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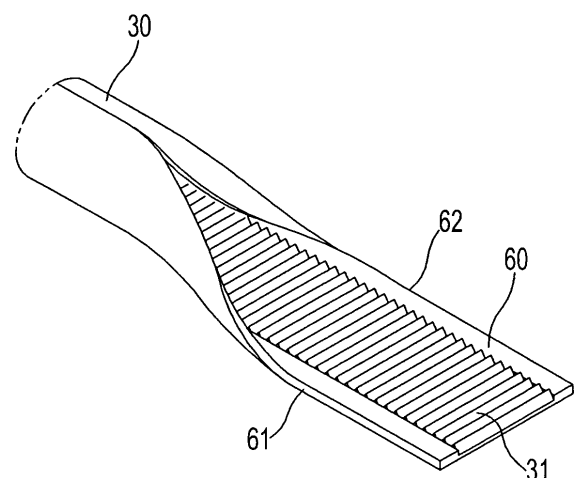
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(54) **Heat exchanger for refrigerator and method for manufacturing a tube thereof**

(57) A heat exchanger for a refrigerator and a method for manufacturing a tube thereof with improved heat exchanger heat transfer efficiency. The heat exchanger for a refrigerator comprising of: a tube (30) to guide a refrigerant; and a plurality of ridges (31) disposed on an inner peripheral surface of the tube, the ridges configured to cause the refrigerant flowing along the tube to form a turbulent flow. The method of manufacturing a tube (30) having a plurality of ridges (31) comprising the steps of: providing a surface of a plate (60); forming ridges (31) on the surface of the plate; and coupling opposite longitudinal edges (61,62) of the plate such that the surface of the plate provided with the ridges becomes an inner peripheral surface of the tube.

Fig.10



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 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. The air inside the storage chamber is thereby 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 tubes. Refrigerant flowing closest to an inner surface of the tube actively exchanges heat across the walls of the tube with the surrounding air. However, the refrigerant flowing in a central portion of the tube does not transfer heat as actively. Thus, a portion of the refrigerant flowing within the tube transfers heat relatively poorly with the surrounding air, resulting in reduced heat transfer efficiency.

Summary of the Invention

[0005] 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 improved configuration of a tube to guide refrigerant.

[0006] An exemplary embodiment of the present invention provides a heat exchanger for a refrigerator comprising of: a tube to guide a refrigerant; and a plurality of ridges disposed on an inner peripheral surface of the

tube, the ridges configured to cause the refrigerant flowing along the tube to form a turbulent flow.

[0007] A longitudinal direction of each of the plurality of ridges may be substantially orthogonal to a longitudinal direction of the tube.

[0008] Each of the plurality of ridges may be shaped to have a triangular cross section. Each of the plurality of ridges may be a ridge forming member, each ridge forming member shaped as a rod of predetermined length and coupled to the inner peripheral surface of the tube. Each of the plurality of ridges is a lump of fine powder disposed on the inner peripheral surface of the tube. The fine powder may be a fine metal powder. The fine powder may also be a fine stone powder.

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

[0010] A plurality of heat exchange fins may be disposed around an outer peripheral surface of the tube to increase a heat exchange area of the tube.

[0011] In accordance with another aspect, the present invention provides a method of manufacturing a tube for a heat exchanger of a refrigerator, the tube having a plurality of ridges, comprising the steps of: (a) providing a surface of a plate; (b) forming ridges on the surface of the plate; and (c) coupling opposite longitudinal edges of the plate such that the surface of the plate provided with the ridges becomes an inner peripheral surface of the tube.

[0012] The method may further comprise the step of welding the opposite longitudinal ends of the plate to each other.

[0013] The method may further comprise the step of disposing ridges away from the opposite longitudinal edges of the plate, thereby allowing the welding of the opposite longitudinal edges of the plate without deformation.

[0014] The method may further comprise the step of forming ridges on the surface of the plate by pressing the plate between a normal roller and a processing roller, the processing roller having a ridged outer peripheral surface. The method may further comprise the step of providing the ridges by coupling a plurality of ridge forming members to the surface of the plate. The method may further comprise the step of providing the ridges by attaching fine powder to the surface of the plate to allow the fine powder to form lumps. The method may further comprise the step of attaching a fine metal powder to the surface of the plate to allow the fine metal powder to form lumps. The method may further comprise the step of attaching a fine stone powder to the surface of the plate to allow the fine stone powder to form lumps.

