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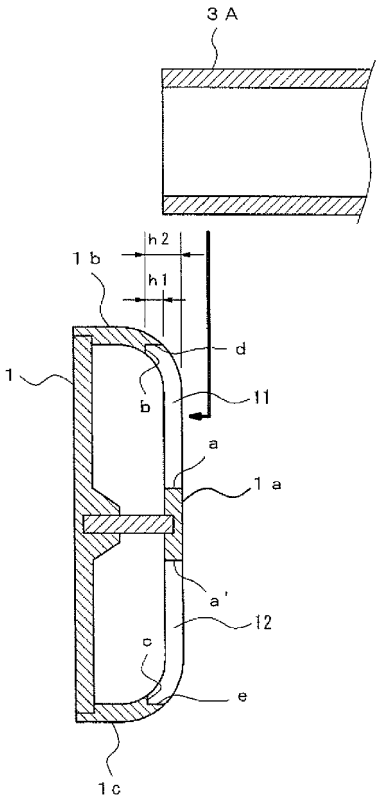
(54) HEAT EXCHANGER AND METHOD FOR ASSEMBLING HEAT EXCHANGER

(57) Assembly of a header tank 1 and flat tubes 3A in a heat exchanger is simplified. A communication portion of the header tank 1 side which communicates with the flat tube 3A is a slit 11 formed over a region (a side surface 1 b, or a connection portion between a facing surface 1 a and the side surface 1 b) that retreats from a center portion side in a width direction of the facing surface 1a, from the facing surface 1 a on one end portion side in the width direction. An end portion of the flat tube 3A is able to be inserted from the side surface side of the header tank 1 into the slit 11 of the header tank 1. The flat tube 3A is caused to abut, in the width direction thereof, on a first abutting portion a of an end portion on the facing surface 1a side of the slit 11, and abut, in the longitudinal direction, on a second abutting portion b of an end portion on the side surface 1 b side of the slit 11.

FIG.6



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Description

TECHNICAL FIELD

[0001] The present invention relates to a heat exchanger that includes a pair of header tanks and a plurality of flat tubes that communicate with the header tanks, and more particularly, to an assembly structure and an assembly method of header tanks and flat tubes.

BACKGROUND ART

[0002] As a heat exchanger according to the related art, as disclosed in Patent Document 1, there is a heat exchanger which includes a pair of header tanks that extend in parallel, and a plurality of flat tubes that communicate with the pair of header tanks and are lined up in two parallel rows.

CITATION LIST

PATENT DOCUMENT

[0003]

[Patent Document 1] Japanese Laid-Open Patent Publication No. 2003-075024

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0004] However, in an assembly structure of the header tanks and the flat tubes in the heat exchanger according to the related art, the end portions of the flat tubes are inserted into slits for flat tube insertion of the header tanks. However, the clearances of the insertion portions are narrow, and thus insertion is not easy.
Therefore, end processing is performed on the end portion of the flat tube to form a tapered shape by squeezing or the like in order to ensure insertability into the slits on the header tank side. However, due to the end processing, productivity is poor and automation is difficult. In addition, when the end portion in the tapered shape is inserted, there is no abutting portion, resulting in a problem in management of insertion dimensions. In addition, the squeezing process reduces the flow path area and has a considerable effect on heat exchange performance.
[0005] In addition, in a case in which the two rows of the flat tubes are inserted in the longitudinal direction thereof to be positioned between the pair of header tanks, when the flat tubes are to be mounted between the pair of header tanks in units of one row, mounting of the second row after mounting of the first row is difficult. Therefore, the two rows of the flat tubes have to be inserted concurrently. However, the concurrent insertion of the two rows requires accuracy of insertion direction and position, and has poor productivity.

[0006] The present invention has been made taking the foregoing circumstances into consideration, and an object thereof is to easily assemble header tanks and flat tubes without performing end processing on the flat tubes.

