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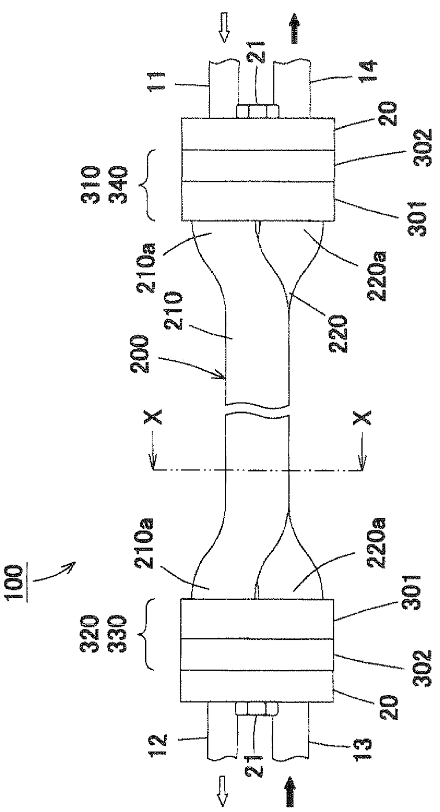
(54) Heat exchanger

(57) [Problem] To provide a heat exchanger in which the medium flow structure in a tube body is logically configured.

[Solving Means] A heat exchanger comprising a tube body 200 comprising a first flow passage 211 and a second flow passage 221, an inlet part 310 and outlet part 320 for a medium that flows through the first flow passage, and an inlet part 330 and outlet part 340 for a medium that flows through the second flow passage in which heat exchange is effected between the medium flowing through the first flow passage and the medium flowing through the second flow passage by means of heat transmitted to the tube body, the tube body being formed by stacking of a plurality of flat first tubes 210 in which the first flow passage is provided and a plurality of flat second tubes 220 in which the second flow passage is provided, the plurality of first tubes and the plurality of second tubes being alternately stacked with uniformity along a longitudinal direction and a flatness direction thereof, and end parts 210a of the plurality of first tubes and end parts 220b of the plurality of second tubes being connected at the end parts of the tube body to each of a predetermined inlet part and outlet part with displacement therebetween in the flatness direction.

[FIG. 2]



EP 1 867 944 A2

Description

[Field of Technology]

[0001] The present invention relates to a heat exchanger comprising a tube body having a first flow passage and a second flow passage in which heat exchange is effected between a medium flowing through the first flow passage and a medium flowing through the second flow passage by way of heat transmitted to said tube body.

[Background Art]

[0002] The refrigeration efficiency of a compression-type refrigeration cycle in which a refrigerant is circulated can be improved by heat exchange performed between the high-pressure side and low-pressure side of the refrigerant. Refrigeration cycles that use CO_2 as a refrigerant and in which the internal pressure of the radiator exceeds the critical point of the refrigerant have become particularly well known in recent years. Supercritical refrigeration cycles such as this necessitate a very high pressure resistance, and a demand exists for a heat exchanger configuration in which heat exchange is effected between the high-pressure side and the low-pressure side of the refrigerant having improved heat exchange efficiency and the capacity to withstand the pressure of the refrigerant. Cited references 1 to 3 disclose a basic configuration of a heat exchanger logically configured with consideration thereof. The heat exchangers disclosed in these cited references comprise a tube body through which a high-pressure side and low pressure side refrigerant flows in which heat exchange is effected between a high-pressure side and low-pressure side refrigerant by means of heat transmitted to the tube body. The tube body is configured from a flat first tube through which the high-pressure side refrigerant flows and a flat second tube through which the low-pressure side refrigerant flows. A configuration based on the stacking of these tubes is also disclosed in cited reference 4.

[Cited reference 1] Japanese Unexamined Patent Application No. 2002-98424
[Cited reference 2] Japanese Unexamined Patent Application No. 2002-98486
[Cited reference 3] Japanese Unexamined Patent Application No. 2004-347258
[Cited reference 4] Japanese Unexamined Patent Application No. 2002-243374

[Disclosure of the Invention]

[Problems to be Solved by the Invention]

[0003] Thereupon, important issues for consideration in the configuring of refrigeration internal heat exchangers include improved pressure-resistance and heat exchange efficiency, as well as the reduction in space occupied by the apparatus and reduction in manufacturing costs. For example, an issue for consideration in the flow of each of a high-pressure side and a low-pressure side refrigerant through a tube body formed by stacking of a plurality of flat tubes is the design of the refrigerant flow structure of the tubes. In other words, the refrigerant flow structure of conventional heat exchangers is to a certain extent unavoidably complex due to the need for provision of a refrigerant inlet part and outlet part in the end part of the tubes. Heat exchanger manufacturing plants desire the development of a heat exchanger based on this kind of refrigerant flow structure having improved productivity.

[0004] For example, while the end part of the tubes of the heat exchanger disclosed in cited reference 4 is bent in the direction of stacking of the tubes, the bend angle is different for each tube and, accordingly, productivity is affected because of the commonality of the component parts.

[0005] With the foregoing conditions in mind, it is an object of the present invention to provide a heat exchanger in which the media flow structure of the tube body is logically configured.

[Means to Solve the Problems]

[0006] The invention according to Claim 1 of the subject application constitutes a heat exchanger comprising a tube body having a first flow passage and a second flow passage, an inlet port and outlet port for a medium that flows through the first flow passage, and an inlet port and outlet port for a medium that flows through the second flow passage in which heat exchange is effected between the medium flowing through said first flow passage and the medium flowing through said second flow passage by way of heat transmitted to the tube body of a configuration in which the tube body is formed by stacking of a plurality of flat first tubes in which the first flow passage is provided and a plurality of flat second tubes in which the second flow passage is provided, in which the plurality of first tubes and the plurality of second tubes are alternately stacked with uniformity in a longitudinal direction and a flatness direction thereof, and in which end parts of the plurality of first tubes and end parts of the plurality of second tubes are respectively connected at an end part of the tube body to a predetermined inlet part and outlet part with displacement therebetween in the flatness direction.

[0007] The invention according to Claim 2 of the subject application constitutes the heat exchanger of Claim 1 of a configuration in which the predetermined inlet part and outlet part are formed by a coupling of a first block member in which a plurality of slits through which the end parts of the plurality of first tubes and the end parts of the plurality of second tubes are inserted are provided with a second block member comprising a communication part by which the plurality of slits communicate.

[0008] The invention according to Claim 3 of the subject application constitutes the heat exchanger of Claim 1 or Claim 2 of a configuration in which the heat exchanger constitutes an internal heat exchanger employed in a compression-type refrigeration cycle in which a refrigerant is circulated and in which heat exchange is effected between a high-pressure side and a low-pressure side of the refrigerant.

[0009] The invention according to Claim 4 of the subject application constitutes the heat exchanger of Claim 3 of a configuration in which the heat exchanger is supported in a radiator of the refrigeration cycle, and a pipe through which the refrigerant flows from the radiator to the heat exchanger and the inlet part of the first flow passage are integrated.

[Effect of the Invention]

[0010] According to the present invention, a heat exchanger in which the media flow structure of the tube body is logically configured can be produced.

[Best Mode for Carrying out the Invention]

[0011] Embodiments of the present invention will be hereinafter described with reference to the drawings. A compression-type refrigeration cycle 1 as shown in FIG. 1 refers to a vehicle air conditioner mounted in a vehicle that comprises a compressor 2 for compressing a refrigerant, a radiator 3 for cooling a refrigerant compressed by the compressor 2, a depressurizer 4 for reducing the pressure and expanding the refrigerant cooled by the radiator 3, an evaporator 5 for evaporating the refrigerant depressurized by the depressurizer 4, and an accumulator 6 for separating the refrigerant that flows out from the evaporator 5 into a gas layer and a liquid layer and feeding the gas layer refrigerant to the compressor 2. CO_2 is employed as the refrigerant, and the internal pressure of the radiator 3 exceeds the critical point of the refrigerant in accordance with usage conditions such as the gas temperature. The critical point of the refrigerant refers to the high-pressure side limit of thereof in a state in which the gas layer and liquid layer are coexisting, in other words the high-pressure side limit, and on a vapour pressure curve thereof is represented as the terminus. The pressure, temperature and density at the critical point are referred to as the critical pressure, critical temperature and critical density. When the pressure exceeds the critical point of the refrigerant in the interior of a radiator condensation of the refrigerant will not occur.

[0012] In addition, in the refrigeration cycle 1, a heat exchanger 100 for performing heat exchange between a high-pressure side and low-pressure side refrigerant is provided between the radiator 3 and depressurizer 4 and between the accumulator 6 and compressor 2. The heat exchanger 100 improves the efficiency of the refrigeration cycle 1 by effecting heat exchange between the high-pressure side refrigerant and low-pressure side refrigerant. The white arrow in this diagram denotes the direction in which the high-pressure side refrigerant flows, and the black arrow denotes the direction in which the low-pressure side refrigerant flows. In addition, the symbol 11 in the drawing denotes a pipe through which the refrigerant flows from the radiator 3 to the heat exchanger 100, the symbol 12 denotes a pipe through which the refrigerant flows from the heat exchanger 100 to the depressurizer 4, and the symbol 13 denotes a pipe through which the refrigerant flows from the accumulator 6 to the heat exchanger 100, and the symbol 14 denotes a pipe through which the refrigerant flows from the heat exchanger 100 to the compressor 2.

[0013] As shown in FIGS. 2 to FIG. 8, the heat exchanger 100 of this example comprises a tube body 200 through which the high-pressure side refrigerant and the low pressure side refrigerant flow, heat exchange being effected by means of heat transmitted to the tube body 200. More specifically, the tube body 200 comprises a first flow passage 211 and a second flow passage 221, an inlet part 310 and outlet part 320 for a medium that flows through the first flow passage 211, and an inlet part 330 and outlet part 340 for a medium that flows through the second flow passage 221, heat exchange being effected between the medium that flows through the first flow passage 211 (high-pressure side refrigerant) and the medium that flows through the second flow passage 221 (low-pressure side refrigerant) by means of heat transmitted to the tube body 200.

[0014] The tube body 200 is formed by stacking of a plurality of first tubes 210 in which the first flow passage 211 is provided and a plurality of flat second tubes 220 in which the second flow passage 221 is provided. The first tubes 210 and the second tubes 220 are configured as extruded members in which a plurality of flow passages is arranged in a row. The cross-sectional area of the first flow passage 211 is designed to be smaller than the cross-sectional area of the second flow passage 221 from the viewpoint of pressure resistance.

