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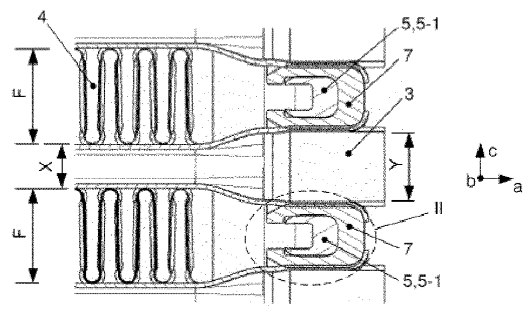
(54) **HEAT TRANSFER APPARATUS**

(57) The present disclosure relates to a heat transfer system 1 for transferring heat between a first fluid and a second fluid. The system 1 has an arrangement 2 composed of pipe elements 3, 3a, 3b, 3c for passing through the first fluid, one or more pipe bottoms 5 having a through opening 6, and one or more sealing elements 7 having a through opening 8. The pipe elements 3, 3a, 3b, 3c are formed of a flat pipe having a first region 10 having a first height X and a width W and one or more second regions 11 having a support surface 13 arranged on one end portion of the pipe elements 3, 3a, 3b, 3c and having a second height Y, respectively. The sealing element 7 is arranged between the edge of the through-hole 6 of the pipe bottom 5 and the support surface 13, respectively, and has a specific wall thickness G. The pipe elements 3, 3a, 3b, 3c having a wide side are arranged in a state aligned parallel to each other and at an interval F with respect to each other in the first region 10. A web 5-1 having a height H is provided between the through openings 6 arranged adjacent to each other of the pipe bottom 5. The deformation degree of the end portion of the pipe elements 3, 3a, 3b, 3c in the height direction c, which is placed in a range from the maximum value CM_{max} to the minimum value CM_{min}, is previously set with reference to the dimension relationship.

[FIG. 3B]



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Description

[Technical Field**]**

[0001] The present disclosure particularly relates to a heat transfer system for using in a vehicle. In this system, heat is preferably transferred between a coolant as a first fluid, for example, water or water-glycol-mixture, and the air as a second fluid. This system has an assembly composed of a pipe element for passing through the first fluid, and one or more pipe bottoms and one or more sealing elements having a through opening for passing through the pipe element, respectively.

[Background Art**]**

[0002] A coolant-air-heat exchanger known in the related art for transferring heat to the ambient air from a coolant circulation system is used in a so-called high-temperature coolant circulation system for discharging the heat of a combustion engine. The coolant-air-heat exchanger formed from aluminum has few pipes, a multi-disc, and a side element fixed within the pipe bottom, a coolant collector arranged on a crimp connection part has various elements to be assembled for heat exchange. The pipes aligned parallel to each other and arranged as a matrix are used to guide the liquid coolant between the collectors. The coolant collector arranged at both sides on the end portion of the pipe is sealed with respect to the pipe and the pipe bottom by an Ethylene-Propylene-diene-rubber-sealing element simply called as an EPDM-sealing part according to the conventional method. The pipe, the pipe bottom, the multi-disc, and the side element are completed in a completely soldered state as a so-called slot cooler or completed in a completely soldered state as a so-called soldering cooler.

[0003] When the soldering method is used in the controlled atmosphere simply called as a "Controlled Atmospheric Brazing (CAB)," the matrix composed of the pipe and the multi-disc is connected to each other and in some cases, is connected with the pipe bottom as the metal element of the collector, respectively. In the plugging method, the soldering or welding of adjacent metal parts is avoided by using the mechanical assembly between the matrix and the collector simply called as a Mechanical Assembly (MA).

[0004] The air absorbing heat from the coolant flows through the outer surface of the pipe, and therefore, flows between the pipes. The multi-disc or a rib arranged between the pipes on the outer surface is used for enlarging an air-side heat transfer surface, and therefore, is used for increasing the output of the heat exchanger.

[0005] A known coolant-air-heat exchanger has unsatisfactory durability against the quickly changing temperature of the coolant. Therefore, the coolant-air-the heat exchanger can be cooled to the temperature within a range of -20°C to -10°C in the extreme application examples, and operated by the coolant having the temperature of about 120 °C due to the quickly opened valve within the coolant circulation system. At this time, the coolant-air-heat exchanger undergoes a very strong change in temperature, and experiences thermal shock. A very large material stress appears due to the thermal expansion time-displaced of the individual pipe.

[0006] The slot cooler has a very high resistance capability against the change in temperature of the coolant due to the sliding bearing-connection between the pipe as the element of the collector and the pipe bottom, but has cooling performance smaller than that of the soldering cooler because of the connection of the forced coupling method between the pipe and the multi-disc. The soldering cooler has the limited durability against the change in temperature and the thermal expansion of the individual pipe caused thereby due to the rigid soldering connection between the pipe and the pipe bottom again.

[0007] DE 10 2015 113 905 A1 discloses a method for manufacturing and mounting a heat exchanger having a collector mechanically mounted for using in a vehicle, particularly, an air flow-heat exchanger and the heat exchanger. This heat exchanger includes a matrix completely bonded mechanically from a plurality of metal pipes and a plurality of metal ribs arranged in parallel. The pipe has a heat transfer section having a straight-type lateral cross-sectional shape with two longer side surfaces and shorter side surfaces disposed to face each other, respectively. In order to provide the sealing and to enable the relative motion between the pipe and a first collector mechanically connected due to the thermal expansion and contraction of the matrix, one or more pipes are connected with the first collector by one or more flexible elements extended by a first end portion section of the pipe in the first end portion section.

[0008] In this case, according to a method that is inserted into the pipe in a state where the pipe and the multi-disc has been soldered without the pipe bottom and then the pipe bottom has been sealed within a sealing part through a press fit, the synergy of the methods for manufacturing the slot cooler and the soldering cooler is described. The temperature exceeding 600 °C during soldering within a soldering oven is provided, such that the pipe cannot withstand permanently the resistance force provided by the sealing by the press fit in the end portion region, particularly, according to the demand to assure a sealing device through the entire circumference of the pipe.

[0009] The conventional pipe of the heat exchanger used in the vehicle, particularly, the pipe made of an aluminum alloy, cannot often withstand the sealing pressure acting on the wall of the pipe after the compression of the sealing part between the pipe and the pipe bottom. In this case, the heat exchanger known in the related art and the method for manufacturing the heat exchanger are limited to the use of the pipe having the width or the depth of about 11mm at maximum, particularly, the welded pipe. On the other hand, the sealing part should be compressed within a range of 10% to 50% through the entire circumference of the pipe, and in this case, the compressed sealing part causes the situation where the unsupported wide wall of the pipe can be collapsed, particularly, due to the force applied to the wall of the pipe. On the another hand, the compression of the sealing part is placed in the central region of the wall of the pipe, that is, is often placed below a target value described above within the region of the pipe crown.

