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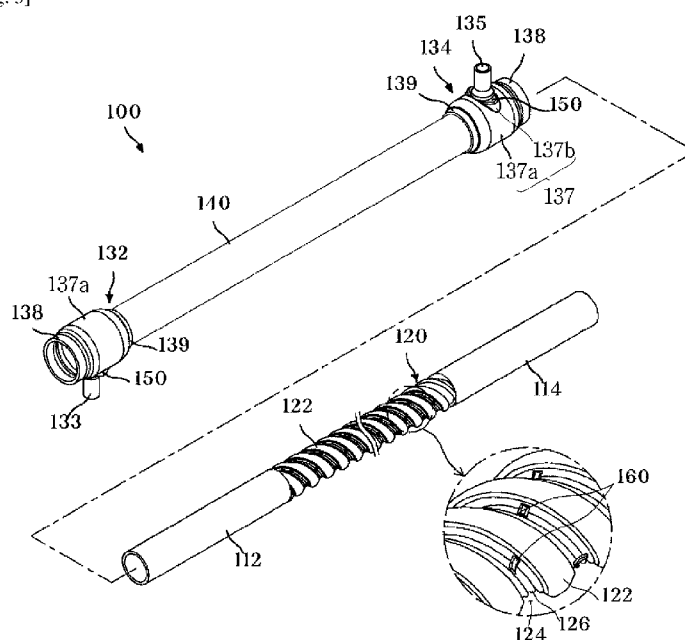
(71) Applicant: **CONTITECH FLUID KOREA LTD.**

[KR/KR]; (Palbok-dong 1-ga), 14, Guretdeul 1-gil, Deokjin-gu, Jeonju-si, Jeollabuk-do 54844 (KR).

(72) Inventors: **HENDRIK, Steffen**; (Chungho Apt.), 301-203, 18-41, Jiksan-ro, Jiksan-eup, Seobuk-gu, Cheonan-si, Chungcheongnam-do 31035 (KR). **LEE, Kil Nam**; (Chwiam-dong), 1040, Gyebaek-ro, Nonsan-si, Chungcheongnam-do 32973 (KR). **CHA, Jong Hun**; (Sinbu-dong), 101-ho, 254-1, Jungang-ro, Dongnam-gu, Cheonan-si, Chungcheongnam-do 31118 (KR). **KO, Jin Won**; (Sajik-dong, Doosan We've The Zenith), A-1104, 93, Saun-ro, Seowon-gu, Cheongju-si, Chungcheongbuk-do 28555 (KR). **LEE, Ji Yeon**; 7-306, 17-3, Sameun 4-gil, Jiksan-eup, Seobuk-gu, Cheonan-si, Chungcheongnam-do 31037 (KR). **IM, Hyun Jin**; 8-203, 17-3, Sameun 4-gil, Jiksan-eup, Seobuk-gu, Cheonan-si, Chungcheongnam-do 31037 (KR). **GA, Sun Phil**; (Bunpyeong-dong, Bunpyeong Jugong 6-danji Apt.), 607-1102, 19, 1sunhwan-ro 1137beon-gil, Seowon-gu, Cheongju-si, Chungcheongbuk-do 28800 (KR).

(54) Title: DOUBLE TUBE FOR HEAT-EXCHANGE

[Fig. 3]



(57) **Abstract:** Disclosed herein is a double tube for heat exchange. The double tube for heat exchange includes: a spiral pipe having ridges and valleys alternately formed on a circumferential surface thereof along a spiral track thereof and guiding a first fluid to flow therethrough; an outer pipe receiving the spiral pipe axially inserted therein and guiding a second fluid to flow along the circumferential surface of the spiral pipe in an axial direction such that the second fluid exchanges heat with the first fluid; and a resistance member protruding from the spiral pipe or the valleys to increase residence time of the second fluid in the valleys on the circumferential surface of the spiral pipe and to support the ridges adjacent thereto. Unlike typical double tubes, the double tube for heat exchange can improve heat exchange efficiency between a second fluid flowing inside an outer pipe and a fluid flowing inside a spiral pipe axially inserted into the outer pipe to increase residence time of the second fluid inside the outer pipe by virtue of a spiral shape of the spiral pipe; can



(74) **Agent: NAM & NAM WORLD PATENT & LAW FIRM;** (Seosomun-dong, KAL Bldg.), 3rd Fl., 117, Seosomun-ro, Jung-gu, Seoul 04515 (KR).

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improve flow directionality of the second fluid through formation of the grooves in valleys of the spiral pipe along a spiral track of the valleys; can reduce flow-induced noise through expansion of a space defined between an end joint of the outer pipe and the inner pipe to reduce the pressure of the second fluid; and further improve heat exchange efficiency through resistance members protruding from the valleys to increase residence time of the second fluid.

Description

Title of Invention: DOUBLE TUBE FOR HEAT-EXCHANGE

Technical Field

- [1] The present invention generally relates to a double tube for heat exchange. More particularly, the present invention relates to a double tube for heat exchange, which can improve heat exchange efficiency between a second fluid and a first fluid flowing through a spiral pipe axially inserted into an outer pipe to increase a contact area between an outer surface of the spiral pipe and a second fluid flowing between the outer pipe and the spiral pipe; can improve flow directionality of the second fluid through formation of grooves in valleys of the spiral pipe along a spiral track thereof; can reduce flow-induced noise through expansion of a space between an end joint of the outer pipe and an inner pipe to reduce pressure of the second fluid; and can further improve heat exchange efficiency through resistance members protruding from valleys to increase residence time of the second fluid.

Background Art

- [2] Generally, a double tube includes an inner pipe and an outer pipe surrounding an outer circumferential surface of the inner pipe to form a flow path between the outer pipe and the inner pipe. Such a double tube allows heat exchange between a first fluid flowing through the inner pipe and a second fluid flowing through the flow path between the inner pipe and the outer pipe.
- [3] Thus, the double tube may be used in a liquid supercooling system, which allows a low-temperature and low-pressure refrigerant at an outlet of an evaporator of an automotive air conditioner to exchange heat with a high-temperature and high-pressure refrigerant at an outlet of a condenser of the air conditioner to increase a supercooling degree of a refrigerant entering the evaporator, thereby improving cooling performance of the air conditioner. In such a liquid supercooling system, a refrigerant circulates in order of a compressor → a condenser → an expansion valve → an evaporator → a compressor, and a double tube is employed to allow a refrigerant at an outlet of the evaporator to exchange heat with a refrigerant at an outlet of the condenser (or at an inlet of the evaporator).
- [4] As one example of such a double tube, a double tube connection structure is disclosed in Korean Patent Publication No. 10-2012-0007799 A.

Disclosure of Invention

Technical Problem

- [5] A typical double tube for heat exchange has a problem in that the double tube cannot secure a sufficient heat transfer area during flow of the second fluid and thus exhibits

poor heat exchange efficiency. In order to overcome this problem, there has been proposed a method in which an inner pipe is formed in a spiral shape to increase a heat transfer area to improve heat exchange efficiency. However, there is a limitation in improvement in heat exchange efficiency by this method.

[6] Therefore, there is a need for an improved double tube.