[0015] The method may further comprise the step of providing a plurality of heat exchange fins around an outer peripheral surface of the tube thereby increasing a heat exchange area of the tube.

[0016] The method may further comprise the step of coupling the heat exchanger to a refrigeration cycle of

the refrigerator.

[0017] 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

[0018] A more complete appreciation of the invention and many of the aspects and advantages thereof will become more 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 a 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 of a tube for the heat exchanger illustrated in FIG. 3;

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

FIG. 6 is a sectional view of the tube taken along the line B-B of FIG. 4;

FIG. 7 is a perspective view illustrating a plurality of ridges of the tube being manufactured on a plate as the plate is pressed between a normal roller and a processing roller;

FIG 8 is a partial perspective views illustrating opposite longitudinal edges of the plate being coupled to each other;

FIG. 9 is a partial perspective view illustrating ridged portions of the tube according to an embodiment of the present invention;

FIG. 10 is a partial perspective view illustrating ridged portions of the tube according to an embodiment of the present invention; and

FIG. 11 is a sectional view of the ridged portions of the tube taken along the line C-C of FIG 10.

Detailed Description of the Invention

[0019] 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.

[0020] 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 other expansion devices, such as an expansion valve.

[0021] 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. 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.

[0022] 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 heat transfer efficiency.

[0023] 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.

[0024] Both the compressor 3 and condenser 4 are installed in a machine room 12 that may be defined in a lower portion of the body 10 to be separated 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.

[0025] 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 into the storage chamber 11.

[0026] 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.

[0027] 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 hollow tube 30 and a plurality of heat exchange fins 40 may be coupled around an outer peripheral surface of the 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 tube 30 is preferably made of copper and may have a circular cross section.

[0028] After coupling the plurality of heat exchange fins 40 around the outer peripheral surface of the tube 30, the tube 30 is repeatedly bent in a 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 so that the supporting members 51 and 52 maintain the shape of the heat exchanger 4 or 6.

[0029] Referring to FIG. 4, a plan sectional view of the tube 30 is shown. The tube 30 is formed, at an inner peripheral surface thereof, with ridges 31, to allow the refrigerant flowing along the tube 30 to form a turbulent flow. Preferably, the ridges 31 are arranged such that a longitudinal direction of each ridge is substantially orthogonal to a longitudinal direction of the tube 30, thereby creating a stronger resistance against the refrigerant flowing along the tube 30. The ridges 31 may have an irregular or regular pattern.

[0030] Referring to FIG. 5, a sectional view of the tube 30 taken along the line A-A of FIG. 4 is shown. When the ridges 31 are formed at the inner peripheral surface of the tube 30, the refrigerant flowing along the tube 30 collides with the ridges 31, thereby forming a turbulent flow rather than a laminar flow. Because the refrigerant passing through the tube 30 has an irregular turbulent flow, the refrigerant closest to the inner peripheral surface of the tube 30 and the refrigerant flowing in the center of the tube 30 actively exchange heat across the walls of the tube 30, resulting in improved heat transfer efficiency for heat exchanger 4 or 6.

[0031] Referring to FIG. 6, a heat exchange fin disposed around an outer peripheral surface of tube 30 is shown. Each heat exchange fin 40 is centrally perforated with a tube penetration hole 42, to be coupled around the outer peripheral surface of the tube 30. Referring to FIGS. 7 and 8, a method for manufacturing the tube 30 will be explained. The method for manufacturing the tube 30 first comprises the step of providing a surface 63 of a plate 60. Plate 60 is preferably a copper plate that is prepared for the manufacture of the tube 30. The next step is forming ridges 31 on the surface 63 of the plate 60.

[0032] As shown in FIG. 7, the plate 60 is first located between a normal roller 100 and a processing roller 200 having a ridged outer peripheral surface. Then, both the rollers 100 and 200 are rotated in opposite directions. By the rotation of rollers 100 and 200, plate 60 travels between the rollers 100 and 200. Thus, the plate 60 is pressed between the rollers 100 and 200, thereby forming ridges 31 on the surface 63 of the plate 60.

