(2006.01)

(21) Application number: **07250621.5**

(22) Date of filing: **15.02.2007**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
SK TR**
Designated Extension States:
AL BA HR MK YU

- **Kim, Seung Jin**
Gwangju (KR)
- **Bae, Su Yong**
Gwangju (KR)
- **Kim, Hyuk Joong**
Gwangju (KR)

(30) Priority: **02.05.2006 KR 20060039724**

(74) Representative: **Pratt, David Martin et al**
Withers & Rogers LLP
Goldings House
2 Hays Lane
London SE1 2HW (GB)

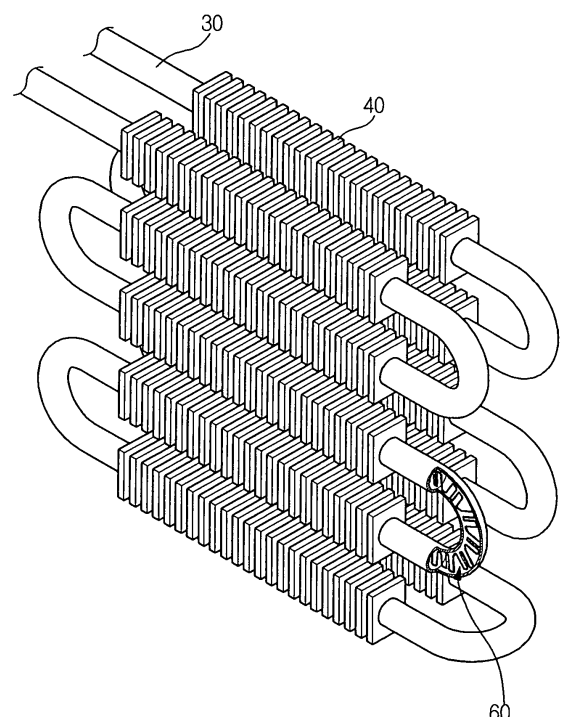
(71) Applicant: **Samsung Gwangju Electronics Co.,
Ltd.**
Gwangju-city (KR)

(72) Inventors:
• **Nam, Seung Weon**
Gwanfju-City (KR)

(54) **Heat exchanger for refrigerator**

(57) A heat exchanger (4,6) for a refrigerator with improved heat transfer efficiency by inducing turbulent flow in a refrigerant flowing along a refrigerant guiding tube. The heat exchanger (4,6) for the refrigerator comprised of: the refrigerant guiding tube (30) configured to allow the refrigerant to flow there through; a plurality of heat exchange fins (40) disposed around an outer peripheral surface of the refrigerant guiding tube (30), the plurality of heat exchange fins (40) increasing a heat exchange area of the refrigerant guiding tube (30); and a turbulent flow inducing member (60,60',60'',60''') positioned in the refrigerant guiding tube (30), whereby the turbulent flow inducing member (60,60',60'',60''') is configured to cause the refrigerant flowing along the refrigerant guiding tube (30) to form a turbulent flow.

Fig.10



EP 1 852 668 A2

Description

Field of the Invention

[0001] The present invention relates to a heat exchanger for a refrigerator. In particular, the present invention relates to a heat exchanger for a refrigerator in which a refrigerant flowing along a refrigerant guiding tube has a turbulent flow, resulting in improved heat transfer efficiency.

Background of the Invention

[0002] Generally, a refrigerator is an apparatus to cool a storage chamber with cold air produced by an evaporator of a refrigeration cycle, so as to keep contents stored in the storage chamber in a chilled or frozen state.

[0003] The refrigeration cycle includes a compressor, a condenser, an evaporator and a capillary tube. The compressor serves to compress a refrigerant into a high-temperature and high-pressure gas-phase refrigerant, and the condenser serves to condense the refrigerant transmitted from the compressor into a high-temperature and high-pressure liquid-phase refrigerant. The high-temperature and high-pressure liquid-phase refrigerant condensed in the condenser undergoes a throttling expansion as it passes through the capillary tube and is thereby changed into a low-temperature and low-pressure liquid-phase refrigerant. After having passed through the capillary tube, the evaporator serves to evaporate the low-temperature and low-pressure liquid-phase refrigerant into a low-temperature and low-pressure gas-phase refrigerant. Thus, the refrigerant circulating in the refrigeration cycle emits heat while being condensed in the condenser, and absorbs heat from the air inside the storage chamber while being evaporated in the evaporator. Then, the air inside the storage chamber is cooled via heat transfer with the evaporator.

[0004] Accordingly, the evaporator and the condenser serve as heat exchangers for the refrigerator. Such heat exchangers have a refrigerant guiding tube. Refrigerant flowing closest to an inner surface of the refrigerant guiding tube actively exchanges heat across the walls of the refrigerant guiding tube with the surrounding air.

[0005] However, the refrigerant flowing in the central portion of the refrigerant guiding tube does not transfer heat as actively. Thus, a portion of the refrigerant flowing along the refrigerant guiding tube transfers heat relatively poorly with the surrounding air, resulting in reduced heat transfer efficiency.

Summary of the Invention

[0006] It is an aspect of the invention to provide a heat exchanger for a refrigerator capable of achieving an enhancement in heat transfer efficiency via an improvement in the flow of a refrigerant flowing along a refrigerant guiding tube.