MEANS FOR SOLVING THE PROBLEMS

[0007] In order to accomplish the object, in an assembly structure according to an embodiment of the present invention, communication portions of a header tank which communicate with flat tubes include a first slit which is formed over a region that retreats, from a center portion side in a width direction of a facing surface of the header tank which faces the other header tank that forms a pair, in a direction opposite to a facing direction from the center portion on one end portion side in the width direction, and a second slit which is formed over a region that retreats, from the center portion side in the width direction of the facing surface, in a direction opposite to the facing direction from the center portion on the other end portion side in the width direction. In addition, end portions of the flat tubes are able to be inserted from the side surface side of the header tanks into the first and second slits of the header tanks, and the flat tubes abut, in the width direction thereof, on first abutting portions of end portions on the center portion side of the facing surface of the first and second slits.
The retreating region may be a side surface of the header tank or may be a connection portion between the facing surface and the side surface of the header tank. In addition, the connection portion may form a rounded portion or may form an inclined portion having a chamfered shape.
[0008] End portions on the retreating region side of the first and second slits may be provided at right angles from the end portions on the center portion side of the facing surface, and the flat tubes may abut, in the longitudinal direction thereof, on second abutting portions of end portions on the retreating region side of the first and second slits.
Moreover, a step may be provided in the end portions on the retreating region side of the first and second slits on which the flat tubes abut in the longitudinal direction thereof, third abutting portions on which the flat tubes abut in the width direction may be formed, and a height of the step may be lower than a height of the facing surface.
[0009] Otherwise, end portions on the retreating region side of the first and second slits may be provided to be parallel to the end portions on the center portion side of the facing surface, and the flat tubes, in the longitudinal direction thereof, may passes through the first and second slits and abut on fourth abutting portions in the header tanks.
Here, regarding the front end and rear end in a slit hole direction of the end portions on the retreating region side of the first and second slits, where it is assumed that:

a plate thickness of the flat tube is D1;
a distance in a retreating direction from the facing surface of the flat tube to the front end is D2; and
a distance from the rear end to the end portion of the flat tube is D3,

$$D2 \geq D1 \text{ and } D3>0,$$

preferably,

$$D2>D1 \text{ and } D3>0$$

may be set.

[0010] As a method for assembling the heat exchanger having the structure described above, the following first and second assembly methods are proposed.
The first assembly method includes: a first process of arranging flat tubes in a first row so that end portions in a width direction thereof are on an upper side; a second process of fitting first slits on one side surface side of a pair of header tanks with both end portions of the flat tubes in the first row from above; and a third process of fitting flat tubes in a second row into second slits on the other side surface side of the pair of header tanks from above.

[0011] The second assembly method includes: a first process of arranging a pair of header tanks so that one side surface side of the pair of header tanks are on an upper side; a second process of fitting both end portions of flat tubes in a first row into first slits on the one side surface side of the pair of header tanks; a third process of turning over the pair of header tanks and the flat tubes in the first row which fit with each other; and a fourth process of fitting flat tubes in a second row into second slits on the other side surface side of the pair of header tanks from above.

[0012] Here, in the third process of the first assembly method or in the fourth process of the second assembly method, the upper ends of the pair of header tanks may be opened to the outside before fitting the flat tubes in the second row into the second slits of the pair of header tanks, and may be closed after the fitting.

ADVANTAGEOUS EFFECTS OF THE INVENTION

[0013] An aspect of the present invention provides the assembly structure in which since the end portions of the flat tubes are inserted into the slits from the side surface side of the header tanks, the rounded portions of the end portions in the width direction of the flat tubes serve as guides. Therefore, insertability is ensured without performing special end processing.
In addition, by causing the flat tubes to have a configuration in which various abutting portions are provided, the insertion positions may be stabilized. Therefore, assembly becomes easy, and maintaining the positioning condition becomes easier.

[0014] An aspect of the present invention provides the first and second assembly methods in which there is an advantage that the flat tubes are able to be inserted from the side surfaces of the header tanks, and thus the pair of the header tanks and the flat tubes in the two rows may be efficiently assembled.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 is a schematic perspective view of a heat exchanger according to an embodiment of the present invention;
Fig. 2 is a plan view illustrating a first embodiment of an assembly structure of header tanks and flat tubes;
Fig. 3 is a side view of the first embodiment of the assembly structure;
Fig. 4 is a plan view illustrating a second embodiment of the assembly structure of the header tanks and the flat tubes;
Fig. 5 is a side view of the second embodiment of the assembly structure;
Fig. 6 is an enlarged view of the main parts of the second embodiment of the assembly structure;
Fig. 7 is a view illustrating a first specific assembly method;
Fig. 8 is a view illustrating a second specific assembly method;
Fig. 9 is a plan view illustrating a third embodiment of the assembly structure of the header tanks and the flat tubes;
Fig. 10 is a plan view of the assembled state of the third embodiment of the assembly structure;
Fig. 11 is a plan view illustrating the dimensional relationship in the third embodiment of the assembly structure; and
Fig. 12 is a view taken along an arrow X of Fig. 11.