[7] Embodiments of the present invention have been conceived to solve such a problem in the art and it is one aspect of the present invention to provide a double tube for heat exchange which includes a spiral pipe axially inserted into an outer pipe to increase residence time of a second fluid inside the outer pipe by virtue of a spiral shape of the spiral pipe, thereby improving heat exchange efficiency.

[8] It is another aspect of the present invention to provide a double tube for heat exchange which includes at least three grooves, preferably at least four grooves formed on a circumferential surface of a spiral pipe along a spiral track of valleys to improve flow directionality of a second fluid so as to allow the second fluid to flow more stably, thereby further improving heat exchange efficiency.

[9] It is a further aspect of the present invention to provide a double tube for heat exchange which has increased diameters of joints at both ends of an outer pipe to expand a space between the outer pipe and an inner pipe so as to reduce pressure of a fluid during inflow and outflow of the fluid, thereby reducing flow-induced noise.

[10] It is yet another aspect of the present invention to provide a double tube for heat exchange which includes resistance members protruding from valleys of a spiral pipe to increase residence time of a second fluid, thereby further improving heat exchange efficiency.

[11] It is yet another aspect of the present invention to provide a double tube for heat exchange which includes resistance members adjacent to ridges of a spiral pipe to prevent warpage of ridges of the spiral pipe, thereby improving durability of a spiral pipe.

Solution to Problem

[12] In accordance with one aspect of the present invention, a double tube for heat exchange includes: a spiral pipe having ridges and valleys alternately formed on a circumferential surface thereof along a spiral track thereof and guiding a first fluid to flow therethrough; an outer pipe receiving the spiral pipe axially inserted therein and guiding a second fluid to flow along the circumferential surface of the spiral pipe in an axial direction such that the second fluid exchanges heat with the first fluid; and a resistance member protruding from the spiral pipe or the valleys to increase residence time of the second fluid in the valleys on the circumferential surface of the spiral pipe and to support the ridges adjacent thereto.

- [13] The double tube for heat exchange may further include: inner pipes connected to opposite sides of the spiral pipe to allow the first fluid to flow therethrough; and pipe expansion joints provided at opposite sides of the outer pipe to have a greater diameter than the outer pipe to be placed at junctions of the spiral pipe and the inner pipes, the pipe expansion joints being sealed against the corresponding pipe of the inner pipes and provided with ports for introducing and discharging the second fluid, respectively.
- [14] Each of the valleys may have at least three grooves, preferably at least four grooves formed along a spiral track thereof to improve flow directionality of the second fluid and to increase a contact area between the second fluid and the spiral pipe. Resistance members may be at least partially formed over the remaining grooves except for two grooves located outside among the at least three grooves, preferably at least four grooves.
- [15] Each of the pipe expansion joints may include pipe expansion portions having a greater diameter than the outer pipe and integrally connected to the outer pipe. The pipe expansion portions may include a first pipe expansion portion and a second pipe expansion portion protruding from the first pipe expansion portion and having a flattened upper surface. The flattened upper surface may be formed by flattening a curved circumferential surface of the pipe expansion portion to create a space expansion portion inside the flattened upper surface and to improve weldability of the ports.

Advantageous Effects of Invention

- [16] According to the present invention, the double tube for heat exchange includes the spiral pipe axially inserted into the outer pipe to increase residence time of a second fluid inside the outer pipe, thereby improving heat exchange efficiency between the second fluid flowing between the outer pipe and the spiral pipe and a first fluid flowing through the spiral pipe.
- [17] In addition, according to the present invention, the double tube for heat exchange includes at least three grooves, preferably at least four grooves formed on the circumferential surface of the spiral pipe along the spiral track of the valleys to improve flow directionality of the second fluid so as to allow the second fluid to flow more stably, thereby further improving heat exchange efficiency.
- [18] Further, according to the present invention, the double tube for heat exchange has increased diameters of pipe expansion joints connecting outer pipes to each other to expand a space between the outer pipe and the inner pipe so as to reduce pressure of a fluid during inflow and outflow of the fluid, thereby reducing flow-induced noise.
- [19] Furthermore, according to the present invention, the double tube for heat exchange can improve durability of a spiral pipe by preventing warpage of ridges of the spiral

pipe through the resistance member adjacent to the ridges.

Brief Description of Drawings

- [20] The above and other aspects, features and advantages of the present invention will become apparent from the following description of embodiments given in conjunction with the accompanying drawings, in which:
- [21] FIG. 1 is a perspective view of a double tube for heat exchange according to one embodiment of the present invention;
- [22] FIG. 2 is an exploded perspective view of the double tube for heat exchange according to one embodiment of the present invention;
- [23] FIG. 3 is a sectional view taken along A-A line of FIG. 1;
- [24] FIG. 4 is an enlarged view of a main section of FIG. 3;
- [25] FIG. 5 is a sectional view taken along B-B line of FIG. 1;
- [26] FIG. 6 is a plan view of a flattened upper surface according to one embodiment of the present invention;
- [27] FIG. 7 is a perspective view of the flattened upper surface of FIG. 6; and
- [28] FIG. 8 is an enlarged view of a resistance member disclosed in FIG. 3.

Mode for the Invention

- [29] Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings. It should be noted that the drawings are not to precise scale and may be exaggerated in thicknesses of lines or sizes of components for descriptive convenience and clarity only. In addition, the terms used herein are defined by taking functions of the present invention into account and can be changed according to user or operator custom or intention. Therefore, definition of the terms should be made according to the overall disclosure set forth herein.
- [30] FIG. 1 is a perspective view of a double tube for heat exchange according to one embodiment of the present invention, and FIG. 2 is an exploded perspective view of the double tube for heat exchange according to one embodiment of the present invention.
- [31] FIG. 3 is a sectional view taken along A-A line of FIG. 1, FIG. 4 is an enlarged view of a main section of FIG. 3, and FIG. 5 is a sectional view taken along B-B line of FIG. 1.
- [32] FIG. 6 is a plan view of a flattened upper surface according to one embodiment of the present invention.
- [33] FIG. 7 is a perspective view of the flattened upper surface of FIG. 6, and FIG. 8 is an enlarged view of a resistance member disclosed in FIG. 3.
- [34] Referring to Figs. 1 to 8, a double tube for heat exchange 100 according to one embodiment of the present invention includes inner pipes 112, 114, a spiral pipe 120, pipe expansion joints 132, 134, and an outer pipe 140.

