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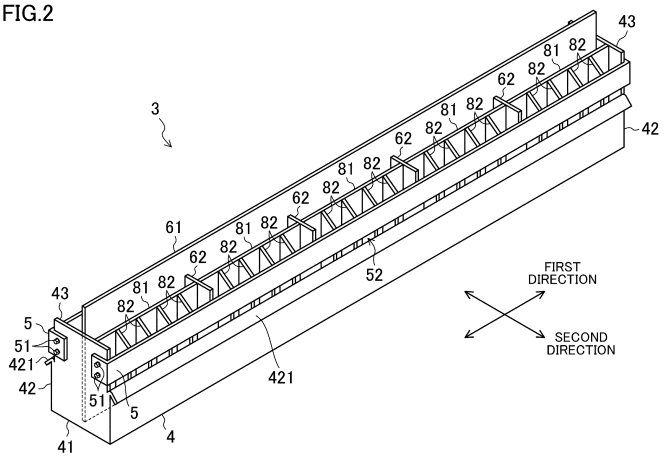
(54) **VAPORIZER**

(57) A vaporizer (an ORV 1) includes heat exchange panels (2) and troughs (3) arranged adjacent to the heat exchange panels and configured to supply a heat medium to outer surfaces of the heat exchange panels. The trough extends in a first direction, and a slit (52) extending in the first direction is formed at an intermediate position of a side wall, which faces the heat exchange panel, of the trough in a height direction. The heat medium accumulated in the trough flows to the outer surface of the heat exchange panel through the slit.

FIG.2



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Description

TECHNICAL FIELD

[0001] The technique disclosed herein relates to a vaporizer.

BACKGROUND ART

[0002] Patent Document 1 describes a liquefied gas vaporizer mounted on, e.g., a ship. This vaporizer is a so-called open rack vaporizer. The open rack vaporizer includes heat exchange panels and troughs. The heat exchange panel is configured such that a plurality of heat transfer pipes is arrayed in a first direction. The heat exchange panel vaporizes liquefied gas in each heat transfer pipe. The heat exchange panels are arranged next to each other in a second direction perpendicular to the first direction. The trough extends in the first direction between adjacent ones of the heat exchange panels. The trough supplies a heat medium to an outer surface of the heat exchange panel. The heat medium in the trough overflows from an opening of an upper end of the trough because a water surface of the heat medium reaches a position higher than an edge of the opening.

[0003] The vaporizer described in Patent Document 1 is placed on a swinging location. The trough has, at the center thereof, a partition plate higher than the edge of the opening. With this configuration, even in a case where the vaporizer tilts to the second direction, the heat medium overflows from the opening, and therefore, the trough can supply the heat medium to the heat exchange panel.

CITATION LIST

PATENT DOCUMENT

[0004] PATENT DOCUMENT 1: Japanese Patent No. 6053389

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0005] The vaporizer described in Patent Document 1 is also configured such that the inside of the trough is divided into a plurality of spaces in the first direction so that the heat medium can be supplied to the entirety of the heat exchange panel even in a case where the vaporizer tilts to the first direction, i.e., a longitudinal direction of the trough.

[0006] However, there are concerns that when the vaporizer described in Patent Document 1 greatly tilts to the first direction, the heat medium is less likely to overflow or no heat medium overflows at end portions of the trough in the first direction.

[0007] The technique disclosed herein can supply a heat medium to a heat exchange panel from the entirety of a trough even in a case where a vaporizer tilts to a longitudinal direction thereof.

SOLUTION TO THE PROBLEM

[0008] The technique described herein relates to a vaporizer.

[0009] The vaporizer includes

a heat exchange panel including a plurality of heat transfer pipes arrayed in a first direction and configured to vaporize liquefied gas flowing in each heat transfer pipe, and

a trough arranged adjacent to the heat exchange panel in a second direction perpendicular to the first direction and configured to supply a heat medium to an outer surface of the heat exchange panel.

[0010] The trough extends in the first direction, and a slit extending in the first direction is formed at an intermediate position of a side wall, which faces the heat exchange panel, of the trough in a height direction.

[0011] The heat medium accumulated in the trough flows to the outer surface of the heat exchange panel through the slit.

[0012] According to the vaporizer having this configuration, the slit extending in the first direction is formed at the intermediate position of the side wall of the trough in the height direction. When a water surface in the trough is at a position higher than the slit, the heat medium accumulated in the trough flows to the outer surface of the heat exchange panel through the slit. The amount of heat medium to be supplied to the heat exchange panel corresponds to the upper-lower width of the slit. Note that the "intermediate position" is an optional position between an upper end and a lower end of the side wall and the slit may be provided at an optional height so that the heat medium can be stably supplied to the heat exchange panel.

[0013] When the vaporizer tilts to the first direction, one end portion of the trough in the first direction moves upward, and the other end portion moves downward. At the end portion of the trough having moved upward, a height difference between the upper end of the side wall of the trough and the water surface decreases. However, this trough is not configured such that the heat medium overflows. This trough supplies the heat medium to the heat exchange panel through the slit formed at the intermediate position of the side wall in the height direction. In a case where the vaporizer tilts to the first direction, if the water surface in the trough is at a position higher than the slit, the heat medium flows to the outer surface of the heat exchange panel through the slit. At this point, the amount of heat medium to be supplied is an amount corresponding to the upper-lower width of the slit. Thus, even in a case where the vaporizer having the above-described configuration tilts to the first direction, the trough

can supply the heat medium equally or substantially equally across the entirety of the heat exchange panel in the first direction.

[0014] The trough may have a supply port for supplying the heat medium into the trough and a baffle plate arranged between the supply port and the side wall.

[0015] The heat medium may flow from the supply port to the slit through a position lower than the slit to flow around the baffle plate.

[0016] With this configuration, the heat medium supplied into the trough through the supply port flows, by due to the baffle plate, into a space between the side wall and the baffle plate through the position lower than the slit. While the heat medium is flowing around the baffle plate, the heat medium flows to expand in the first direction. The heat medium is distributed equally or substantially equally across the entirety of the inside of the trough in the first direction. Not only in a case where the vaporizer is in the horizontal direction, but also in a case where the vaporizer tilts to the first direction, the trough can supply the heat medium equally or substantially equally to the entirety of the heat exchange panel.

[0017] The baffle plate may be arranged with a clearance from the side wall in the second direction, and may extend in the first direction.

[0018] The trough may have a guide plate configured to divide the space between the side wall and the baffle plate into a plurality of spaces in the first direction.

[0019] The guide plate described herein may completely divide two adjacent spaces with respect to the guide plate, or may divide these two spaces such that these two spaces are not completely separated from each other, but are partially connected to each other.

[0020] The heat medium flowing into the space between the side wall and the baffle plate through the position lower than the slit is distributed equally or substantially equally to the plurality of spaces divided by the guide plate. The trough can supply the heat medium equally or substantially equally across the entirety of the heat exchange panel in the first direction.

[0021] In a case where the vaporizer tilts to the first direction, the guide plate prevents the heat medium from flowing in the first direction in the trough. Even in a case where the vaporizer tilts to the first direction, the trough can supply the heat medium equally or substantially equally across the entirety of the heat exchange panel in the first direction.

[0022] The trough may have a partition plate configured to divide a space in the trough into a plurality of spaces in the first direction.

[0023] The partition plate described herein may completely divide two adjacent spaces with respect to the partition plate, thereby blocking the flow of heat medium in the first direction between the spaces sandwiching the partition plate. Alternatively, the partition plate does not completely divide two spaces from each other, but may divide two spaces such that these spaces are partially connected to each other.