DESCRIPTION OF EMBODIMENTS

[0016] Hereinafter, embodiments of the present invention will be described in detail.
Fig. 1 is a schematic perspective view of a heat exchanger according to an embodiment of the present invention. The heat exchanger of this embodiment includes a pair of header tanks 1 and 2 that extend in parallel, a plurality of flat tubes 3 (flat tubes 3A in a first row and flat tubes 3B in a second row) that communicate with the pair of header tanks 1 and 2 and are lined up in two parallel rows, and fins 4 provided between the flat tubes 3 and 3 in each of the rows. An arrow in the figure represents the flow direction of the air for heat exchange.

[0017] Figs. 2 and 3 are a plan view and a side view respectively illustrating a first embodiment of an assembly structure of the header tanks 1 and 2 and the flat tubes 3.

The header tanks 1 and 2 are cylindrical bodies (here, in this embodiment, constituted by divided bodies) made of aluminum, which have substantially rectangular cross-sections as illustrated in Fig. 2. In addition, in each of the header tanks 1 and 2, there is provided a partition wall 5 that halves the internal space thereof along the extending direction, and accordingly the internal space is partitioned into a first passage 6 and a second passage 7.

[0018] Here, of the pair of header tanks 1 and 2, in one header tank 1, an inlet pipe (not illustrated) of a cooling medium is connected to the first passage 6 thereof and an outlet pipe (not illustrated) of the cooling medium is connected to the second passage 7 thereof.

In the other header tank 2, a communication hole 8 is provided in the partition wall 5 thereof, and thus the first passage 6 and the second passage 7 of the header tank 2 communicate with each other. Therefore, regarding the header tank 2, the partition wall 5 itself may be omitted.

[0019] The flat tube 3 is a tube made of aluminum, which has a flat cross-section as illustrated in Fig. 3, both end portions in the width direction (the left and right direction of Fig. 3) of which are rounded portions. In addition, the plurality of flat tubes 3 are lined up in the extending direction of the header tanks 1 and 2 so that the flat surfaces thereof face each other. Therefore, the flat surfaces are parallel to the flow direction of the air for heat exchange which passes through the space between the header tanks 1 and 2.

[0020] In addition, the rows of the flat tubes 3 are two rows so that the flat tubes 3A in the first row cause the first passage 6 of the header tank 1 and the first passage 6 of the header tank 2 to communicate with each other and the flat tubes 3B in the second row cause the second passage 7 of the header tank 1 and the second passage 7 of the header tank 2 to communicate with each other. Here, the communication portions are joined through brazing.

The fins 4 (Fig. 1) are, for example, corrugated fins, and are arranged by being joined between the flat surfaces of the flat tubes 3 through brazing.

[0021] Here, the cooling medium flows from the first passage 6 of the header tank 1 through the flat tubes 3A in the first row, flows to the first passage 6 of the header tank 2, flows from the second passage 7 of the header tank 2 which communicates with the first passage 6 of the header tank 2 through the flat tubes 3B in the second row, and flows to the second passage 7 of the header tank 1. Therefore, the flows of the cooling medium in the flat tubes 3A in the first row and the flat tubes 3B in the second row are in reverse directions and thus become a so-called counterflow. In addition, when the cooling medium flows through the flat tubes 3A and 3B, heat exchange is made with the air for heat exchange that passes through the space between the header tanks 1 and 2 via the corrugated fins 4.

[0022] Next, the assembly structure of the header tanks 1 and 2 and the flat tubes 3 in the heat exchanger of this embodiment will be described.

The communication portions on the header tank 1 side that communicate with the flat tubes 3 are a first slit 11 formed, in an angular portion (rounded portion) between a facing surface 1 a that faces the other header tank 2 that forms the pair and one side surface 1 b that continues to the facing surface 1 a, over both the surfaces 1 a and 1 b, and a second slit 12 formed, in an angular portion (rounded portion) between the facing surface 1 a and the other side surface 1 c that continues to the facing surface 1 a, over both the surfaces 1 a and 1 c. In addition, end portions a and a' on the facing surface 1 a side of the first and second slits 11 and 12 are rounded portions. End portions b and c on the side surfaces 1 b and 1 c side of the first and second slits 11 and 12 are not provided with rounded portions.