[0007] An exemplary embodiment of the present invention provides a heat exchanger for a refrigerator comprising of: a refrigerant guiding tube configured to allow a refrigerant to flow there through; a plurality of heat exchange fins disposed around an outer peripheral surface of the refrigerant guiding tube, the plurality of heat exchange fins increasing a heat exchange area of the refrigerant guiding tube; and a turbulent flow inducing member positioned in the refrigerant guiding tube, whereby the turbulent flow inducing member is configured to cause the refrigerant flowing along the refrigerant guiding tube to form a turbulent flow.

[0008] The turbulent flow inducing member may be disposed along a longitudinal direction of the refrigerant guiding tube. The turbulent flow inducing member may be comprised of a wire bent in a serpentine manner. The turbulent flow inducing member may have a coil spring shape. The turbulent flow inducing member may have a twisted plate shape. The turbulent flow inducing member may be further comprised of a plurality of protrusions disposed at an outer peripheral surface thereof, the plurality of protrusions protruding substantially orthogonal to a flow direction of the refrigerant flowing along the refrigerant guiding tube.

[0009] The heat exchanger may be an evaporator or a condenser employed in a refrigeration cycle of the refrigerator.

[0010] The turbulent flow inducing member and the refrigerant guiding tube may be flexible.

[0011] In accordance with another aspect, the present invention provides a refrigerator comprising of: a body including an internal storage chamber having an opening; a door coupled to the storage chamber of the body at the opening thereof, thereby providing access to the storage chamber; a compressor disposed in the body, the compressor having a compressor refrigerant guiding tube and a compressor turbulent flow inducing member disposed therein; a condenser disposed in the body; an evaporator disposed in the storage chamber, the evaporator having an evaporator refrigerant guiding tube and an evaporator turbulent flow inducing member disposed therein; and a plurality of refrigerant tubes, each of the refrigerant tubes coupling the compressor, the condenser, and the evaporator to form a refrigeration cycle.

[0012] Either the compressor turbulent flow inducing member or the evaporator turbulent flow inducing member, respectively, may be disposed in a longitudinal direction of the compressor refrigerant guiding tube. Either the compressor turbulent flow inducing member or the evaporator turbulent flow inducing member, respectively, may be a wire bent in a serpentine manner.

[0013] In accordance with yet another aspect, the present invention provides a method of manufacturing a heat exchanger for a refrigerator, the heat exchanger including a refrigerant guiding tube for receiving refrigerant and a turbulent flow inducing member, comprising the steps of: inserting the turbulent flow inducing member into a refrigerant guiding tube; and bending the refriger-

ant guiding tube.

[0014] The method may further comprise the step of inserting the turbulent flow inducing member longitudinally in the direction of the refrigerant guiding tube. The method wherein the turbulent flow inducing member may be a wire bent in a serpentine manner. The method wherein the turbulent flow inducing member may have a coil spring shape. The method wherein the turbulent flow inducing member may have a twisted plate shape. The method wherein a turbulent flow inducing member may have a plurality of protrusions formed at an outer peripheral surface thereof, the plurality of protrusions protruding substantially orthogonal to a flow direction of the refrigerant flowing along the refrigerant guiding tube. The method may further comprise the step of coupling a plurality of heat exchange fins to an outer peripheral surface of the refrigerant guiding tube. The method may further comprise the step of coupling the heat exchanger to a refrigeration cycle of the refrigerator. The method may further comprise the step of bending the turbulent flow inducing member in a serpentine manner prior to inserting the turbulent flow inducing member into the refrigerant guiding tube.

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

Brief Description of the Drawings

[0016] A more complete appreciation of the invention and many of the aspects and advantages thereof will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a configuration diagram illustrating a refrigeration cycle of a refrigerator according to an embodiment of the present invention;

FIG. 2 is a side sectional view illustrating the refrigerator according to an embodiment of the present invention;

FIG. 3 is a perspective view illustrating a heat exchanger for the refrigerator according to an embodiment of the present invention;

FIG. 4 is a partial side sectional view illustrating a refrigerant guiding tube;

FIG. 5 is a sectional view of the refrigerant guiding tube taken along the line A-A of FIG. 4;

FIG. 6 is a perspective view illustrating a turbulent flow inducing member of an embodiment of the present invention;

FIG. 7 is a perspective view illustrating the turbulent flow inducing member of another embodiment of the present invention;

FIG. 8 is a perspective view illustrating the turbulent flow inducing member of yet another embodiment of the present invention;

FIG. 9 is a sectional view of the refrigerant guiding tube of the present invention prior to receiving the turbulent flow inducing member;

FIG. 10 is a sectional view of the refrigerant guiding tube of FIG. 9 showing the turbulent flow inducing member being inserted into the refrigerant guiding tube: and

FIG. 11 is a partial perspective view of the refrigerant guiding tube after being bent in a generally serpentine manner into the heat exchanger shown in FIG. 3.

Detailed Description of the Invention

[0017] Reference will now be made in detail to exemplary embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. The embodiments are described below to explain the present invention by referring to the figures.

[0018] Referring to FIG. 1, a refrigeration cycle of a refrigerator is illustrated. The refrigeration cycle is a closed circuit and comprises a compressor 3, a condenser 4, a capillary tube 5, a drier 7, an evaporator 6, and interconnecting refrigerant tubes 8. The capillary tube 5 may be replaced with another expansion device such as an expansion valve.