- [35] The double tube for heat exchange 100 according to the present invention allows heat exchange between a refrigerant (first fluid) at an outlet of an evaporator of an automotive air conditioner and a refrigerant (second fluid) at an outlet of a condenser of the air conditioner to reduce load of the compressor through increase in temperature of the first fluid introduced into a compressor, while improving vaporization efficiency through decrease in temperature of the second fluid introduced into an expansion valve.
- [36] Particularly, the outer pipe 140 has a tubular shape and allows a high-temperature and high-pressure fluid (the second fluid) at the outlet of the condenser to flow therethrough.
- [37] The inner pipes 112, 114 have a tubular shape, allow a low-temperature and low-pressure fluid (the first fluid) at the outlet of the evaporator to flow therethrough, and are inserted into the outer pipe 140.
- [38] Thus, the second fluid at high temperature and high pressure at the outlet of the condenser flows through a space between the inner pipes 112, 114 and the outer pipe 140.
- [39] That is, the double tube for heat exchange 100 according to the present invention allows heat exchange between the first fluid at low temperature and low pressure at the outlet of the evaporator and the second fluid at high temperature and high pressure at the outlet of the condenser through the inner pipes 112, 114.
- [40] In addition, the spiral pipe 120 connects the inner pipes 112, 114 to each other and is formed on a circumferential surface thereof with ridges 122 and valleys 124 in an alternating manner along a spiral track thereof.
- [41] Further, the spiral pipe 120 is connected at opposite sides thereof to the inner pipes 112, 114. In other words, a first inner pipe 112 is connected to one side of the spiral pipe 120 and the second inner pipe 114 is connected to the other side of the spiral pipe 120. It should be understood that the spiral pipe 120 may be formed at a portion of the first inner pipe 112 or a portion of the second inner pipe 114. Thus, the first fluid flows through the first inner pipe 112, the spiral pipe 120, and the second inner pipe 114.
- [42] Particularly, the spiral pipe 120 is formed with the ridges 122 and the valleys 124 in an alternating manner. Since the second fluid flows along the valleys 124 of the circumferential surface of the spiral pipe 120, residence time of the second fluid in the outer pipe 140 and the spiral pipe 120 is increased, thereby improving heat exchange efficiency between the second fluid and the first fluid.
- [43] In addition, the ridges 122 of the spiral pipe 120 may consecutively adjoin an inner surface of the outer pipe 140. As a result, the second fluid is allowed to flow along the valleys 124 of the spiral pipe 120.
- [44] Here, the ridges 122 consecutively adjoin the inner surface of the outer pipe 140 such

that the second fluid can stably flow in a particular direction.

- [45] The pipe expansion joints 132, 134 are placed at junctions between the inner pipes 112, 114 and the spiral pipe 120, respectively. The pipe expansion joints 132, 134 are sealed against a circumferential surface of the corresponding pipe of the inner pipes 112, 114 and are provided with ports 133, 135 for inflow/outflow of the second fluid, respectively.
- [46] In other words, a first pipe expansion joint 132 covers a junction between the first inner pipe 112 and the spiral pipe 120, and a second pipe expansion joint 134 covers a junction between the second inner pipe 114 and the spiral pipe 120.
- [47] The first pipe expansion joint 132 is sealed along a circumferential surface of the first inner pipe 112 by welding and the like. The second pipe expansion joint 134 is sealed along a circumferential surface of the second inner pipe 114 by welding and the like.
- [48] The first pipe expansion joint 132 and the second pipe expansion joint 134 are connected to the outer pipe 140. Here, the outer pipe 140 may be integrally formed with the first pipe expansion joint 132 at one side thereof and be integrally formed with the second pipe expansion joint 134 at the other side thereof.
- [49] It should be understood that the first pipe expansion joint 132 and the second pipe expansion joint 134 may also be connected to the outer pipe 140 by welding and the like.
- [50] As such, the outer pipe 140 is configured to surround the entire spiral pipe 120.
- [51] In addition, the first pipe expansion joint 132 has a first port 133 for receiving the second fluid at high temperature and high pressure from the outlet of the condenser, and the second pipe expansion joint 134 has a second port 135 for discharging the heat exchanged second fluid to the expansion valve.
- [52] Thus, the second fluid introduced through the first port 133 flows along the valleys 124 in a space between the outer pipe 140 and the spiral pipe 120 and is then discharged through the second port 135.
- [53] Here, the second fluid exchanges heat with the first fluid that flows along the first inner pipe 112, the spiral pipe 120, and the second inner pipe 114. That is, the first fluid is heated through heat exchange with the second fluid, and the second fluid is cooled through heat exchange with the first fluid.
- [54] Thus, the inner pipes 112, 114, the spiral pipe 120, and the outer pipe 140 may be formed of a material having high thermal conductivity.
- [55] The first pipe expansion joint 132 and the second pipe expansion joint 134 have the same shape to be interchangeable with each other. Here, each of the first pipe expansion joint 132 and the second pipe expansion joint 134 includes a pipe expansion portion 137, a packing member 138, and a connection member 139.
- [56] The pipe expansion portion 137 has a greater diameter than the outer pipe 140 so as

to reduce flow noise of the second fluid. Here, the pipe expansion portions 137 are configured to surround a junction between the first inner pipe 112 and the spiral pipe 120 and a junction between the second inner pipe 114 and the spiral pipe 120, respectively. It should be understood that the pipe expansion portions 137 may also be placed at both sides in an axial direction of the spiral pipe 120.

[57] In addition, the pipe expansion portion 137 has a greater diameter than the outer pipe 140.

[58] That is, a space between the pipe expansion portion 137 and the spiral pipe 120 is expanded, whereby the transfer pressure and transfer rate of the second fluid can be reduced when the second fluid is introduced through the first port 133 of the pipe expansion portion 137, thereby reducing flow-induced noise.

[59] In addition, since the space between the pipe expansion portion 137 and the spiral pipe 120 is expanded, transient storage capacity for the second fluid is increased just before the second fluid is discharged through the second port 135 of the pipe expansion portion 137, thereby stably securing a sufficient discharge amount.

[60] The pipe expansion portion 137 may include a first pipe expansion portion 137a and a second pipe expansion portion 137b protruding from the first pipe expansion portion 137a.

[61] Further, the packing member 138 is tapered from one side of the first pipe expansion portion 137a and is connected to the circumferential surface of the corresponding pipe of the first inner pipe 112 and the second inner pipe 114 to be packed on the surface. Particularly, since the packing member 138 is downwardly tapered from the first pipe expansion portion 137a, flow resistance of the second fluid can be reduced, thereby reducing flow-induced noise.

[62] Moreover, the connection member 139 is tapered from the other side of the first pipe expansion portion 137a and connected to the outer pipe 140. Here, the connection member 139 is sealed at an edge thereof against a corresponding edge of the outer pipe 140 by welding and the like. Since the connection member 139 is downwardly tapered from the first pipe expansion portion 137a, flow resistance of the second fluid can be reduced, thereby reducing flow-induced noise.

[63] As described above, the second fluid stably flows along the valleys 124 in a particular direction. In order to allow the second fluid to flow more stably, each of the valleys 124 is provided with at least three grooves, preferably at least four grooves 126 along a spiral track of the valley 124.

[64] Particularly, a plurality of grooves 126 is formed to be parallel to one another in order to improve flow directionality of the second fluid while increasing a contact area between the second fluid and the spiral pipe 120.

[65] Here, the grooves 126 are not particularly limited in terms of shape, number, and

height.