[0033] Next, opposite longitudinal edges 61 and 62 of the plate 60 are coupled to each other. The plate 60 is

subjected to a roll forming process resulting in a cylindrical shape such that the surface 63 of the plate 60 formed with the ridges 31 becomes an inner peripheral surface of the roll-formed plate 60. Then, opposite longitudinal edges 61 and 62 of plate 60 are coupled to each other. Thus, plate 60 is manufactured into tube 30.

[0034] The longitudinal edges 61 and 62 of plate 60 may be coupled to each other via a welding process. The welding process is preferably performed when both longitudinal edges 61 and 62 of plate 60 correspond with each other so that the welding process will be easier and the tube 30 will be air-tight. However, if the ridges 31 are formed too close to the longitudinal edges 61 and 62 of the plate 60, then both longitudinal edges 61 and 62 of the plate 60 may be deformed in the course of forming the ridges 31, thus causing a thickness difference therebetween. Accordingly, ridges 31 should be configured to be disposed away from both of the longitudinal edges 61 and 62 to eliminate the risk of deformation in both of the longitudinal edges 61 and 62 during formation of the ridges 31.

[0035] Although the above described embodiment describes that the ridges 31 are formed by pressing the plate 60 between rollers 100 and 200, ridges 31 may be formed at the surface 63 of the plate 60 by other methods. Ridges 31 may be formed by a press or other simple tools, such as a scratch tool for grinding the surface 63 of the plate 60. Ridges 31 formed at the surface of the plate 60 may have other various shapes so long as they can create a resistance against the refrigerant flowing in the tube 30 of the heat exchanger 4 or 6, thereby inducing the refrigerant in the tube 30 to form a turbulent flow.

[0036] Referring to FIG. 9, plate 60 is shown with ridge portions 31' formed by ridge forming members 31'a. The ridged portion 31' formed at the surface of the plate 60 may be obtained by coupling a plurality of ridge forming members 31'a, which take the form of a rod having a predetermined length, to the surface of the plate 60. In this case, each ridge forming member 31'a is coupled to the plate 60 via a welding process, etc. Referring first to FIG. 10, plate 60 with ridged portion 31" is shown. The ridged portion 31" may be obtained by attaching fine powder of certain material on the surface 63 of the plate 60 to allow the fine powder to form lumps. The fine powder may be of various materials, such as metal powder or stone powder. The fine powder is attached to the surface 63 of the plate 60 by use of an adhesive, etc. to form lumps. Thus, the surface of the plate 60 is provided with the ridged portion 31".

[0037] As apparent from the above description, the present invention provides a heat exchanger for a refrigerator in which a refrigerant flowing along a tube of the heat exchanger has a turbulent flow produced by ridges formed at an inner peripheral surface of the tube. Accordingly, in the heat exchanger for a refrigerator consistent with the present invention, the refrigerant being guided along the tube can be moved toward an inner wall of the tube evenly and thus, actively exchange heat with air

outside of the tube, resulting in improved heat transfer efficiency.

[0038] Further, according to the present invention, the tube included in the heat exchanger for a refrigerator is manufactured to have a cylindrical pipe shape by roll forming a plate, and the ridges are formed at a surface of the plate in the course of manufacturing the tube. This enables the ridges to be easily formed at an inner peripheral surface of the tube.

[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 tube to guide a refrigerant; and
a plurality of ridges disposed on an inner peripheral surface of the tube, the ridges configured to cause the refrigerant flowing along the tube to form a turbulent flow.

2. A heat exchanger according to claim 1, wherein a longitudinal direction of each of the plurality of ridges is substantially orthogonal to a longitudinal direction of the tube.

3. A heat exchanger according to claim 1, wherein each of the plurality of ridges is shaped to have a triangular cross-section.

4. A heat exchanger according to claim 1, wherein each of the plurality of ridges is a ridge forming member, the ridge forming member shaped as a rod of predetermined length and coupled to the inner peripheral surface of the tube.

5. A heat exchanger according to claim 1, wherein each of the plurality of ridges is a lump of fine powder disposed on the inner peripheral surface of the tube.

6. A heat exchanger according to claim 5, wherein each of the plurality of ridges is a lump of fine metal powder disposed on the inner peripheral surface of the tube.

7. A heat exchanger according to claim 5, wherein each of the plurality of ridges is a lump of fine stone powder disposed on the inner peripheral surface of the tube.

8. 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.

