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

(11) EP 1 479 993 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
24.11.2004 Bulletin 2004/48

(51) Int Cl.[7]: **F28D 7/00**

(21) Application number: **04010816.9**

(22) Date of filing: **06.05.2004**

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

(30) Priority: **23.05.2003 JP 2003146347**

(71) Applicant: **Zexel Valeo Climate Control Corporation**
Ohsato-gun, Saitama 360-0193 (JP)

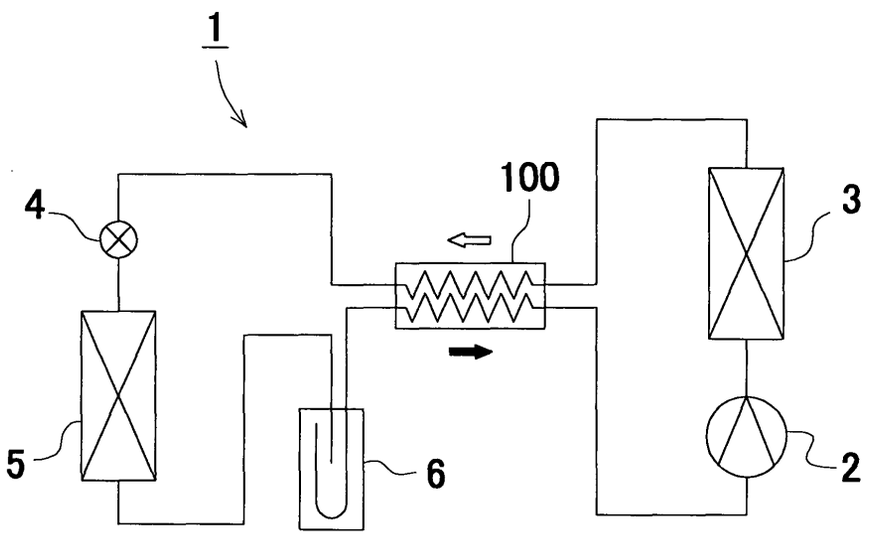
(72) Inventor: **Takano, Akihiko**
Zexel Valeo Climate Control Corp
Ohsato-gun Saitama 360-0193 (JP)

(74) Representative: **HOFFMANN - EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) Heat exchanger

(57) A heat exchanger which is used for a compression type refrigerating cycle for circulating a refrigerant and executes heat exchange between a high-pressure side and a low-pressure side of the refrigerant, wherein the heat exchanger is provided with a tube body 200 for flowing the refrigerant on the high-pressure side and the refrigerant on the low-pressure side and executes the heat exchange through heat conducted to the tube body; the tube body is comprised of a lamination of first tubes 210 of a flat type for flowing the refrigerant on the high-pressure side and second tubes 220 of a flat type for flowing the refrigerant on the low-pressure side; ends 201 of the tube body are formed by bending the ends 211 of the first tubes and those 221 of the second tubes to one side of a lamination direction; and the ends of the first tubes and the ends of the second tubes are provided with headers 310, 320, 330, 340 which become an inlet or an outlet for the refrigerant.

FIG.1



EP 1 479 993 A2

Description

TECHNICAL FIELD

[0001] The present invention relates to a heat exchanger which is used for a compression-type refrigerating cycle for circulating a refrigerant and performs heat exchange between a high-pressure side and a low-pressure side of the refrigerant.

BACKGROUND ART

[0002] The compression-type refrigerating cycle for circulating the refrigerant is highly demanded to have an improved refrigerating efficiency, a narrow and small mounting space, reduction in production cost and the like.

[0003] The refrigerating cycle of the above-described type can perform the heat exchange between the high- and low-pressure sides of the refrigerant to improve the refrigerating efficiency. Especially, a refrigerating cycle adopting CO_2 as a refrigerant and having a pressure in a radiator exceeding the critical point of the refrigerant has also become known in recent years. This supercritical refrigerating cycle requires very high pressure resistance, and the heat exchanger which performs the heat exchange between the high- and low-pressure sides of the refrigerant is also demanded to be configured so as to improve its heat exchange efficiency and to be resistant to the pressure of the refrigerant.

[0004] Patent Documents 1 and 2 given below disclose the basic structures of heat exchangers which are configured rationally considering the above-described various points. The heat exchangers disclosed in these documents are provided with a tube body for flowing the refrigerants on the high- and low-pressure sides and perform the heat exchange between the high-pressure side and the low-pressure side of the refrigerant by heat transmitted to the tube body. The tube body comprises lamination of first tubes for flowing the refrigerant on the high-pressure side and second tubes for flowing the refrigerant on the low-pressure side.

[Patent Document 1] Japanese Patent Laid-Open Publication No. 2002-98424
[Patent Document 2] Japanese Patent Laid-Open Publication No. 2002-98486

[0005] Where the refrigerants on the high-pressure side and the low-pressure side each are flowed to the tube body which comprises the lamination of plural flat-type tubes, a structure for flowing the refrigerant to the individual tubes is very significant. In other words, because such a heat exchanger requires a header, which makes an inlet or an outlet for the refrigerant, disposed at the ends of the individual tubes, the structure for flowing the refrigerant inevitably becomes complex to some extent. On the basis of the structure for flowing the refrigerant, a heat exchanger excelling in productivity is desired to be configured at the site of production of the heat exchanger.

[0006] The present invention has been made in view of the above circumstances and provides a heat exchanger for heat exchange between the high-pressure side and the low-pressure side of a refrigerant, which is provided with a tube body comprising the lamination of plural tubes, wherein a structure for flowing the refrigerant to the tube body is simplified.

DISCLOSURE OF THE INVENTION

[0007] The invention according to Claim 1 of the present application is a heat exchanger which is used for a compression type refrigerating cycle for circulating a refrigerant and executes heat exchange between a high-pressure side and a low-pressure side of the refrigerant, wherein the heat exchanger is provided with a tube body for flowing the refrigerant on the high-pressure side and the refrigerant on the low-pressure side and executes the heat exchange through heat conducted to the tube body; the tube body is comprised of a lamination of first tubes of a flat type for flowing the refrigerant on the high-pressure side and second tubes of a flat type for flowing the refrigerant on the low-pressure side; ends of the tube body are formed by bending the ends of the first tubes and those of the second tubes to one side of the lamination direction; and the ends of the first tubes and the ends of the second tubes are each provided with a header which becomes an inlet or an outlet for the refrigerant.

[0008] According to the above-described structure, the heat exchanger whose structure for flowing the refrigerant to the tube body is simplified can be obtained.

[0009] Specifically, the ends of the first tubes and the second tubes configuring the tube body are respectively provided with the header which becomes the inlet or the outlet for the refrigerant. Those headers must be disposed so not to interfere with each other. But, according to the present invention, the ends of the first tubes and the second tubes are bent toward one side of the lamination direction to save space for the headers and at the sometime to rationally prevent the headers from interfering with each other.

[0010] The invention according to Claim 2 of the present application is the heat exchanger according to Claim 1, wherein the first tubes and the second tubes are alternately laminated into a total of at least three layers.

[0011] Specifically, the construction of the invention that the ends of the first tubes and the second tubes are bent toward one side of the lamination direction is quite effective for the tube body which is comprised of the lamination of a total of at least three layers of the first tubes and the second tubes.

[0012] The invention according to Claim 3 of the present application is the heat exchanger according to

Claim 2, wherein the header is provided with plural cylindrical sections which are disposed in parallel to the width direction of the ends of the first tubes or the ends of the second tubes, and the plural cylindrical sections are connected with the ends of the first tubes or the ends of the second tubes.