[0023] In other words, the communication portions on the header tank 1 side that communicate with the flat tubes 3 are the first slit 11 formed over a region (the side surface 1 b, or a connection portion between the facing surface 1 a and the side surface 1 b) that retreats, from the center portion side in the width direction of the facing surface 1 a that faces the other header tank 2 that forms the pair, in a direction opposite to the facing direction from the center portion on the one end portion side in the width direction, and the second slit 12 formed over a region (the side surface 1 c, or a connection portion between the facing surface 1 a and the side surface 1 c) that retreats, from the center portion side in the width direction of the facing surface 1 a, in a direction opposite to the facing direction from the center portion on the other end portion side in the width direction. In this example, the connection portions between the facing surface 1 a and the side surfaces 1 b and 1 c form rounded portions. In addition, the retreating distances of the end portions b and c on the retreating region side of the first and second slits 11 and 12 from the facing surface 1 a are greater than the plate thickness of the header tank 1 (a part of the facing surface 1 a thereof). In addition, the end portions b and c on the retreating region side of the first and second slits 11 and 12 are provided at right angles from the end portions a and a' on the facing surface 1 a side. The communication portions on the header tank 2 side that communicate with the flat tubes 3 are similar to the above communication portions.

[0024] The end portion of the flat tube 3A in the first row is inserted into the first slit 11, and the end portion of the flat tube 3B in the second row is inserted into the second slit 12.

Here, the end portion of the flat tube 3A in the first row is able to be inserted from the one side surface 1 b of the header tank 1 into the first slit 11 of the header tank 1, and the end portion of the flat tube 3B in the second row is able to be inserted from the one other side surface 1c

of the header tank 1 into the second slit 12 of the header tank 1.

[0025] In addition, the end portion of the flat tube 3A in the first row abuts, in the width direction thereof, on the end portion (rounded portion) a on the facing surface 1 a side of the first slit 11, and abuts, in the longitudinal direction thereof, on the end portion b on the side surface 1 b side of the first slit 11. In addition, the end portion of the flat tube 3B in the second row abuts, in the width direction thereof, on the end portion (rounded portion) a' on the facing surface 1 a side of the second slit 12, and abuts, in the longitudinal direction thereof, on the end portion c on the side surface 1c side of the second slit 12. Here, the end portions a and a' constitute first abutting portions and the end portions b and c constitute second abutting portions.

The relationship between the end portions of the flat tubes 3A and 3B in the first and second rows and the first and second slits 11 and 12 of the header tank 2 is similar to that described above.

[0026] In this configuration, when the flat tubes 3A in the first row are assembled to the header tanks 1 and 2, the end portions of the flat tubes 3A in the first row are inserted into the first slits 11 of the header tanks 1 and 2 from the side (the side surface 1 b side) of the header tanks 1 and 2, the end portions (the rounded portions) in the width direction of the flat tubes 3A are caused to abut on the end portion (rounded portion) a on the facing surface 1 a side of the first slit 11, and the end portions (end surfaces) in the longitudinal direction of the flat tubes 3A are caused to abut on the end portion (right-angled portion) b on the side surface 1 b side of the first slit 11.

[0027] In addition, when the flat tubes 3B in the second row are assembled to the header tanks 1 and 2, similarly, the end portions of the flat tubes 3B in the second row are inserted into the second slits 12 of the header tanks 1 and 2 from the side (the side surface 1 c side) of the header tanks 1 and 2, the end portions (the rounded portions) in the width direction of the flat tubes 3B are caused to abut on the end portion (rounded portion) a' on the facing surface 1 a side of the second slit 12, and the end portions (end surfaces) in the longitudinal direction of the flat tubes 3B are caused to abut on the end portion (right-angled portion) c on the side surface 1 c side of the second slit 12.