[0019] The compressor 3 serves to compress a refrigerant into a high-temperature and high-pressure gas-phase refrigerant. The condenser 4 serves to condense the refrigerant from the compressor 3 into a high-temperature and high-pressure liquid-phase refrigerant.

[0020] The drier 7 may be installed on an intermediate position of the refrigerant tube 8 that connects the condenser 4 and capillary tube 5 to each other. The drier 7 serves to remove moisture contained in the gas-phase refrigerant condensed in the condenser 4.

[0021] The high-temperature and high-pressure liquid-phase refrigerant condensed in the condenser 4 is subjected to a throttling expansion while passing through the capillary tube 5 and is thereby changed into a low-temperature and low-pressure liquid-phase refrigerant. After having passed through the capillary tube 5, the evaporator 6 serves to evaporate the low-temperature and low-pressure liquid-phase refrigerant into a low-temperature and low-pressure gas-phase refrigerant. The evaporator 6 and condenser 4 serve as heat exchangers. The evaporator 6 and condenser 4 consistent with the present invention causes the refrigerant flowing therein to form turbulent flow thereby improving the heat transfer efficiency.

[0022] Referring to FIG. 2, a refrigerator consistent with the present invention is shown. The refrigerator comprises a body 10 provided with constituent elements of a refrigeration cycle. The body 10 is internally defined with a storage chamber 11 having an opening formed at a front surface thereof. A door 20 may be coupled to the front surface of the body 10 by use of hinges in a pivotally rotatable manner, providing access to the storage chamber 11.

[0023] Both the compressor 3 and condenser 4 may be installed in a machine room 12 that may be defined in a lower portion of the body 10 separate from the storage chamber 11. The machine room 12 is configured to communicate with the outside of the body 10, to allow outside air to be introduced into and discharged out of the machine room 12.

[0024] The evaporator 6 may be installed in a rear region of the storage chamber 11. A circulating fan 13 may also be installed in the body 10 at a side of the evaporator 6 and adapted to circulate cooled air in the storage chamber 11.

[0025] With the above described configuration, the refrigerant circulating in the refrigeration cycle emits heat when condensed in the condenser 4 via heat exchange with the air in the machine room 12, and absorbs heat from the air inside the storage chamber 11 when evaporated in the evaporator 6 via heat exchange with the air inside the storage chamber 11. The air inside the storage chamber 11 is cooled into cold air via heat exchange with the evaporator 6. Accordingly, the evaporator 6 and condenser 4 serve as heat exchangers for the refrigerator.

[0026] FIG. 3 illustrates the heat exchanger 4 or 6 for the refrigerator consistent with the present embodiment. Each heat exchanger 4 or 6 includes a refrigerant guiding tube 30 similar to a conventional refrigerant tube and a plurality of heat exchange fins 40 coupled around an outer peripheral surface of the refrigerant guiding tube 30 to increase a heat exchange area. Each heat exchanger 4 or 6 may also include a supporting member 50 and another supporting member 51. The refrigerant guiding tube 30 is preferably made of a flexible material, such as copper, and may have a circular cross section. The refrigerant guiding tube 30 is initially manufactured to have a straight pipe shape.

[0027] After coupling the plurality of heat exchange fins 40 around the outer peripheral surface of the refrigerant guiding tube 30, the refrigerant guiding tube 30 is repeatedly bent in a generally serpentine manner, to have a multistage multiple-row structure. Then, a pair of supporting members 51 and 52 may be coupled to the ends of the multistage multiple-row structure to maintain the shape of the heat exchanger 4 or 6.

[0028] Referring to FIG. 4, the refrigerant guiding tube 30 is provided therein with a turbulent flow inducing member 60 to cause the refrigerant flowing along the tube 30 to form a turbulent flow. Preferably, the turbulent flow inducing member 60 is arranged along a longitudinal direction of the refrigerant guiding tube 30, and extends throughout the refrigerant guiding tube 30 to cause the refrigerant to form a turbulent flow throughout the refrigerant guiding tube 30. In one embodiment, the turbulent flow inducing member 60 may be configured as a wire, bent in a serpentine manner to have a plurality of bent portions 61 substantially orthogonal to the longitudinal direction of the refrigerant guiding tube 30.

[0029] When the turbulent flow inducing member 60 is disposed in the refrigerant guiding tube 30, the refrigerant

flowing along the refrigerant guiding tube 30 collides with each bent portion 61 of the turbulent flow inducing member 60, thereby forming a turbulent flow rather than a laminar flow. Because the refrigerant passing through the refrigerant guiding tube 30 has an irregular turbulent flow, the refrigerant flowing closest to an inner surface of the refrigerant guiding tube 30 and refrigerant flowing in the center of the tube 30 actively exchanges heat across the walls of the refrigerant guiding tube 30. Thus, substantially all the refrigerant actively exchanges heat with air surrounding the refrigerant guiding tube 30, resulting in improved heat transfer efficiency for heat exchanger 4 or 6.

[0030] The turbulent flow inducing member 60 is preferably made of an elastically deformable material and is adapted to have a width slightly smaller than a diameter of the refrigerant guiding tube 30, to allow insertion into the refrigerant guiding tube 30.

[0031] Referring to FIG. 5, a heat exchange fin 40 is shown. Each heat exchange fin 40 is centrally perforated with a tube penetration hole 42 adapted to be coupled around the outer peripheral surface of the refrigerant guiding tube 30.