[0015] The plurality of first tubes 210 and second tubes 220 are alternately stacked with uniformity in the longitudinal direction and in the flatness direction thereof. In addition, end parts 210a of the plurality of first tubes 210 and end parts 220a of the plurality of second tubes 220 are respectively connected at the end part of the tube body 200 to predetermined inlet parts 310, 330 or outlet parts 320, 340 with displacement therebetween in the flatness direction. Both end parts 210a of the first tubes 210 and both end parts 220a of the second tubes 220 are subjected to a predetermined bend processing following extrusion moulding.

[0016] The inlet parts 310, 330 and outlet parts 320, 340 are configured by coupling of a first block member 301 with a second block member 320. Notably, in this example, the first block member 301 and the second block member 302 from which the inlet part 310 of the first flow passage 211 is configured is integrated with the first block member 301 and the second block member 302 from which the outlet part 340 of the second flow passage 221 is configured, and the first block member 301 and the second block member 302 from which the outlet part 320 of the first flow passage 211 is configured is integrated with the first block member 301 and the second block member 302 from which the inlet part 330 of the second flow passage 221 is configured. Based on this kind of configuration, the number of component parts is reduced and the operation for the assembly thereof can be simplified.

[0017] The first block member 301 constitutes a member that comprises a plurality of first slits 301 a in which the end parts 210a of the plurality of first tubes 210 are inserted and a plurality of second slits 301 b into which the end parts 220a of the plurality of second tubes 220 are inserted. The second block member 302 constitutes a member that comprises a first communication part 302a through which the plurality of first slits 301 a communicate, and a second communication part 302b through which the plurality of second slits 301 b communicate. The end parts 210a of the first tubes 210 are inserted to around the middle of the first slits 301 a. The end parts 220a of the second tubes 220 are also inserted to around the middle of the second slits 301 b. In this configuration the pipes 11, 12, 13 and 14 are inserted to have connection with each of the first communication part 302a and the second communication part 302b.

[0018] The pipe 11 in which the refrigerant flows from the radiator 3 to the heat exchanger 100 and the pipe 14 in which the refrigerant from the heat exchanger 100 flows to the compressor 2 are formed as a bundle by a block-shaped connector member 20, the pipes 11, 14 being connected by screwing of the connector member 20 to the second block member 302. Similarly, the pipe 12 in which the refrigerant flows from the heat exchanger 100 to the depressurizer 4 and the pipe 13 in which the refrigerant flows from the accumulator 6 to the heat exchanger 100 are formed as a bundle by the block-shaped connector member 20, and the pipes 12, 13 are connected by screwing of a connector member 20 into the second block member 302. A female screw part and a through-hole penetrated by a screw bolt 21 are provided in the connector member 20 and the second block member respectively.

[0019] The heat exchanger 100 of this example is configured by assembly of the first tubes 210, the second tubes 220, the first block member 301 and the second block member 302, the assembly being heat-processed and soldered in a furnace. During the soldering, the solder material and flux are provided in the necessary positions of each member.

[0020] As is described above, a simplification of the refrigerant flow structure in the tube body 200 and a compacting of the space occupied thereby can be achieved in the heat exchanger 100 of this example. More particularly, the configuration of this embodiment in which the end parts 210a of the plurality of first tubes 210 and the end parts 220a of the plurality of second tubes 220 are respectively connected to predetermined inlet parts 310, 330 or outlet parts 320, 340 with displacement in the flatness direction between the first tubes 210 and the second tubes 220 is advantageous in that a plurality of first tubes 210 of the same shape and a plurality of second tubes 220 of the same shape can be employed whereupon, accordingly, the shape thereof can be reliably simplified.

[0021] Notably, the configuration of each part of this example is clearly not limited to the configuration described above, and design alterations within the technical range described by the range of the patent claims may be made thereto as appropriate.

[0022] For example, as the configuration of the first slits 301 a and second slits 301 b of the first block member 301 shown in FIG. 8, a step part 301 c may be provided in the middle region thereof, the insert amount of the end parts 210a of the first tubes 210 and the end parts 220a of the second tubes 220 being regulated as a result of abutting against the step part 301 c. Based on a configuration such as this, a state in which the first flow passage 211 or the second flow passage 221 is caused to close as a result of having abutted against the second block member 302 can be reliably prevented. If the processing of the step part 301 c is difficult, the first block member 301 may be configured from a plurality of members as shown in FIG. 9. Furthermore, as shown in FIG. 10, as an effective method for preventing closure of the first flow passage 211 and the second flow passage 221, a method in which the end parts 210a of the first tubes 210 or the end parts 220a of the second tubes 220 are cut to a predetermined angle may be employed.

[0023] In addition, as shown in FIG. 11 to FIG. 15, the positional relationship between the inlet parts 310, 330 and the outlet parts 320, 340 can be set as appropriate. The bend processing of the end parts 210a of the first tubes 210 and the end parts 220a of the second tubes 220 can be set as appropriate. A bend processing administered to each of both end parts 210a of the first tubes 210 and both end parts 220a of the second tubes 220a (see FIG. 2 and FIG. 11) is advantageous from the viewpoint of reducing the amount of processing. Administering of this processing on both end parts 210a of the first tubes 210 only (see FIG. 12), or on both end parts 220a of the second tubes 220 only (see FIG. 13), or on one end part of the first tube and the other end part of the second tube (see FIG. 14 and FIG. 15) only is advantageous from the viewpoint of reducing the number of processing steps.

[0024] Notably, a heat-insulating member may be fitted around the perimeter of the tube body 200. Fitting of a heat-insulating body improves the heat insulation characteristics to the exterior whereupon, as a result, heat exchange efficiency between the high-pressure side refrigerant and low-pressure side refrigerant is further improved.

[0025] A second embodiment of the present invention will be hereinafter described with reference to FIG. 16 and FIG. 17. The heat exchanger 100 of this example is supported in the radiator 3 of the refrigeration cycle 1, a pipe 11 in which the refrigerant flows from the radiator 3 to the heat exchanger 100 being integrated with the inlet part 310 of the first flow passage 211. A bracket 30 for supporting the heat exchanger 100 is provided in the radiator 3. The heat exchanger 100 and radiator 3 are manufactured by assembly of members from which the heat exchanger 100 is configured, members from which the radiator 3 is configured, and the pipe 11 and bracket 30, and is then heat-processed and soldered in a furnace. The pipe 11 is connected to the radiator 3 and is inserted to connect with the first communication part 302a of the second block member 302. Notably, the basic configuration of the remainder of the embodiment is the same as the embodiment described above. Based on a configuration in which the heat exchanger 100 and the radiator 3 are provided as a single unit, the space occupied by the refrigeration cycle 1 can be effectively utilized. The pipe 11 between the heat exchanger 100 and radiator 3 is also short.

[0026] A third embodiment of the present invention will be hereinafter described with reference to FIG. 18 to FIG. 20. The heat exchanger 100 of this example is configured from hollow tank bodies comprising inlet parts 310, 330 and outlet parts 320 and 340 respectively. The pipes 11, 12, 13, 14 are inserted in and soldered to the predetermined tank bodies. First slits 301 a and second slits 301b are respectively provided in the tank bodies. In this way, the inlet parts 310, 330 and outlet parts 320, 340 are able to be configured in hollow tank bodies. The orientation of the end parts 210a of the first tubes 210 and the end parts 220a of the second tubes 220 are able to be arbitrarily set as shown in, for example, FIG. 20.

[Field of Industrial Utilization]

[0027] The heat exchanger of the present invention is very suitable for utilization as an internal heat exchanger of a refrigeration cycle in which the internal pressure of the radiator exceeds the critical point of the refrigerant.

[Brief Description of the Drawings]

[0028]

[FIG. 1] is an explanatory diagram of a refrigeration cycle of an embodiment of the present invention;
[FIG. 2] is a front view of a heat exchanger of an embodiment of the present invention;
[FIG. 3] is a cross-sectional view along the line X-X of FIG. 2 that serves as a cross-sectional view of a tube body of an embodiment of the present invention;
[FIG. 4] is a front view of a heat exchanger showing a separated pipe state of an embodiment of the present invention;
[FIG. 5] is a front cross-sectional view of a heat exchanger showing a separated pipe state of an embodiment of the present invention;
[FIG. 6] is an exploded perspective view of the main part of a heat exchanger of an embodiment of the present invention;
[FIG. 7] is an exploded perspective view of the inlet part and outlet part of an embodiment of the present invention;
[FIG. 8] is an exploded front cross-sectional view of a main part of a heat exchanger of an embodiment of the present invention;
[FIG. 9] is an exploded front cross-sectional view of a main part of a heat exchanger of an embodiment of the present invention;
[FIG. 10] is an exploded front cross-sectional view of a main part of a heat exchanger of an embodiment of the present invention;
[FIG. 11] is a front view of the heat exchanger of an embodiment of the present invention;
[FIG. 12] is a front view of a heat exchanger of an embodiment of the present invention;
[FIG. 13] is a front view of a heat exchanger of an embodiment of the present invention;
[FIG. 14] is a front view of a heat exchanger of an embodiment of the present invention;
[FIG. 15] is a front view of a heat exchanger of an embodiment of the present invention;
[FIG. 16] (a) is a front view of a radiator and a heat exchanger of an embodiment of the present invention, and (b) is an expanded view of the A part of (a);
[FIG. 17] is an exploded perspective view of the main part of a heat exchanger of an embodiment of the present invention;
[FIG. 18] is a front cross-sectional view of a heat exchanger of an embodiment of the present invention;
[FIG. 19] is a perspective view of an inlet part and outlet part of an embodiment of the present invention; and
[FIG. 20] is a front surface cross-sectional view of a heat exchanger of an embodiment of the present invention;

[Explanation of Symbols]

[0029]

1	Refrigeration cycle
2	Compressor
3	Radiator
4	Depressurizer
5	Evaporator
6	Accumulator
11	Pipe
12	Pipe
13	Pipe
14	Pipe
20	Connector member
21	Bolt
30	Bracket
100	Heat exchanger

200	Tube body
210	First tube
210a	End part
211	First flow passage
220	Second tube
220a	End part
221	Second flow passage
301	First block member
301 a	First slit
301 b	Second slit
301 c	Step part
302	Second block member
302a	First communication part
302b	Second communication part
310	Inlet part
320	Outlet part
330	Inlet part
340	Outlet part