[0028] Therefore, since the end portions of the flat tubes 3A and 3B are inserted into the slits 11 and 12 from the side surface side of the header tanks 1 and 2, the rounded portions of the end portions in the width direction of the flat tubes 3A and 3B serve as guides. Therefore, insertability is ensured without performing special end processing. In addition, since the flat tubes 3A and 3B are caused to abut in the width direction and the longitudinal direction, the insertion positions are stabilized. Therefore, assembly becomes easy.

After the header tanks 1 and 2, and the flat tubes 3A and 3B are assembled as described above, the peripheries of the insertion portions are joined through brazing.

[0029] Figs. 4 and 5 are respectively a plan view and a side view illustrating a second embodiment of the assembly structure of the header tanks 1 and 2 and the flat tubes 3. Fig. 6 is an enlarged view of the main parts of the second embodiment of the assembly structure.

In the second embodiment (Figs. 4 to 6), like elements which are the same as those of the first embodiment (Figs. 2 and 3) are denoted by like reference signs to simplify description, and different elements are mainly described with reference to Fig. 6.

[0030] The communication portions of the header tank 1 side that communicate with the flat tubes 3 are the first slit 11 formed over a region (the side surface 1 b, or a connection portion between the facing surface 1 a and the side surface 1 b) that retreats, from the center portion side in the width direction of the facing surface 1 a that faces the other header tank 2 that forms the pair, in the direction opposite to the facing direction from the center portion on the one end portion side in the width direction, and the second slit 12 formed over a region (the side surface 1 c, or a connection portion between the facing surface 1 a and the side surface 1 c) that retreats, from the center portion side in the width direction of the facing surface 1 a, in the direction opposite to the facing direction from the center portion on the other end portion side in the width direction. In this example, the connection portions between the facing surface 1 a and the side surfaces 1 b and 1c form rounded portions.

[0031] In the second embodiment, a step (stepped wall) is provided close to the outside of each of the end portions b and c on the side surfaces 1 b and 1 c side of the first and second slits 11 and 12, on which the flat tubes 3A and 3B abut in the longitudinal direction thereof, and third abutting portions d and e on which the flat tubes 3A and 3B abut in the width direction are formed. In addition, a height h1 (the height of the protrusion from the second abutting portions b and c) of the step (stepped wall) is less than a height h2 of the facing surface 1 a in the same direction.

[0032] Therefore, regarding the relationship between the header tank 1 (the first slit 11) and the flat tube 3A in the second embodiment, as in the first embodiment, the flat tube 3A abuts, in the width direction, on the first abutting portion of the end portion a on the facing surface 1 a side of the first slit 11, abuts, in the longitudinal direction, on the second abutting portion of the end portion b on the side surface 1 b side of the first slit 11, and as the characteristics of the second embodiment, abuts on the third abutting portion d on the opposite side in the width direction.

[0033] Therefore, the flat tube 3A is caused to abut on the first abutting portion a and the third abutting portion d, in other words, is inserted therebetween, and thus the position in the width direction thereof is restricted. In addition, the flat tube 3A is caused to abut on the second abutting portions b and c in the longitudinal direction, and thus the insertion length thereof is restricted.

In addition, by causing the height h1 of the step to be

less than the height h2 of the facing surface 1 a, the insertion operation includes two actions. However, insertion of the flat tube 3A from the side of the header tank 1 is enabled.

[0034] That is, the flat tube 3A is inserted from the side of the header tank 1 into the first slit 11 of the header tank 1, abuts on the first abutting portion a (in this state, is inserted in the longitudinal direction by h2-h1), and is thereafter press-fit in the longitudinal direction (further, by h1) of the flat tube 3A so as to cause the end portion of the flat tube 3A to abut on the second abutting portion b while being guided by the first abutting portion a and the third abutting portion d.

[0035] As described above, by employing a configuration in which the third abutting portions d and e are further included, both sides in the width direction may be restricted by the first abutting portions a and a' and the third abutting portions d and e though the insertion operation includes two actions. Therefore, maintaining the positioning condition becomes easier.

[0036] Next, a more specific method for assembling the header tanks and the flat tubes is proposed.

Fig. 7 illustrates a first specific assembly method.

In Process 1, the plurality of the flat tubes 3A in the first row are arranged using tools and the like so that the end portions in the width direction are on the upper side.

In Process 2, the first slits 11 on one side of the pair of the header tanks 1 and 2 are fitted with both end portions of the flat tubes 3A in the first row from above. Here, in the structure of the first embodiment, one action is performed, and in the structure of the second embodiment, two actions are performed.