[0032] FIGS. 6 to 8 illustrate turbulent flow inducing members 60', 60'', 60''' consistent with alternative embodiments of the present invention. As shown in FIG. 6, the turbulent flow inducing member 60' may have a coil spring shape. Alternatively, as shown in FIG. 7, the turbulent flow inducing member 60'' may have a twisted plate shape. Or, as shown in FIG. 8, the turbulent flow inducing member 60''' may include a rod shaped body 61''' extending in the longitudinal direction of the refrigerant guiding tube 30 and a plurality of protrusions 62''' formed at an outer peripheral surface of the body 61''' to protrude substantially orthogonal to a flow direction of the refrigerant flowing along the refrigerant guiding tube 30. As will be appreciated from the above description, the turbulent flow inducing members 60, 60', 60'' and 60''' may have other various shapes so long as they can create a resistance against the refrigerant flowing in the refrigerant guiding tube 30, thereby causing the refrigerant in the refrigerant guiding tube 30 to form a turbulent flow.

[0033] Referring to FIGS. 9 to 11, a method of manufacturing the heat exchanger 4 or 6 of the refrigerator according to the present invention will be described. As shown in FIG. 9, while the refrigerant guiding tube 30 has a straight unbent shape, the heat exchange fins 40 may first be coupled around the outer peripheral surface of the refrigerant guiding tube 30. Next, the turbulent flow inducing member 60 is completely inserted into the refrigerant guiding tube 30 in a manner as shown in FIG. 10. Then, the refrigerant guiding tube 30 is bent in a serpentine manner to have a multistage multiple-row structure as shown in FIG. 11. Thereafter, to complete assembling of the heat exchanger 4 or 6, the supporting members 51 and 52 may be coupled to the sides of the multistage multiple-row structure formed from bending the re-

refrigerant guiding tube 30.

[0034] Since the turbulent flow inducing member 60 was inserted into the refrigerant guiding tube 30 prior to bending the refrigerant guiding tube 30, the turbulent flow inducing member 60 is bent together with the refrigerant guiding tube 30 in the course of bending the refrigerant guiding tube 30. Therefore, in one embodiment, when the refrigerant guiding tube 30 is bent in a serpentine manner, the turbulent flow inducing member 60 is caught by bent portions of the refrigerant guiding tube 30 and supported thereby. Thus, the turbulent flow inducing member 60 can be secured in the refrigerant guiding tube 30 in a fixed position.

[0035] In alternative embodiments where the turbulent flow inducing members 60', 60" or 60''' are made of an elastically deformable material, each of the turbulent flow inducing members 60', 60" or 60''' may be fixedly secured by bending the refrigerant guiding tube 30 while assembling the heat exchanger 4 or 6, similar to the turbulent flow inducing member 60 of the previously described embodiment.

[0036] Accordingly, the heat exchanger 4 or 6 for the refrigerator having the turbulent flow inducing member 60 consistent with the present invention can eliminate the need for a separate securing means for securing the turbulent flow inducing member 60 at a fixed position and improve heat transfer efficiency. Therefore, eliminating separate securing means and improving heat transfer efficiency can reduce the cost associated with adding the turbulent flow inducing member 60.

[0037] As apparent from the above description, the present invention provides a heat exchanger for a refrigerator in which a refrigerant guiding tube has a turbulent flow member disposed therein. Thus, the refrigerant flowing along a refrigerant guiding tube forms an irregular turbulent flow.

[0038] Accordingly, in the heat exchanger for a refrigerator consistent with the present invention, the entire refrigerant being guided along the refrigerant guiding tube can be moved toward an inner surface of the refrigerant guiding tube, and thus, actively exchange heat with the air surrounding the refrigerant guiding tube, resulting in a considerably improved heat transfer efficiency.

[0039] Although embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

Claims

1. A heat exchanger for a refrigerator, comprising of:

a refrigerant guiding tube configured to allow a refrigerant to flow therethrough;
a plurality of heat exchange fins disposed

around an outer peripheral surface of the refrigerant guiding tube, the plurality of heat exchange fins increasing a heat exchange area of the refrigerant guiding tube; and

a turbulent flow inducing member positioned in the refrigerant guiding tube, whereby the turbulent flow inducing member is configured to cause the refrigerant flowing along the refrigerant guiding tube to form a turbulent flow.

2. A heat exchanger according to claim 1, wherein the turbulent flow inducing member is disposed along a longitudinal direction of the refrigerant guiding tube.

3. A heat exchanger according to claim 1, wherein the turbulent flow inducing member is a wire bent in a serpentine manner.

4. A heat exchanger according to claim 1, wherein the turbulent flow inducing member has a coil spring shape.

5. A heat exchanger according to claim 1, wherein the turbulent flow inducing member has a twisted plate shape.

6. A heat exchanger according to claim 1, wherein the turbulent flow inducing member is further comprised of a plurality of protrusions disposed at an outer peripheral surface thereof, the plurality of protrusions protruding substantially orthogonal to a flow direction of the refrigerant flowing along the refrigerant guiding tube.

7. A heat exchanger according to claim 1, wherein the heat exchanger is an evaporator or a condenser employed in a refrigeration cycle of the refrigerator.

8. A heat exchanger according to claim 1, wherein the refrigerant guiding tube and turbulent flow inducing member are flexible.