Claims

1. Heat exchanger comprising a tube body having a first flow passage and a second flow passage, an inlet port and outlet port for a medium that flows through said first flow passage, and an inlet port and outlet port for a medium that flows through said second flow passage in which heat exchange is effected between the medium flowing through said first flow passage and the medium flowing through said second flow passage by way of heat transmitted to said tube body, **characterized in that**:

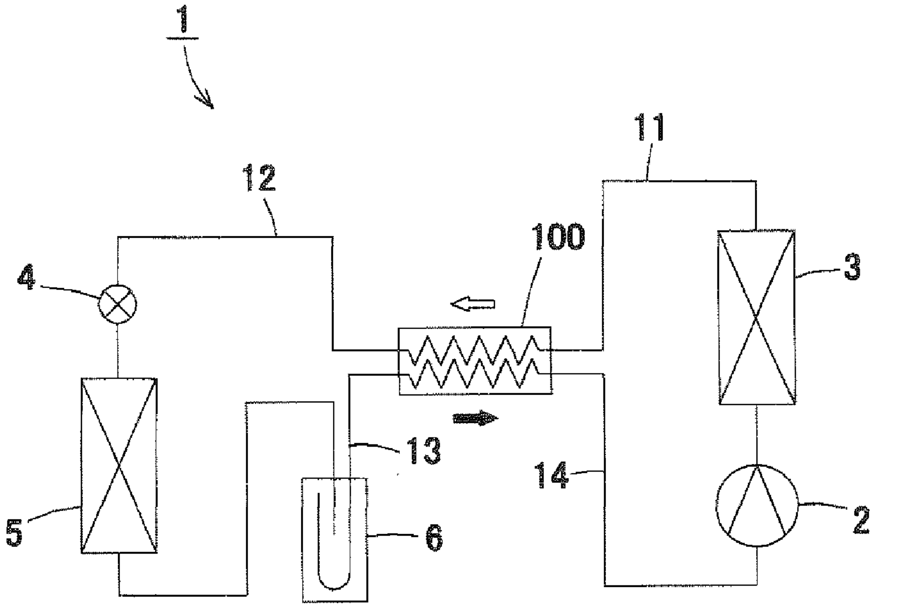
   said tube body is formed by stacking of a plurality of flat first tubes in which said first flow passage is provided and a plurality of flat second tubes in which said second flow passage is provided;
   said plurality of first tubes and said plurality of second tubes are alternately stacked with uniformity in a longitudinal direction and a flatness direction thereof; and
   end parts of said plurality of first tubes and end parts of said plurality of second tubes are respectively connected at an end part of said tube body to a predetermined said inlet part and said outlet part with displacement therebetween in said flatness direction.

2. Heat exchanger according to Claim 1, **characterized in that** said predetermined inlet part and outlet part are formed by a coupling of a first block member in which a plurality of slits through which the end parts of said plurality of first tubes and the end parts of said plurality of second tubes are inserted are provided with a second block member comprising a communication part by which said plurality of slits communicate.

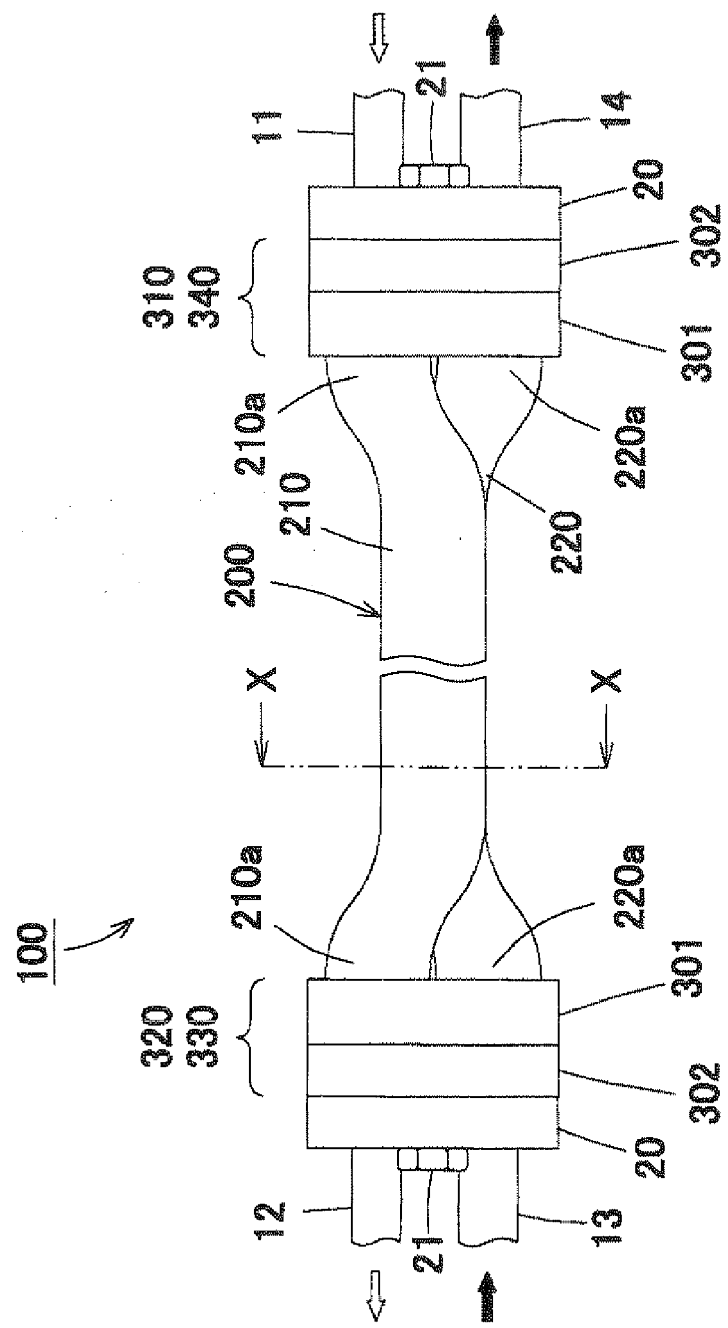
3. Heat exchanger according to Claim 1 or Claim 2, **characterized in that** the heat exchanger constitutes an internal heat exchanger employed in a compression-type refrigeration cycle in which a refrigerant is circulated and in which heat exchange is effected between a high-pressure side and a low-pressure side of said refrigerant.

4. Heat exchanger according to Claim 3, **characterized in that** the heat exchanger is supported in a radiator of said refrigeration cycle, and a pipe through which the refrigerant flows from said radiator to the heat exchanger and the inlet part of said first flow passage are integrated.

[FIG. 1]



[FIG. 2]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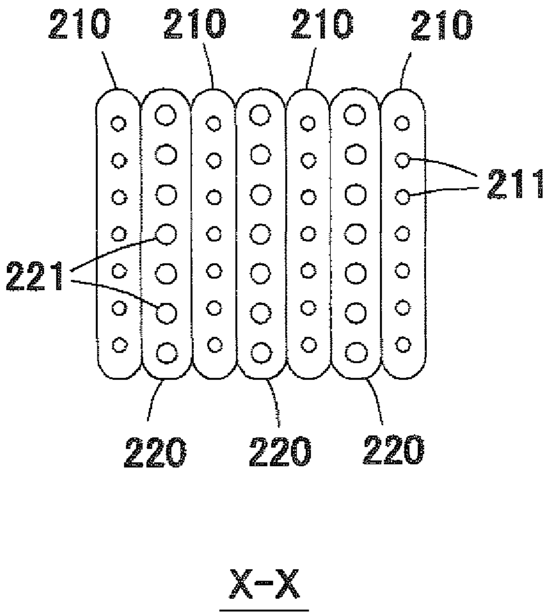
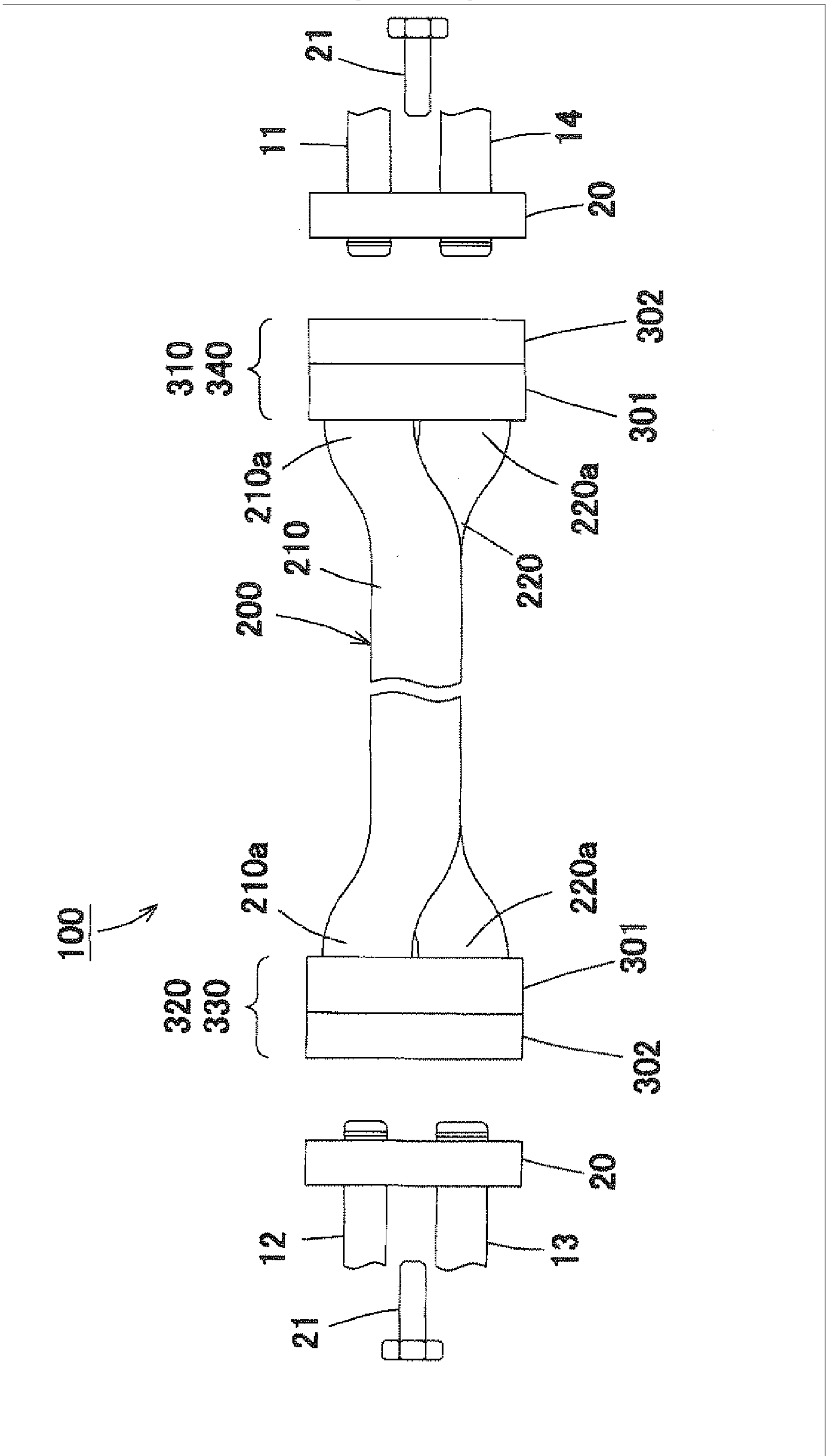
[FIG. 3]