9. A heat exchanger according to claim 1, wherein a plurality of heat exchange fins are disposed around an outer peripheral surface of the tube to increase a heat exchange area of the tube.

10. A method of manufacturing a tube for a heat exchanger of a refrigerator, the tube having a plurality of ridges, comprising the steps of:

(a) providing a surface of a plate;
(b) forming ridges on the surface of the plate; and
(c) coupling opposite longitudinal edges of the plate such that the surface of the plate provided with the ridges becomes an inner peripheral surface of the tube.

11. A method according to claim 10, further comprising the step of welding the opposite longitudinal ends of the plate to each other.

12. A method according to claim 10, further comprising the step of disposing ridges away from the opposite longitudinal edges of the plate, thereby allowing the welding of opposite longitudinal edges of the plate without deformation.

13. A method according to claim 10, further comprising the step of forming ridges on the surface of the plate by pressing the plate between a normal roller and a processing roller, the processing roller having a ridged outer peripheral surface.

14. A method according to claim 10, further comprising the step of providing the ridges by coupling a plurality of ridge forming members to the surface of the plate.

15. A method according to claim 10, further comprising the step of providing the ridges by attaching fine powder to the surface of the plate to allow the fine powder to form lumps.

16. A method according to claim 15, wherein the fine powder is a metal powder.

17. A method according to claim 15, wherein the fine powder is a stone powder.

18. A method according to claim 10, further comprising the step of providing a plurality of heat exchange fins around an outer peripheral surface of the tube thereby increasing a heat exchange area of the tube.

19. A method according to claim 10, further comprising the step of coupling the heat exchanger to a refrigeration cycle of the refrigerator.