[0013] Specifically, the header connecting the ends of the plural first tubes or the ends of the plural second tubes may be configured by disposing two or more of the cylindrical sections.

[0014] The invention according to Claim 4 of the present application is the heat exchanger according to Claim 3, wherein the header is provided with pipe members bent into a prescribed shape and configuring the plural cylindrical sections.

[0015] Specifically, the plural cylindrical sections can be configured of the pipe members bent into a prescribed shape.

[0016] The invention according to Claim 5 of the present application is the heat exchanger according to Claim 3, wherein the header is provided with plural pipe members respectively configuring the plural cylindrical sections, and communicating members communicating the plural pipe members.

[0017] Specifically, the plural cylindrical sections can be configured by disposing the pipe members at the ends of the plural first tubes or the ends of the plural second tubes. The individual pipe members are communicated by the communicating members.

[0018] The invention according to Claim 6 of the present application is the heat exchanger according to any of Claims 1 through 5, wherein the refrigerating cycle has a pressure in a radiator exceeding the critical point of the refrigerant.

[0019] Here, the critical point is a limit on the high temperature side (namely, a limit on the high-pressure side) in a state where a gas phase and a liquid phase coexist and which is an endpoint at one end of a vapor pressure curve. A pressure, temperature and density at the critical point become a critical pressure, critical temperature and critical density, respectively. When the pressure in the radiator exceeds the critical point of the refrigerant, the refrigerant is not condensed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

Fig. 1 is a schematic diagram showing a refrigerating cycle according to an embodiment of the present invention;

Fig. 2 is a perspective diagram showing a heat exchanger according to the embodiment of the present invention;

Fig. 3 is an exploded perspective diagram showing relevant portions of the heat exchanger according to the embodiment of the present invention;

Fig. 4 is an exploded perspective diagram showing relevant portions of the heat exchanger according to the embodiment of the present invention;

Fig. 5 is a perspective diagram showing the heat exchanger according to the embodiment of the present invention;

Fig. 6 is a perspective diagram showing the heat exchanger according to the embodiment of the present invention;

Fig. 7 is a perspective diagram showing a heat exchanger according to an embodiment of the present invention;

Fig. 8 is an exploded perspective diagram showing relevant portions of the heat exchanger according to the embodiment of the present invention;

Fig. 9 is an exploded perspective diagram showing relevant portions of the heat exchanger according to the embodiment of the present invention;

Fig. 10(a) is a top sectional diagram showing a first header and a fourth header and Fig. 10(b) is a top sectional diagram showing a second header and a third header according to the embodiment of the present invention; and

Fig. 11 is a perspective diagram showing the heat exchanger according to the embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0021] Embodiments of the present invention will be described in detail with reference to the drawings.

[0022] A compression type refrigerating cycle 1 shown in Fig. 1 is for a car room air conditioner mounted on a vehicle, and provided with a compressor 2 for compressing a refrigerant, a radiator 3 for cooling the refrigerant compressed by the compressor 2, a decompressor 4 for decompressing to expand the refrigerant cooled by the radiator 3, an evaporator 5 for evaporating the refrigerant decompressed by the decompressor 4, and an accumulator 6 for separating the refrigerant flowing out of the evaporator 5 into a gas phase and a liquid phase and sending the refrigerant of gas phase to the compressor 2. As the refrigerant, CO_2 is used, and the pressure in the radiator 3 exceeds the critical point of the refrigerant depending on the conditions such as a temperature under which the refrigerant is used.

[0023] This refrigerating cycle 1 is provided with a heat exchanger 100 for heat exchange between the high-pressure side and the low-pressure side of the refrigerant between the radiator 3 and the decompressor 4 and between the accumulator 6 and the compressor 2. The heat exchanger 100 improves the efficiency of the refrigerating cycle 1 by executing the heat exchange between the refrigerant on the high-pressure side and the refrigerant on the low-pressure side. A white arrow mark in the drawing indicates a flowing direction of the refrigerant on the high-pressure side and a black arrow mark indicates a flowing direction of the refrigerant on the low-pressure side.

[0024] As shown in Fig. 2 through Fig. 4, the heat exchanger 100 of this embodiment is provided with a tube body 200 for flowing the refrigerant on the high-pressure side and the refrigerant on the low-pressure side and executes the heat exchange through heat conducted to the tube body 200.

[0025] The tube body 200 comprises a vertical lamination of first tubes 210 of a flat type for flowing the refrigerant on the high-pressure side and second tubes 220 of a flat type for flowing the refrigerant on the low-pressure side. At least three layers of the first tubes 210 and the second tubes 220 are alternately laminated. The illustrated tube body 200 comprises the lamination of two layers of the first tubes 210 and three layers of the second tubes 220. The first tubes 210 and the second tubes 220 are formed of extruded members with plural refrigerant passages provided as a row.

[0026] Ends 211 of the first tubes 210 and ends 221 of the second tubes 220 at one end section 201 of the tube body 200 are vertically bent upward to one side of the lamination direction. And, the ends 211 of the first tubes 210 and the ends 221 of the second cubes 220 at the other end section 201 of the tube body 200 are vertically bent downward to one side of the lamination direction.

[0027] Headers 310, 320, 330, 340, which are inlets or outlets for the refrigerant, are disposed at the ends 211 of the first tubes 210 and the ends 221 of the second tubes 220. The headers 310, 320, 330, 340 include a first header 310 which becomes an inlet for the refrigerant of the first tubes 210, a second header 320 which becomes an outlet for the refrigerant of the first tubes 210, a third header 330 which becomes an inlet for the refrigerant of the second tubes 220, and a fourth header 340 which becomes an outlet for the refrigerant of the second tubes 220. The first header 310 and the fourth header 340 are disposed at one end section 201 of the tube body 200, and the second header 320 and the third header 330 are disposed at the other end section 201 of the tube body 200.

[0028] The individual headers 310, 320, 330, 340 each is provided with plural cylindrical sections 301 which are disposed in parallel to the width direction of the ends 211 of the first tubes 210 or the ends 221 of the second tubes 220. The ends 211 of the first tubes 210 or the ends 221 of the second tubes 220 are respectively connected to the plural cylindrical sections 301 at the individual headers 310, 320, 330, 340. A slit 302 is formed in the individual cylindrical sections 301 for insertion of the ends 211 of the first tubes 210 or the ends 221 of the second tubes 220.

[0029] The headers 310, 320, 330, 340 in this embodiment are formed of pipe members P_1 bent in a prescribed shape configuring the plural cylindrical sections 301. The pipe members P_1 each is formed of an extruded member, and the cylindrical sections 301 connecting the ends 211 of the first tubes 210 or the ends 221 of the second tubes 220 are mutually communicated at the U-shaped curved portions. One end of each of the pipe members P1 is connected to the piping of the refrigerating cycle 1. And, the other end of each of the pipe members P_1 is closed.

[0030] A prescribed space is set between the ends 211 of the first tubes 210 and the ends 221 of the second tubes 220, and the end faces of the ends 211 of the first tubes 210 and those of the ends 221 of the second tubes 220 are so set to have a different phase in the vertical direction. In other words, in the individual end sections 201 of the tube body 200, the ends 211 of the first tubes 210 and the ends 221 of the second tubes 220 are appropriately bent toward one side of the lamination direction to avoid the interference between the first header 310 and the fourth header 340 and between the second header 320 and the third header 330.