[FIG. 4]



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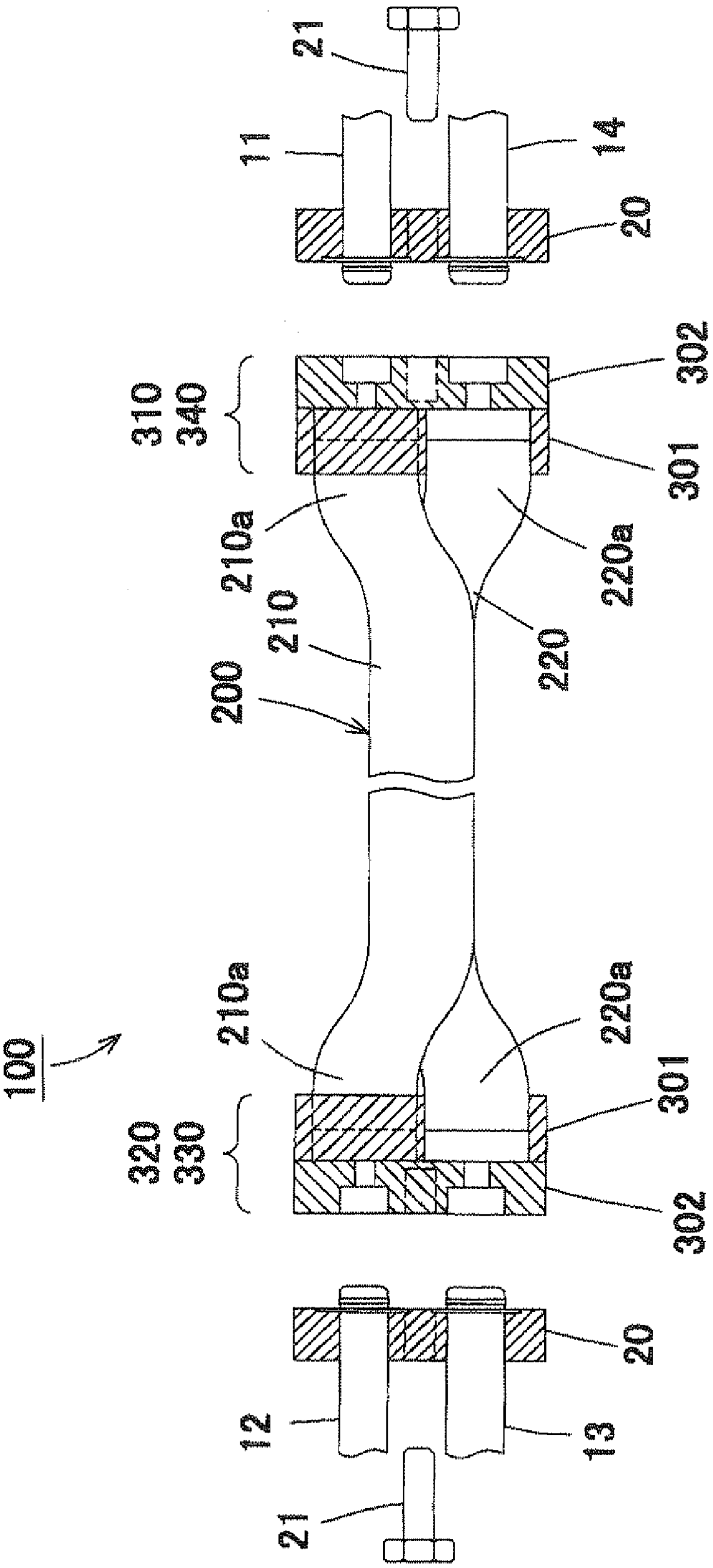
[FIG. 5]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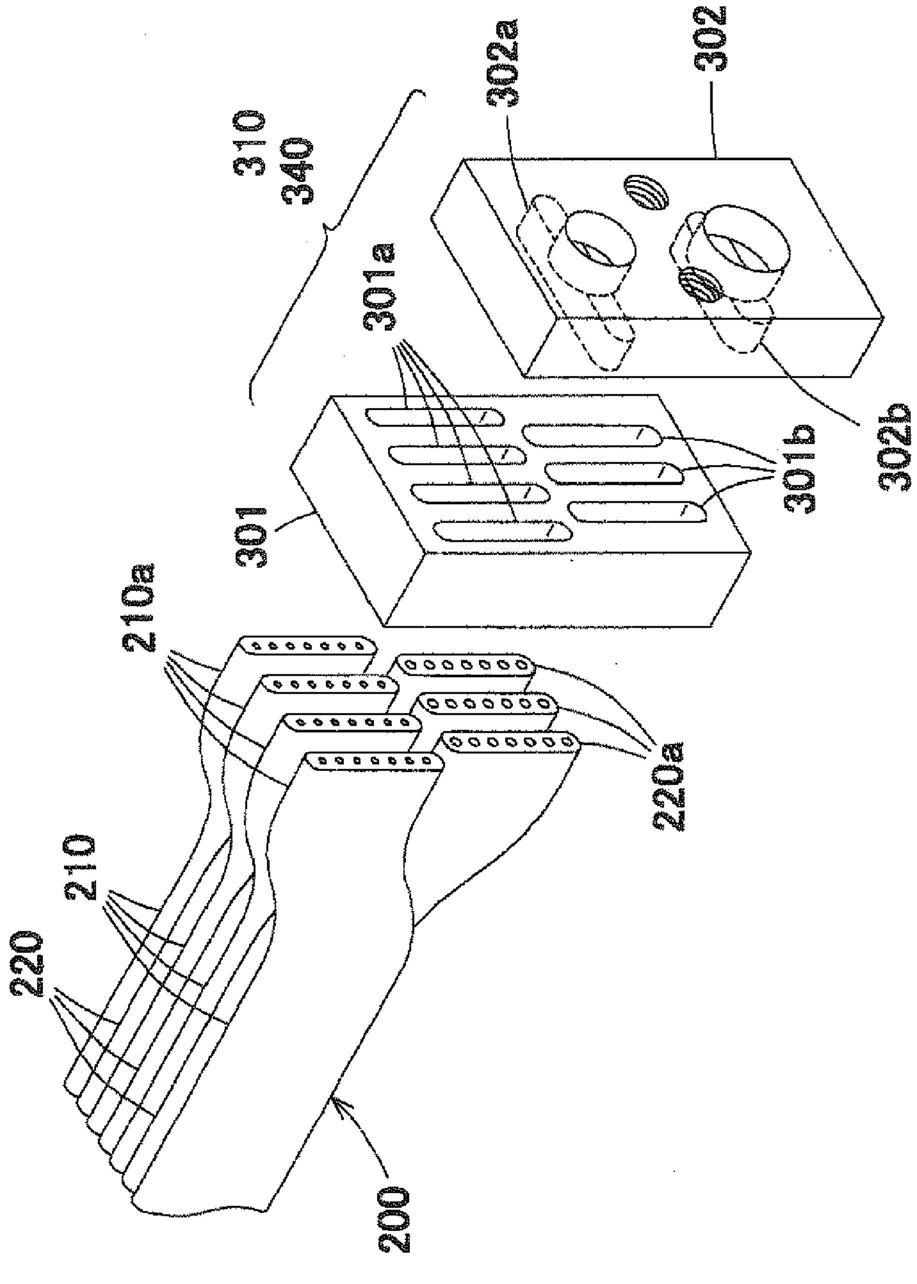
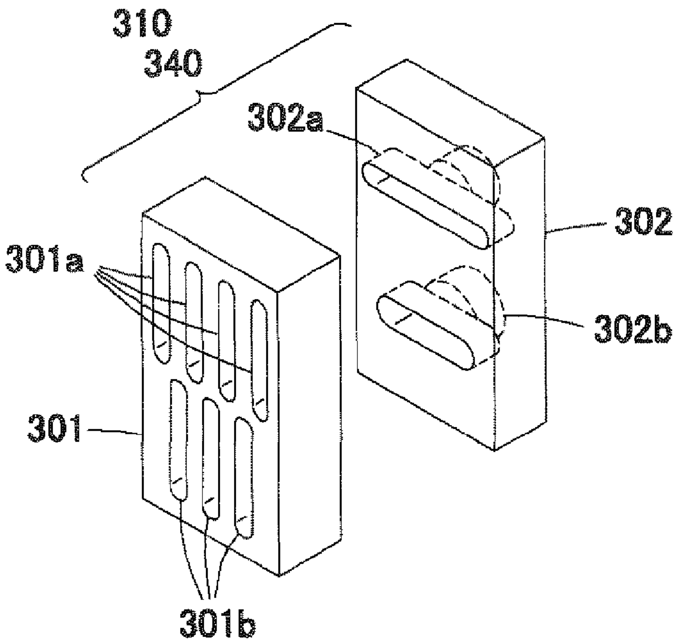
[FIG. 6]