[DISCLOSURE**]**

[Technical Problem**]**

[0010] An object of the present disclosure is to provide a system for efficiently transferring heat between two fluids, particularly, between the liquid-phase fluid as a coolant and the air, and in addition, to constitute the system as intended. At this time, a heat exchanger should have the sufficient and uniform compressed state and the maximum sealing state, that is, the high thermal shock durability of a sealing part through the entire circumference of the pipe, respectively, even when a change in temperature is large. According to the heat exchanger, the maximum heat output should be transferred at the minimum size of structure or at the demand for the minimum installation space. In addition, the heat exchanger should have the minimum weight, and cause the minimum manufacturing cost and material cost.

[Technical Solution**]**

[0011] The object is achieved by the elements having the features of the independent claims. The improvement examples are recited in the dependent claims.

[0012] The object is achieved by a system according to the present disclosure for transferring heat between a first fluid and a second fluid. The system has an assembly composed of one or more pipe bottoms having a through opening and one or more sealing elements having a through opening, and pipe elements for passing through the first fluid.

[0013] The pipe elements arranged in a state having passed through the through opening, respectively, can be formed of a flat pipe having a first region having a first height X and a depth W, and one or more second regions having a support surface for sealing and fixing on the pipe bottom having a second height Y and arranged on one end portion of the pipe element, respectively.

[0014] Therefore, the pipe elements have a heat transfer region circulated by the second fluid, particularly, the air in the first region, and preferably has a region connected with the pipe bottom in the second region.

[0015] The sealing element is arranged between the support surface of the pipe element and the edge of a through opening of the pipe bottom, and has a specific wall thickness G, respectively. One or more pipe bottoms having the through opening are connected with the pipe elements in the fluid sealing method by the sealing element intermediate-supported. The through openings of the pipe bottom and the sealing element are matched to each other in the shape, respectively, and also matched with the outer shape of the pipe element. In this case, one pipe element is preferably present in a state having passed through the through opening, respectively, such that each end portion of one pipe element is accurately assigned with one through opening.

[0016] The pipe elements have a wide side to be aligned parallel to each other and at an interval F with respect to each other in the first region, respectively. A web having a predetermined height H can also be provided one by one between the through openings arranged adjacent to each other of the pipe bottom, respectively.

[0017] According to the concept of the present disclosure, when viewing in the height direction, the expansion inside the first region of the pipe element formed at the first height X of one pipe element and the interval F of the pipe elements adjacent to each other corresponds to the expansion inside the second region of the pipe element formed at the second height Y of one pipe element, the height H of one web of the pipe bottom, and two times the wall thickness G of the sealing element, and in this case, the following equation is applied:

$$CM = F - H = Y - X + 2 \cdot G$$

[0018] In the equation, the CM refers to the deformation degree of the end portion of the pipe element in the height direction, and is placed in a range between the maximum value CM_{max} and the minimum value CM_{min}. The CM_{min} corresponds to two times the wall thickness G of the sealing element, that is, $CM_{min} = 2 \cdot G$. In the minimum value $CM_{min} = 2 \cdot G$, the end portions of the pipe of the pipe element have not been broken in shape or not deformed in at least height direction.

[0019] Particularly, the deformation limitation CM_{max} is specified as the maximum value, and the deformation limitation CM_{min} is specified as the minimum value, such that the CM as a parameter describes the deformation suitable for the end portion of the pipe element formed for the purpose of securing the firm and reliable sealing of the pipe element of the circumference with respect to the sealing element surrounding the peripheral within a press fit.

[0020] The pipe element can be preferably made of metal. The lateral cross section of the pipe element is preferably expanded within the second region on the plane aligned vertically with respect to the vertical direction.

[0021] According to one improvement example of the present disclosure, the flow lateral cross section of the pipe element is limited by two side surfaces disposed to face each other, respectively, and these side surfaces form the narrow side or the vertical side of the flow lateral cross section in pair, respectively.

[0022] According to an alternative first embodiment of the present disclosure, the side surfaces of the pipe element arranged adjacent to each other are aligned vertically with respect to each other at the contact edges proceeding in the vertical direction. In this case, the contact edges have a transition part round-processed having an edge radius R, respectively.

[0023] The first height X of the first region of the pipe element is preferably greater than a value of two times the edge radius R of the pipe element. In this case, the maximum value CM_{max} is appeared from the following equation,

$$CM_{max} = [(2\pi R + 2(W-2R) + 2(X-2R))A / \pi] - X + 2G,$$

and

the A in the equation describes a ratio of the circumference of the pipe element on the end portion of the pipe after deformation to the circumference of the pipe element on the end portion of the pipe element before deformation. The characteristic of the geometrical structure and material enables the maximum deformation, particularly, the expansion of the end portion of the pipe until when the deformation according to the tensile limitation of the material of the pipe element causes the crack of the material.

[0024] According to an alternative second embodiment of the present disclosure, the side surfaces arranged at the vertical side of the flow lateral cross section of the pipe element, respectively, are connected to each other through the side surface of the narrow side bent outwards in the semicircle hollow cylinder shape and having the outer radius R.

[0025] The first height X of the first region of the pipe element preferably corresponds to two times the radius R of the side surface of the narrow side of the pipe element bent outwards in the semicircle hollow cylinder shape. In this case, the maximum value CM_{max} is appeared from the following equation,

$$CM_{max} = [(X\pi + 2(W-X))A / \pi] - X + 2G,$$

and

the A in the equation corresponds to the expansion capacity of the pipe.

[0026] One advantage of the present disclosure is that the flow channel limited by the wall of the pipe element is substantially deformed from the rectangular lateral cross section shape into the elliptical lateral cross section shape, when the lateral cross section of the second region of the pipe element is expanded on the plane aligned vertically with respect to the vertical direction.

[0027] According to an improvement example of the present disclosure, the pipe element has the wall thickness of 0.22mm, the first height X of about 2.5mm, and the width W of about 10.8mm in the first region, and has the second height Y of about 4.69mm and the width of about 10.95mm in the second region.

[0028] According to another preferred embodiment of the present disclosure, the pipe element on the end portion of the pipe is formed in a state expanded starting from the front in the region of an apex of the vertical side, respectively, such that the wall of the pipe element is deformed to have a molding part outwards in the height direction, respectively. Therefore, the pipe element is formed to have the shape in the region of the apex of the upper surface and the lower surface, respectively. At this time, the pipe element preferably has an extension part of about 7.6mm in the maximally expanded region of the molding part in the height direction.

[0029] According to a preferred embodiment of the present disclosure, the pipe bottom can have a ring element for at least locally reducing the opened lateral cross section of the through opening for receiving the sealing element in the region of the web, respectively.

[0030] Another preferred embodiment of the present disclosure can form the pipe bottom as the sidewall element of a collector of the heat transfer system.

[0031] The heat transfer system can preferably form to have two pipe bottoms having the through opening and two sealing elements having the through opening. The pipe bottoms are connected with the pipe elements in the fluid sealing method, respectively, and in this case, the through openings coincide with the outer shape of the pipe element in the shape, respectively, and the respective pipe elements are arranged to have a first end portion passing through the through opening formed on a first pipe bottom and a second end portion passing through the through opening formed on a second pipe bottom, respectively.

[0032] The pipe elements are preferably formed in a straight line and preferably made of an aluminum alloy.