- [66] By a flattening process, the second expansion portion 137b of each of the pipe expansion joints 132, 134 may be formed with a flattened upper surface 150 at a portion of the curved circumferential surface thereof at which the corresponding pipe of the first port 133 and the second port 135 is formed.
- [67] The flattened upper surface 150 is formed by flattening the circumferential surfaces of the pipe expansion joints 132, 134 along the peripheries of the first port 133 and the second port 135 such that the first port 133 and the second port 135 can be easily coupled to the pipe expansion joints 132, 134, respectively, by welding and the like.
- [68] In other words, the first port 133 and the second port 135 may be partially inserted into the corresponding pipe of the pipe expansion joints 132, 134 and then welded by two-dimensionally moving a welding jig (not shown) on the flattened upper surface 150, thereby allowing easy welding while preventing welding defects.
- [69] By providing the flattened upper surface 150, a space expansion portion 152 can be naturally created inside the second pipe expansion portion 137b. It should be understood that the space expansion portion 152 may also be separately formed in an inner surface of each of the pipe expansion joints 132, 134.
- [70] The space expansion portion 152 can further reduce flow resistance of the second fluid, thus reducing flow-induced noise. It should be understood that the flattened upper surface 150 may be machined using various jigs.
- [71] That is, the second pipe expansion portion 137b can create the space expansion portion 152 inside the second pipe expansion portion 137b by flattening the circumferential surfaces of the pipe expansion joints 132, 134, and the first port 133 and the second port 135 can be welded on the flattened upper surface 150 along the peripheries of the first port 133 and the second port 135, thereby allowing easy welding while preventing welding defects. Heat exchange performance can be controlled by increasing/reducing the pitch between adjacent valleys 124 or between adjacent ridges 122 of the spiral pipe 120.
- [72] Particularly, as the number of grooves 126 of the valley 124 is increased, the distance between the ridge 122 and the outer pipe 140 decreases or the width of the ridge 122 increases in the circumferential direction of the outer pipe 140, thereby reducing flow-induced noise.
- [73] As the distance between the ridge portion 122 and the outer pipe 140 or the width of the ridge portion 122 is increased, noise reduction is further improved. However, increase in width of the ridge 122 with increasing distance between the ridge 122 and the outer pipe 140 can cause increased pressure loss in a flow path or re-expansion of the second fluid when the second fluid at high temperature and high pressure flows through the valleys 124. Thus, it is necessary to appropriately adjust a ratio of a

sectional area of a flow path for the second fluid to the distance between the ridge portion 122 and the outer pipe.

- [74] In addition, a resistance member 160 may protrude from the valley 124. The resistance member 160 protrudes between adjacent ridges 122 and is not limited in terms of shape and number.
- [75] The resistance member 160 serves to increase the residence time of the second fluid in the valleys 124 while supporting the ridges 122 adjacent thereto.
- [76] It should be understood that the distance of adjacent resistance members 160 is not particularly limited.
- [77] Here, the spiral pipe 120 is formed with the valleys 124 and the grooves 126 along the spiral track thereof in a discontinuous manner such that the resistance members 160 can be naturally formed. Particularly, the resistance member 160 needs to have a smaller height than the ridge portion 122 to allow flow of the second fluid.
- [78] Thus, the resistance member 160 may be partially chamfered at an upper portion thereof. It should be understood that the resistance member 160 may be formed in various shapes.
- [79] Although some embodiments have been described herein, it should be understood that these embodiments are provided for illustration only and are not to be construed in any way as limiting the present invention, and that various modifications, changes, and alterations can be made by those skilled in the art without departing from the spirit and scope of the invention.
- [80] Therefore, the scope of the present invention should be defined by the appended claims and equivalents thereof.

Sequence Listing Free Text

- [81] 100: Double tube 112, 114: First and second inner pipes
- [82] 120: Spiral pipe 122: Ridge portion
- [83] 124: Valley 126: Groove
- [84] 132, 134: First and second pipe expansion joints
- [85] 133,135: First and second ports 137: Pipe expansion portion
- [86] 137a, 137b: First and second pipe expansion portions
- [87] 138: Packing member 139: Connection member
- [88] 140: Outer pipe 150: Flattened upper surface
- [89] 152: Space expansion portion 160: Resistance member
- [90]

Claims

- [Claim 1] A double tube for heat exchange, comprising:
a spiral pipe having ridges and valleys alternately formed on a circumferential surface thereof along a spiral track thereof and guiding a first fluid to flow therethrough;
an outer pipe receiving the spiral pipe axially inserted therein and guiding a second fluid to flow along the circumferential surface of the spiral pipe in an axial direction such that the second fluid exchanges heat with the first fluid;
inner pipes connected to opposite sides of the spiral pipe to allow the first fluid to flow therethrough; and
pipe expansion joints provided at opposite sides of the outer pipe to have a greater diameter than the outer pipe to be placed at junctions of the spiral pipe and the inner pipes, pipe expansion joints being sealed against the corresponding pipe of the inner pipes and provided with ports for introducing and discharging the second fluid, respectively, wherein the pipe expansion joints include pipe expansion portions having a greater diameter than the outer pipe and integrally connected to the outer pipe,
wherein the pipe expansion portions include a first pipe expansion portion and a second pipe expansion portion protruding from the first pipe expansion portion and having a flattened upper surface, and
wherein the ports are welded on the flattened upper surface of the second pipe expansion portion along the peripheries of the ports.
- [Claim 2] The double tube for heat exchange according to claim 1, wherein the pipe expansion joints further comprising:
a packing member tapered from one side of the first pipe expansion portion and connected to the circumferential surface of the corresponding pipe of the inner pipes to be packed on the surface, and
a connection member tapered from the other side of the first pipe expansion portion and integrally connected to the outer pipe.
- [Claim 3] The double tube for heat exchange according to claim 1, further comprising:
a resistance member protruding from the valleys to increase a residence time of the second fluid in the valleys on the circumferential surface of the spiral pipe.
- [Claim 4] The double tube for heat exchange according to claim 3, wherein each

of the valleys has at least three grooves formed along the spiral track,
and

wherein the resistance member is at least partially formed over the
remaining grooves except for two grooves located outside among the at
least three grooves.

[Claim 5]

The double tube for heat exchange according to claim 4, wherein each
of the valleys has at least four grooves formed along the spiral track,
and

wherein the resistance member is at least partially formed over the
remaining grooves except for two grooves located outside among the at
least four grooves.

[Claim 6]

A double tube for heat exchange, comprising:

a spiral pipe having ridges and valleys alternately formed on a circum-
ferential surface thereof along a spiral track thereof and guiding a first
fluid to flow therethrough;

an outer pipe receiving the spiral pipe axially inserted therein and
guiding a second fluid to flow along the circumferential surface of the
spiral pipe in an axial direction such that the second fluid exchanges
heat with the first fluid;

inner pipes connected to opposite sides of the spiral pipe to allow the
first fluid to flow therethrough; and

pipe expansion joints provided at opposite sides of the outer pipe to
have a greater diameter than the outer pipe to be placed at junctions of
the spiral pipe and the inner pipes, pipe expansion joints being sealed
against the corresponding pipe of the inner pipes and provided with
ports for introducing and discharging the second fluid, respectively,
wherein the pipe expansion joints include pipe expansion portions
having a greater diameter than the outer pipe and integrally connected
to the outer pipe,

wherein each of the valleys has at least three grooves formed along the
spiral track, and

wherein a resistance member is protruded at least partially over the
remaining grooves except for two grooves located outside among the at
least three grooves.

[Claim 7]

The double tube for heat exchange according to claim 6, wherein each
of the valleys has at least four grooves formed along the spiral track,
and

wherein the resistance member is at least partially formed over the

remaining grooves except for two grooves located outside among the at least four grooves.