[FIG. 7]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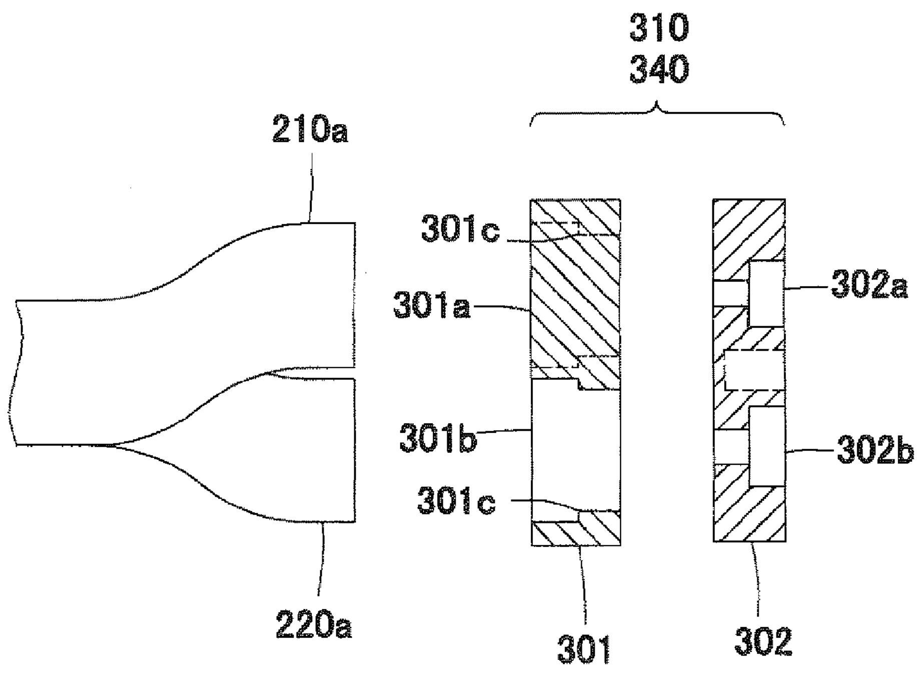
[FIG. 8]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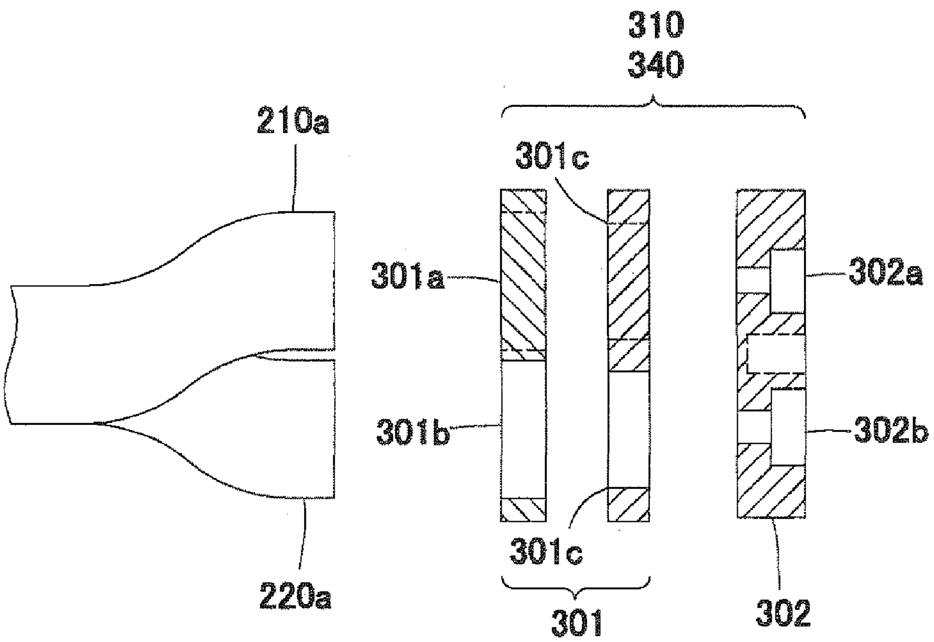
[FIG. 9]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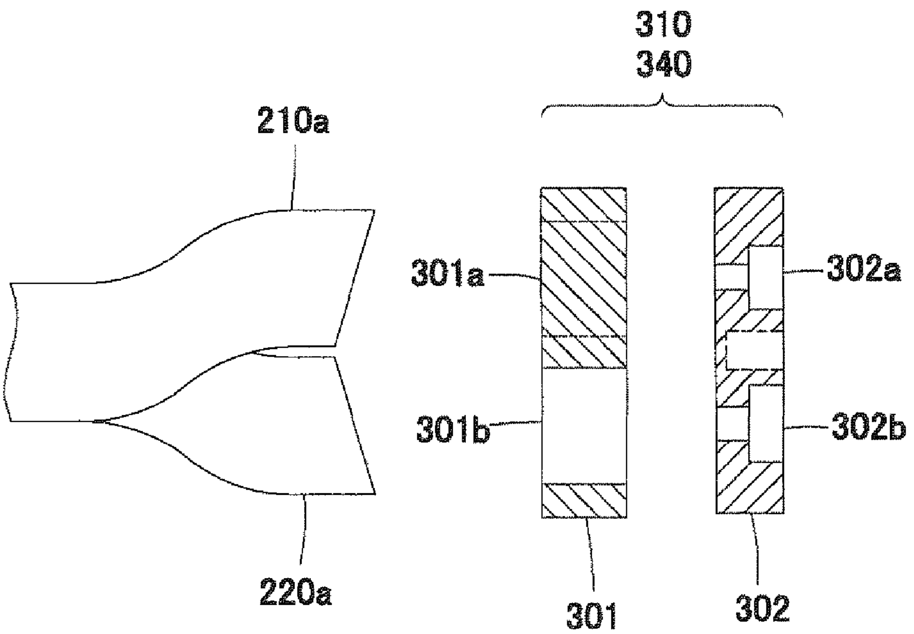
[FIG. 10]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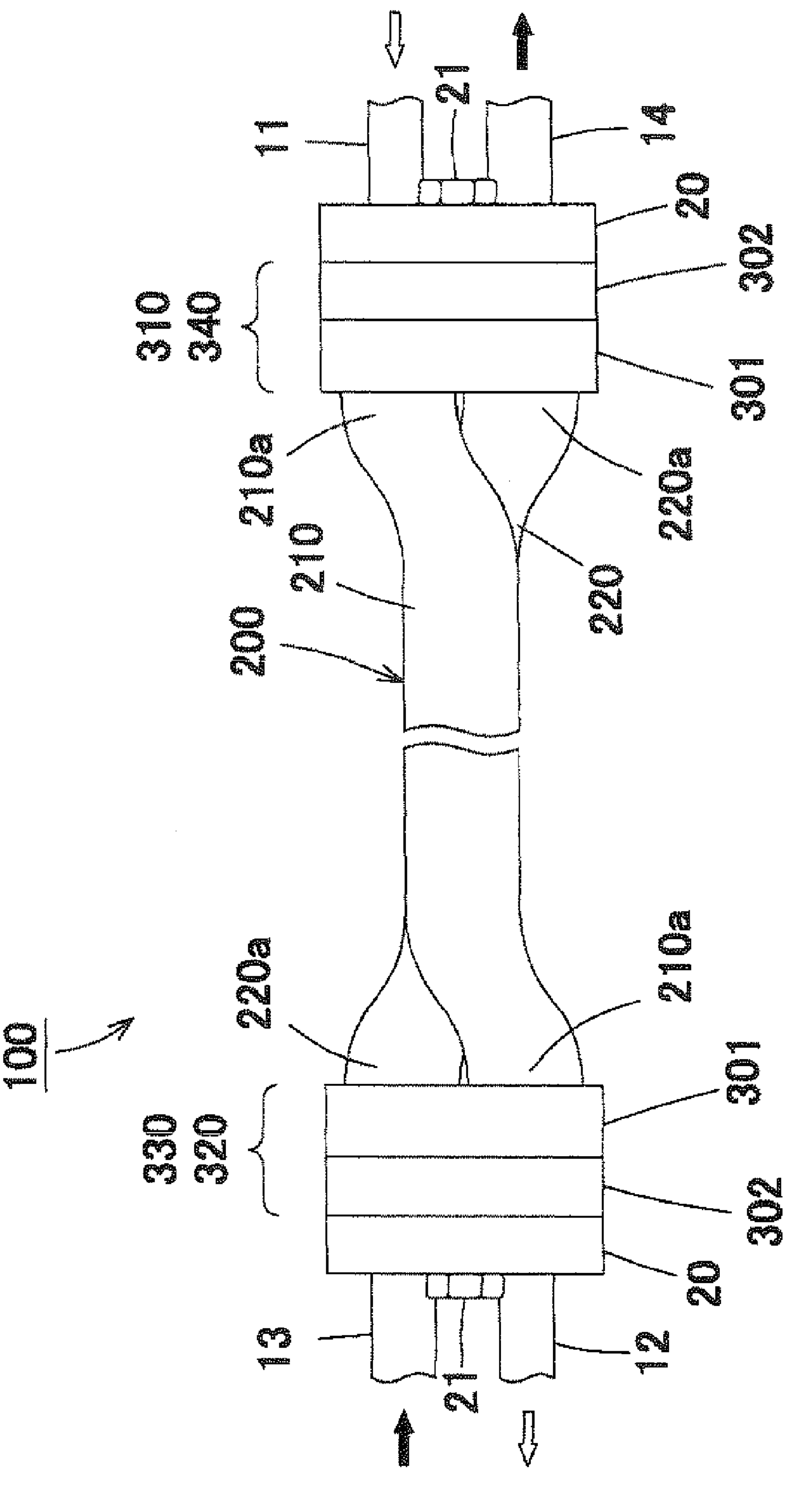