[0033] According to an improvement example of the present disclosure, the pipe elements are aligned by one column or a plurality of columns inside an arrangement.

[0034] The pipe elements of one column of the system according to the present disclosure aligned side by side and parallel to each other, and to have a wide side with respect to each other are preferably arranged so that the flow path for the second fluid, particularly, the air, is directly formed one by one between the pipe elements arranged adjacent to each other, respectively.

[0035] A multi-disc or a rib for changing the flow lateral cross section and/or expanding a heat transfer area is preferably arranged within the flow path formed inside the first region by the pipe elements arranged adjacent to each other. In this case, the multi-disc has an extension part in the height direction, and the extension part corresponds to the interval F of the pipe elements arranged adjacent to each other. The multi-disc or the rib is preferably made of an aluminum alloy.

[0036] A preferred embodiment of the present disclosure can allow the heat transfer system to be used as a coolant-air-heat exchanger within a coolant circulation system, particularly, within an engine coolant circulation system, of a vehicle.

[0037] In summary, the heat transfer system according to the present disclosure has various advantages as follows.

- The use of CAB/MA-manufacturing principle is expanded within the frame of the conventional pipe portfolio,
- when the size of the structure is the minimum or the demand for the installation space is the minimum, that is, when a ratio of the opened volume to the transferable heat output is optimum, the maximum heat output is transferred even by a optimum ratio of the geometrical structure,
- the complexity and the material cost are reduced, and therefore, the manufacturing cost is reduced,
- the minimum weight is obtained,
- it is possible to have the maximum sealing, that is, the high thermal shock durability and the high resistance capability against the change in temperature even when the change in temperature is large, such that the high opening speed and closing speed of the valves are possible within the fluid circulation system, particularly, within the coolant circulation system when the connection between the pipe element, the sealing element, and the pipe bottom is flexible,
- the use is secured even when the pressure pulsation load is high,
- the connection of the end portion of the pipe inside the pipe bottom and the sealing element is permanently secured by the press fit executing the uniform sealing compression at the specified level, such that the maximum lifespan is secured.

[Advantageous Effects**]**

[0038] According to the heat transfer system of the present disclosure, the use of CAB/MA-manufacturing principle can be expanded within the frame of the conventional pipe portfolio, when the size of the structure is the minimum or the demand for the installation space is the minimum, that is, when a ratio of the opened volume to the transferable heat output is optimum, the maximum heat output can be transferred even by a optimum ratio of the geometrical structure.

[0039] In addition, the complexity and the material cost is reduced, and therefore, the manufacturing cost is reduced, and the minimum weight is obtained.

[0040] In addition, it is possible to have the maximum sealing, that is, the high thermal shock durability and the high resistance capability against the change in temperature even when the change in temperature is large, such that the high opening speed and closing speed of the valves are possible within the fluid circulation system, particularly, within the coolant circulation system when the connection between the pipe element, the sealing element, and the pipe bottom is flexible, the use is secured even when the pressure pulsation load is high, and the connection of the end portion of the pipe inside the pipe bottom and the sealing element is permanently secured by the press fit executing the uniform sealing compression at the specified level, such that the maximum lifespan is secured.

[Description of Drawings**]**

[0041] Additional specific items, features and advantages of the embodiments of the present disclosure will be appeared from the following detailed descriptions for the embodiments of the present disclosure with reference to the relevant drawings. Herein,

FIG. 1 is an exploded diagram specifically showing a heat transfer system having a pipe element arrangement including a multi-disc intermediate-supported, a pipe bottom, a sealing element, and a collector as an individual component.

FIG. 2A is a side diagram showing the pipe element having a first region and a second region to be formed of a flat pipe.

FIGS. 2B and 2D are perspective diagrams showing the pipe element having different flow lateral cross sections, respectively, and formed of the flat pipe.

FIG. 2C is a diagram specifically showing the pipe element shown in FIG. 2B.

FIG. 3A is a side diagram specifically showing the arrangement of the pipe element having the multi-disc intermediate-supported of the heat transfer system shown in FIG. 1.

FIG. 3B is a side cross-sectional diagram specifically showing the arrangement of the pipe element having the multi-disc intermediate-supported, the pipe bottom, and the sealing element of the heat transfer system shown in FIG. 1.

FIG. 3C is a diagram specifically showing the pipe bottom having the sealing element shown in FIG. 3B.

FIGS. 4A and 4B are a perspective diagram and a plane diagram showing the pipe element partially enlarged on the end portion of the pipe, and having the elliptical lateral cross section similar to the pipe element shown in FIG. 2A.

FIGS. 4C to 4F are a perspective diagram and a plane diagram showing the pipe element finally enlarged on the end portion of the pipe shown in FIGS. 4A and 4B.

FIGS. 5A and 5B are a perspective diagram and a plane diagram showing the pipe element having partially enlarged on the end portion of the pipe, and having the elliptical lateral cross section similar to the pipe element shown in FIG. 4A.

FIG. 6A is a side cross-sectional diagram specifically showing the arrangement of the pipe element shown in FIG. 5A within a through opening of the pipe bottom having the sealing element.

FIG. 6B is a diagram specifically showing the pipe bottom having the sealing element and the pipe element shown in FIG. 6A.

[Best Mode**]**

[0042] FIG. 1 shows a pipe element 3 having a pipe bottom 5 and a sealing element 7 of a heat transfer system 1, particularly, an arrangement 2 of a flat pipe. In this drawing, the heat transfer system 1 having the arrangement 2 including a pipe element 3 having a multi-disc 4 intermediate-supported, the pipe bottom 5, the sealing element 7, and a collector 9 is specifically shown. The collector 9 is also called as a coolant collector when coolant is used as fluid.

[0043] The arrangement 2 formed of the flat pipe 3 is formed in one column or a plurality of columns according to the output demand condition, and is adjustable in terms of size, that is, in terms of the length or the width, particularly. The pipe element 3 is arranged in two columns.

[0044] The pipe element 3 aligned side by side and parallel to each other is aligned with respect to each other inside one column having a wide side, such that the flow path for fluid, particularly, the air, is directly generated between the pipe elements 3 adjacent to each other, respectively. At this time, the flow path proceeds between the pipe elements 3, respectively. The pipe elements 3 of one column are arranged in the same line with respect to each other, and extended between two collectors 9, respectively. The inner volume of the pipe element 3 is connected with the inner volume of the collector 9.

[0045] Within the flow path and the intermediate space of the pipe element 3 arranged adjacent to each other, an element for changing the flow lateral cross section and/or expanding the heat transfer area is formed. As the element for changing the flow lateral cross section and/or expanding the heat transfer area, the multi-disc 4 is provided. Alternatively, a rib can also be used. The multi-disc 4 is preferably formed in a material having the excellent heat conductivity such as an aluminum alloy like the pipe element 3.