Fig.1

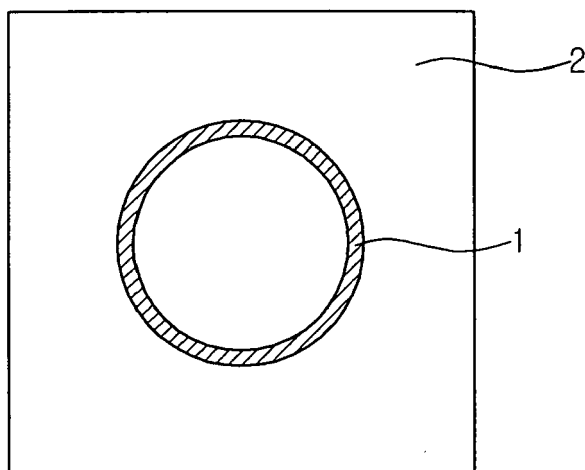


Fig.2

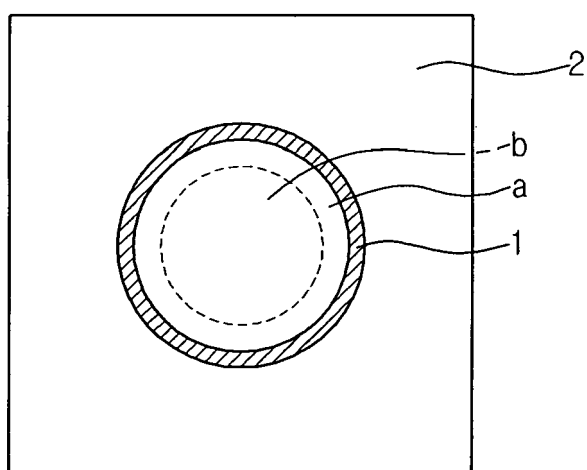


Fig.3

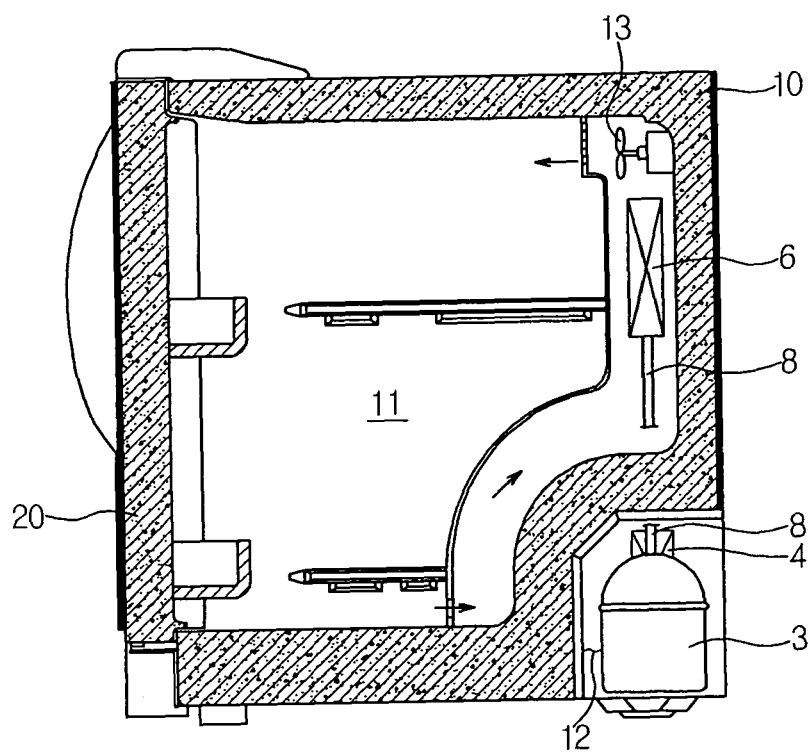


Fig.4