[FIG. 11]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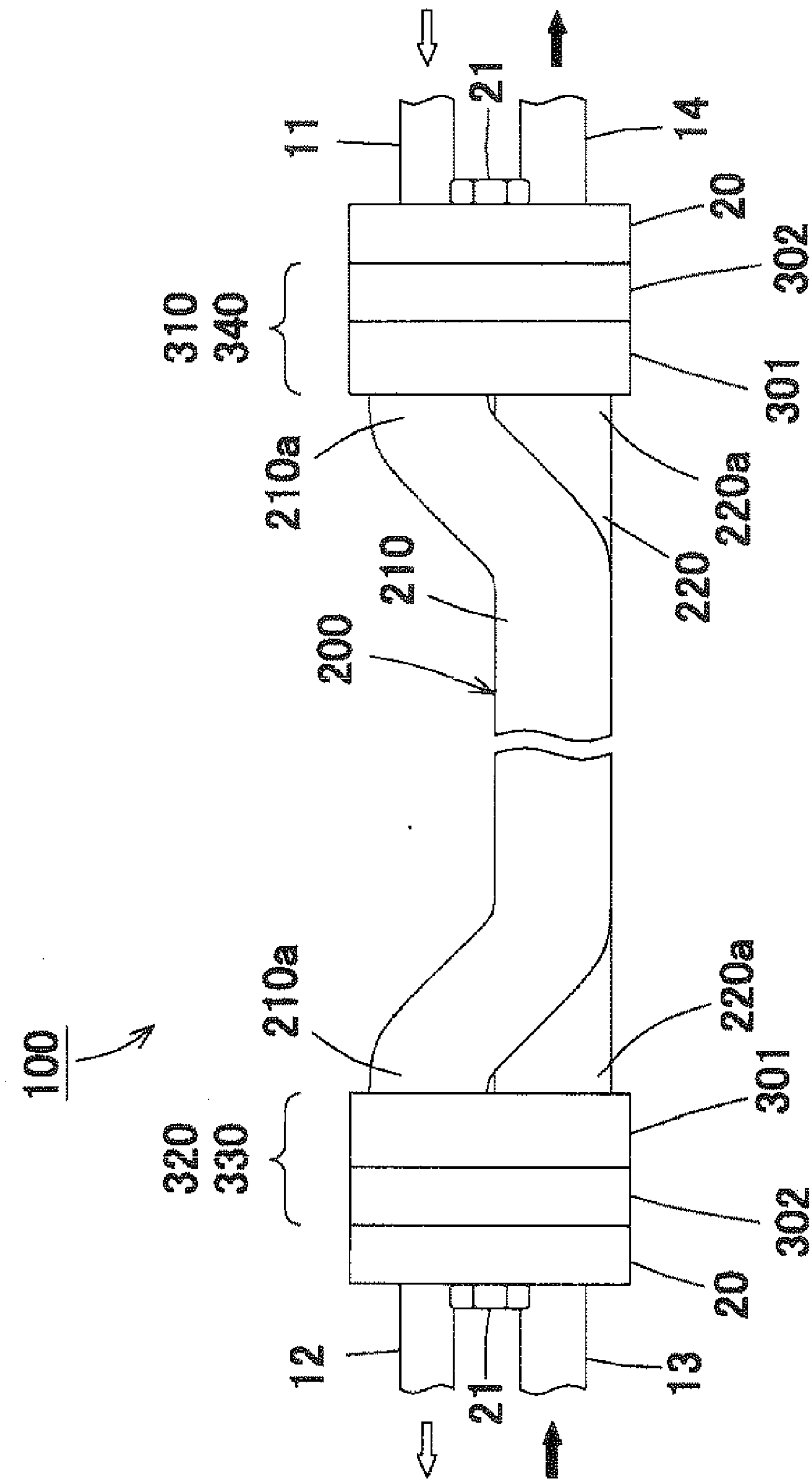
[FIG. 12]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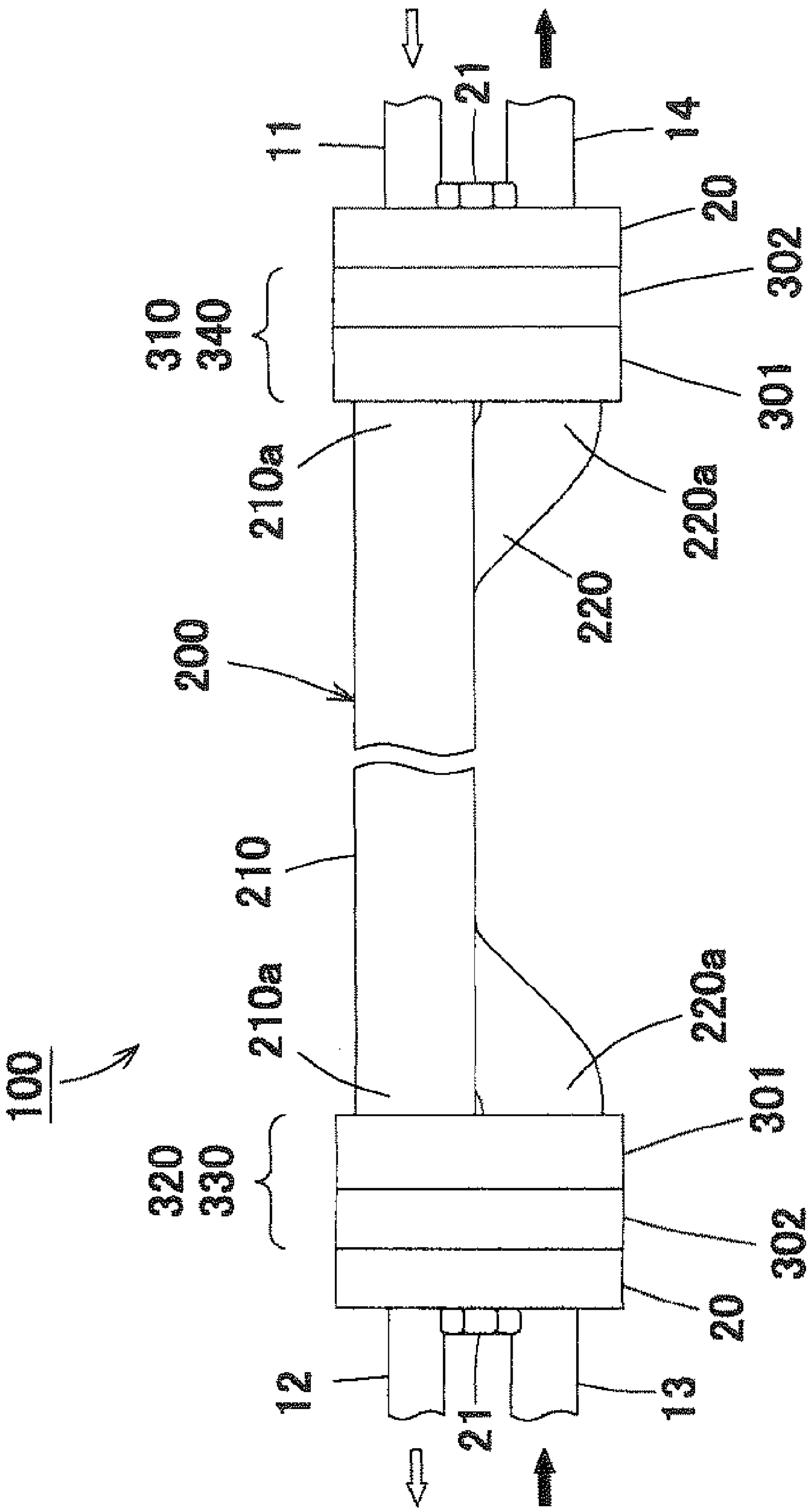
[FIG. 13]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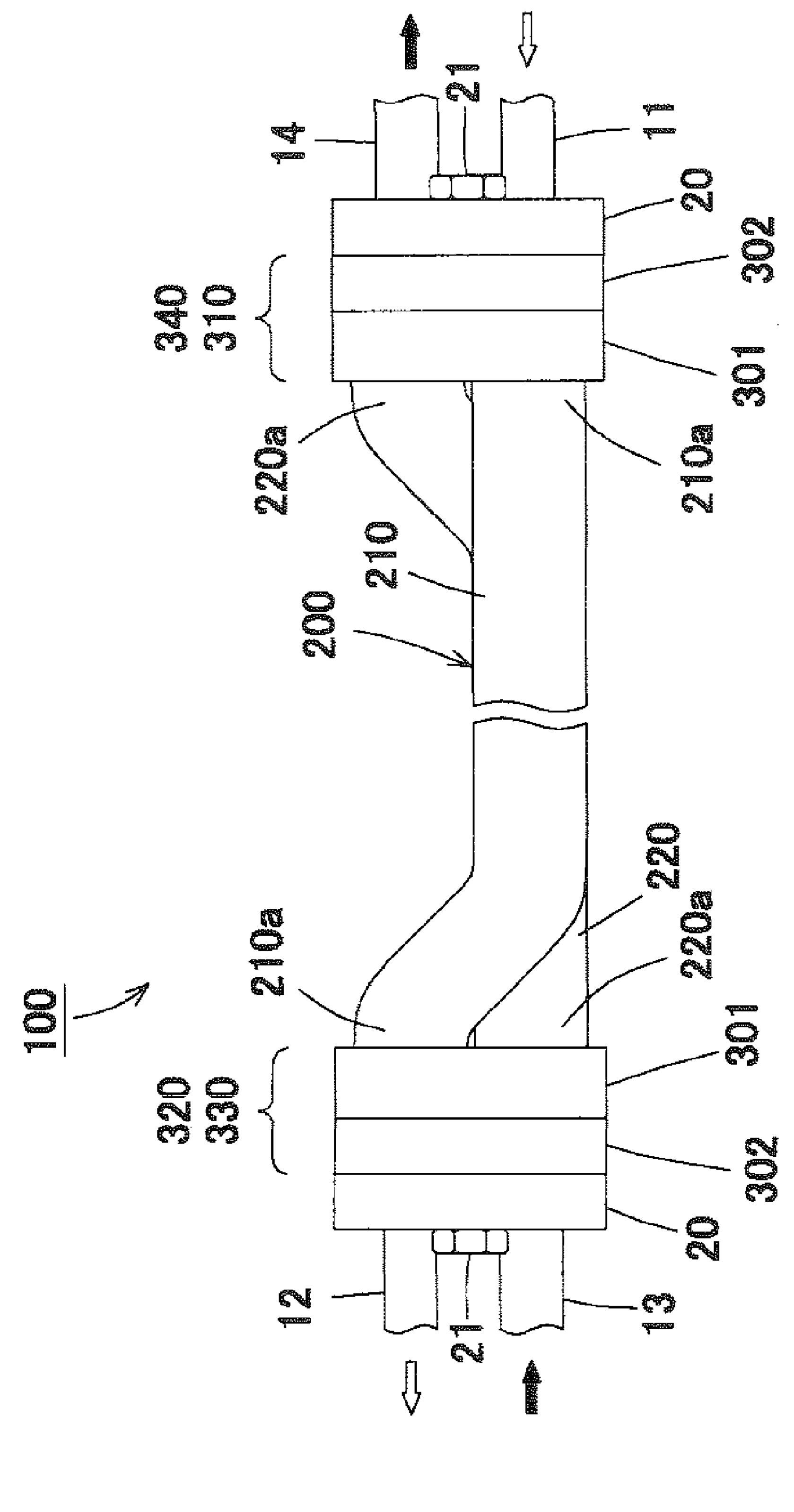
[FIG. 14]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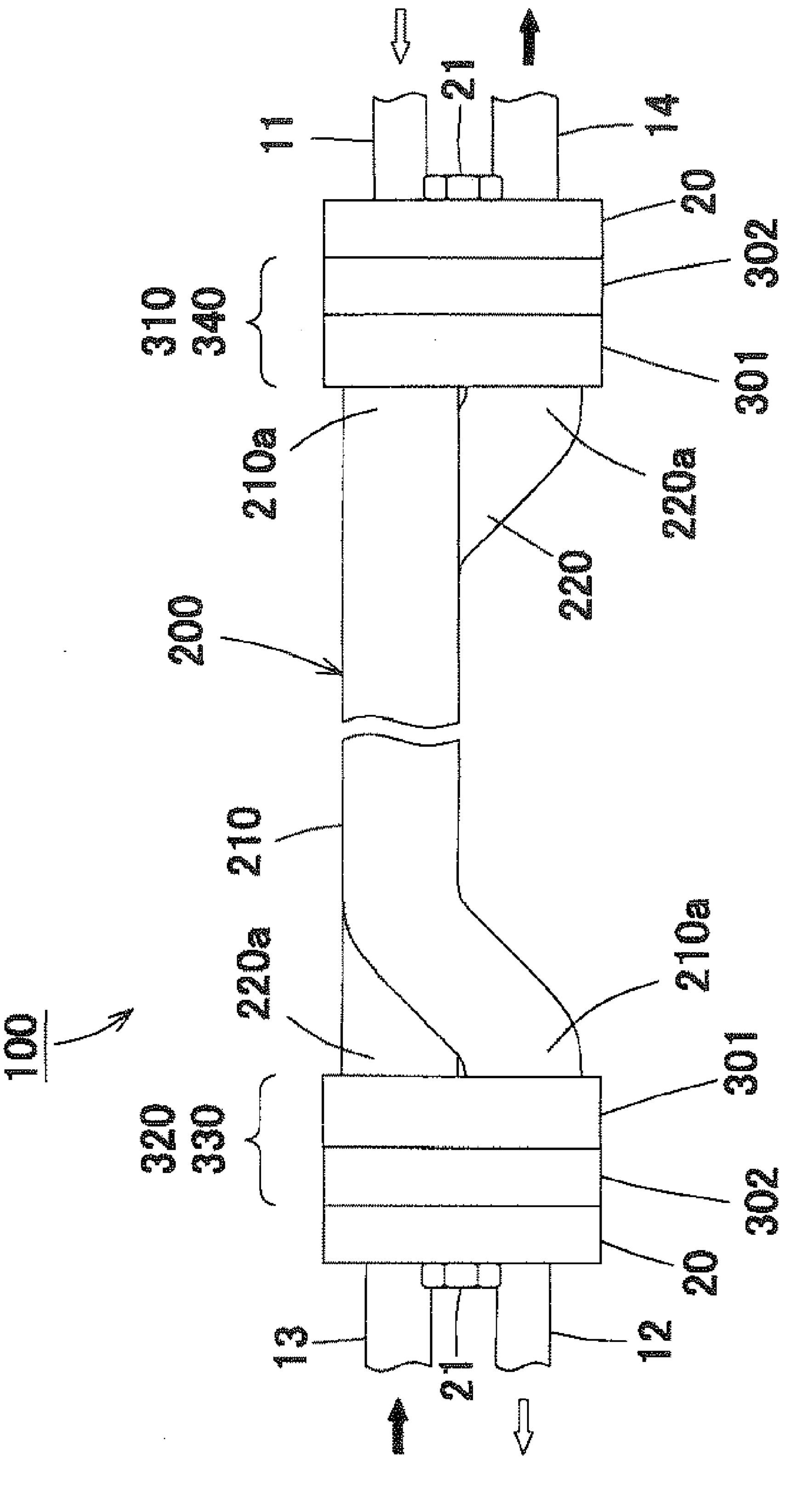
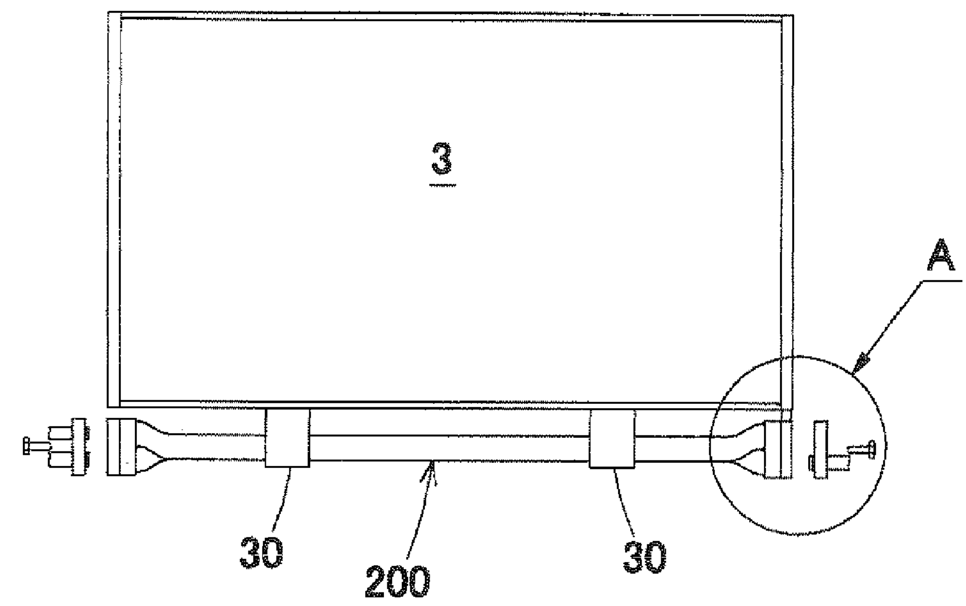
200
100
210a
220
220a
301
320
330
302
20
12
21
13