[0046] In a state where the system 1 has been assembled, the pipe bottom 5, which can be used even as the sidewall element of the collector 9 is provided at the front or the narrow side of the arrangement 2, respectively. In this case, the side surface on which the end portion of the pipe element 3 has been aligned is called as a front. The pipe bottom 5 is made of metal, particularly, an aluminum alloy, respectively, as a deep drawing part, a perforation part or a hydrofoaming part, which are substantially the form of the rectangular-shaped sheet. In this case, the sheet is understood as a flat final product of a rolling mill made of metal. The hydrofoaming also called as high-pressure deformation is regarded as deforming the sheet within the closed mold tool by using the pressure generated within the tool by the water-oil-emulsion.

[0047] The sealing element 7 as well as the pipe bottom 5 on which the edge region has been round-processed also has the through openings 6, 8 for receiving the pipe element 3. In order to make the fluid sealing connection between the individual pipe element 3 and the pipe bottom 5, the through opening 6 of the pipe bottom 5 and the through opening 8 of the sealing element 7 are matched to each other, and also matched with the outer dimension of the pipe element 3. A web 5-1 is formed between the through openings 6 of the pipe bottom 5, respectively.

[0048] The pipe bottom 5 arranged at the side facing each other of the collector 9 is fixedly connected with the pipe element 3. The fixing connection can be regarded as the zero-leakage technically sealed by the sealing element 7, respectively. The pipe bottom 5 is aligned vertically with respect to the pipe element 3 at the narrow side of the pipe element 3 to be arranged on the arrangement 2.

[0049] FIG. 2A is a side diagram showing the pipe element 3 formed of the flat pipe having a first region 10 not deformed as a heat transfer region, a second region 11 not deformed as a deformation region, and a connection part with the pipe bottom 5. The regions 10, 11 of the pipe element are formed in a state connected to each other when viewing in the vertical direction a.

[0050] The pipe element 3 is expanded and deformed at least partially on the end portion of the pipe. The lateral cross section of a flow channel surrounded by the wall of the pipe element 3 is expanded constantly and uniformly between the first region 10 circulated by the fluid and the second region 11 facing the end portion side of the pipe. The cross-sectional area of the flow channel is constant inside the regions 10, 11, respectively. The second region 11 of the pipe element 3 is preferably used as a support surface for the sealing element 7 formed flatly, that is, without a structure such as a notch or a groove, respectively.

[0051] The pipe element 3 has an outer extension part X also called as the height X of the first region 10 when viewing in the height direction c within the first region 10 not deformed. The second region 11 of the pipe element 3, which has been expanded at least partially, is formed by an outer extension part Y also called as the height Y of the second region 11 when viewing in the height direction c. The width of the pipe element 3 is extended in the depth direction b, respectively.

[0052] In FIGS. 2B and 2D, perspective diagrams showing the pipe elements 3a, 3b having different flow lateral cross sections and formed of the flat pipe are shown, respectively. In these drawings, one end surface of the first region 10 not deformed of the pipe elements 3a, 3b are shown, respectively. The flow lateral cross section is extended within the plane set by the depth direction b and the height direction c.

[0053] The flow lateral cross-sections are limited by two side surfaces placed to face each other, respectively, and these side surfaces form the narrow side or the vertical side of the flow lateral cross section, respectively. The side surfaces formed to face each other in pair have the same dimension, respectively. In this case, the side surfaces of the narrow side as a first pair in the height direction c have the same height X, while the side surfaces of the vertical side as a second pair in the depth direction b aligned parallel to each other have the same width W.

[0054] A substantial difference between FIGS. 3A and 3B is the dimension of the height X, the shape of the transition part between the side surfaces adjacent to each other or the shape of the side surface of the narrow side.

[0055] A pipe element 3a of FIG. 2B is formed to have the transition part round-processed on the side surface aligned vertically with respect to each other. The transition part has the edge radius R, and this situation is particularly shown in the diagram specifically showing the pipe element 3a of FIG. 2C.

[0056] The side surfaces arranged, respectively, at the vertical side of the flow cross section of a pipe element 3b shown in FIG. 2D is connected to each other through the side surface of the semicircle hollow cylinder shape of the narrow side, respectively. In this case, the outer radius R of the side surface corresponds to a half of the height X.

[0057] FIGS. 3A and 3B are diagrams specifically showing the arrangement 2 of the pipe element 3 having the multi-disc 4 intermediate-supported of the heat transfer system 1 shown in FIG. 1. In this case, FIG. 3A shows a side diagram, while in FIG. 3B, a diagram specifically showing the arrangement 2 shown in FIG. 3A is shown as a side cross-sectional diagram in a state expanded by the pipe bottom 5 and the sealing element 7.

[0058] The pipe element 3 is formed by the height X in the first region 10, respectively, and by the height Y in the second region 11, respectively, and in this case, the extension part of the pipe element 3 is smaller within the first region 10 than within the second region 11 when viewing in the height direction c. The pipe element 3 is uniformly expanded to the circumference of the central axis aligned in the vertical direction a within the second region 11.

[0059] Within the intermediate space inside the first region 10 having a wide side and formed within the pipe element 3 aligned side by side and parallel to each other, the multi-disc 4 is provided as the element for changing the flow lateral cross section and/or expanding the heat transfer area. The multi-disc 4 connected with the pipe element 3, respectively, at the wide side of the pipe element 3 arranged adjacent to each other completely fills the intermediate space between the pipe elements 3, such that the interval F of the pipe element 3 arranged adjacent to each other also corresponds to the height F of the multi-disc 4 when viewing in the height direction c. In this case, the multi-disc 4 is formed only within the first region 10 of the pipe element 3.

[0060] The pipe element 3 has the second region 11, respectively, and is arranged within the through openings 6, 8 of the sealing element 7 and the pipe bottom 5. The web 5-1 is formed between the through opening 6 of the pipe bottom 5 arranged adjacent to each other in the height direction c, and this web limits the through opening 6 in the depth direction b, respectively, and substantially contacts the wide side of the pipe element 3 in a state connected with the sealing element 7. In FIG. 3C, a diagram specifically showing the web 5-1 of the pipe bottom 5 having the sealing element 7 shown in FIG. 3B is shown.

[0061] Within the intermediate space inside the second region 11 having a wide side and formed within the pipe element 3 aligned side by side and parallel to each other, the web 5-1 of the pipe bottom 5 and the sealing part 7 are arranged. Therefore, the intermediate space between the pipe elements 3 arranged adjacent to each other when viewing the height direction c is completely filled by one web 5-1 and two sections of the sealing part 7. When viewing in the height direction c, the web 5-1 is formed at the height H, while the two sections of the sealing element 7 have the wall thickness G, respectively.