9. A refrigerator, comprising of:

a body including an internal storage chamber having an opening;

a door coupled to the storage chamber of the body at the opening thereof, thereby providing access to the storage chamber;

a compressor disposed in the body, the compressor having a compressor refrigerant guiding tube and a compressor turbulent flow inducing member disposed therein;

a condenser disposed in the body;

an evaporator disposed in the storage chamber, the evaporator having an evaporator refrigerant guiding tube and an evaporator turbulent flow

- inducing member disposed therein; and
a plurality of refrigerant tubes, each of the refrigerant tubes coupling the compressor, the condenser, and the evaporator to form a refrigeration cycle. 5
- 10.** A refrigerator according to claim 9, wherein either the compressor turbulent flow inducing member or the evaporator turbulent flow inducing member, respectively, is disposed in a longitudinal direction of the compressor refrigerant guiding tube. 10
- 11.** A refrigerator according to claim 9, wherein either the compressor turbulent flow inducing member or the evaporator turbulent flow inducing member, respectively, is a wire bent in a serpentine manner. 15
- 12.** A method of manufacturing a heat exchanger for a refrigerator, the heat exchanger including a refrigerant guiding tube for receiving refrigerant and a turbulent flow inducing member, comprising the steps of: 20
- inserting the turbulent flow inducing member into a refrigerant guiding tube; and 25
- bending the refrigerant guiding tube.
- 13.** A method according to claim 12, further comprising the step of inserting the turbulent flow inducing member longitudinally in the direction of the refrigerant guiding tube. 30
- 14.** A method according to claim 12, wherein the turbulent flow inducing member is a wire bent in a serpentine manner. 35
- 15.** A method according to claim 12, wherein the turbulent flow inducing member has a coil spring shape.
- 16.** A method according to claim 12, wherein the turbulent flow inducing member has a twisted plate shape. 40
- 17.** A method according to claim 12, wherein a turbulent flow inducing member has a plurality of protrusions formed at an outer peripheral surface thereof, the plurality of protrusions protruding substantially orthogonal to a flow direction of the refrigerant flowing along the refrigerant guiding tube. 45
- 18.** A method according to claim 12, further comprising the step of coupling a plurality of heat exchange fins to an outer peripheral surface of the refrigerant guiding tube. 50
- 19.** A method according to claim 12, further comprising the step of coupling the heat exchanger to a refrigeration cycle of the refrigerator. 55
- 20.** A method according to claim 12, further comprising the step of bending the turbulent flow inducing member in a serpentine manner prior to inserting the turbulent flow inducing member into the refrigerant guiding tube.