[FIG. 15]

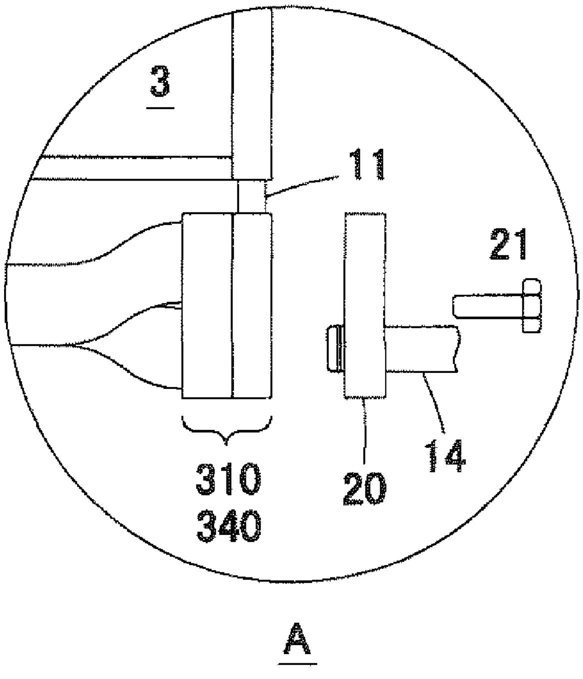

11
21
14
20
302
310
340
301
210a
220a
220
200
210
220a
210a
100
301
320
330
302
20
13
21
12

[FIG. 16]

(a)

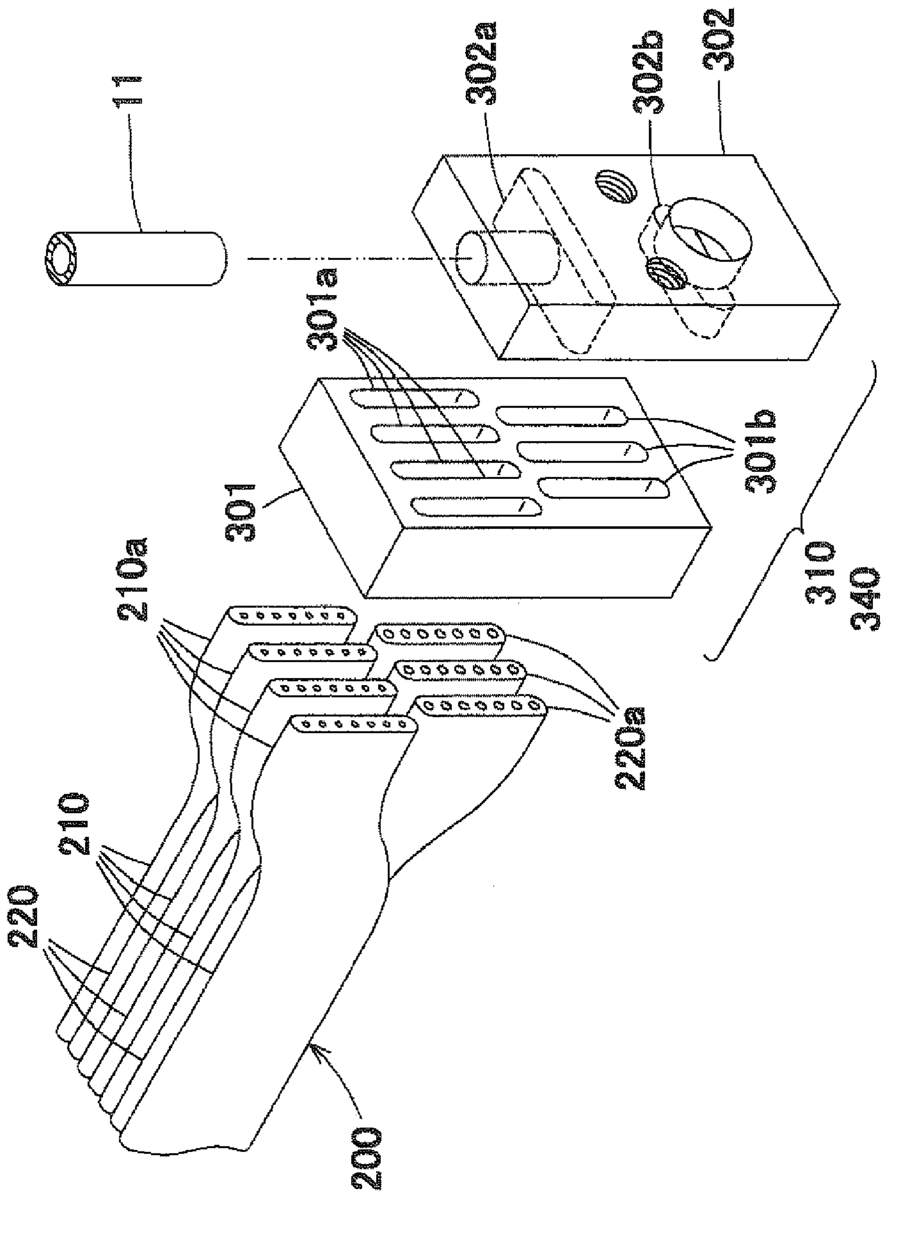


(b)