[0024] The trough is long in the first direction. In a case where the vaporizer tilts to the first direction, the partition plate prevents or suppresses the heat medium from flowing in the first direction in the trough. An uneven flow of heat medium to one side in the first direction in the trough is reduced. The trough divided into the plurality of spaces by the partition plate can supply the heat medium equally or substantially equally across the entirety of the heat exchange panel in the first direction.

[0025] The number of guide plates may be greater than the number of partition plates.

[0026] That is, the partition plate may divide the inside of the trough into the plurality of spaces, and the guide plate may further divide each of the plurality of spaces into a plurality of spaces. With both of the guide plate and the partition plate in the trough, even in a case where the vaporizer tilts to the first direction, the heat medium is supplied equally or substantially equally across the entirety of the heat exchange panel in the first direction.

[0027] The trough may have a trough body and a restriction plate detachably attached to the trough body and forming part of the side wall.

[0028] The slit may be formed between the trough body and the restriction plate.

[0029] In a case where the heat medium is seawater, part of the slit might be clogged with, e.g., trash or shells in seawater. The restriction plate is detached from the trough body so that the trash etc. can be easily removed. Maintenance of the vaporizer is facilitated.

[0030] The upper-lower width of the slit may be adjusted in such a manner that an attachment position of the restriction plate is changed.

[0031] The upper-lower width of the slit is changed so that the amount of heat medium to be supplied from the trough to the heat exchange panel can be adjusted. In some cases, a great amount of trash etc. is contained in seawater as the heat medium. The upper-lower width of the slit is expanded according to use environment of the vaporizer so that clogging of the slit with the trash etc. can be reduced.

[0032] The vaporizer may be placed on a floating body on water.

[0033] As described above, the vaporizer can supply the heat medium from the entirety of the trough to the heat exchange panel even in a case where the vaporizer tilts to the longitudinal direction. Thus, the vaporizer is suitable as a vaporizer placed on a floating body (including a ship, a tied-up float, etc.) on water.

ADVANTAGES OF THE INVENTION

[0034] As described above, the above-described vaporizer can supply the heat medium from the entirety of the trough to the heat exchange panel even in a case where the vaporizer tilts.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035]

[FIG. 1] FIG. 1 is a perspective view schematically illustrating, as an example, an entire configuration of a vaporizer.
[FIG. 2] FIG. 2 is a perspective view illustrating, as an example, the configuration of a trough.
[FIG. 3] FIG. 3 is a plan view of the trough.
[FIG. 4] FIG. 4 is a side view of the trough.
[FIG. 5] FIG. 5 is a partial cutaway sectional view of the trough.
[FIG. 6] FIG. 6 is a view illustrating, as an example, a restriction plate attachment structure.
[FIG. 7] FIG. 7 is a side view illustrating, as an example, a state in which the vaporizer tilts to a first direction.
[FIG. 8] FIG. 8 is a side view illustrating, as an example, a state in which the vaporizer tilts to a second direction.

DESCRIPTION OF EMBODIMENTS

[0036] Hereinafter, an embodiment of a vaporizer will be described with reference to the drawings. The vaporizer described herein is an example. FIG. 1 schematically illustrates an entire configuration of the vaporizer. The vaporizer is a so-called open rack vaporizer (ORV) 1. The ORV 1 is placed on a floating body on water. The ORV 1 is, for example, mounted on a liquefied gas carrier. The ORV 1 exchanges heat between carried liquefied gas and seawater as a heat medium, thereby turning the liquefied gas into gaseous gas. The ORV 1 may be placed on a floating storage and regasification unit (FSRU) or a floating production storage and offloading (FPSO).

[0037] The ORV 1 includes a plurality of heat exchange panels 2. In the illustrated example, the heat exchange panels 2 includes five heat exchange panels. Note that the number of heat exchange panels 2 may be an optional number. Although detailed illustration is omitted, each heat exchange panel 2 is configured such that a plurality of heat transfer pipes is arrayed in a first direction and adjacent ones of the heat transfer pipes are joined to each other. The five heat exchange panels 2 are arranged in a second direction perpendicular to the first direction. The first direction described herein corresponds to a direction in which the bow and stern of a ship on which the ORV 1 is mounted are connected to each other. The second direction corresponds to a direction in which the port and starboard sides of the ship are connected to each other.

[0038] A lower header tank 21 is arranged below each heat exchange panel 2. The single lower header tank 21 is provided for the single heat exchange panel 2. The lower header tank 21 extends in the first direction. A lower end of each heat transfer pipe is connected to the lower header tank 21. The lower header tank 21 distributes liquefied gas into each heat transfer pipe. Ends of the lower header tanks 21 arranged in the second direction are connected to an inlet manifold 22 extending in the second direction. The inlet manifold 22 distributes liquefied gas into each lower header tank 21.

[0039] Liquefied gas is supplied into each heat transfer pipe through the inlet manifold 22 and the lower header tanks 21, and is vaporized while flowing upward in the heat transfer pipes.

[0040] An upper header tank 23 is arranged above each heat exchange panel 2. The single upper header tank 23 is provided for the single heat exchange panel 2. The upper header tank 23 extends in the first direction. An upper end of each heat transfer pipe is connected to the upper header tank 23. The upper header tank 23 collects gaseous gas from each heat transfer pipe. Ends of the upper header tanks 23 arranged in the second direction are connected to an outlet manifold 24 extending in the second direction. The outlet manifold 24 collects and sends out gas from each upper header tank 23.

[0041] Note that liquefied gas may be supplied into each heat transfer pipe through the upper header tanks 23 and may be vaporized while flowing downward in the heat transfer pipes.

[0042] Troughs 3 are arranged on both sides of each heat exchange panel 2 in the second direction. The trough 3 stores seawater, and supplies the stored seawater to an outer surface of the heat exchange panel 2. The trough 3 extends in the first direction in the vicinity of an upper portion of the heat exchange panel 2.

[0043] FIG. 2 is a perspective view illustrating, as an example, an entire configuration of the trough 3. FIG. 3 is a plan view of the trough 3, and FIG. 4 is a side view of the trough 3. FIG. 5 is a cutaway sectional view of the trough 3. Note that FIG. 5 illustrates two heat exchange panels 2 and illustrates three troughs 3 corresponding to these two heat exchange panels 2. The trough 3 at the left end of FIG. 5 is the trough 3 arranged on the leftmost side on the far side as viewed in FIG. 1, and is the trough 3 at an end of the ORV 1. The trough 3 at the right end of FIG. 5 is the trough 3 arranged on the rightmost side on the near side as viewed in FIG. 1, and is the trough 3 at an end of the ORV 1. The trough 3 arranged between adjacent ones of the heat exchange panels 2 has such a sectional shape that two troughs 3 arranged at the ends are arranged back to back.

[0044] The trough 3 has a trough body 4 and a restriction plate 5 attached to the trough body 4. The trough body 4 has a bottom wall 41, two side walls 42, and two end walls 43. The trough body 4 opens upward.

[0045] The bottom wall 41 extends in the first direction. The side walls 42 are connected to edges of the bottom wall 41 in the second direction. Each side wall 42 extends in the first direction. The two side walls 42 are arranged facing each other in the second direction. Each side wall 42 faces the heat exchange panel 2. The end walls 43 are connected to ends of the bottom wall 41 in the first direction. The side wall 42 connects the two opposing

side walls 42 to each other. The height of the end wall 43 is higher than the height of the side wall 42.

[0046] An edge portion 421 is provided at an upper end of the side wall 42. The edge portion 421 is formed in such a manner that an upper portion of the side wall 42 is folded back to the outside in the second direction. The edge portion 421 tilts diagonally downward. The edge portion 421 is continuous across the entirety of the side wall 42 extending in the first direction. Seawater in the trough 3 flows toward the heat exchange panel 2 along the edge portion 421.