[0031] The heat exchanger 100 of this embodiment is produced by assembling the tube body 200 and the headers 310, 320, 330, 340 and brazing the assembly in a furnace by heating. Before brazing, a brazing material and flux are applied to the pertinent portions of the individual members.

[0032] According to the heat exchanger 100 of this embodiment, the refrigerant on the high-pressure side flowed from the radiator 3 into the first header 310 flows through the first tubes 210 into the decompressor 4 via the second header 320. The refrigerant on the low-pressure side flowed from the accumulator 6 to the third header 330 flows through the second tubes 220 into the compressor 2 via the fourth header 340. The heat exchange between the refrigerant on the high-pressure side and the refrigerant on the low-pressure side is executed through the heat conducted to the tube body 100.

[0033] As described above, the heat exchanger of this embodiment has the structure for flowing the refrigerant to the tube body 200 simplified, and the manufacture of the heat exchanger 100 is simplified, and the mounting space is made narrow and small.

[0034] As shown in Fig. 5, a heat insulating material 400 may be fitted around the tube body 200. Thermal insulation from the outside is improved by the heat insulating material 400, and the heat exchange between the refrigerant on the high-pressure side and the refrigerant on the low-pressure side is promoted. As a result, the efficiency of the refrigerating cycle 1 is improved furthermore.

[0035] As shown in Fig. 6, the ends of the first tubes 210 and the ends of the second tubes 220 at both end sections 201 of the tube body 200 may be bent in the same direction. In other words, the bending directions of the ends of the first tubes 210 and the ends of the second tubes 220 can be determined appropriately depending on the mounting position or the like of the heat exchanger 100 when they are mutually aligned at the end sections 201 of the tube body 200.

[0036] Then, a second embodiment of the invention will be described. As shown in Fig. 7 through Fig. 10, individual headers 310, 320, 330, 340 of this embodi-

ment comprise plural pipe members P_2 each configuring plural cylindrical sections 301, and communicating members 303 for communicating the plural pipe members P_2. The communicating members 303 are provided with a joint 304 for connection with the piping of the refrigerating cycle 1.

[0037] The pipe members P_2 of the first header 310 and the pipe members P_2 of the fourth header 340 are alternately disposed in a row and supported between the communicating member 303 of the first header 310 and the communicating member 303 of the fourth header 340. Similarly, the pipe members P_2 of the second header 320 and the pipe members P_2 of the third header 330 are alternately disposed in a row and supported between the communicating member 303 of the second header 320 and the communicating member 303 of the third header 330. The individual pipe members P_2 are communicated with the predetermined communicating members 303 only. The refrigerant flows into or out of the communicating members 303.

[0038] A predetermined space is disposed between the ends 211 of the first tubes 210 and the ends 221 of the second tubes 220, and the end faces of the ends 211 of the first tubes 210 and the end faces of the ends 221 of the second tubes 220 are so set to have the same phase in the vertical direction. Other basic structures are the same as that of the above-described embodiment.

[0039] Thus, the individual headers 310, 320, 330, 340 may also be configured of the pipe members P_2 and the communicating member 303.

[0040] In the heat exchanger 100 of this embodiment, the ends of the first tubes 210 and the ends of the second tubes 220 at both end sections 201 of the tube body 200 may be bent in the same direction as shown in Fig. 11. In other words, the bending directions of the ends of the first tubes 210 and the ends of the second tubes 220 can be set appropriately depending on the mounting place or the like of the heat exchanger 100 when they are mutually aligned at the end sections 201 of the tube body 200.

INDUSTRIAL APPLICABILITY

[0041] The heat exchanger of the present invention can execute the heat exchange between the high-pressure side and the low-pressure side of the refrigerant efficiently and suitably used in the refrigerating cycle, wherein the pressure in the radiator exceeds the critical point of the refrigerant, for example, in automobiles, home use, and the like.

Claims

1. A heat exchanger which is used for a compression type refrigerating cycle for circulating a refrigerant and executes heat exchange between a high-pressure side and a low-pressure side of the refrigerant, wherein:

the heat exchanger is provided with a tube body for flowing the refrigerant on the high-pressure side and the refrigerant on the low-pressure side and executes the heat exchange through heat conducted to the tube body;
the tube body is comprised of a lamination of first tubes of a flat type for flowing the refrigerant on the high-pressure side and second tubes of a flat type for flowing the refrigerant on the low-pressure side;
ends of the tube body are formed by bending the ends of the first tubes and those of the second tubes to one side of a lamination direction; and
the ends of the first tubes and the ends of the second tubes are each provided with a header which becomes an inlet or an outlet for the refrigerant.

2. The heat exchanger according to Claim 1, wherein the first tubes and the second tubes are alternately laminated into a total of at least three layers.

3. The heat exchanger according to Claim 2, wherein the header is provided with plural cylindrical sections which are disposed in parallel to a width direction of the ends of the first tubes or the ends of the second tubes, and the plural cylindrical sections are connected with the ends of the first tubes or the ends of the second tubes.

4. The heat exchanger according to Claim 3, wherein the header is provided with pipe members bent into a prescribed shape and configuring the plural cylindrical sections.

5. The heat exchanger according to Claim 3, wherein the header is provided with plural pipe members each configuring the plural cylindrical sections, and communicating members communicating the plural pipe members.

6. The heat exchanger according to any of Claims 1 through 5, wherein the refrigerating cycle has a pressure in a radiator exceeding the critical point of the refrigerant.