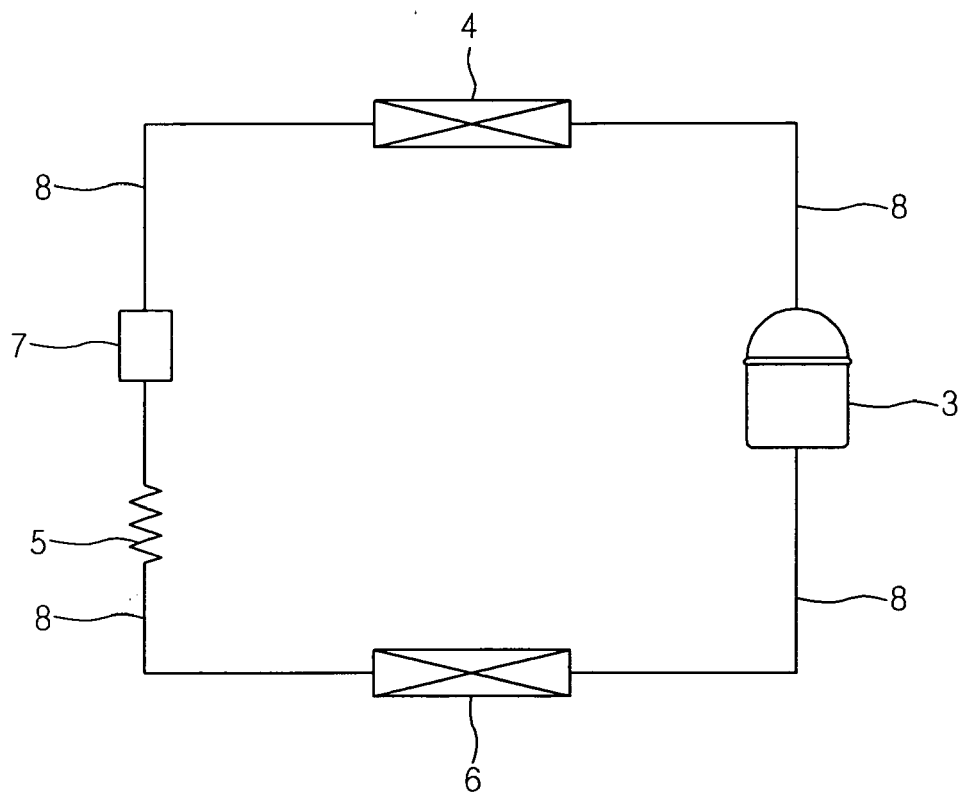


Fig.5

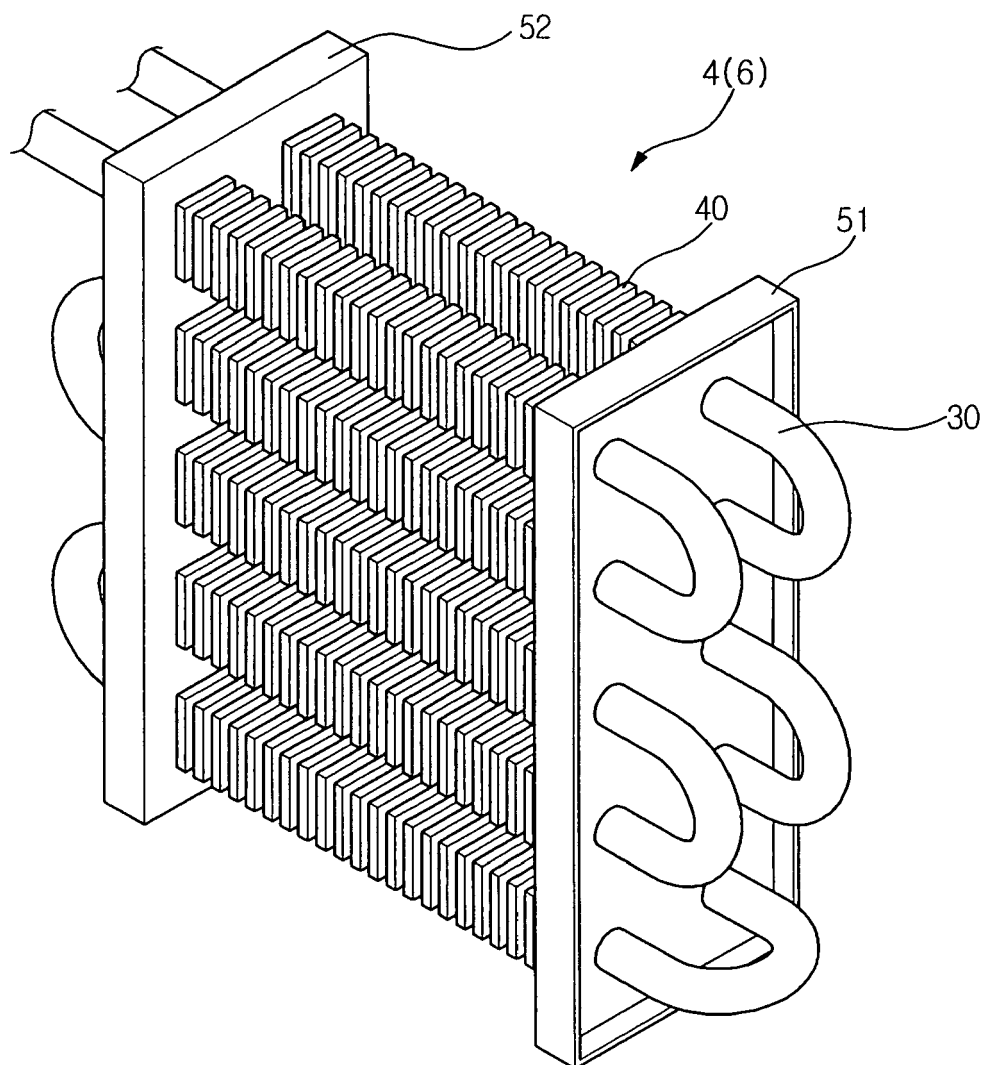


Fig.6

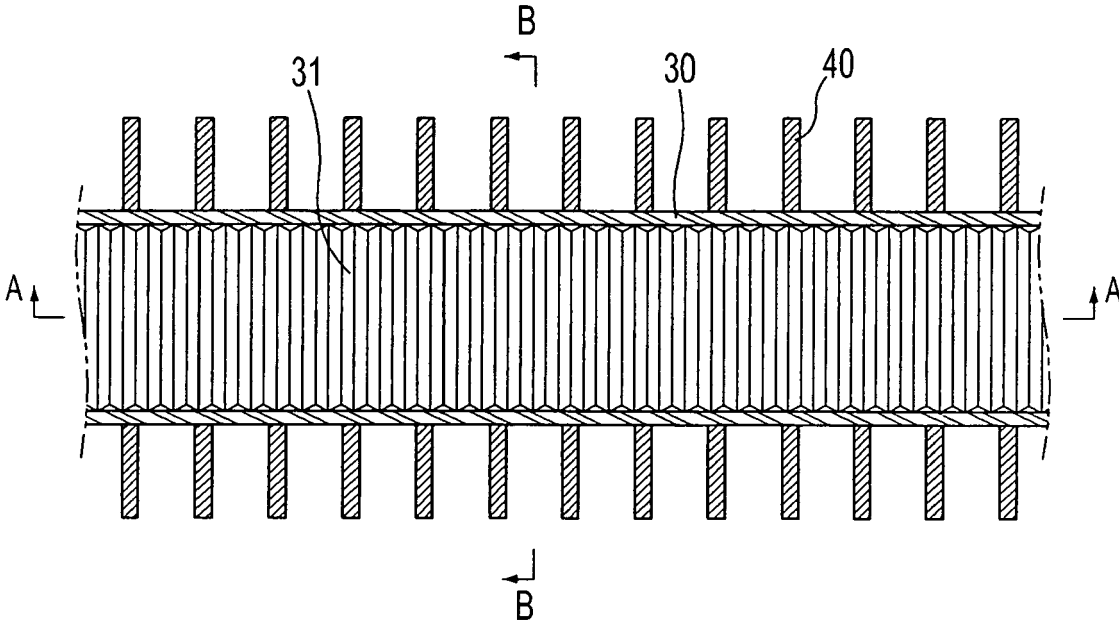


Fig.7

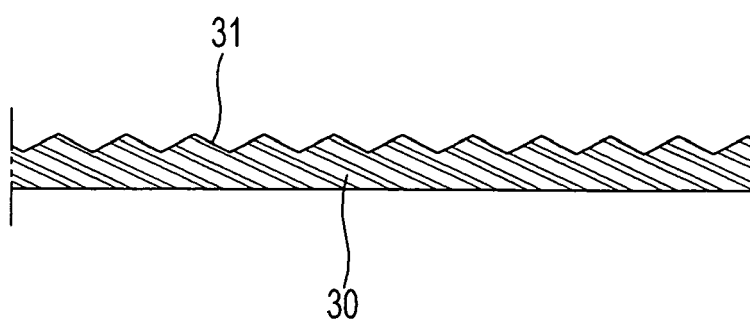


Fig.8