Fig.1

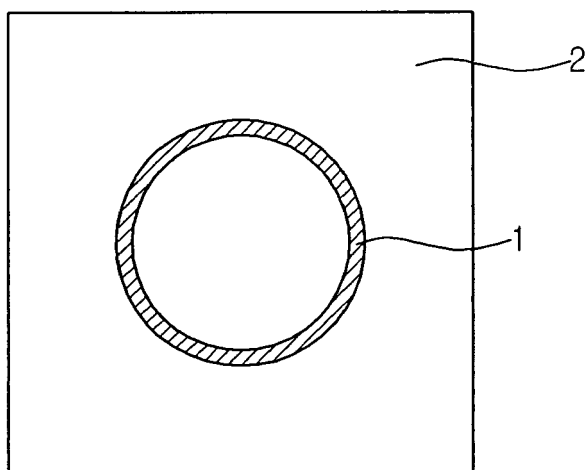


Fig.2

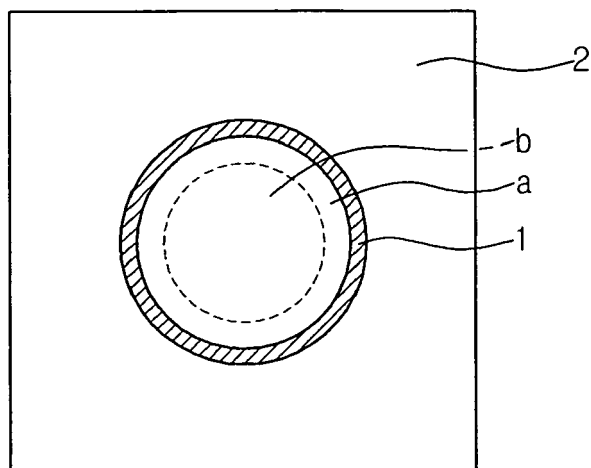


Fig.3

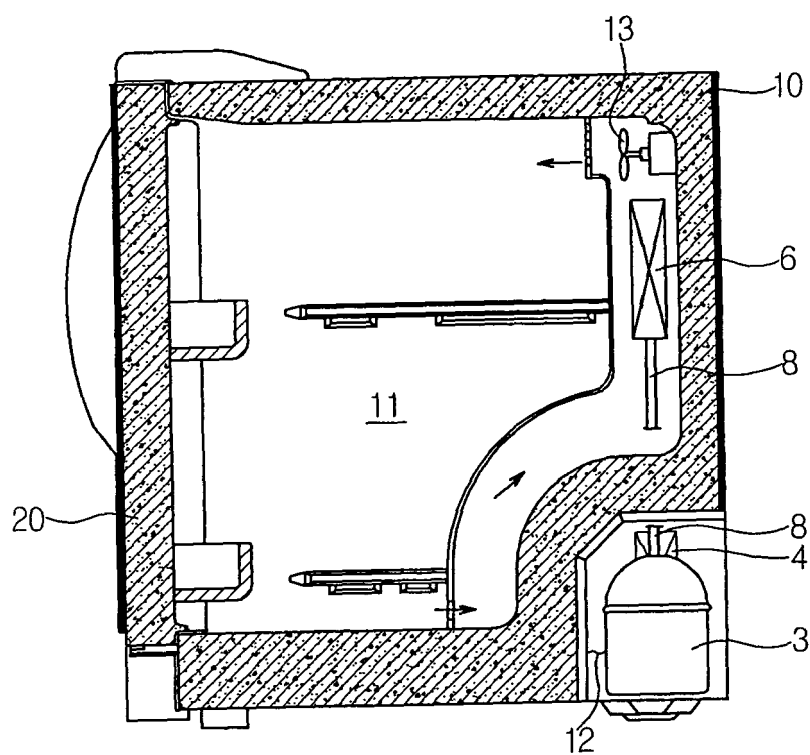


Fig.4

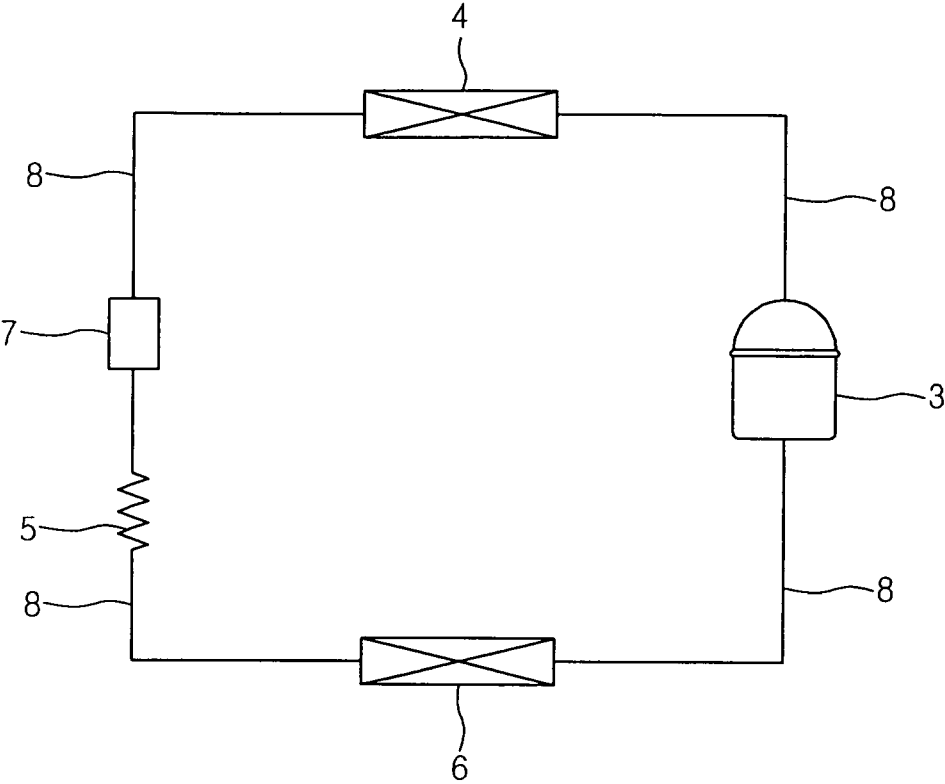


Fig.5