[0062] In the first region 10 of the pipe element 3, the extension part of an unit composed of the pipe element 3 and the multi-disc 4 is appeared from a value obtained by adding the height X of the pipe element 3 to the height F of the multi-disc 4 in the height direction c. In addition, in the second region 11 of the pipe element 3, the extension part of an unit composed of the pipe element 3, the sealing element 7, and the web 5-1 of the pipe bottom 5 is appeared from a value obtained by adding the height Y of the pipe element 3 to the height H of the web 5-1 and two times the wall thickness G of the sealing part, and this situation induces the following equation.

$$\text{Equation 1} \qquad X + F = Y + H + 2 \cdot G$$

[0063] After conversion of Equation 1, the following equation is appeared as

$$\text{Equation 2} \qquad CM = F - H = Y - X + 2 \cdot G$$

[0064] The CM in the equation refers to the optimum range of the difference between the height H of the web 5-1 of the pipe bottom 5 as the extension part in the height direction c formed between the adjacent through openings 6 of the pipe bottom 5 and the height F of the multi-disc 4, and the deformation degree of the end portion of the pipe element 3 in the height direction c.

$$\text{Equation 3} \qquad CM_{max} \geq CM \geq CM_{min}$$

[0065] The equations describe the optimum relationship between the structure of the pipe element 3 referring to the radius R, the width X, and the height X of the first region 10 and the deformation of the pipe element 3 at the end portion thereof referring to the height Y of the second region 11, the height F of the multi-disc 4, the height H of the web 5-1 between the through openings 6 of the pipe bottom 5, and the wall thickness G of the sealing element 7. In this case, particularly, referring to the following Equations 4 to 6, a range between the maximum value CM_{max} at which the deformation of the end portion of the pipe of the pipe element 3 induces the circular flow lateral cross section and the minimum value CM_{min} at which the end portion of the pipe of the pipe element 3 is not deformed is indicated.

[0066] According to FIGS. 2B and 2C in which the side surface is aligned vertically with respect to each other, and the transition part between the side surfaces adjacent to each other has been round-processed, when the height X of the first region 10 is greater than a value of two times the edge radius R of the pipe element 3a ($X > 2 \cdot R$), the maximum value CM_{max} is appeared as follows.

$$\text{Equation 4} \qquad CM_{max} = [(2\pi R + 2(W-2R) + 2(X-2R))A / \pi] - X + 2G$$

[0067] According to FIG. 2D that has the side surface of the vertical side connected to each other through the side surface of the semicircle cylinder shape of the narrow side, respectively, when the height X of the first region 10 coincides with two times the radius R of the pipe element 3b ($X = 2 \cdot R$), the maximum value CM_{max} is appeared as follow.

$$\text{Equation 5} \qquad CM_{max} = [(X\pi + 2(W-X))A / \pi] - X + 2G$$

[0068] The pipe element 3 is not expanded from the end portion of the pipe, not changed in shape, or not deformed, such that the height Y of the second region 11 coincides with the height X of the first region 10 of the pipe elements 3, 3a, 3b ($Y = X$) to determine the minimum limitation CM_{min}. Therefore, the minimum value CM_{min} is always appeared from two times the wall thickness G of the sealing element 7 as follows.

$$\text{Equation 6} \qquad CM_{min} = 2 \cdot G$$

[0069] The parameter A describes the expansion capacity of the pipe as a ratio of the circumference of the pipe element at the end portion of the pipe after deformation to the circumference of the pipe element at the end portion of the pipe before deformation.

[0070] FIGS. 4A and 4B are a perspective diagram and a plane diagram showing the pipe element 3 expanded at least partially from the end portion of the pipe similar to the pipe element 3a shown in FIG. 2A or FIGS. 2B and 2C, respectively. The pipe element 3 is deformed and expanded in the region of the end portion of the pipe, such that the flow channel limited by the wall of the pipe element 3 has been substantially deformed from the rectangular lateral cross-sectional shape into the elliptical lateral cross-sectional shape. The elliptical lateral cross-sectional shape of the flow channel is very stable against the outer pressure, and particularly, is very stable against the pressure provided by the compressed sealing element 7.

[0071] In this case, the pipe element 3 not deformed has been formed at the wall thickness of 0.22mm, the width W of about 10.8mm, and the height X of 2.5mm. The pipe element 3 expanded at least partially has the height of about 4.69mm when the width is about 10.95mm in the second region 11, for example, in the region of the maximum extension part Y. The second region 11 is formed as the support surface 13 having the indicated dimension, and the support surface contacts the wall of the pipe element 3 on the pipe bottom 5 or on the sealing element 7 compressed between the pipe element 3 and the pipe bottom 5.

[0072] In order to withstand the resistance of the compressed sealing element 7, the pipe element 3 is finally expanded in the region of an apex 12. In this case, in order to further increase the rigidity of the support surface 13 with respect to the sealing element 7, the wall of the pipe element 3 is deformed outwards from the vertical side. In a state finally deformed, particularly, the structure of the wall of the pipe element 3 is reinforced at the vertical side.

[0073] FIGS. 4C to 4F are a perspective diagram and a plane diagram showing the pipe element 3 finally expanded from the end portion of the pipe. According to FIGS. 4A and 4B, after the pipe element 3 has been expanded at least partially, the pipe element 3 is finally expanded starting from the front in the already deformed region of the end portion of the pipe, respectively. In this case, particularly, the edges of the upper surface and the lower surface are deformed outwards in the height direction c, respectively. By using a perforation blade, the apex 12 of the pipe element 3 is expanded with respect to the sealing element 7 in the second region 11, and the compression of the sealing element 7 is increased. After the blade has been removed, the flexible material of the pipe is minimally restored in shape in the direction of the starting position, and in this case, the compression of the sealing material 7 is kept within a predetermined range as it is. Finally, the pipe element 3 has a molding part 14 in the region of the apex 12 of the upper surface and the lower surface, respectively.

[0074] The wall of the pipe element 3 deformed on the end portion of the pipe is formed continuously and without crack by the molding part 14. On the other hand, the shape of the molding part 14 is used to increase the structural rigidity of the wall of the pipe element 3, and on the another hand, is used for fixing and sealing inside the through opening 6 within the pipe bottom 5. In this case, a change in relative position of the pipe element 3 with respect to the pipe bottom 5 and in addition, a fixing force of avoiding the movement of the pipe element 3 inside the pipe bottom 5 are also increased.

[0075] The pipe element 3 finally expanded now has an extension part Z of about 7.6mm in the maximally expanded region of the molding part 14, for example.

[0076] The system 1 formed to have the pipe element 3 also has a very high thermal shock-durability due to the pipe element-sealing element-pipe bottom-connection, which is flexible and not rigid, formed on one or more side surfaces of the arrangement 2.

[0077] FIGS. 5A and 5B are a perspective diagram showing the pipe element 3 having the elliptical lateral cross section similar to the pipe element shown in FIG. 4A and a plane diagram in the operating direction of the pressure 15 provided from the outside. The pressure is generated by the sealing element contacting through the entire range, which is not shown in the drawing.

[0078] In this case, when viewing on the lateral cross section, the surface of the arc shape of the narrow side of the deformed end portion of the pipe element 3 has a diameter smaller than the end portion of the pipe element 3 shown in FIG. 4A. The wall of the pipe element 3c has been formed to have a thicker lateral cross section formed in the elliptical shape, which withstands the pressure provided from the outside more excellently.

[0079] The pipe element 3 can also be formed by a combination of the structural features such as the elliptical shape of the lateral cross section on the end portion of the pipe according to FIG. 5A and the deformation of the end portion of the pipe having the molding part 14 in the region of the apex 12 of the upper surface and the lower surface according to FIGS. 4C to 4F.