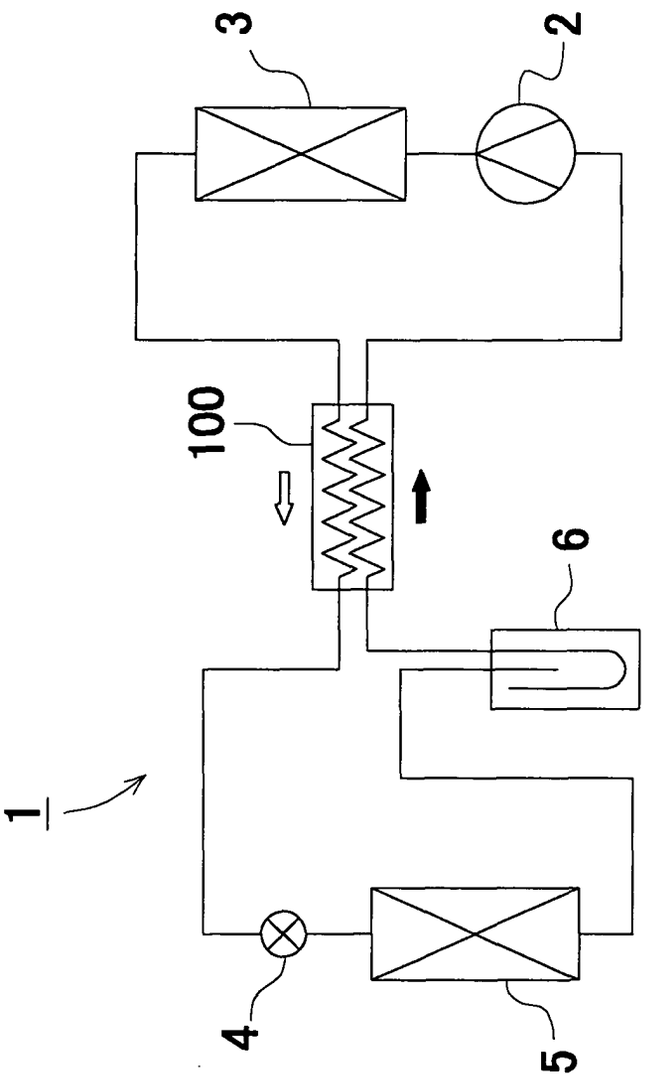


FIG.1

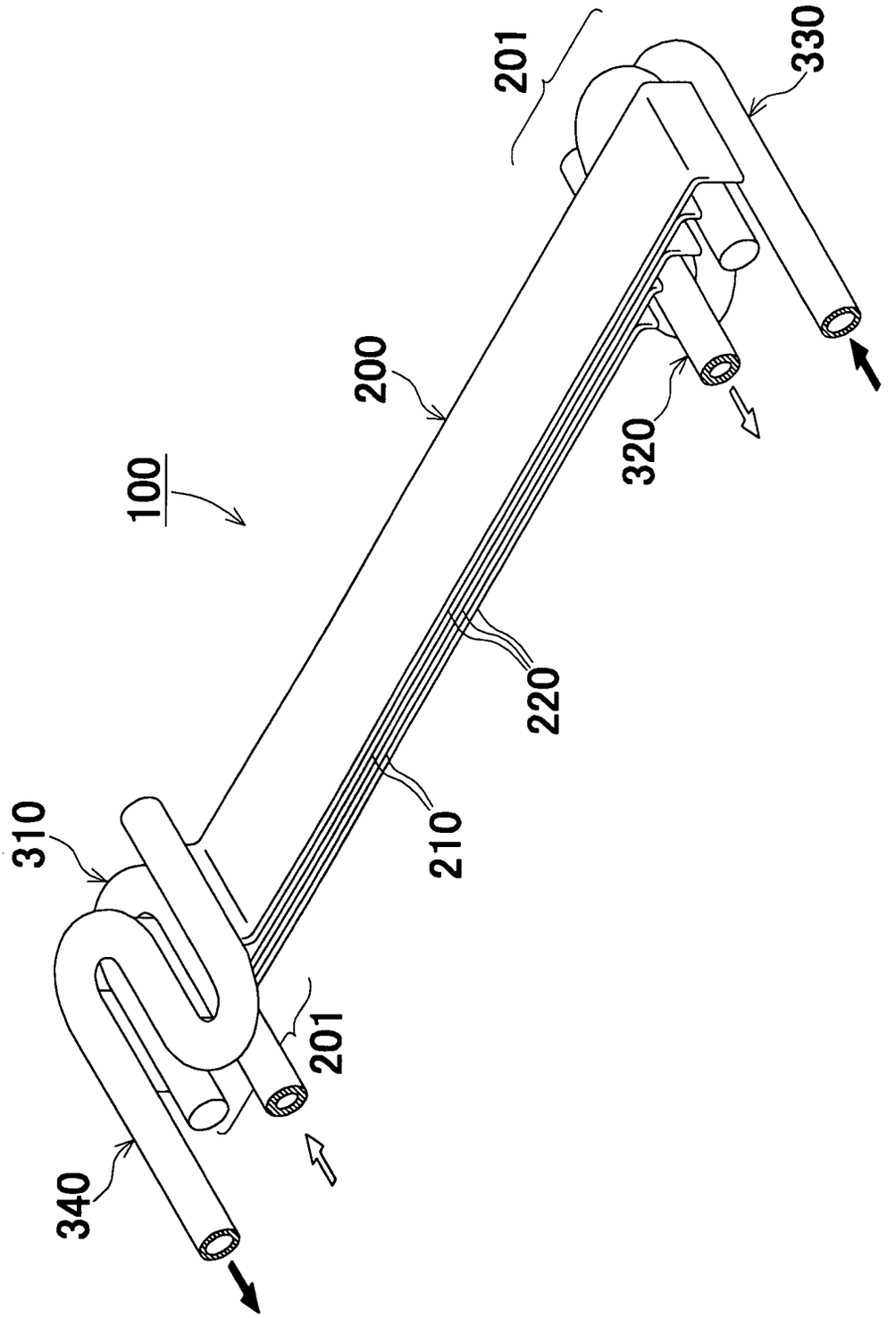


FIG.2

FIG.3

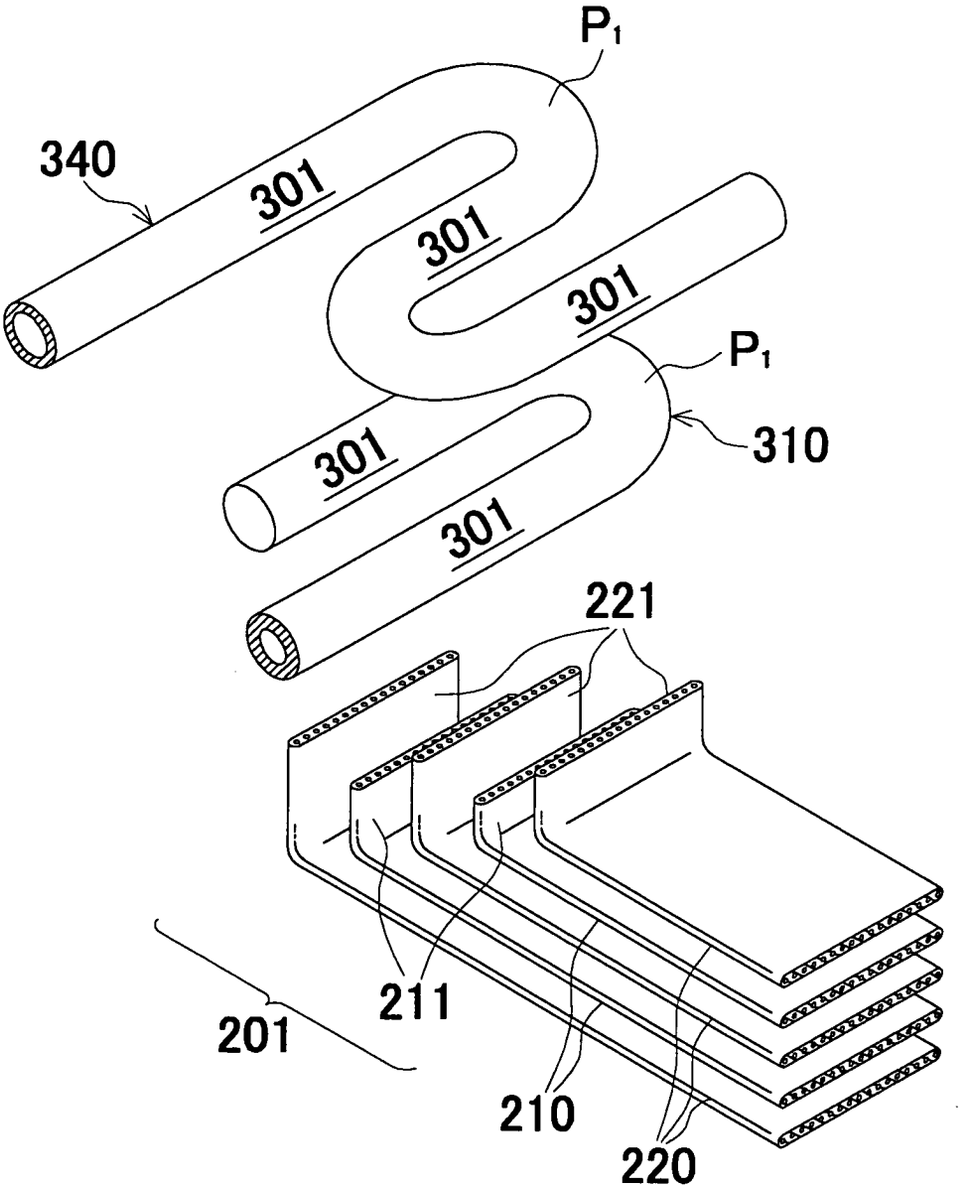
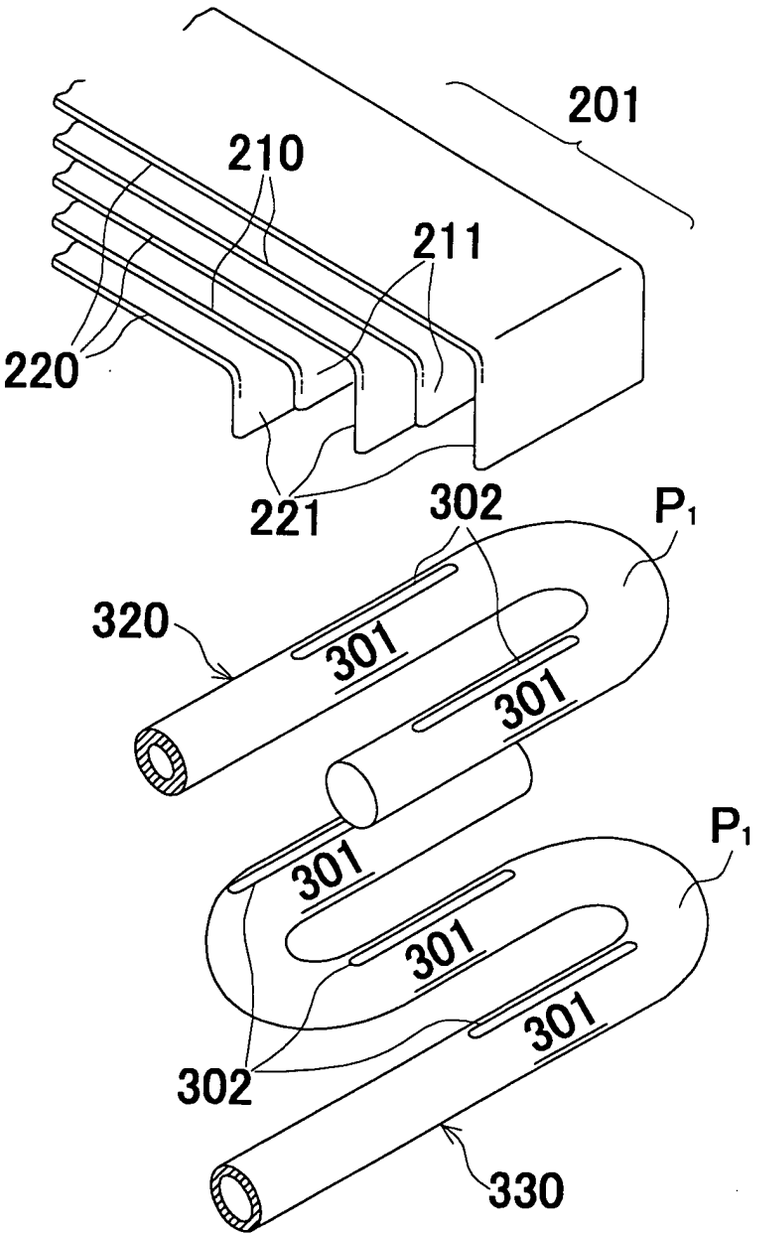