[0047] The restriction plate 5 is positioned above the side wall 42, and therefore, forms part of a side portion of the trough 3. The restriction plate 5 extends in the first direction. Both end portions of the restriction plate 5 in the first direction are bent. Both end portions of the restriction plate 5 are each fixed to the end walls 43. The restriction plate 5 is attached to the end walls 43 with bolts 51. The restriction plate 5 is detachable from the trough body 4.

[0048] A clearance is provided between the restriction plate 5 and the side wall 42. With this configuration, a slit 52 extending in the first direction is formed at an intermediate position of the side wall of the trough 3 in a height direction thereof. More specifically, the slit 52 is positioned above a center position of the side wall of the trough 3 having an entire height from an upper end of the restriction plate 5 to a lower end of the side wall 42. Note that the height position of the slit 52 is not limited to that of the illustrated example and may be an optional position. Moreover, the slit 52 is continuous from an end to an end of the trough 3 in the first direction.

[0049] As illustrated in FIG. 6, bolt holes 53 for attachment of the restriction plate 5 are elongated in an upper-lower direction. The restriction plate 5 is configured so that the position of attachment to the trough body 4 can be changed in the upper-lower direction. As illustrated on the left side in FIG. 6, when the restriction plate 5 is attached to the lower side, the upper-lower width W1 of the slit 52 is narrowed. As illustrated on the right side in FIG. 6, when the restriction plate 5 is attached to the upper side, the upper-lower width W2 of the slit 52 is expanded.

[0050] In the trough 3, a partition wall 61 is arranged. The partition wall 61 extends in the first direction at a center position in the second direction. The partition wall 61 contacts the bottom wall 41. The height of the partition wall 61 is higher than the height of the end wall 43. The partition wall 61 divides the inside of the trough 3 into two spaces in the second direction. Although details will be described later, the partition wall 61 allows stable supply of seawater to the heat exchange panels 2 on both sides of the trough 3 in a case where the vaporizer 1 tilts to the second direction.

[0051] Note that as illustrated in FIG. 5, at the troughs 3 arranged at the ends in the second direction, i.e., the troughs 3 at the right and left ends as viewed in FIG. 5, one side wall 42 is formed higher than the height of the end wall 43. The side wall 42 higher than the height of the end wall 43 performs a function similar to that of the partition wall 61.

[0052] In the trough 3, a plurality of partition plates 62 is arranged. The plurality of partition plates 62 is arranged at equal intervals in the first direction in each of the two spaces divided by the partition wall 61 in the trough 3. Each partition plate 62 contacts the bottom wall 41, the side walls 42, and the partition wall 61. An upper end of each partition plate 62 is positioned at the same position or the substantially same position as that of an upper end of the end wall 43. In the illustrated example, in each of the two spaces divided by the partition wall 61 in the trough 3, four partition plates 62 divide the inside of the trough 3 into five spaces in the first direction. Note that the number of divisions in the first direction by the partition plates 62 is not limited to five. The inside of the trough 3 may be divided into an optional number in the first direction. The inside of the trough 3 is not necessarily divided in the first direction. The partition plates 62 can be omitted.

[0053] The trough 3 has supply ports 71 for supplying seawater into the trough 3. The supply ports 71 are each separately provided at the total of 10 spaces divided by the partition wall 61 and the partition plates 62. More specifically, the supply ports 71 are provided at a distribution pipe 72 arranged in the trough 3. The distribution pipe 72 includes a pipe closed at both ends. The distribution pipe 72 is arranged to extend in the first direction in each of the two spaces divided by the partition wall 61. The distribution pipe 72 penetrates the partition plates 62. The supply ports 71 provided at predetermined positions of the distribution pipe 72 are each positioned in the spaces divided in the first direction. The supply port 71 is formed at a lower portion of the distribution pipe 72, and opens downward.

[0054] Although not illustrated in detail, supply pipes 73 are each connected to the distribution pipe 72 (also see FIG. 1). Seawater supplied into the distribution pipe 72 through the supply pipes 73 is discharged into the trough 3 through the supply ports 71.

[0055] A baffle plate 81 is interposed among the supply ports 71 and the side wall 42. The baffle plate 81 restricts the flow of seawater in the trough 3. Specifically, the baffle plate 81 is arranged in parallel with the side wall 42 with a predetermined clearance from the side wall 42 in the second direction. A lower end of the baffle plate 81 is separated from the bottom wall 41 of the trough 3. The lower end of the baffle plate 81 is positioned lower than the slit 52. As indicated by an arrow in FIG. 5, seawater flows around the baffle plate 81. More specifically, seawater flows from the supply ports 71 to a space between the side wall 42 and the baffle plate 81 through a position lower than the slit 52.

[0056] Guide plates 82 are arranged in the space between the side wall 42 and the baffle plate 81. The guide plates 82 divide the space between the side wall 42 and the baffle plate 81 into a plurality of spaces in the first

direction. In the illustrated example, four guide plates 82 are arranged at equal intervals in the first direction in each space divided by the partition plates 62. Such a space is divided into five spaces by the guide plates 82. The number of guide plates 82 is greater than the number of partition plates 62.

[0057] Each guide plate 82 is fixed to the baffle plate 81, and is fixed to the restriction plate 5. The baffle plate 81 is fixed to the restriction plate 5 through the guide plates 82.

[0058] A lower end of the guide plate 82 is, in the illustrated example, set to the same position as that of the lower end of the baffle plate 81. The guide plate 82 does not divide two adjacent spaces with respect to the guide plate 82 in the vicinity of the bottom wall 41 of the trough 3. Note that although not shown in the figure, the lower end of the guide plate 82 may contact the bottom wall 41 of the trough 3.

[0059] As described above, seawater flows from the supply ports 71 to the space between the side wall 42 and the baffle plate 81 through the position lower than the slit 52 to flow around the baffle plate 81. The guide plates 82 distribute, in the space between the side wall 42 and the baffle plate 81, seawater equally or substantially equally to the spaces divided by the guide plates 82.

[0060] An upper end of the guide plate 82 tilts diagonally to connect an upper end of the baffle plate 81 and the upper end of the restriction plate 5 to each other. Note that unlike the illustrated example, the upper end of the guide plate 82 may be formed horizontally straight.

[0061] The restriction plate 5, the baffle plate 81, and the guide plates 82 are integrally fixed to each other. The stiffness of the restriction plate 5 and the baffle plate 81 elongated in the first direction is enhanced.

[0062] The restriction plate 5 is detachably attached to the trough body 4. When the restriction plate 5 is detached from the trough body 4, the restriction plate 5, the baffle plate 81, and the guide plates 82 can be detached from the trough body 4 (see chain lines in FIGS. 4 and 5). As described later, seawater stored in the trough 3 flows through the slit 52, but in some cases, the slit 52 is clogged with, e.g., trash or shells in seawater. The restriction plate 5, the baffle plate 81, and the guide plates 82 are detached from the trough body 4 so that an operator can easily remove the trash etc. accumulated in the slit 52. The configuration for detaching the restriction plate 5, the baffle plate 81, and the guide plates 82 improves maintenance performance of the trough 3.

[0063] The trough 3 having the above-described configuration supplies seawater in the trough 3 to the outer surface of the heat exchange panel 2 through the slit 52 provided at the intermediate position of the side wall 42. As illustrated as an example in FIG. 5, seawater flows toward the outer surface of the heat exchange panel 2 along the edge portion 421. The slit 52 extends with the same width in the first direction. The trough 3 can supply seawater equally or substantially equally across the entirety of the heat exchange panel 2 in the first direction.

[0064] Since the ORV 1 is mounted on the ship in this configuration example, the ORV 1 tilts to the first direction when the ship swings in a pitching direction in response to influence of wind or wave, and tilts to the second direction when the ship swings in a rolling direction. As illustrated as an example in FIG. 7, when the trough 3 tilts to the first direction in association with tilting of the ORV 1 to the first direction (see θ in FIG. 7), one end portion of the trough 3 in the first direction moves upward, and the other end portion moves downward.