[0080] FIG. 6A is a side cross-sectional diagram specifically showing the arrangement of the pipe element 3 within the through opening 6 of the pipe bottom 5 having the sealing element 7. FIG. 6B is a diagram specifically showing the pipe bottom 5 having the sealing element 7 and the pipe element 3 shown in FIG. 6A.

[0081] FIG. 6A particularly shows the arrangement of the deformed and expanded pipe element 3 preferably having the elliptical lateral cross section arranged by passing through the through opening formed within the pipe bottom 5 and the sealing element 7. Due to the expansion of the pipe element 3, the pipe element 3 is firmly connected with the sealing element 7 arranged between the pipe element 3 and the edge of the through opening of the pipe element 3, and connected with the pipe bottom 5 in the fluid sealing method.

[0082] The pipe bottom 5 is formed to have a ring element 17 in a region 16 of the web 5-1, respectively, and this ring element at least locally reduces the opened lateral cross section of the through opening 6 for receiving the sealing element 7 and the pipe element 3. The ring element 17 is formed so that the compression of the sealing element 7, in which the sealing element 7 is additionally compressed on a predetermined section or a predetermined surface, such that otherwise, the compression is less particularly in the region of the apex of the pipe element 3, increases as intended. However, since the compression is stronger only in a region where the sealing element 7 is small, the final force acting on the wall of the pipe is smaller, and the wall of the pipe is not collapsed.

[0083] Particularly, in order to reach the efficient compression of the sealing element 7 through the entire circumference in the region 16 of the apex 12 again, the system 1 can be formed by any combination of the structural features of the pipe element 3 such as the elliptical shape of the lateral cross section on the end portion of the pipe according to FIG. 5A and the deformation of the end portion of the pipe having the molding part 14 in the region of the apex 12 of the upper surface and the lower surface according to FIGS. 4C to 4F, and by providing the ring element 17 in the region of the web 5-1 of the pipe bottom 5.

[0084] The connection between the pipe bottom 5 and the pipe element 3 is secured so that the pipe element 3 is arranged at the accurate position of the through openings 6, 8 and therefore, so that the reliable connection part of the fluid sealing method is generated. In order to secure the sufficient and reliable compression of the sealing element 7, the intended size of the expansion is previously determined as a final extension part of the pipe element 3. At this time, the compression of the sealing element 7 is placed within a range of 10% to 50%, and in this case, the compression is mostly achieved immediately after mounting the sealing element 7 and the pipe bottom 5 on the pipe element 3.

[Industrial Applicability**]**

[0085] The present disclosure particularly relates to the heat transfer system for using in the vehicle. In this system, heat is preferably transferred between coolant as the first fluid, for example, water or water-glycol-mixture and the air as the second fluid. This system has an assembly composed of a pipe element for passing through the first fluid, and one or more pipe bottoms and one or more sealing elements having a through opening for passing through the pipe element, respectively.

Claims

1. A heat transfer system 1,
as the system 1 for transferring heat between a first fluid and a second fluid, which has an arrangement 2 composed of pipe elements 3, 3a, 3b, 3c for passing through the first fluid, one or more pipe bottoms 5 having a through opening 6, and one or more sealing elements 7 having a through opening 8,
wherein the pipe elements 3, 3a, 3b, 3c are formed of a flat pipe having a first region 10 having a first height X and a depth W and one or more second regions 11 having a support surface 13 arranged on one end portion of the pipe elements 3, 3a, 3b, 3c and having a second height Y, respectively,
wherein the sealing element 7 is arranged between the edge of the through opening 6 of the pipe bottom 5, and having a wall thickness G, respectively,
wherein the pipe elements 3, 3a, 3b, 3c having a wide side are aligned in a state aligned parallel to each other and at an interval F with respect to each other in the first region 10, respectively,
wherein a web 5-1 having a height H is provided between the through openings 6 arranged adjacent to each other of the pipe bottom 5, respectively,
wherein when viewing in a height direction c, an extension part inside the first region 10 of the pipe elements 3, 3a, 3b, 3c appeared from a value obtained by adding a first height X of the pipe elements 3, 3a, 3b, 3c to the interval F corresponds to an extension part inside the second region 11 of the pipe elements 3, 3a, 3b, 3c appeared from a value obtained by adding a second height Y of the pipe elements 3, 3a, 3b, 3c to the height H of the web 5-1 of the pipe bottom 5 and two times the wall thickness G of the sealing element 7, and
wherein $CM = F - H = Y - X + 2 \cdot G$, the CM in the equation refers to the deformation degree of the end portion of the pipe elements 3, 3a, 3b, 3c in the height direction c, is placed within a range between the maximum value CM_{max} and the minimum value CM_{min}, and the CM_{min} appears as $CM_{min} = 2 \cdot G$ when the heights X, Y of the pipe elements 3, 3a, 3b, 3c are the same.

2. The heat transfer system 1 of claim 1,
wherein the pipe elements 3, 3a, 3b, 3c are made of metal.

3. The heat transfer system 1 of claim 1,

wherein the lateral cross sections of the pipe elements 3, 3a, 3b, 3c are expanded within the second region 11 on the plane aligned vertically with respect to a vertical direction a of the pipe elements 3, 3a, 3b, 3c.

4. The heat transfer system 1 of claim 1,
wherein the flow lateral cross sections of the pipe elements 3, 3a, 3b are limited by two side surfaces disposed to face each other, respectively, and the side surface forms the narrow side or the vertical side of the flow lateral cross section in pair, respectively.

5. The heat transfer system 1 of claim 4,
wherein the side surfaces of the pipe elements 3, 3a arranged adjacent to each other are aligned vertically with respect to each other at the contact edges proceeding in the vertical direction a, and the contact edges have a transition part round-processed having an edge radius R, respectively.

6. The heat transfer system 1 of claim 5,
wherein the first height X of the first region 10 of the pipe elements 3, 3a is greater than a value of two times the edge radius R of the pipe elements 3, 3a, and the maximum value CM_{max} is appeared from the following equation, $CM_{max} = [(2\pi R + 2(W-2R) + 2(X-2R))A / \pi] - X + 2G$, and the A in the equation corresponds to the expansion capacity of the pipe.

7. The heat transfer system 1 of claim 4,
wherein the side surfaces arranged at the vertical side of the flow lateral cross section of the pipe elements 3, 3b, respectively, are connected to each other through the side surface of the narrow side bent outwards in the semicircle hollow cylinder shape and having the outer radius R.

8. The heat transfer system 1 of claim 7,
wherein the first height X of the first region 10 of the pipe elements 3, 3a corresponds to two times the radius R of the side surface of the narrow side of the pipe elements 3, 3b bent outwards in the semicircle hollow cylinder shape, and the maximum value CM_{max} is appeared from the following equation, $CM_{max} = [(X\pi + 2(W-X))A / \pi] - X + 2G$, and the A in the equation corresponds to the expansion capacity of the pipe.

9. The heat transfer system 1 of claim 2,
wherein the pipe elements 3, 3a, 3b have the wall thickness of 0.22mm, the first height X of about 2.5mm, and the width W of about 10.8mm in the first region 10, and have the second height Y of about 4.69mm and the width of about 10.95mm in the second region 11.