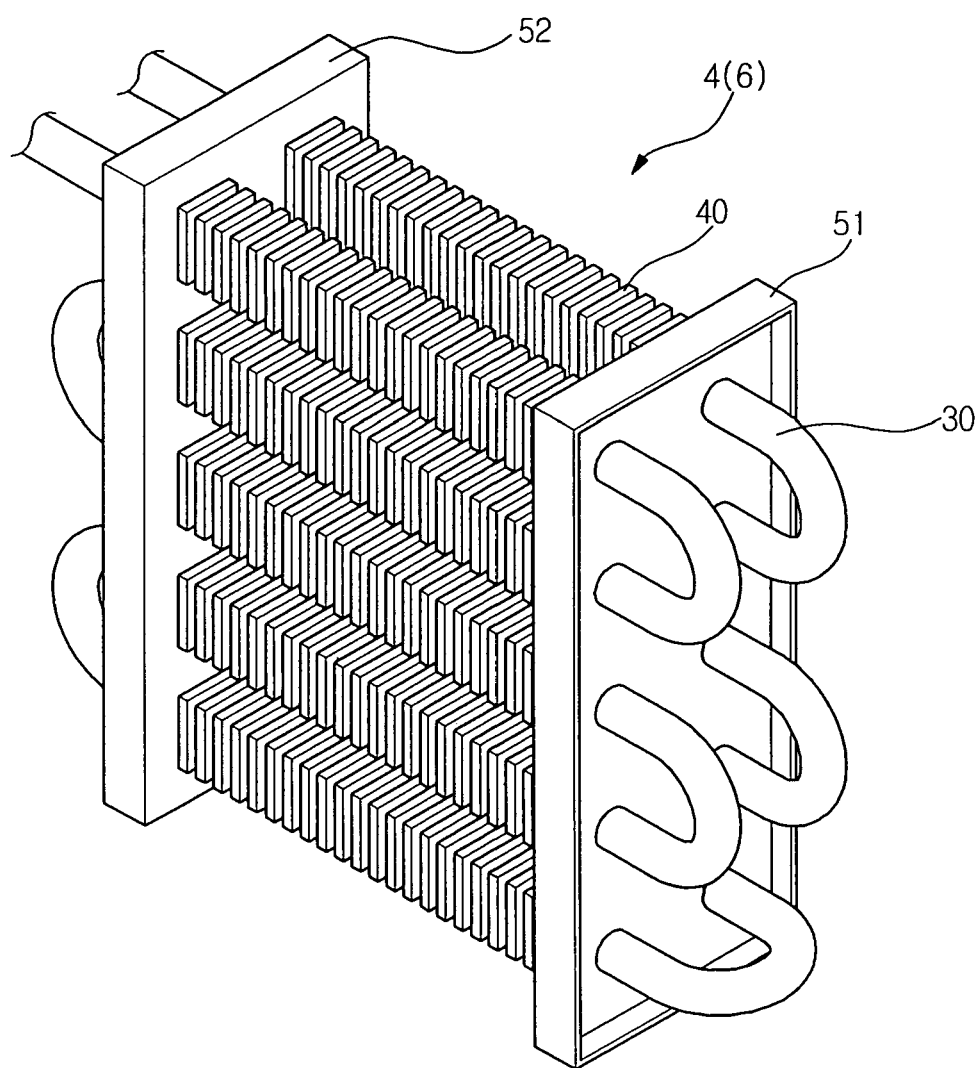


Fig.6

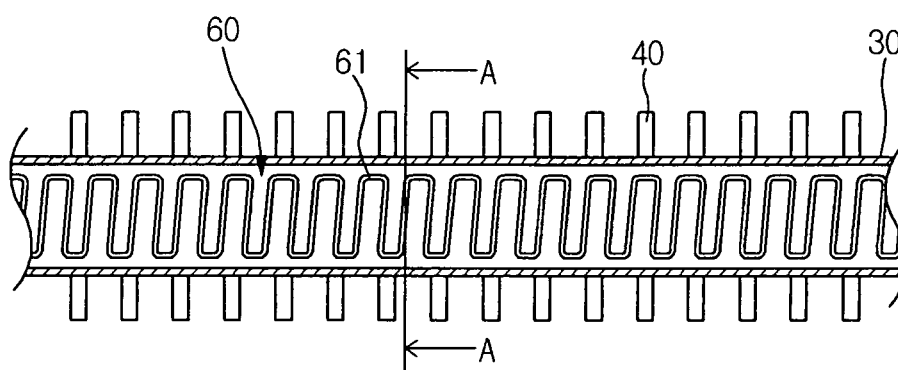


Fig.7

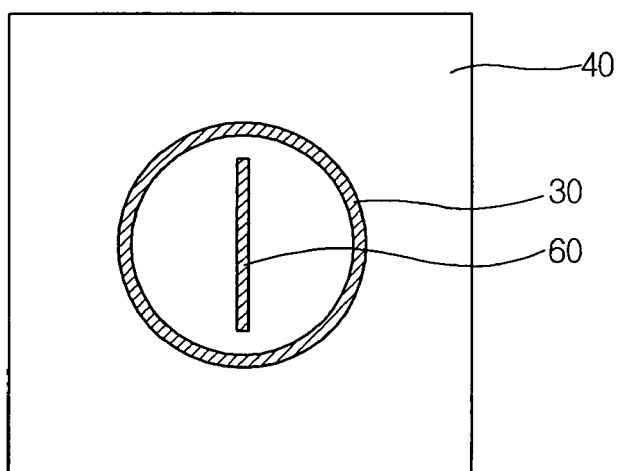


Fig.8

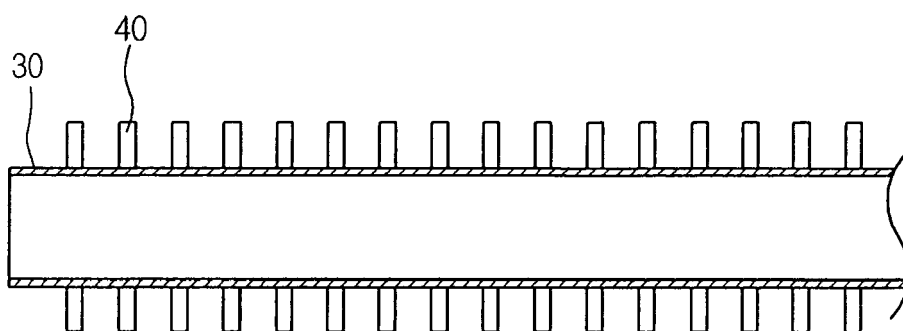


Fig.9