[0065] A typical trough is configured such that seawater overflows from an upper end of a side wall. For this reason, when the upper end of the side wall moves upward relative to a water surface in response to tilting of the trough 3 in the first direction, a height difference between the upper end of the side wall and the water surface decreases, and accordingly, no seawater overflows or seawater is less likely to overflow.

[0066] On the other hand, the trough 3 having the above-described trough 3 supplies seawater to the outer surface of the heat exchange panel 2 through the slit 52 provided at the intermediate position of the side wall 42. Even when the trough 3 tilts to the first direction, if a water surface WL in the trough 3 is at a position higher than the slit 52 as indicated by chain double-dashed lines as an example in FIG. 7, the amount of seawater corresponding to the upper-lower width of the slit 52 can be supplied to the heat exchange panel 2 across the entirety thereof in the first direction. A situation where no seawater is supplied to part of the ORV 1 can be avoided, and the ORV 1 can favorably vaporize liquefied gas.

[0067] The ORV 1 mounted on the ship as described herein is, for example, operated while the ship is in harbor. The ship in harbor has a relatively-small swing angle in the pitching direction. The tilting angle θ of the trough 3 in the first direction is about several degrees, for example. As described above, the trough 3 is divided into the plurality of spaces in the first direction by the partition plates 62. This suppresses the water surface from reaching a position lower than the slit 52 in each space divided by the partition plates 62 even in a case where the trough 3 tilts to the first direction. The trough 3 can supply seawater to the heat exchange panel 2 across the entirety thereof in the first direction.

[0068] The plurality of guide plates 82 is provided between the side wall 42 and the baffle plate 81, and therefore, in a case where the trough 3 tilts to the first direction, the flow of seawater in the first direction in the space between the side wall 42 and the baffle plate 81 is blocked by the guide plates 82. The trough 3 can supply seawater equally or substantially equally across the entirety of the heat exchange panel 2 in the first direction.

[0069] The baffle plate 81 restricts the flow of seawater in the trough 3, and therefore, seawater supplied into the trough 3 through the supply ports 71 can be distributed equally or substantially equally in the first direction in the trough 3. As a result of reduction in an uneven flow of seawater in the trough 3, seawater flows equally or sub-

stantially equally to the heat exchange panel 2 in the first direction through the slit 52 not only in a case where the trough 3 is in the horizontal direction but also in a case where the trough 3 tilts.

[0070] The guide plates 82 between the side wall 42 and the baffle plate 81 contribute not only to blocking of movement of seawater in a case where the trough 3 tilts in the first direction but also equal or substantially equal distribution of seawater, which flows around the baffle plate 81 to flow into the space between the side wall 42 and the baffle plate 81, in the first direction.

[0071] The partition plates 62 dividing the trough 3 elongated in the first direction into the plurality of spaces in the first direction and the guide plates 82 further dividing the inside of the spaces divided by the partition plates 62 into the plurality of spaces are provided at the trough 3. With this configuration, not only a case where the trough 3 is in the horizontal direction, but also in a case where the trough 3 tilts, seawater can be supplied equally or substantially equally across the entirety of the heat exchange panel 2 in the first direction.

[0072] When the upper-lower width of the slit 52 is changed in such a manner that the attachment position of the restriction plate 5 is changed, the amount of seawater to be supplied to the heat exchange panel 2 from the trough 3 can be easily adjusted.

[0073] When the upper-lower width of the slit 52 is expanded, such expansion can suppress the trash etc. in seawater from clogging the slit 52. The upper-lower width of the slit 52 is changed according to use environment of the ORV 1 so that the ORV 1 can be stably operated.

[0074] Since the trough 3 is divided into the two spaces in the second direction by the high partition wall 61, seawater can be, as illustrated in FIG. 8, supplied to the heat exchange panels 2 on both sides of the trough 3 when the ORV 1 tilts to the second direction. The rolling angle of the ship in harbor tends to be greater than the pitching angle. However, the trough 3 having the above-described configuration can continuously supply seawater to the heat exchange panels 2 on both sides of the trough 3 even when the ship rolls with a relatively-great angle.

[0075] Note that although not shown in the figure, the troughs 3 positioned at the ends in the second direction can supply, by the high side walls 42, seawater to the heat exchange panels 2 at the sides of the troughs 3 when the ORV 1 tilts to the second direction. The high side wall 42 fulfills the same function as that of the partition wall 61.

[0076] Note that the configuration of the vaporizer 1 is not limited to the above-described configuration of the ORV 1. For example, a configuration other than the above-described configuration in which the distribution pipe 72 is provided in the trough 3 may be employed as the mechanism for supplying seawater to each space divided by the partition wall 61 and/or the partition plates 62 in the trough 3. For example, a supply pipe may be separately connected to each space in the trough 3.

[0077] The number of guide plates 82 is not limited to that of the above-described configuration example. The number of guide plates 82 may be an optional number. The guide plates 82 may be omitted.

[0078] The baffle plate 81 can be omitted.

[0079] The slit 52 is not necessarily formed continuously from the end to the end of the trough 3 in the first direction. The slit may be divided into a plurality of slits in the first direction.

DESCRIPTION OF REFERENCE CHARACTERS

[0080]

1	ORV (Vaporizer)
2	Heat Exchange Panel
3	Trough
4	Trough Body
42	Side Wall
5	Restriction Plate
52	Slit
62	Partition Plate
71	Supply Port
81	Baffle Plate
82	Guide Plate

Claims

1. A vaporizer comprising:

a heat exchange panel including a plurality of heat transfer pipes arrayed in a first direction and configured to vaporize liquefied gas flowing in each heat transfer pipe; and

a trough arranged adjacent to the heat exchange panel in a second direction perpendicular to the first direction and configured to supply a heat medium to an outer surface of the heat exchange panel,

wherein the trough extends in the first direction, and a slit extending in the first direction is formed at an intermediate position of a side wall, which faces the heat exchange panel, of the trough in a height direction, and

the heat medium accumulated in the trough flows to the outer surface of the heat exchange panel through the slit.

2. The vaporizer according to claim 1, wherein

the trough has a supply port for supplying the heat medium into the trough and a baffle plate arranged between the supply port and the side wall, and

the heat medium flows from the supply port to the slit through a position lower than the slit to flow around the baffle plate.

3. The vaporizer according to claim 2, wherein

the baffle plate is arranged with a clearance from the side wall in the second direction, and extends in the first direction, and
the trough has a guide plate configured to divide a space between the side wall and the baffle plate into a plurality of spaces in the first direction.

4. The vaporizer according to any one of claims 1 to 3, wherein
the trough has a partition plate configured to divide a space in the trough into a plurality of spaces in the first direction.

5. The vaporizer according to claim 3, wherein

the trough has a partition plate configured to divide a space in the trough into a plurality of spaces in the first direction, and
the number of guide plates is greater than the number of partition plates.

6. The vaporizer according to any one of claims 1 to 5, wherein

the trough has a trough body and a restriction plate detachably attached to the trough body and forming part of the side wall, and
the slit is formed between the trough body and the restriction plate.

7. The vaporizer according to claim 6, wherein
an upper-lower width of the slit is adjusted in such a manner that an attachment position of the restriction plate is changed.