10. The heat transfer system 1 of claim 2,
wherein the pipe elements 3, 3a, 3b on the end portion of the pipe are formed in a state expanded starting from the front in the region of an apex 12 of the vertical side, respectively, and the wall of the pipe elements 3, 3a, 3b are deformed to have a molding part 14 outwards in the height direction c, respectively.

11. The heat transfer system 1 of claim 10,
wherein the pipe elements 3, 3a, 3b have an extension part Z of about 7.6mm in the maximally expanded region of the molding part 14 in the height direction c.

12. The heat transfer system 1 of claim 1,
wherein the pipe bottom 5 has a ring element 17 for at least locally reducing the opened lateral cross section of the through opening 6 for receiving the sealing element 7 and the pipe elements 3, 3a, 3b, 3c in the region 16 of the web 5-1.

13. The heat transfer system 1 of claim 1,
wherein the bottom area 5 is formed as the sidewall element of a collector 9 of the system 1.

14. The heat transfer system 1 of claim 13,
wherein two pipe bottoms 5 having the through opening 6 and two sealing elements 7 having the through opening 8 are formed, the pipe bottom 5 is connected with the pipe elements 3, 3a, 3b, 3c in the fluid sealing method, respectively, the through openings 6, 8 coincide with the outer shape of the pipe elements 3, 3a, 3b, 3c in the shape, respectively, and the respective pipe elements 3, 3a, 3b, 3c are arranged to have a first end portion passing through the through opening 6 formed on a first pipe bottom 5 and a second end portion passing through the through opening

6 formed on a second pipe bottom 5, respectively.

15. The heat transfer system 1 of claim 2,
wherein the pipe elements 3, 3a, 3b, 3c are made of an aluminum alloy.

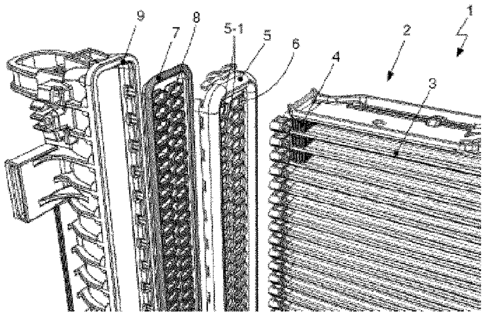
16. The heat transfer system 1 of claim 1,
wherein the pipe elements 3, 3a, 3b, 3c of one column of the system 1 aligned side by side and parallel to each other, and to have a wide side with respect to each other are arranged so that the flow path for the second fluid is directly formed one by one between the pipe elements 3, 3a, 3b, 3c arranged adjacent to each other, respectively.

17. The heat transfer system 1 of claim 16,
wherein a multi-disc 4 or a rib for changing the flow lateral cross section and/or expanding a heat transfer area within the flow path formed inside the first region 10 by the pipe elements 3, 3a, 3b, 3c arranged adjacent to each other, the multi-disc 4 has an extension part in the height direction c, and the extension part corresponds to the interval F of the pipe elements 3, 3a, 3b, 3c arranged adjacent to each other.

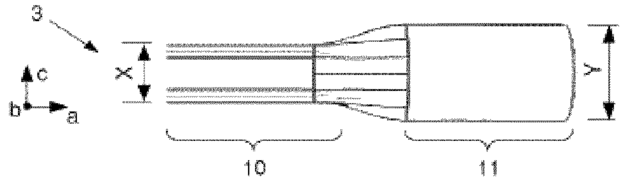
18. The heat transfer system 1 of claim 17,
wherein the multi-disc 4 or the rib is made of an aluminum alloy.

19. An application of a system 1 using the heat transfer system 1 of any one of claims 1 to 18 as a coolant-air-heat exchanger within a coolant circulation system, particularly, within an engine coolant circulation system of a vehicle.

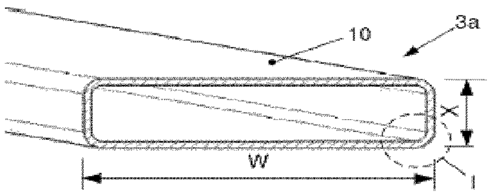
[FIG. 1]



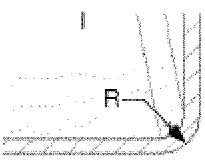
[FIG. 2A]



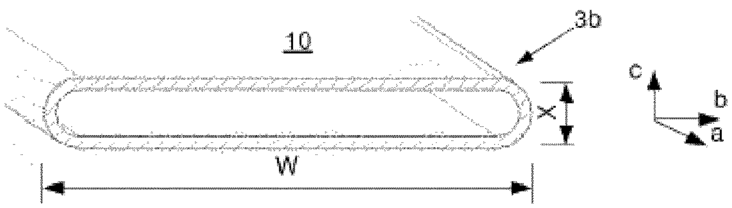
[FIG. 2B]



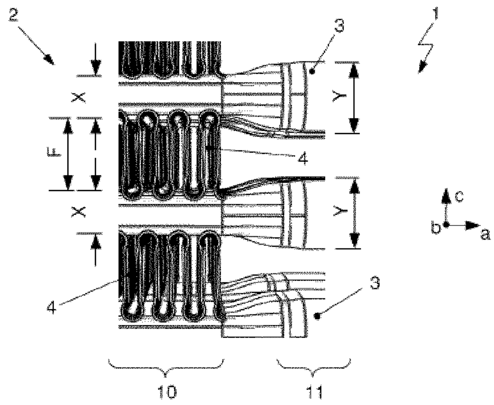
[FIG. 2C]



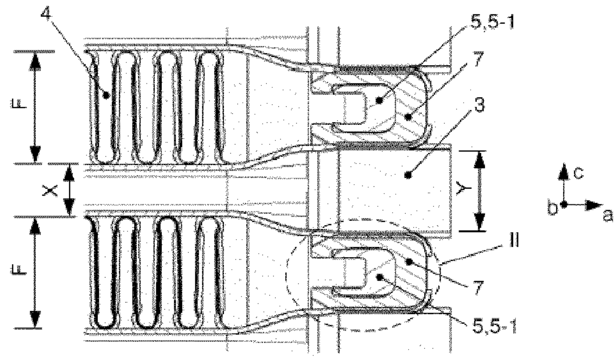
[FIG. 2D]



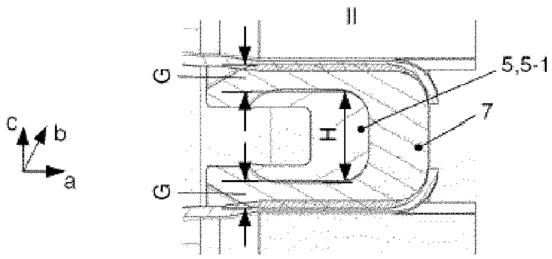
[FIG. 3A]



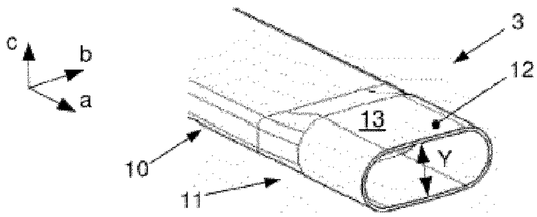
[FIG. 3B]