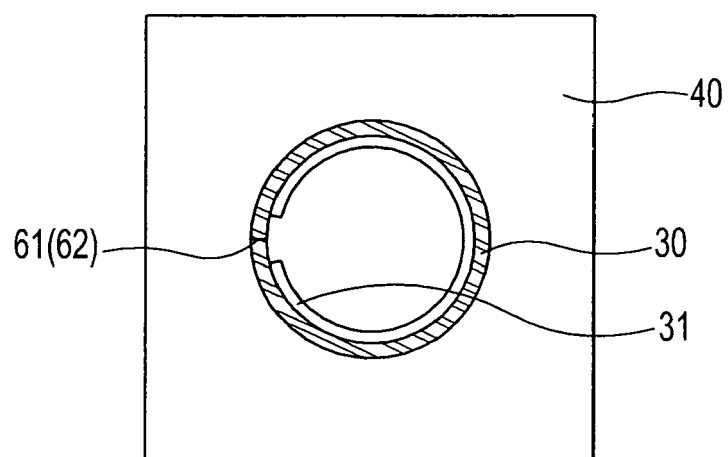


Fig.9

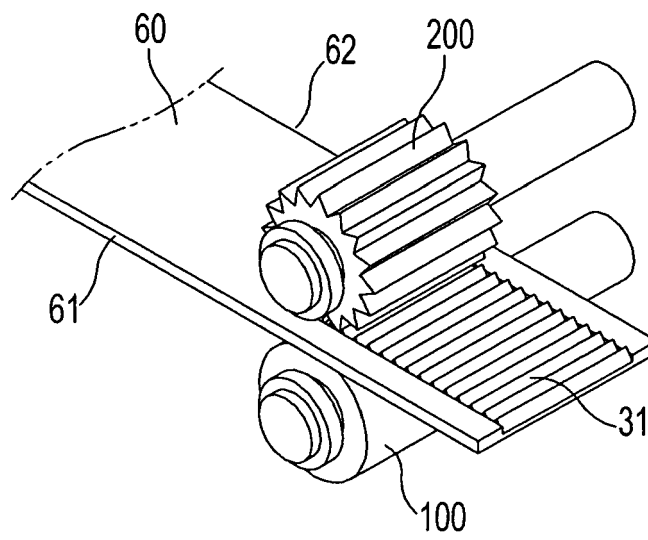


Fig.10

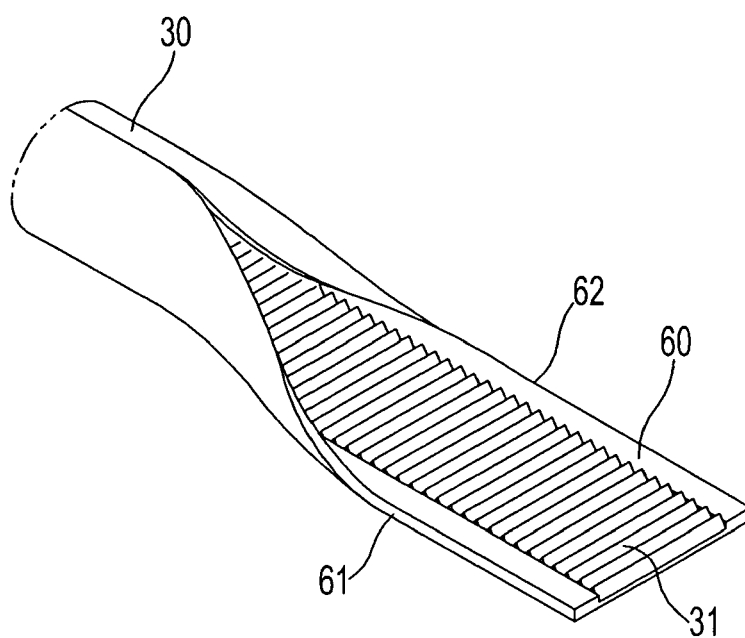


Fig.11

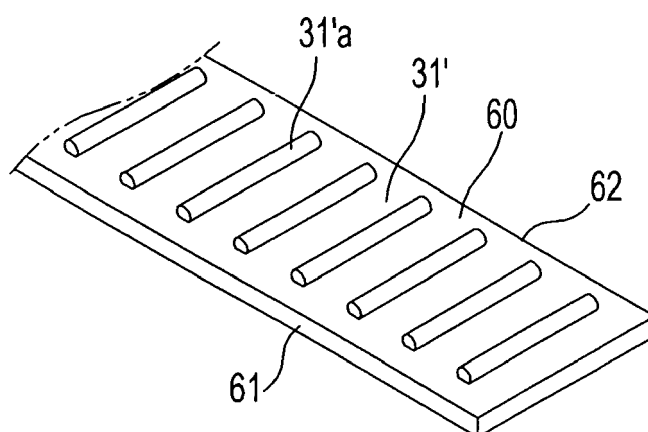