8. The vaporizer according to any one of claims 1 to 7, wherein
the vaporizer is placed on a floating body on water.

FIG.1

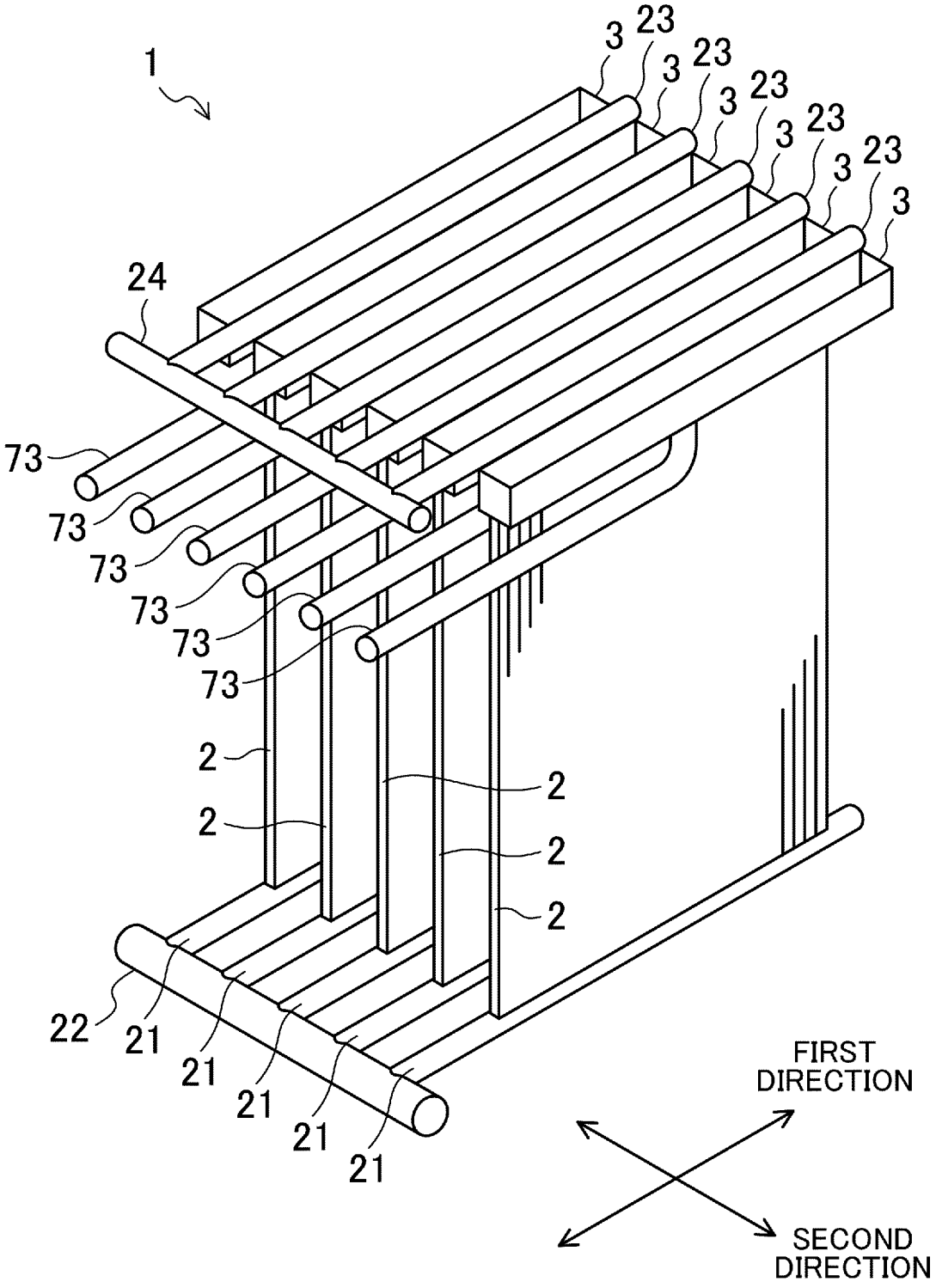
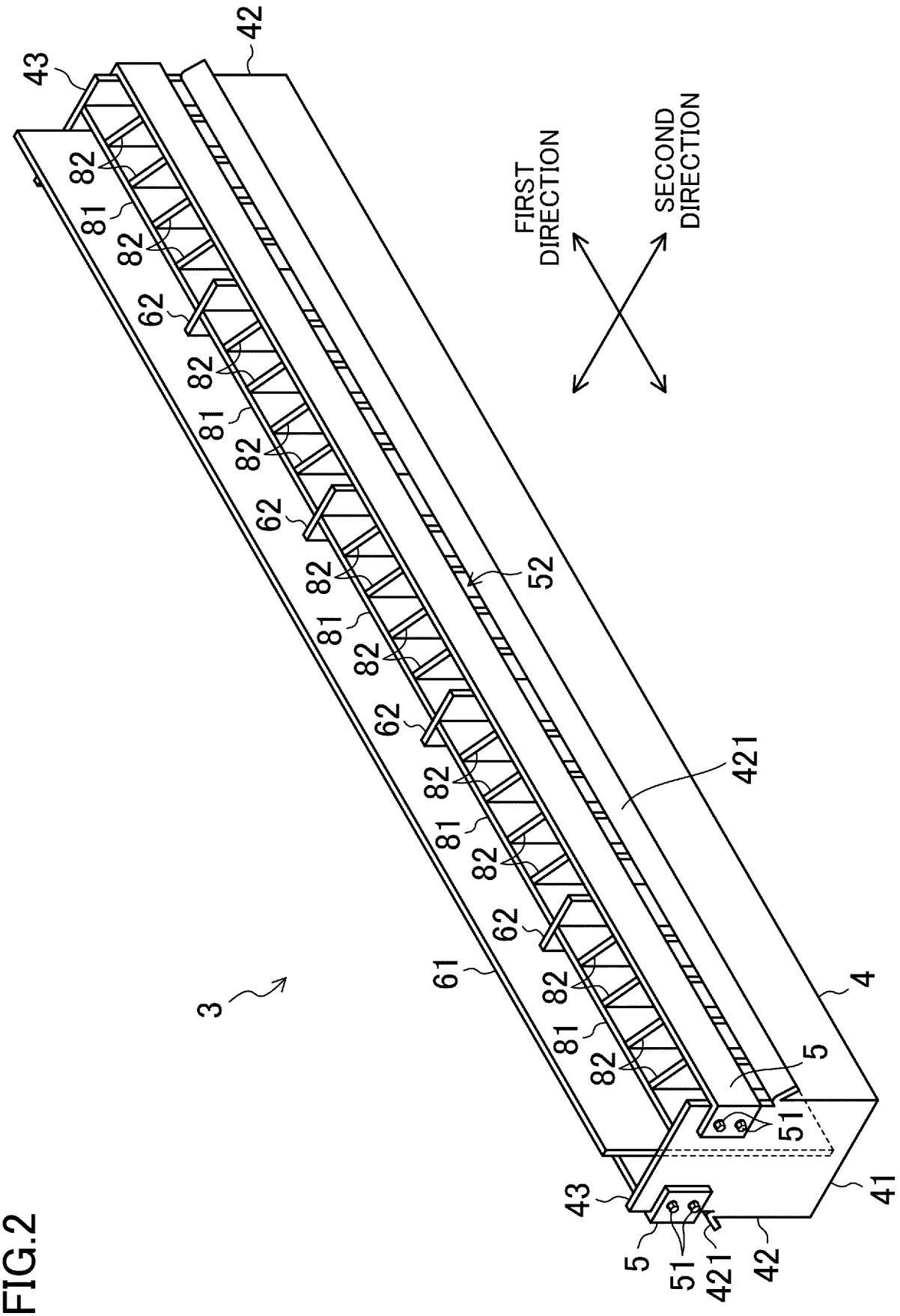