FIG.4



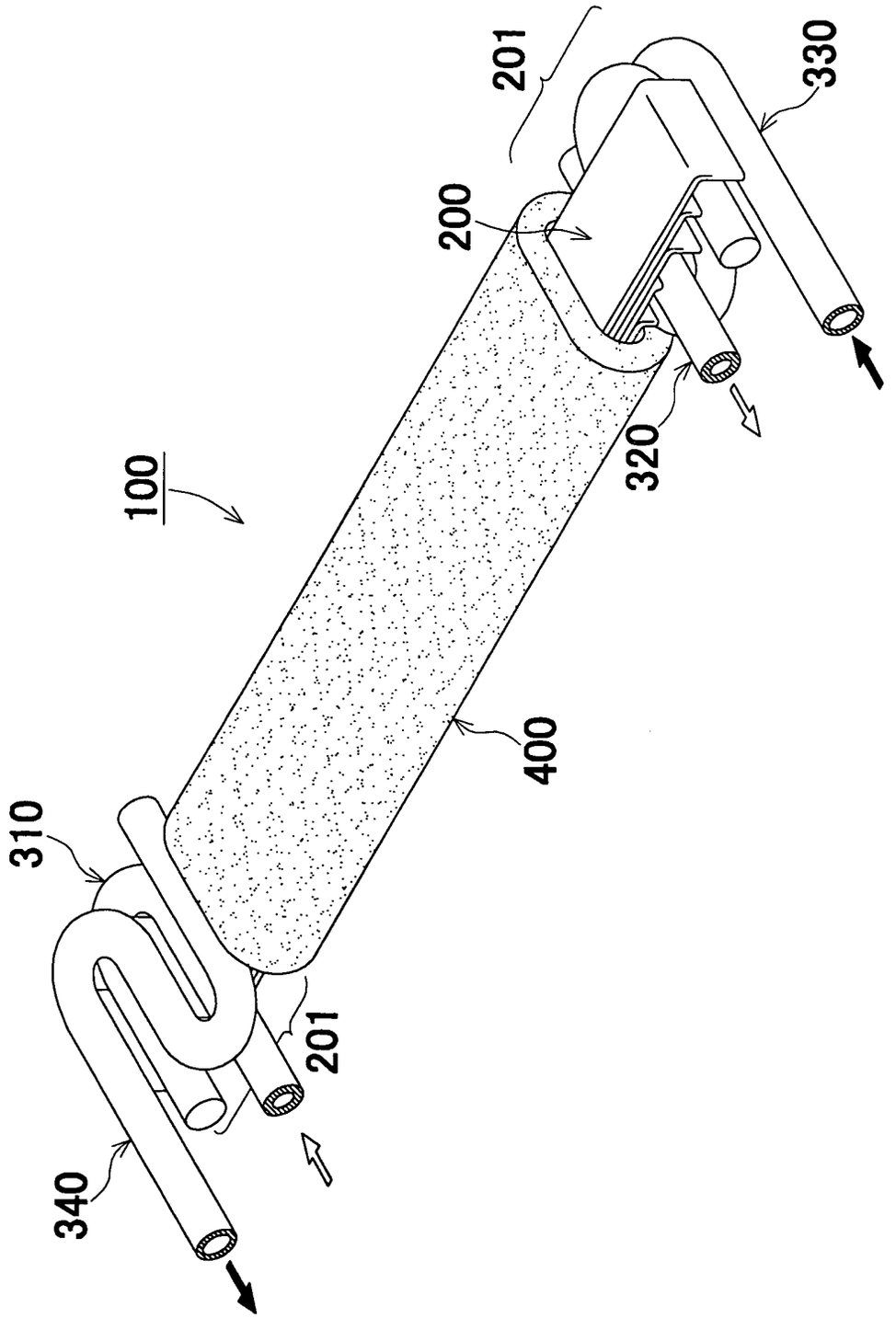


FIG.5

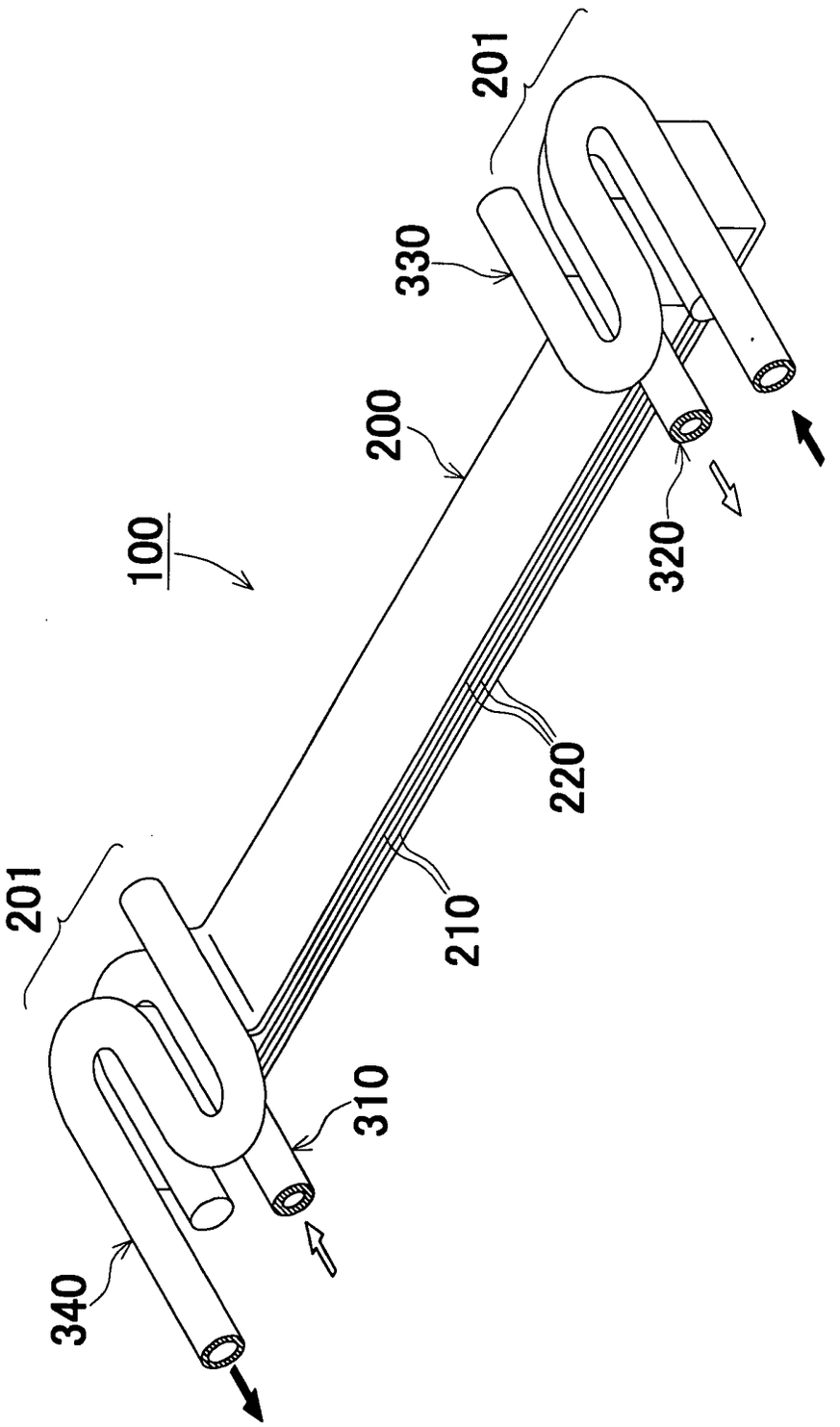