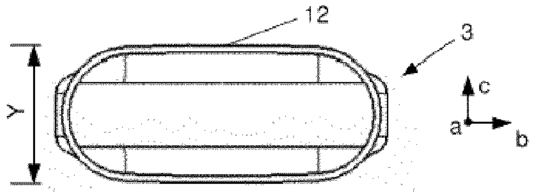
[FIG. 3C]



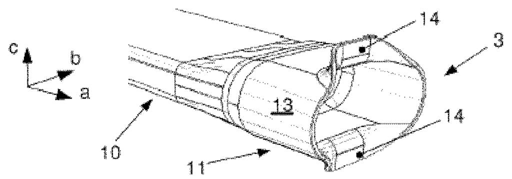
[FIG. 4A]



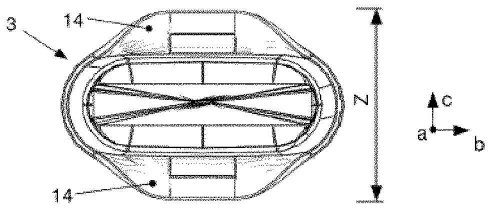
[FIG. 4B]



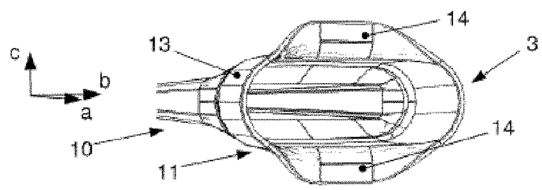
[FIG. 4C]



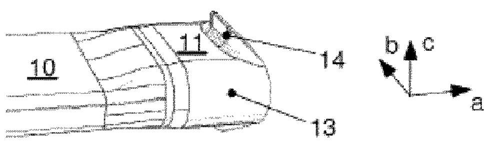
[FIG. 4D]



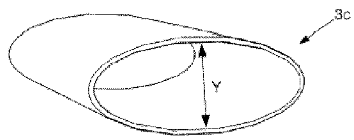
[FIG. 4E]



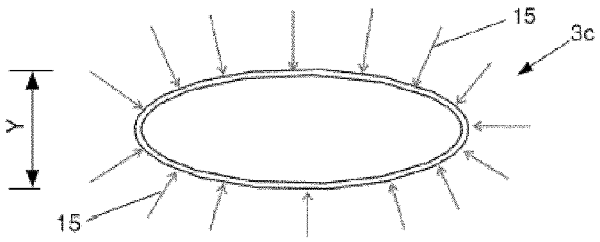
[FIG. 4F]



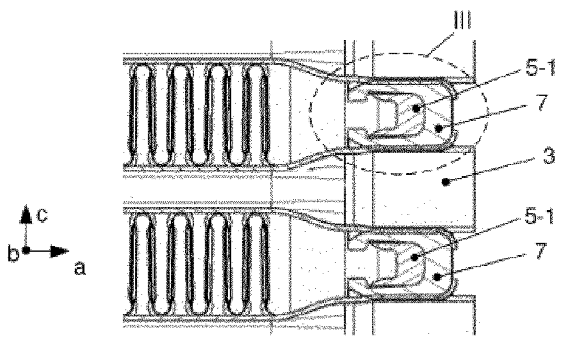
[FIG. 5A]



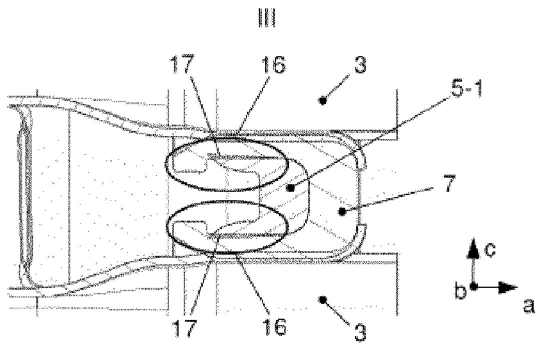
[FIG. 5B]



[FIG. 6A]



[FIG. 6B]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2018/006435

A. CLASSIFICATION OF SUBJECT MATTER
F28F 9/02(2006.01)i, F28F 1/02(2006.01)i, F28F 21/08(2006.01)i, F28F 13/06(2006.01)i, F28D 1/053(2006.01)i, F28D 21/00(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)
F28F 9/02; F28F 916; F28F 9/10; B23P 6/00; F28F 102; F28F 21/06; F28F 9/00; F28F 1/02; F28F 21/08; F28F 13/06; F28D 1/053; F28D 21/00

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: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS (KIPO internal) & Keywords: heat transfer device, pipe, penetration opening, sealing, transformation degree

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6810951 B1 (DUMETZ, Yvon) 02 November 2004 See column 2, lines 32-45; claims 1-2; and figures 1-5.	1-19
A	JP 2013-108686 A (MDI CORP.) 06 June 2013 See paragraphs [0023]-[0024]; and figures 1, 5, 8.	1-19
A	KR 10-2008-0033942 A (DSM IP ASSETS B.V.) 17 April 2008 See paragraphs [0055]-[0083]; and figures 1-5, 6a-6f, 7-9.	1-19
A	KR 10-2008-0032472 A (HALLA CLIMATE CONTROL CORP.) 15 April 2008 See paragraphs [0031]-[0036]; and figures 4-6.	1-19
A	US 2003-0056945 A1 (ZOBEL et al.) 27 March 2003 See paragraphs [0037]-[0051]; and figures 1-17.	1-19

☐ 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

Date of the actual completion of the international search	Date of mailing of the international search report
20 SEPTEMBER 2018 (20.09.2018)	**21 SEPTEMBER 2018 (21.09.2018)**

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Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2018/006435

Patent document cited in search report	Publication date	Patent family member	Publication date
US 6810951 B1	02/11/2004	DE 19982798 T1	22/03/2001
		FR 2786558 A1	02/06/2000
		FR 2786558 B1	02/02/2001
		WO 2000-033008 A1	08/06/2000
JP 2013-108686 A	06/06/2013	NONE	
KR 10-2008-0033942 A	17/04/2008	BR PI0612998 A2	14/12/2010
		CN 100573022 C	23/12/2009
		CN 101223411 A	16/07/2008
		EP 1744117 A1	17/01/2007
		EP 1904802 A1	02/04/2008
		JP 2009-501309 A	15/01/2009
		TW 200710364 A	16/03/2007
		US 2009-0139703 A1	04/06/2009
		WO 2007-009588 A1	25/01/2007
		WO 2007-009588 A8	31/05/2007
KR 10-2008-0032472 A	15/04/2008	NONE	
US 2003-0056945 A1	27/03/2003	AT 341745 T	15/10/2006
		DE 10147192 A1	17/04/2003
		EP 1296109 A2	26/03/2003
		EP 1296109 A3	26/01/2005
		EP 1296109 B1	04/10/2006
		US 6668916 B2	30/12/2003

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE 102015113905 A1 **[0007]**