FIG.2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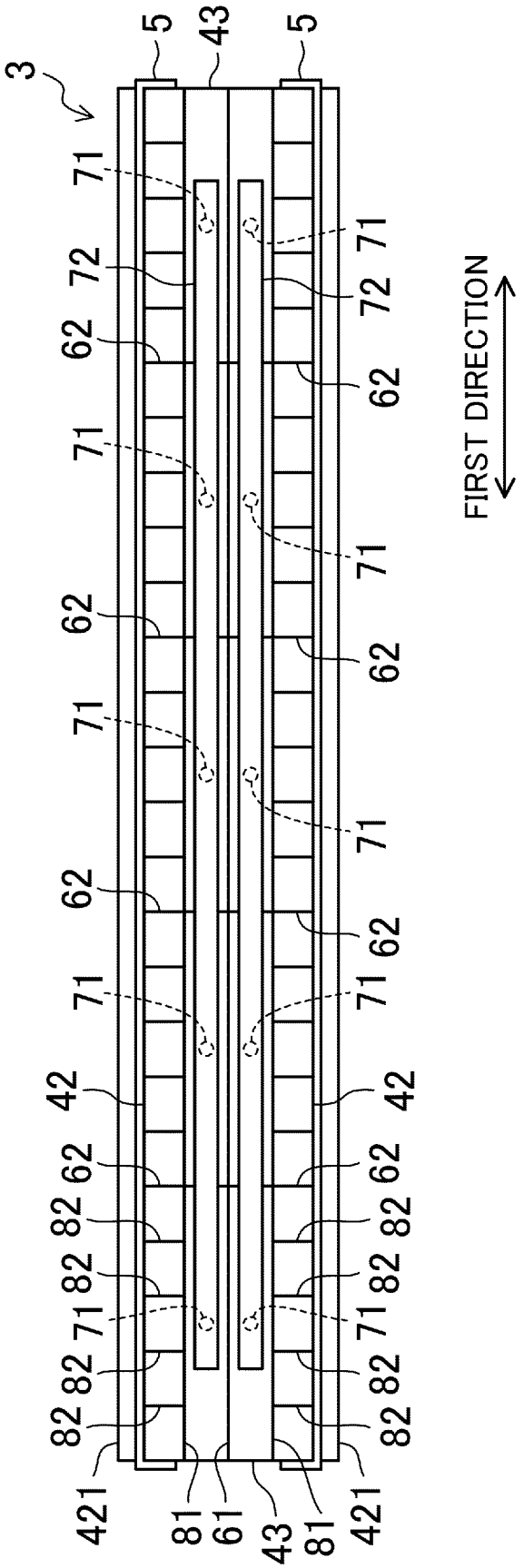
FIRST DIRECTION
SECOND DIRECTION

FIG.3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FIRST DIRECTION

FIG.4

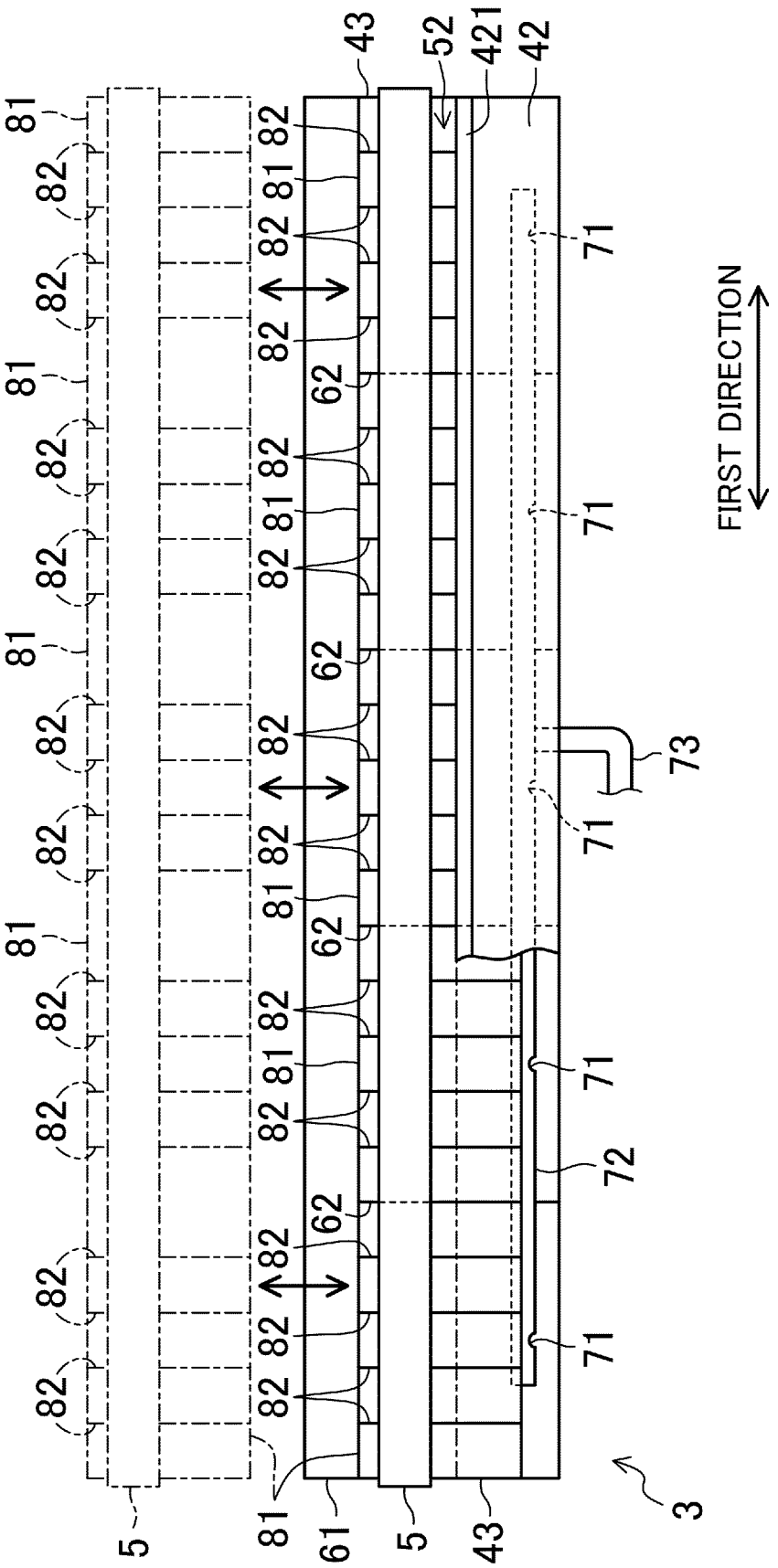
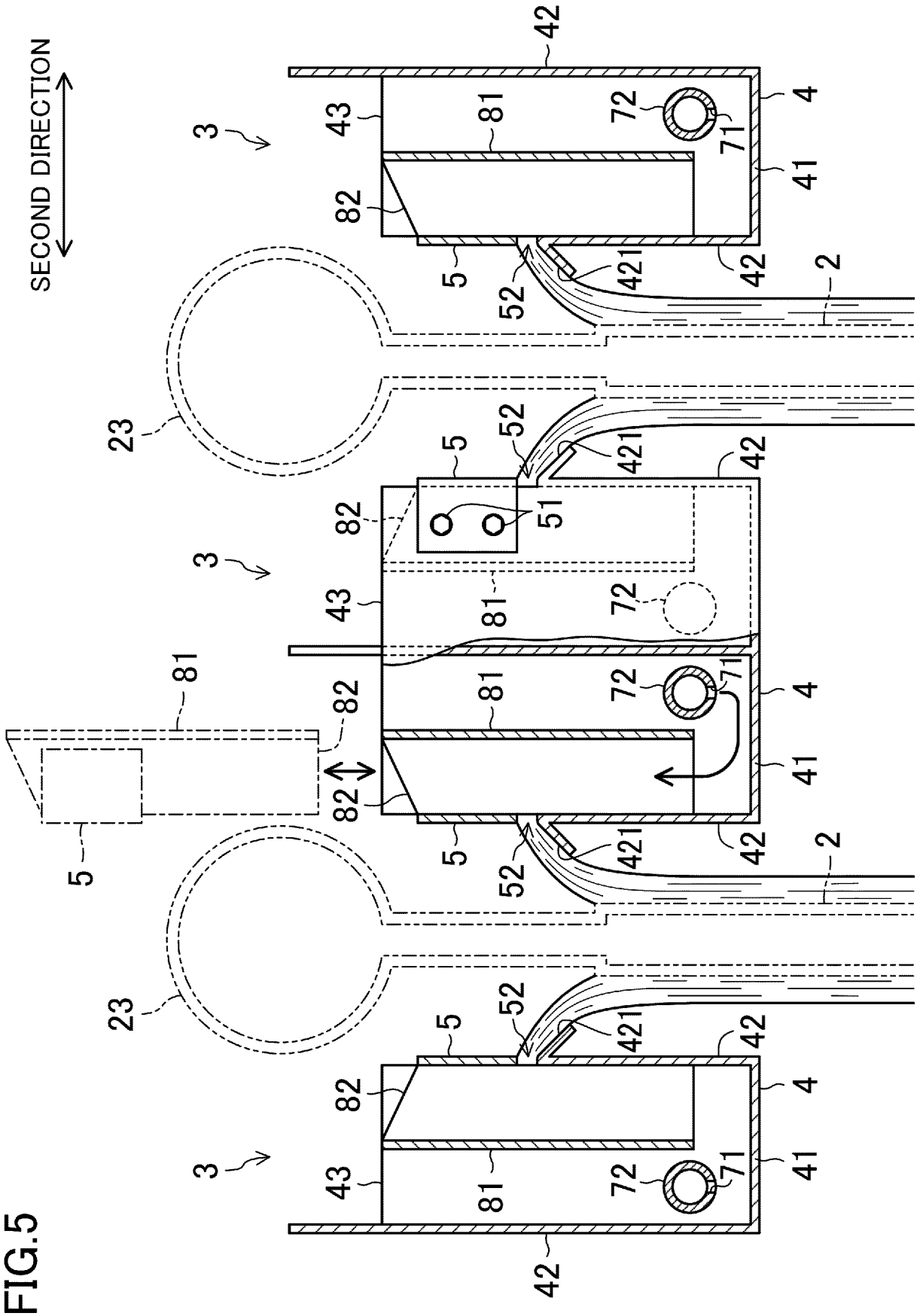