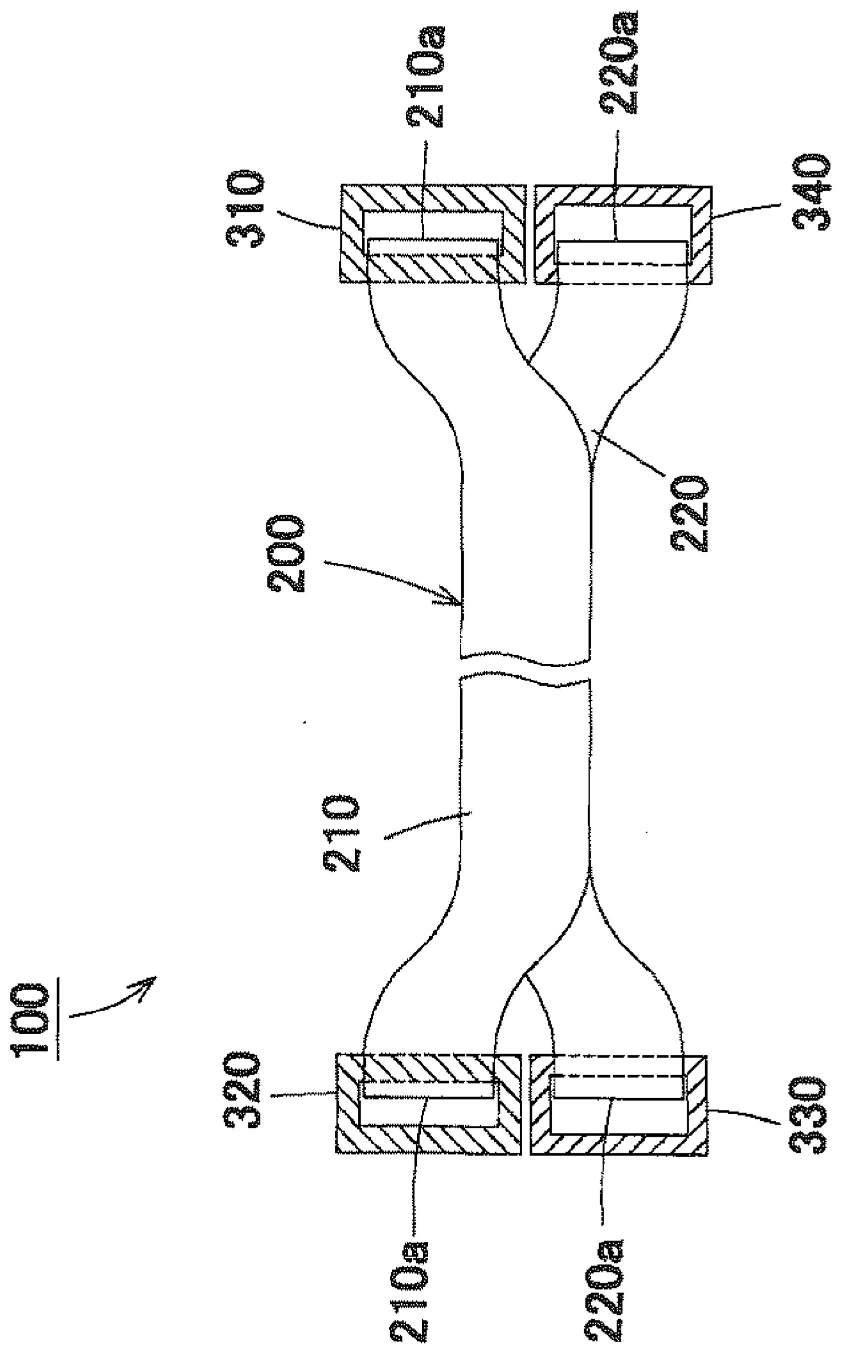


A

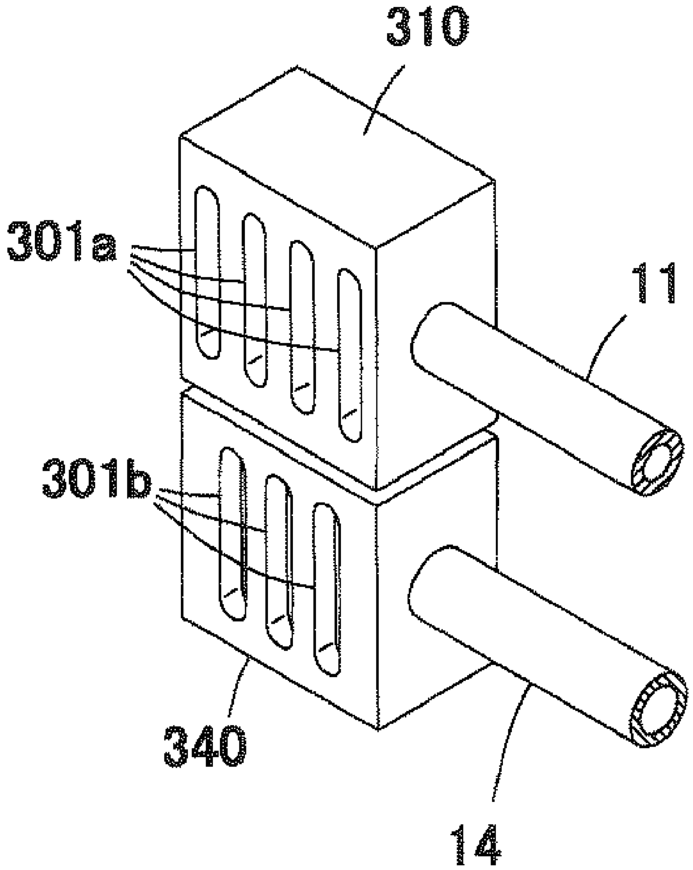
[FIG. 17]



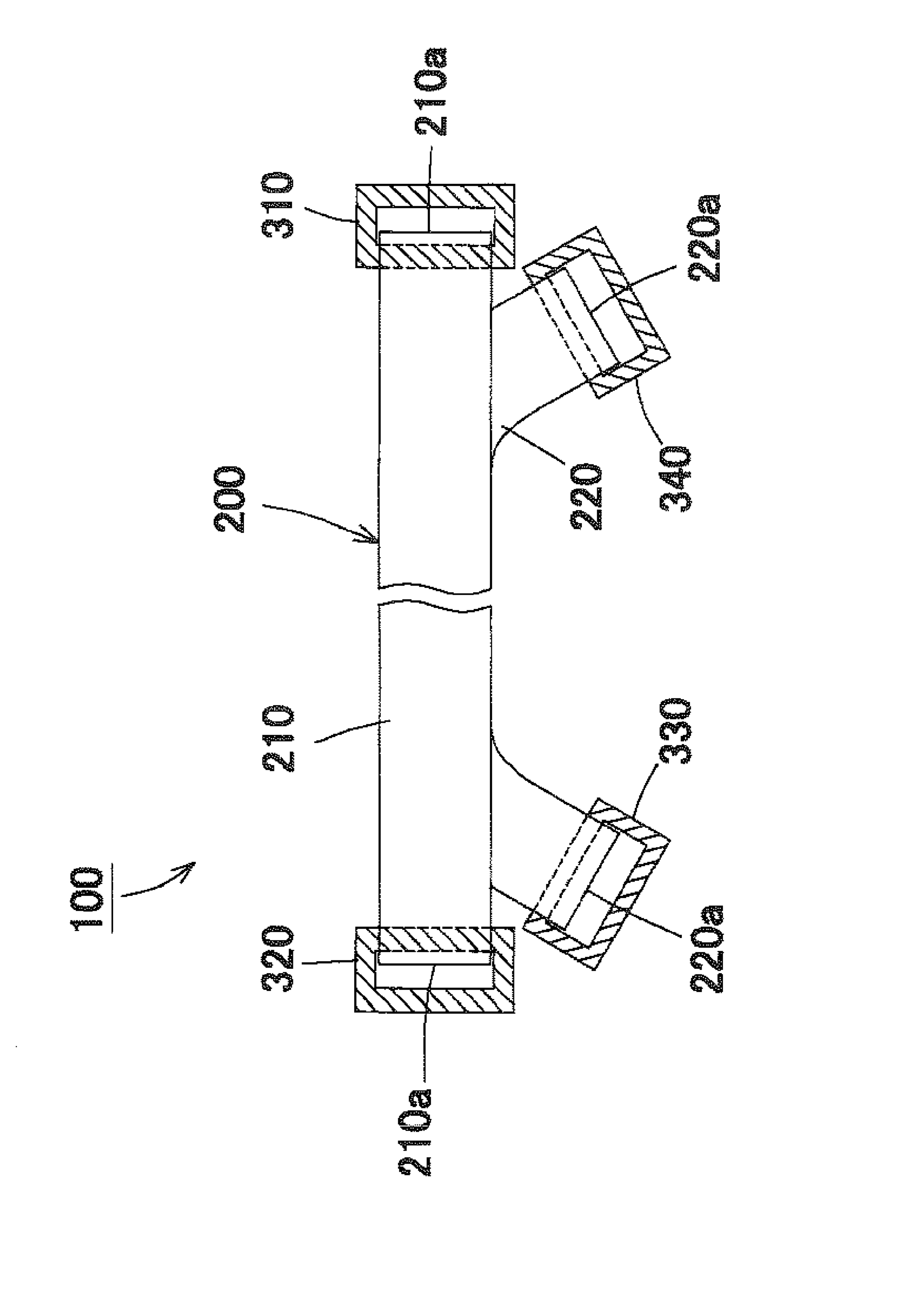
[FIG. 18]



[FIG. 19]



[FIG. 20]



REFERENCES CITED IN THE DESCRIPTION

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