FIG.6

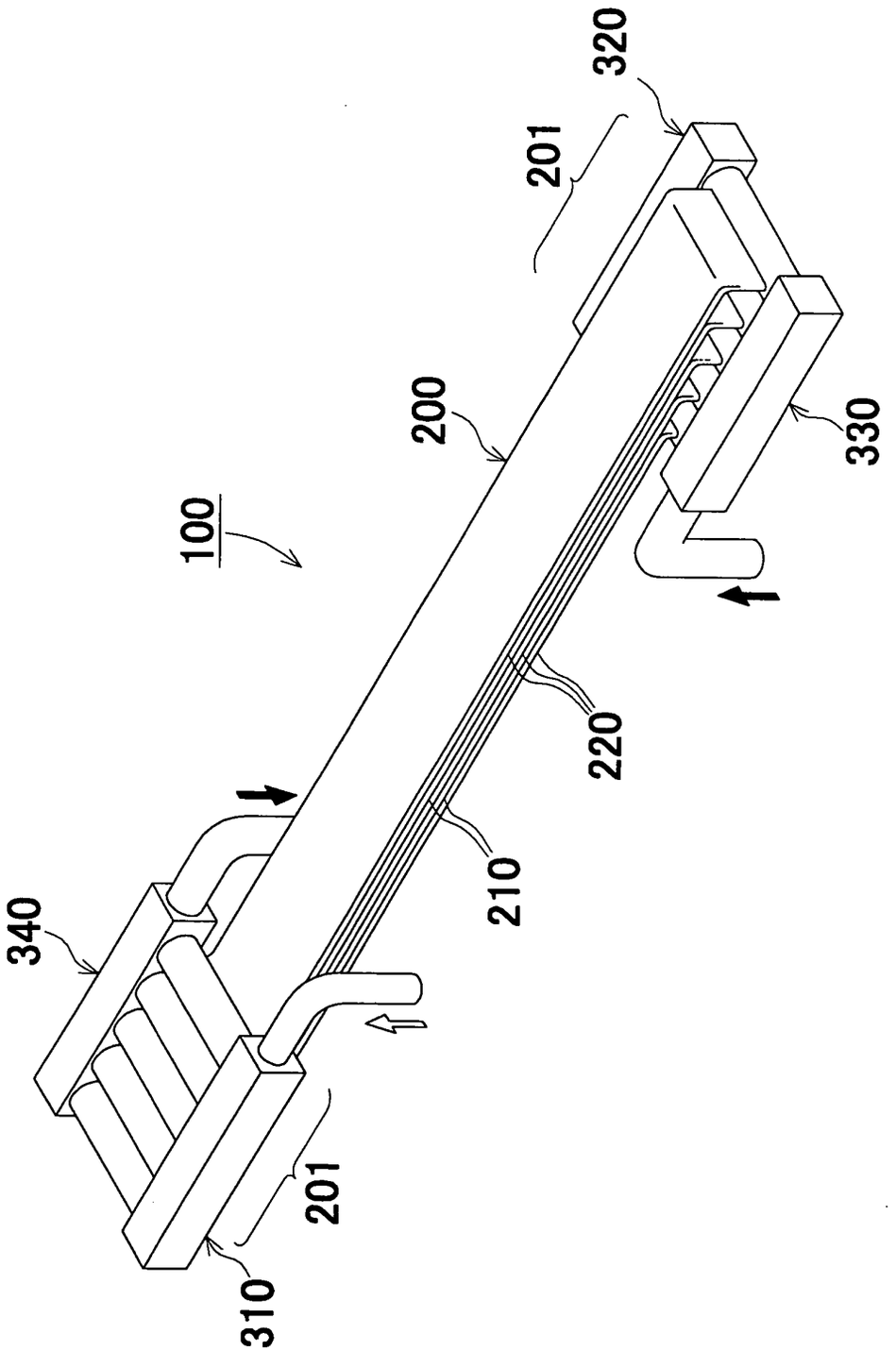
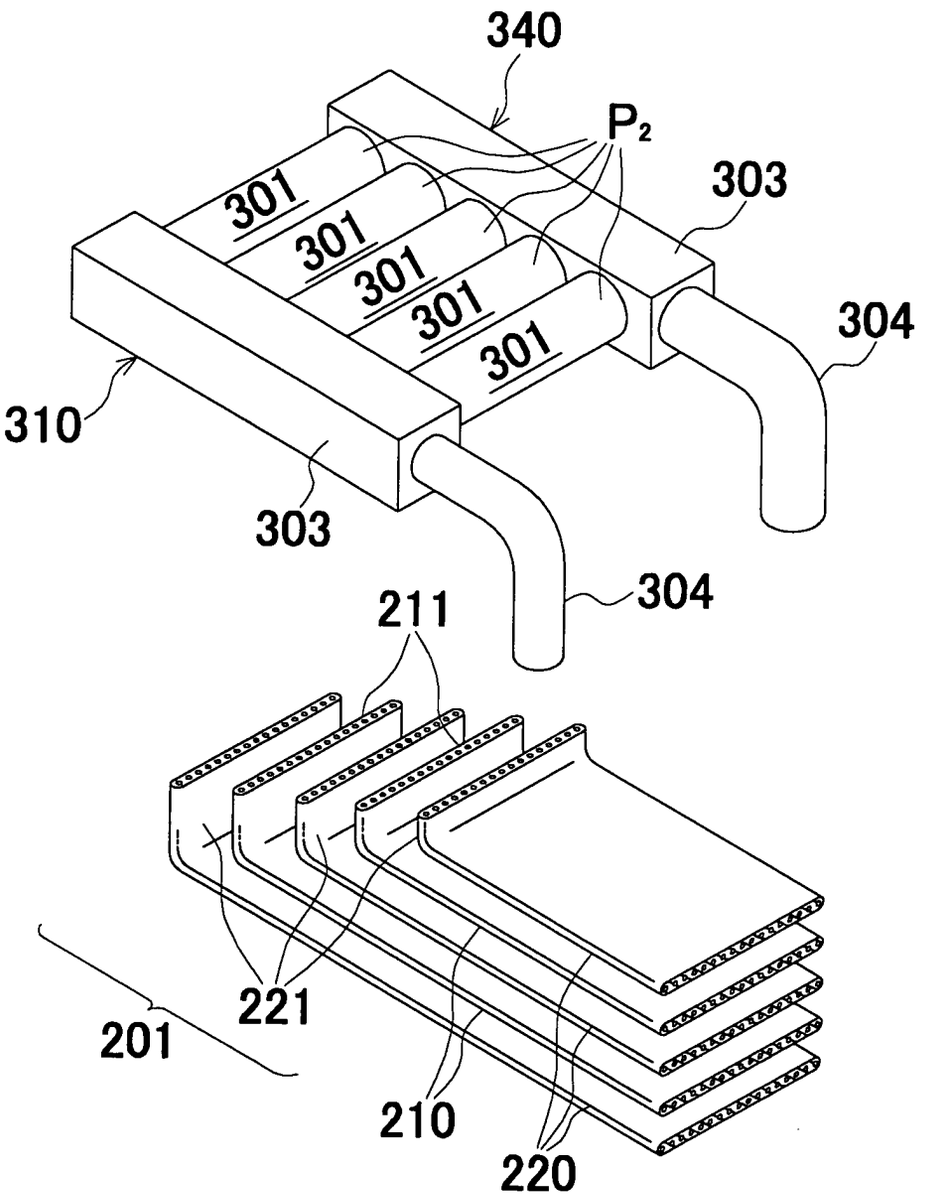