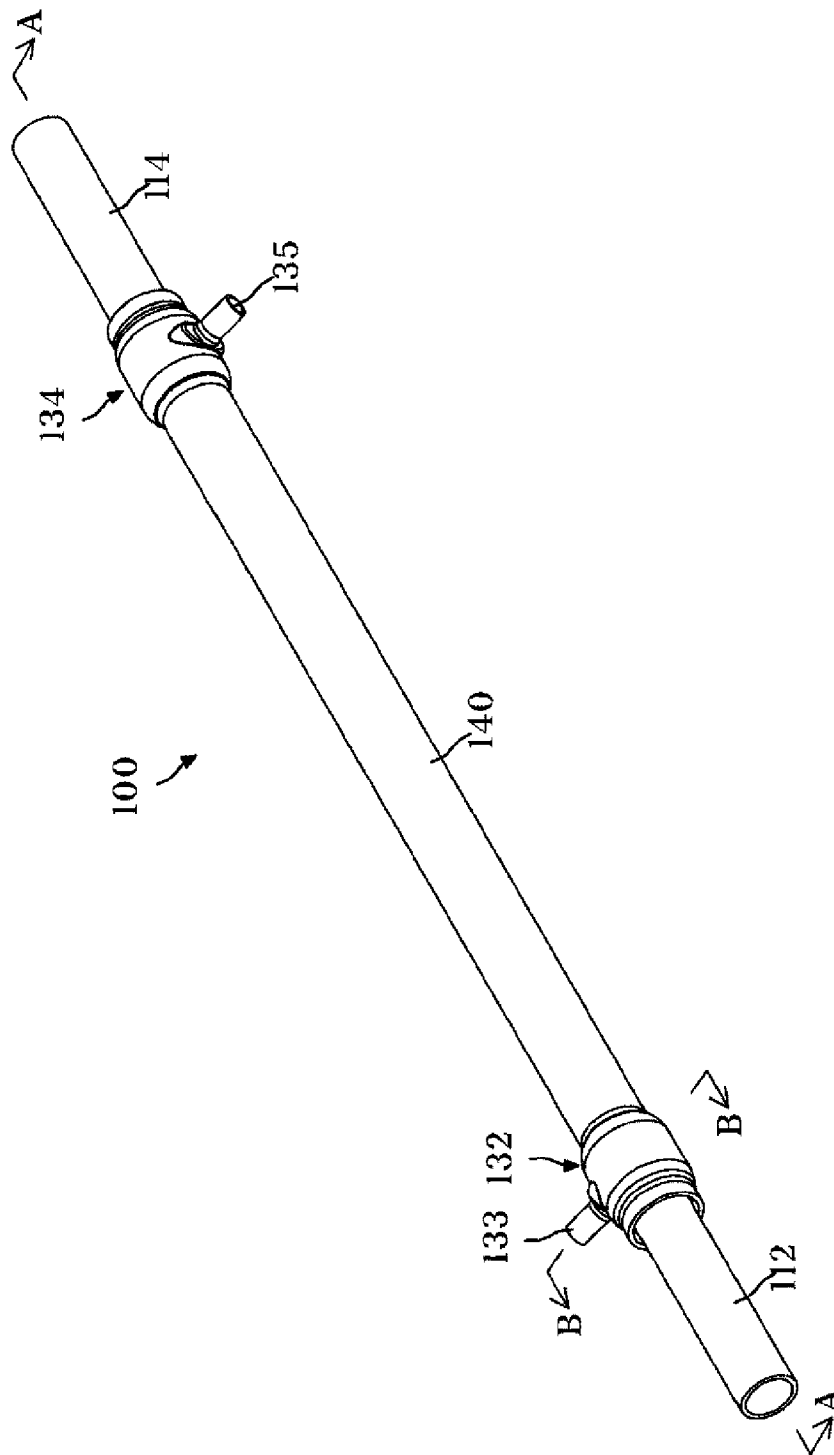
[Claim 8]

The double tube for heat exchange according to claim 6, wherein the pipe expansion joints further comprising:

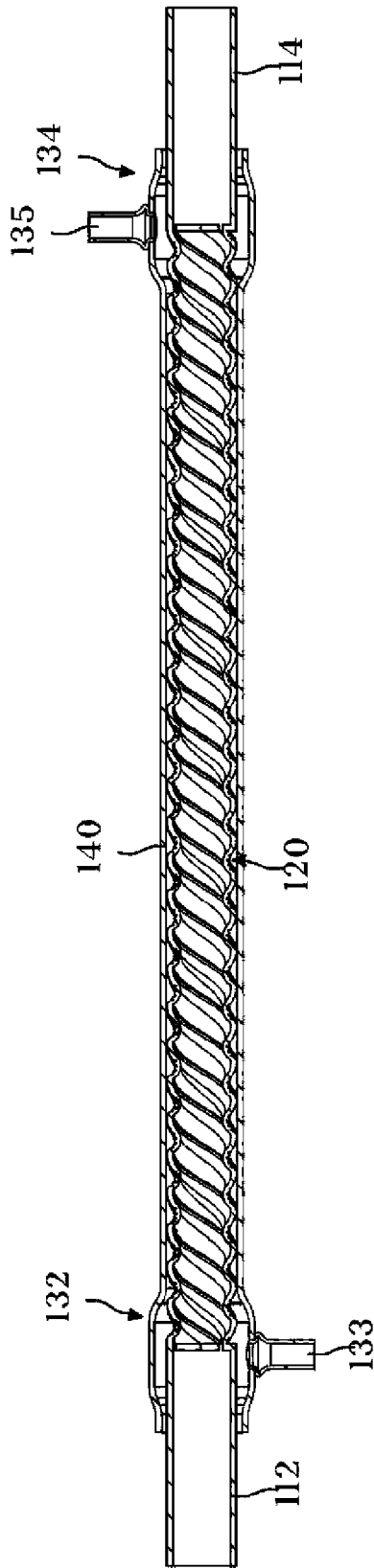
a packing member tapered from one side of the pipe expansion portions and connected to the circumferential surface of the corresponding pipe of the inner pipes to be packed on the surface, and

a connection member tapered from the other side of the pipe expansion portions and integrally connected to the outer pipe.