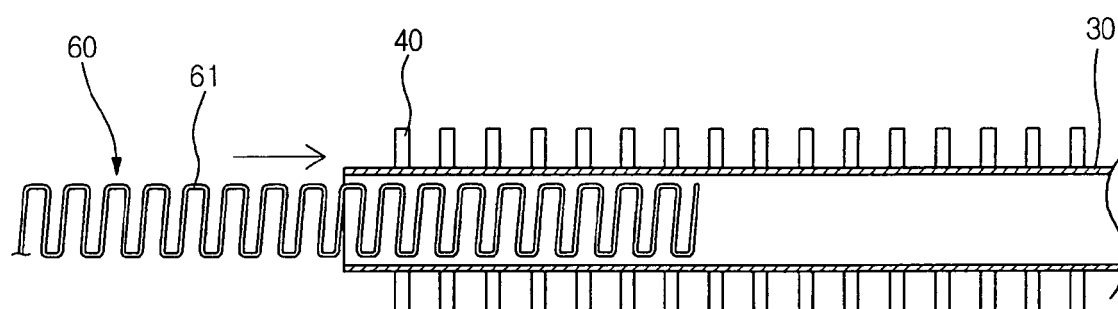


Fig.10

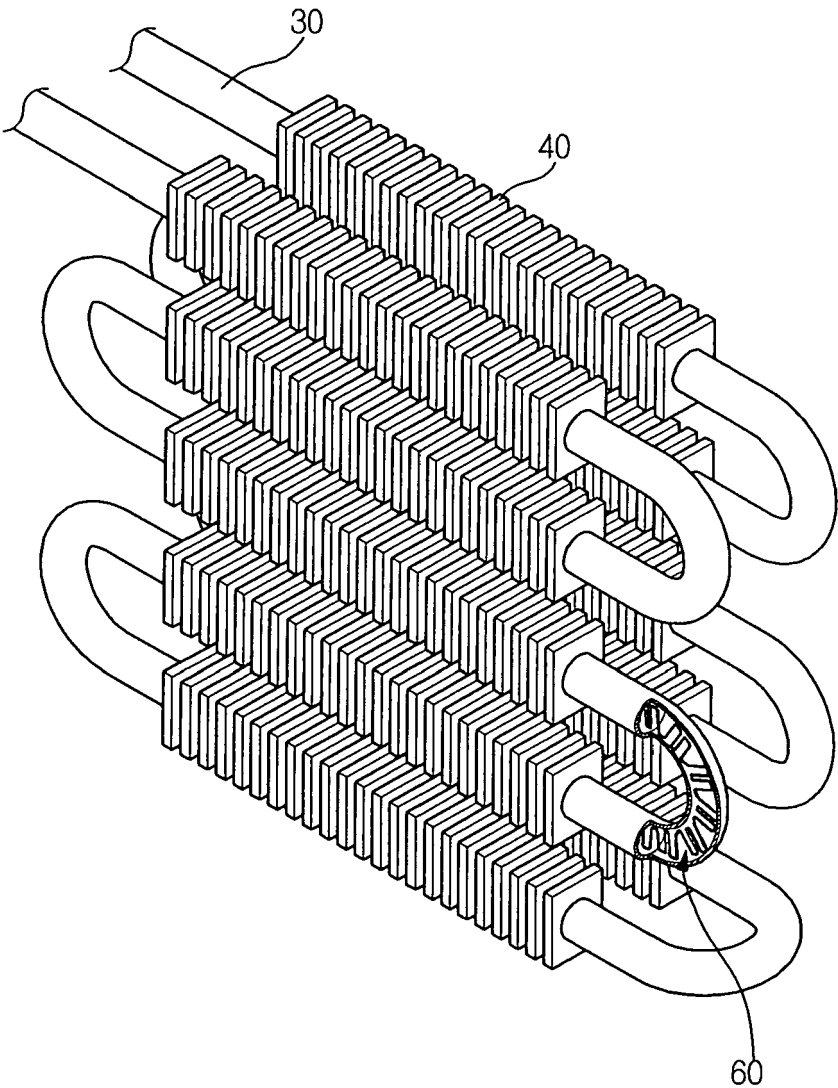


Fig.11

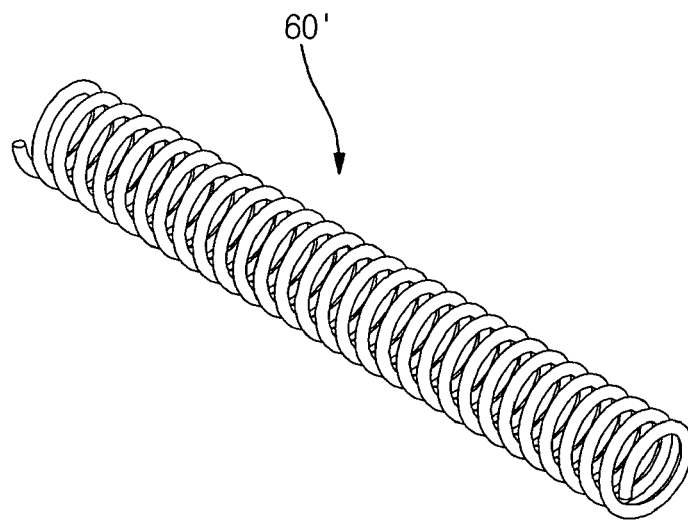


Fig.12

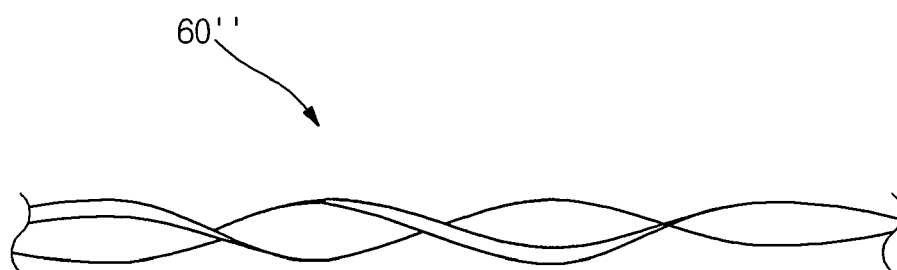


Fig.13