Fig.12

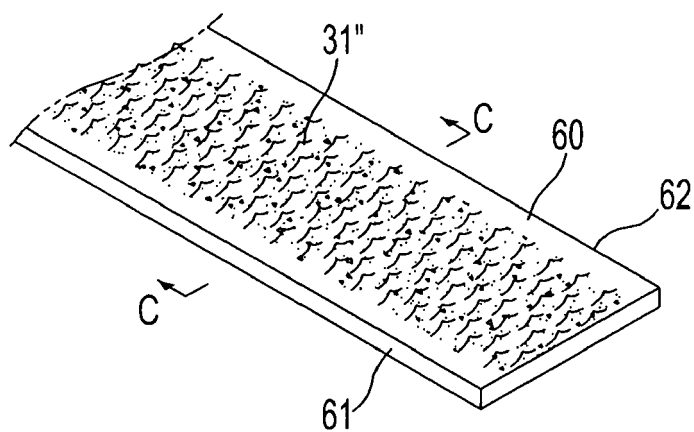
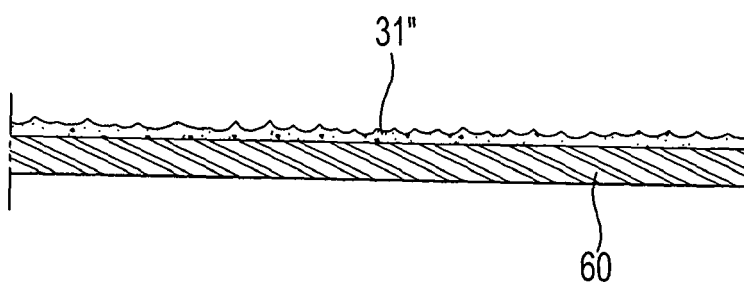


Fig.13





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