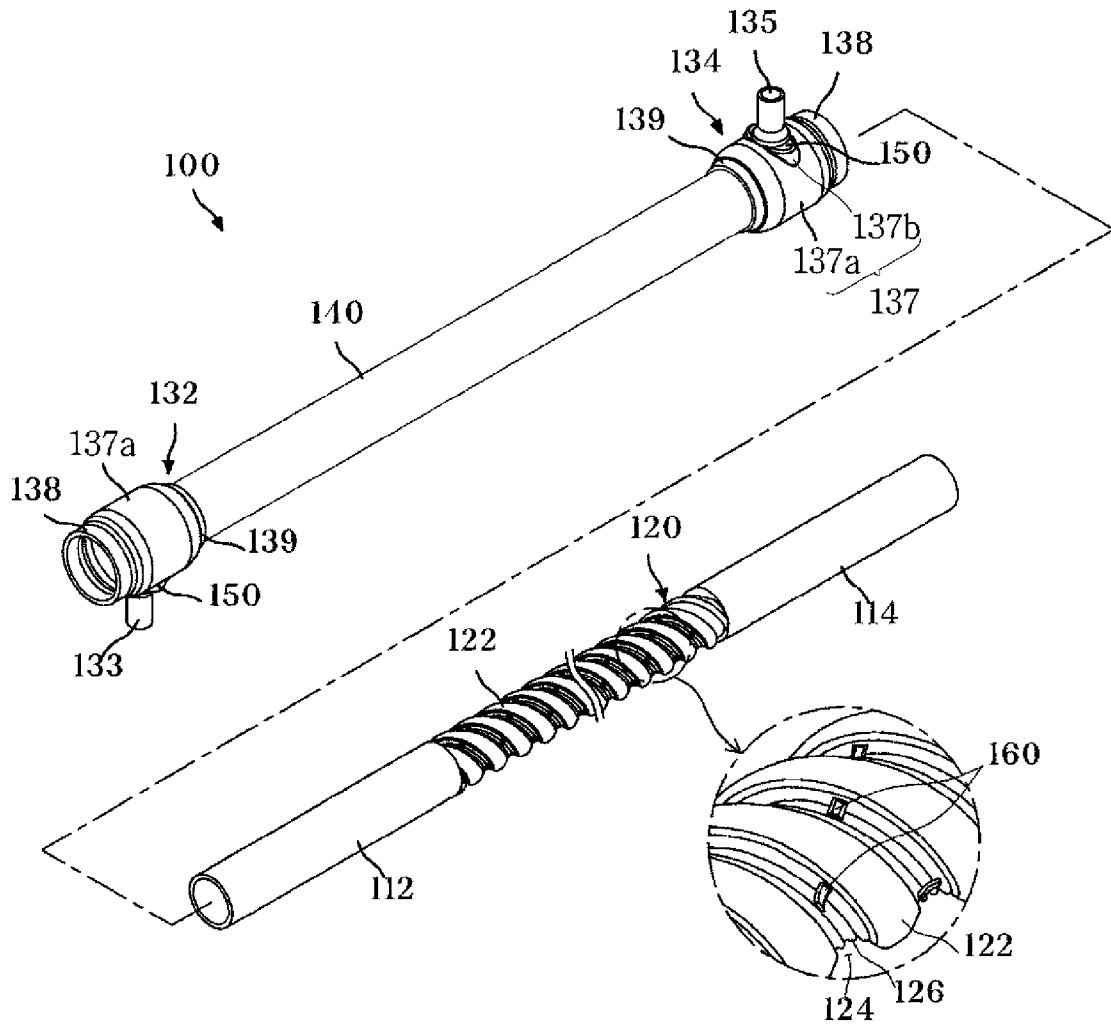
[Fig. 1]



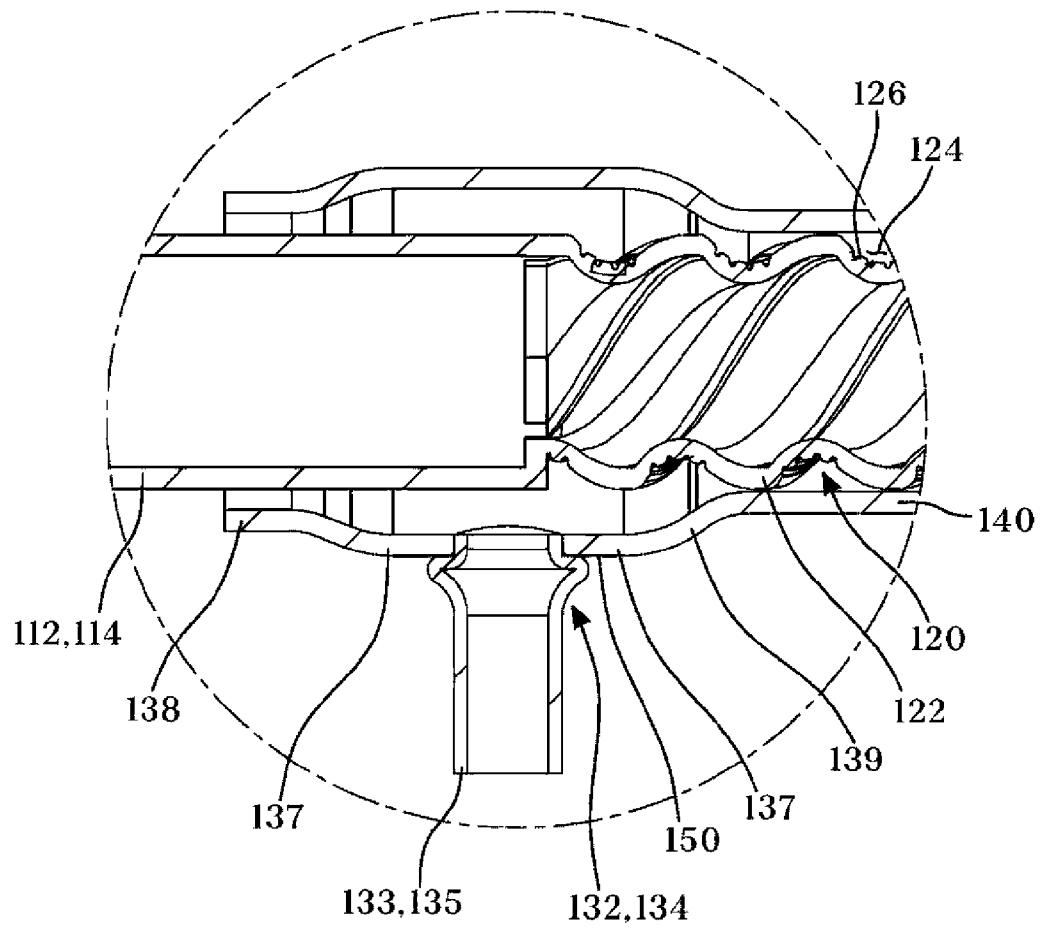
[Fig. 2]