FIG.5



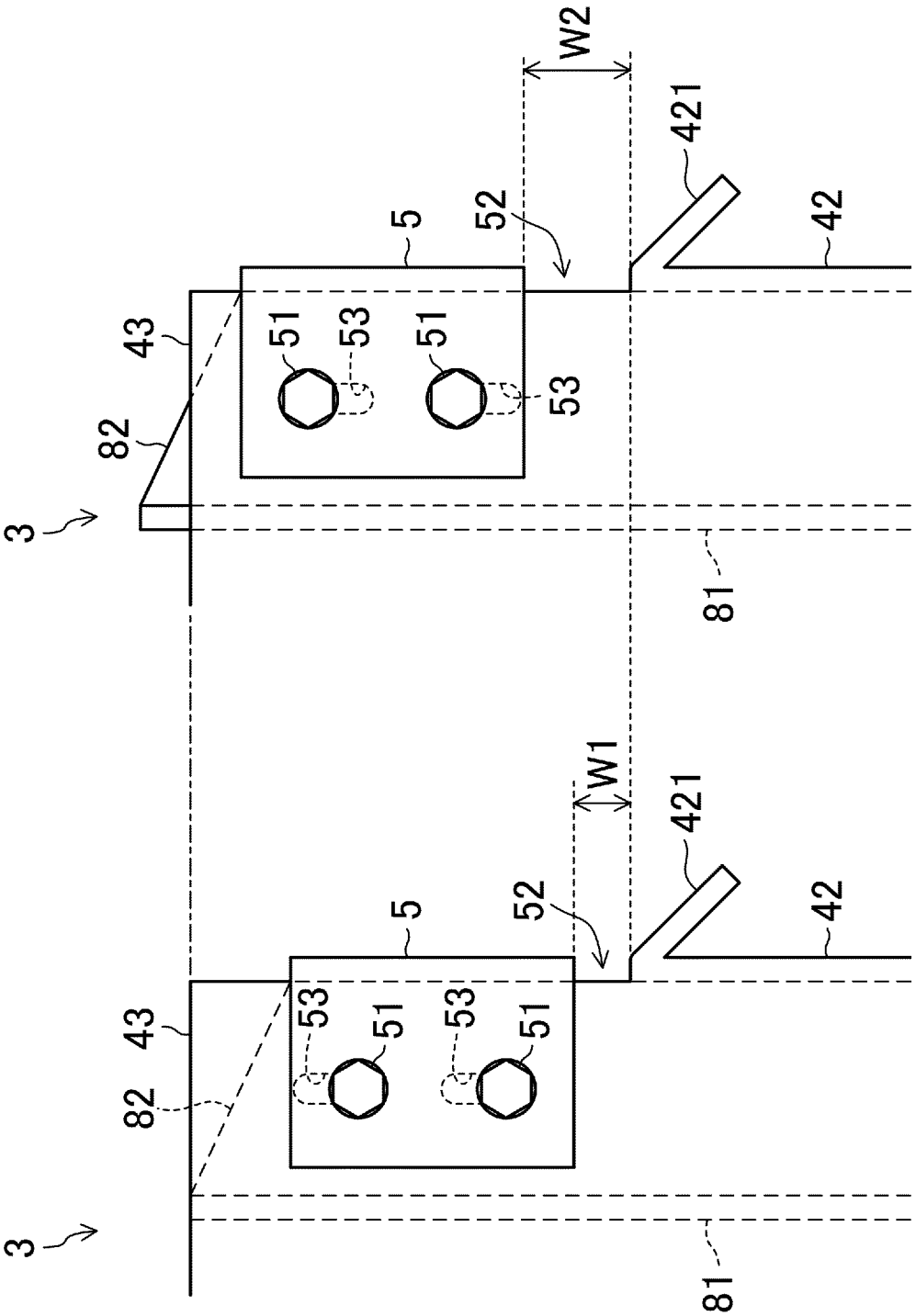

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FIG.6

FIG.7

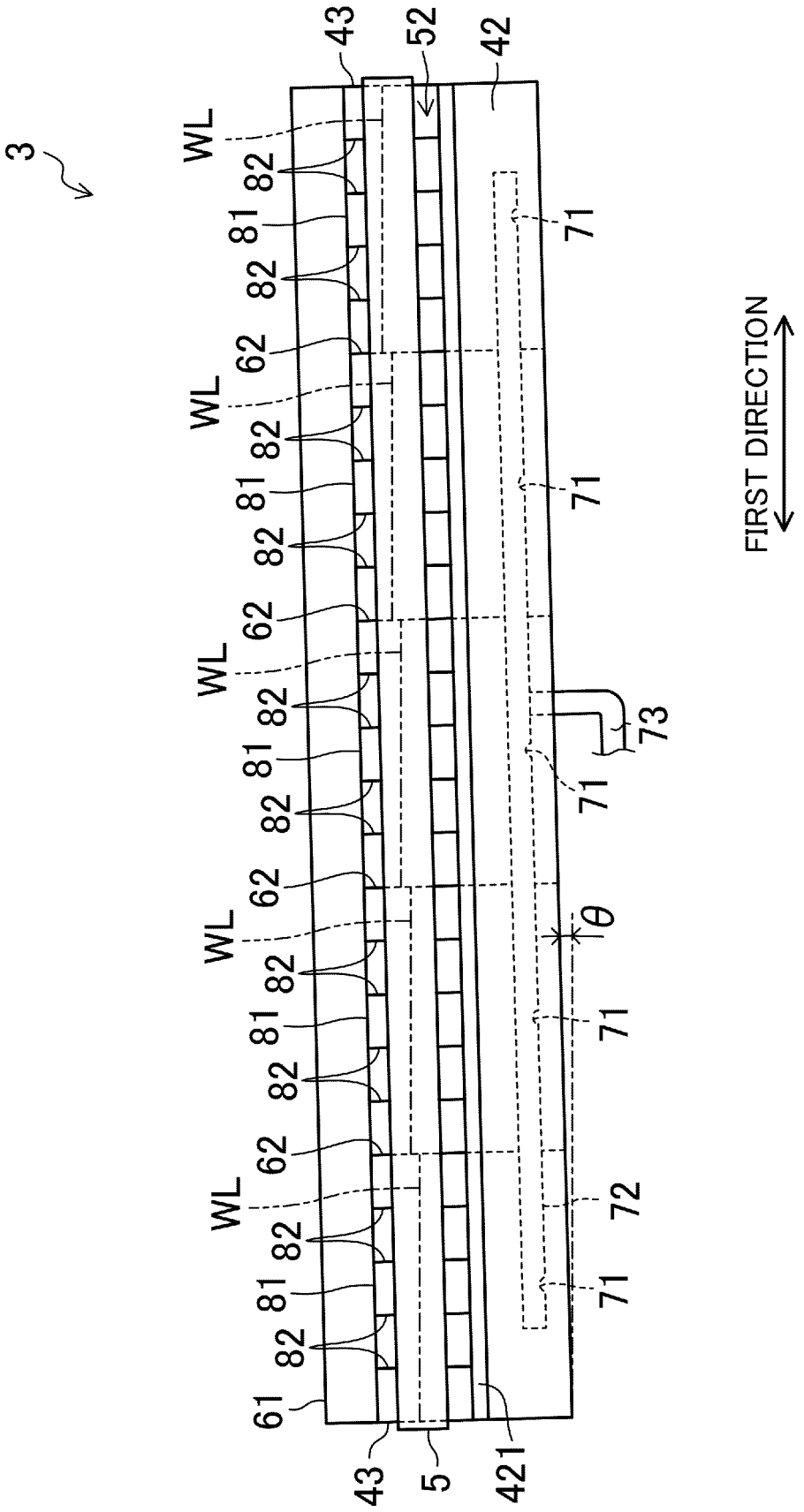
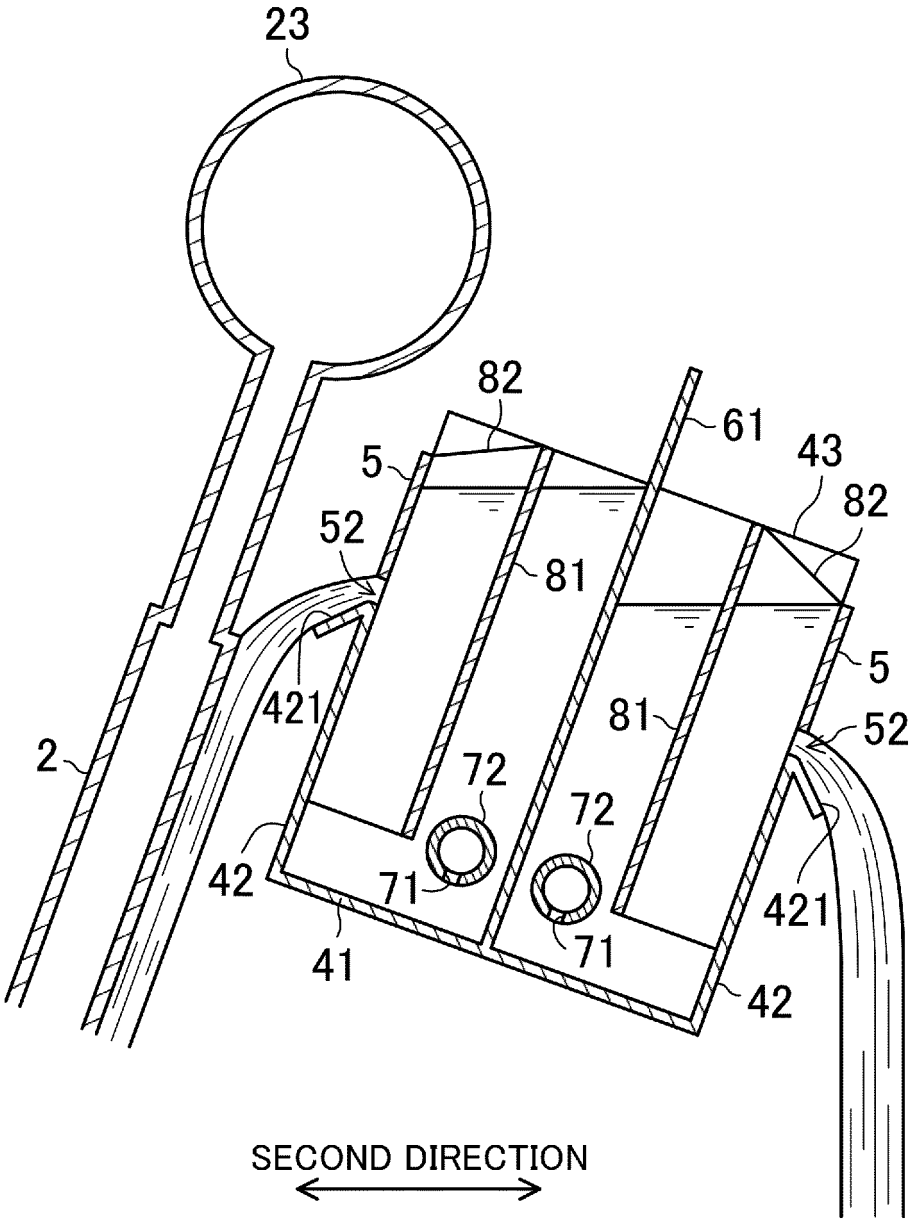


FIG.8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SECOND DIRECTION

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/019413

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. F28D3/02(2006.01)i, F17C9/02(2006.01)i
FI: F28D3/02, F17C9/02

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)
Int. Cl. F28D1/00-13/00, F17C1/00-13/12

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2020
Registered utility model specifications of Japan	1996-2020
Published registered utility model applications of Japan	1994-2020

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 6-7277 Y2 (TOKYO GAS CO., LTD.) 23 February 1994, entire text, all drawings	1-2 3-5, 8 6-7
Y	JP 6053389 B2 (MITSUBISHI HEAVY INDUSTRIES, LTD.) 27 December 2016, paragraphs [0022]-[0030], fig. 1-5	3-5, 8
A	JP 2015-178880 A (SUMITOMO PRECISION PRODUCTS CO., LTD.) 08 October 2015, entire text, all drawings	1-8
A	JP 58-24078 Y2 (TOKYO GAS CO., LTD.) 23 May 1983, entire text, all drawings	1-8

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23.06.2020	07.07.2020
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/019413

Patent Documents referred to in the Report	Publication Date	Patent Family	Publication Date
JP 6-7277 Y2	23.02.1994	JP 63-133699 U	
JP 6053389 B2	27.12.2016	JP 2014-34365 A EP 2865590 A1 paragraphs [0023]-[0033], fig. 1-5 WO 2014/024824 A1 CN 104487338 A KR 10-2015-0022005 A	
JP 2015-178880 A	08.10.2015	(Family: none)	
JP 58-24078 Y2	23.05.1983	JP 57-124700 U	

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 6053389 B **[0004]**