FIG.7

FIG.8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P2
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310
303
304
211
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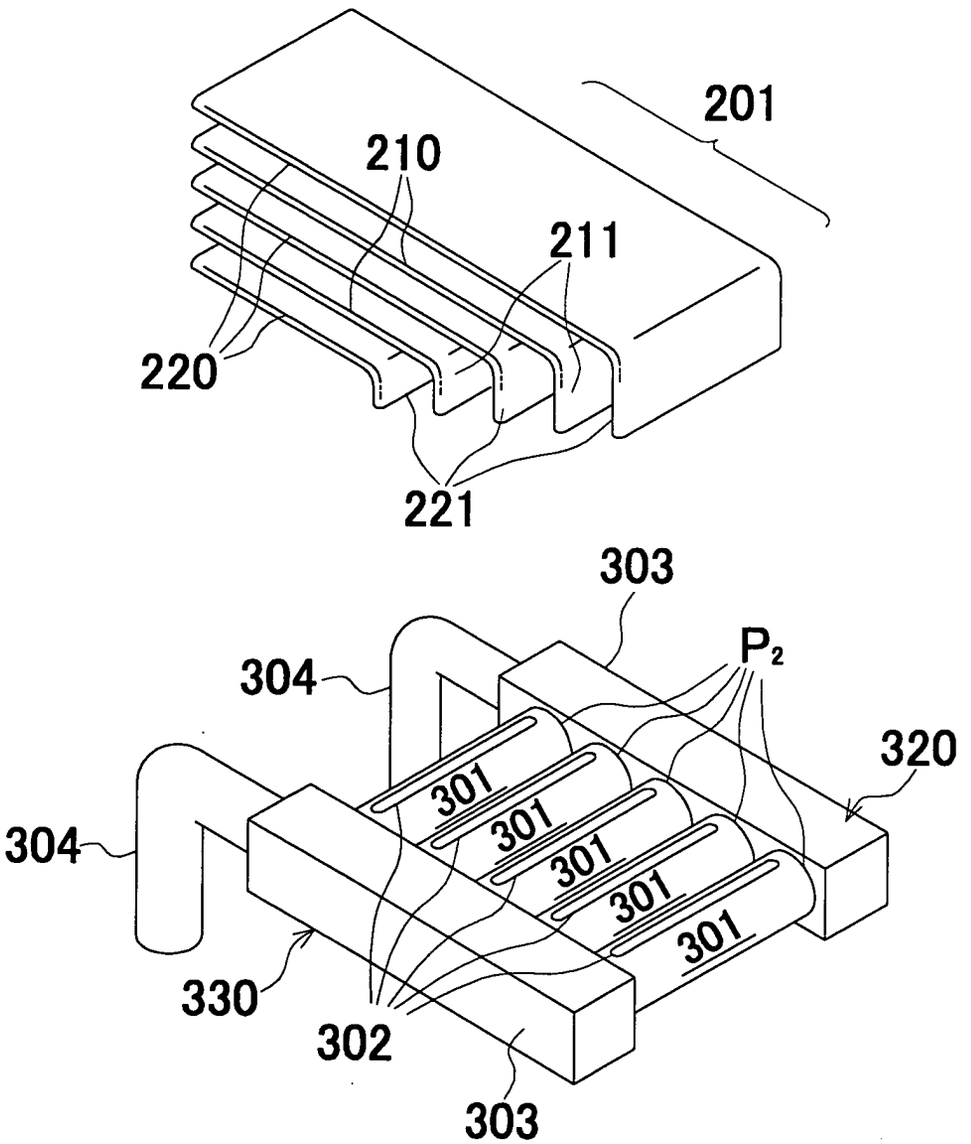
201
210
220