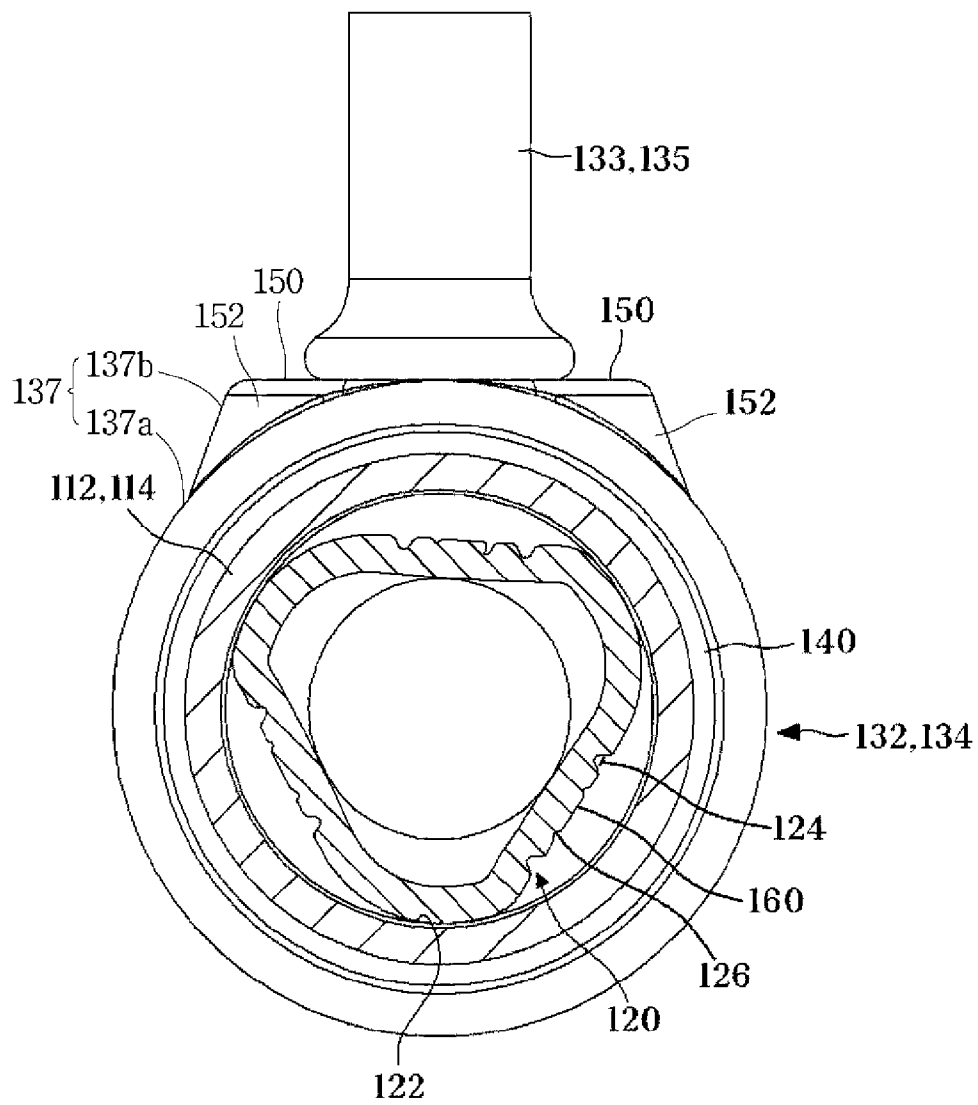
[Fig. 3]



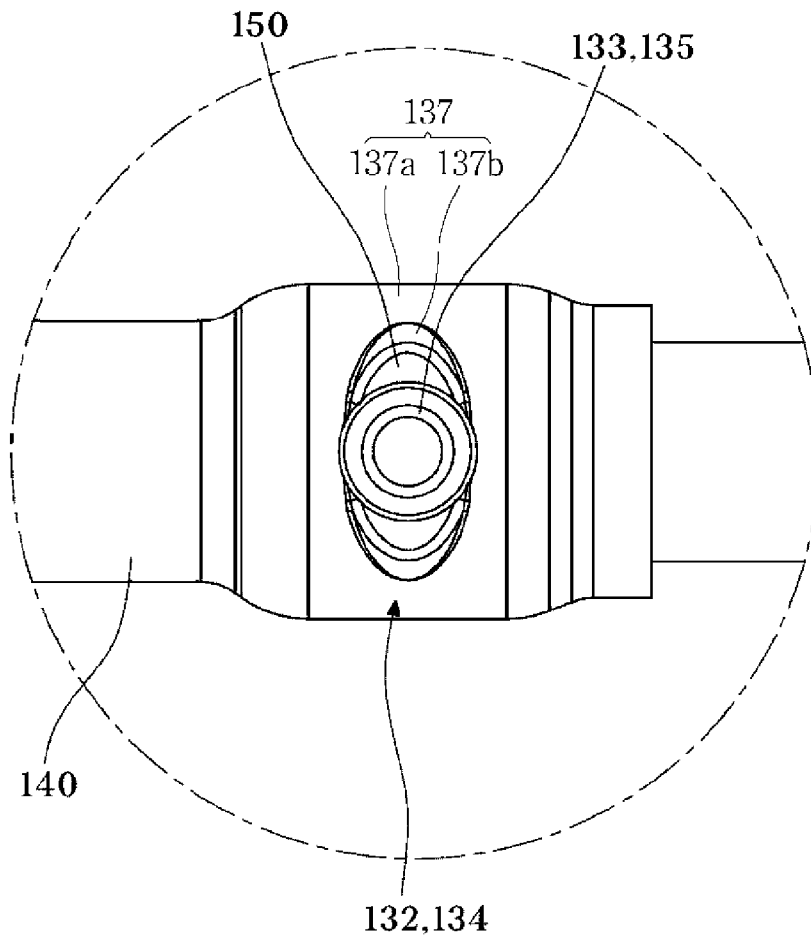
[Fig. 4]



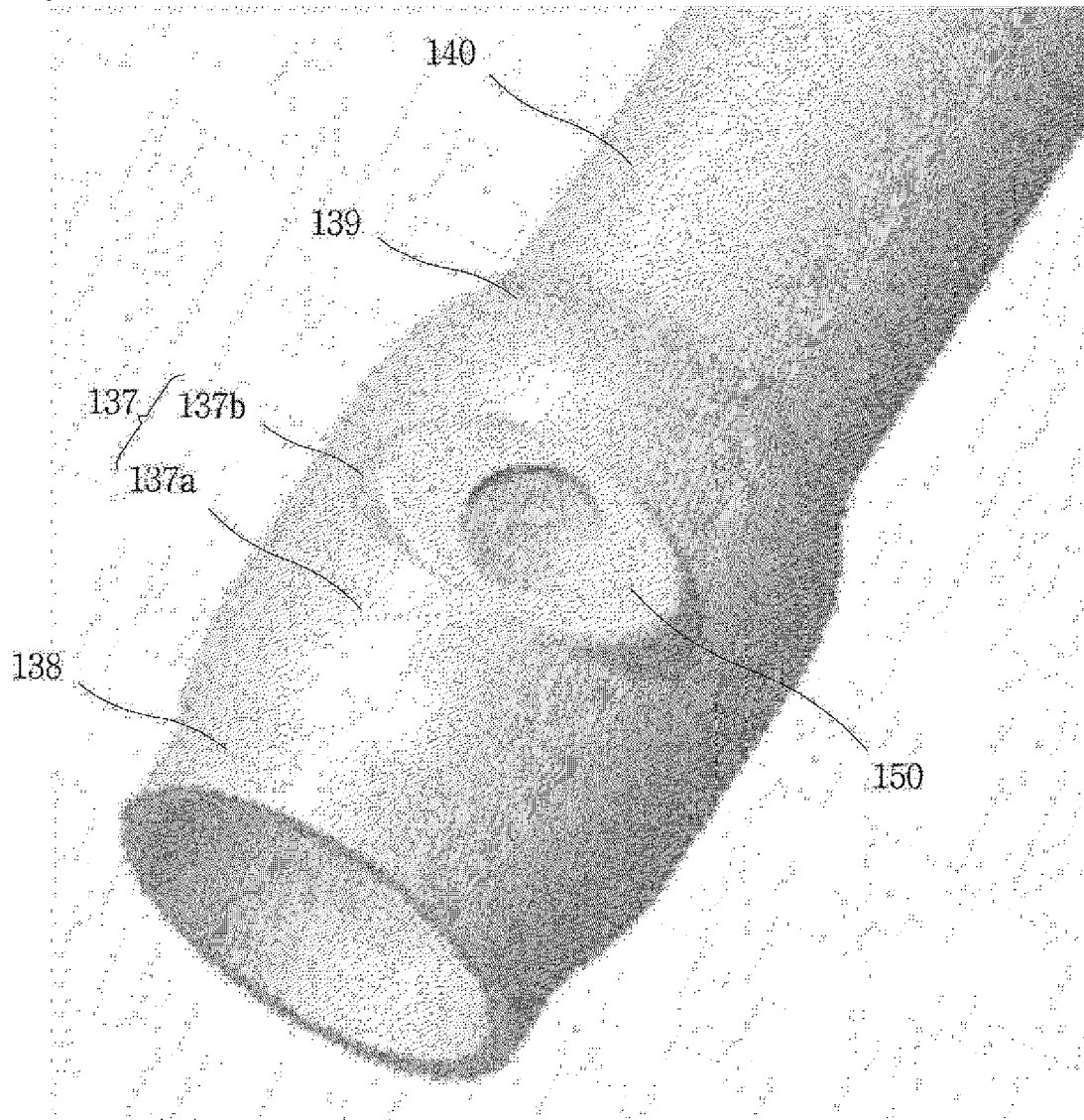
[Fig. 5]