FIG.9


201
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P_2
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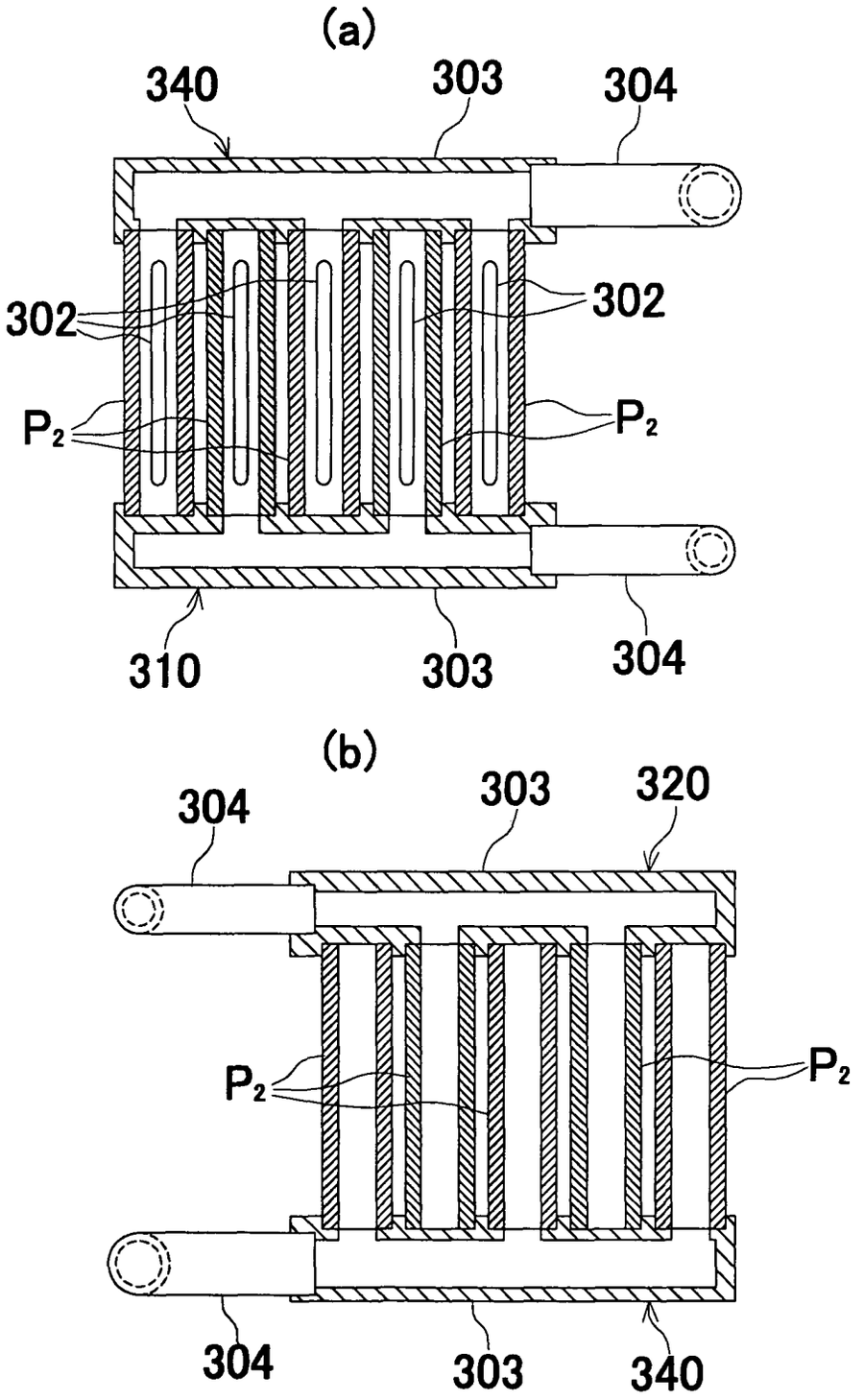
303

FIG.10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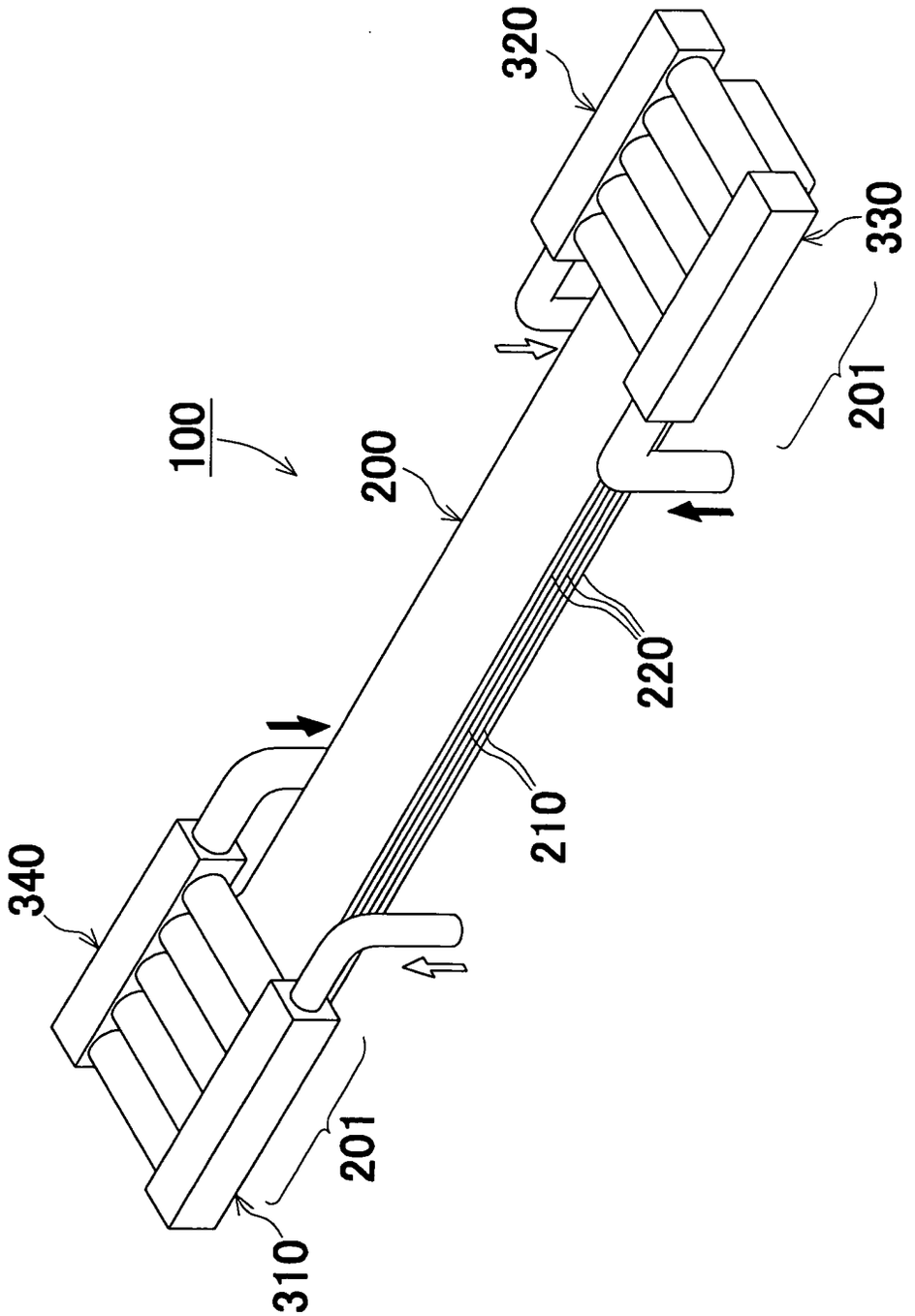

FIG.11