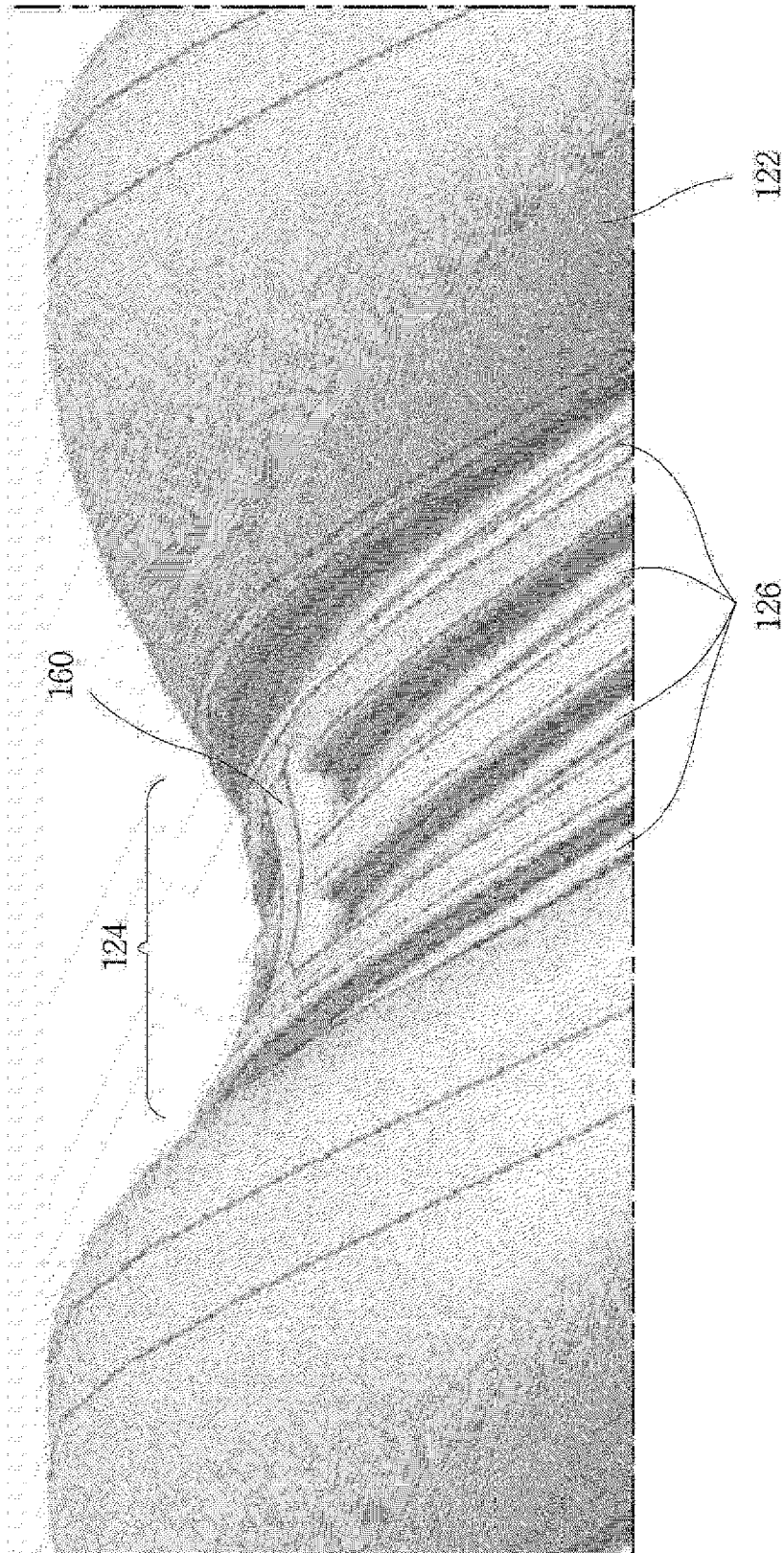
[Fig. 6]



[Fig. 7]



[Fig. 8]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2017/005296**A. CLASSIFICATION OF SUBJECT MATTER****F28D 7/10(2006.01)i, F16L 9/02(2006.01)i, F16L 9/18(2006.01)i, F16L 41/02(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F28D 7/10; F25B 40/02; F16L 21/00; F28F 1/42; F28F 1/12; F16L 9/02; F16L 9/18; F16L 41/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: double tube, heat exchange, spiral pipe, outer pipe, inner pipe, pipe expansion joint

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2012-127623 A (DENSO CORP.) 05 July 2012 See paragraphs [0031], [0050]-[0053]; claims 1, 8; and figures 2-9.	1-8
Y	KR 10-2012-0132707 A (HALLA CLIMATE CONTROL CORP.) 10 December 2012 See paragraphs [0062]-[0082]; and figures 5-8.	1-8
Y	JP 09-113155 A (DENSO CORP.) 02 May 1997 See paragraphs [0023]-[0031]; and figures 1-3.	1-5
Y	KR 10-1415738 B1 (DOOWON CLIMATE CONTROL CO., LTD.) 09 July 2014 See paragraphs [0024]-[0028]; and figures 4-6.	4-8
A	KR 10-2012-0007799 A (DOOWON CLIMATE CONTROL CO., LTD.) 25 January 2012 See paragraphs [0017]-[0022]; and figures 8-10.	1-8



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

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01 August 2017 (01.08.2017)

Date of mailing of the international search report

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International Application Division

Korean Intellectual Property Office

189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea

Facsimile No. +82-42-481-8578

Authorized officer

BAE, Geun Tae

Telephone No. +82-42-481-3547



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2017/005296

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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JP 09-113155 A	02/05/1997	None	
KR 10-1415738 B1	09/07/2014	None	
KR 10-2012-0007799 A	25/01/2012	None	