[0037] In Process 3, the plurality of the flat tubes 3B in the second row are fitted into the second slit 12 on the other side of the pair of the header tanks 1 and 2 from above. At this time, initially, the upper ends of the pair of the header tanks 1 and 2 are slightly widened to the outside, the flat tubes 3B in the second row are then fitted into the second slits 12 on the upper side of the header tanks 1 and 2, and after the fitting, the upper ends of the pair of the header tanks 1 and 2 are closed. Accordingly, assembly is completed and thereafter joining is performed through brazing.

[0038] Fig. 8 illustrates a second specific assembly method.

In Process 1, the pair of the header tanks 1 and 2 are arranged using tools and the like so that the one side surfaces thereof are on the upper side.

In Process 2, both end portions of the plurality of the flat tubes 3A in the first row are fitted into the first slits 11 on the one side surfaces (side surfaces on the upper side) of the pair of the header tanks 1 and 2. Here, in the structure of the first embodiment, one action is performed, and in the structure of the second embodiment, two actions are performed.

[0039] In Process 3, the pair of the header tanks 1 and 2 and the flat tubes 3A in the first row, which fit with each other, are turned over.

In Process 4, the plurality of the flat tubes 3B in the second row are fitted from above into the second slits 12 on the other side surfaces (side surfaces which are on the upper side after the turnover) of the pair of the header tanks 1 and 2. Even at this time, initially, the upper ends of the pair of the header tanks 1 and 2 are slightly widened to the outside, the flat tubes 3B in the second row are then fitted into the second slits 12 on the upper side of the header tanks 1 and 2, and after the fitting, the upper ends of the pair of the header tanks 1 and 2 are closed. Accordingly, assembly is completed and thereafter joining is performed through brazing.

[0040] According to the first and second specific assembly methods, there is an advantage that the flat tubes 3A and 3B are able to be inserted from the side surfaces of the header tanks 1 and 2, and thus the pair of the header tanks 1 and 2 and the flat tubes 3A and 3B in the two rows are able to be efficiently assembled. Particularly, the flat tubes 3A in the first row and the flat tubes 3B in the second row do not need to be inserted concurrently, and thus automation of assembly becomes easy.

[0041] Fig. 9 is a plan view illustrating a third embodiment of the assembly structure of the header tank 1 (or 2) and the flat tubes 3. In addition, Fig. 10 is a plan view of the assembled state of the third embodiment, Fig. 11 is a plan view illustrating the dimensional relationship in the third embodiment, and Fig. 12 is a view taken along an arrow X of Fig. 11.

Also in the third embodiment (Figs. 9 to 12), like elements which are the same as those of the first embodiment (Figs. 2 and 3) are denoted by like reference signs to simplify description, and different elements are mainly described.

[0042] The communication portions of the header tank 1 side that communicate with the flat tubes 3 (3A and 3B) are the first slit 11 formed over a region (a connection portion between the facing surface 1 a and the side surface 1 b) that retreats, from the center portion side in the width direction of the facing surface 1 a that faces the other header tank 2 that forms the pair, in the direction opposite to the facing direction from the center portion on the one end portion side in the width direction, and the second slit 12 formed over a region (a connection portion between the facing surface 1 a and the side surface 1 c) that retreats, from the center portion side in the width direction of the facing surface 1 a, in the direction opposite to the facing direction from the center portion on the other end portion side in the width direction. In this example, the connection portions between the facing surface 1 a and the side surfaces 1 b and 1 c form inclined portions 1 d and 1 e having chamfered shapes.

[0043] Here, end portions f and g on the retreating region (inclined portions 1d and 1 e) side of the first and second slits 11 and 12 are provided in parallel to the end portions a and a' on the center portion side of the facing surface.

In addition, the flat tubes 3 passes through the first and second slits 11 and 12 in the longitudinal direction and

are caused to abut on fourth abutting portions h and i in the header tank 1. The fourth abutting portions h and i are formed at the root portion of the partition wall 5.

[0044] Therefore, in this embodiment, for example, the flat tube 3A is inserted from the side of the header tank 1 into the first slit 11 of the header tank 1, abuts on the first abutting portion a (in this state, is inserted in the longitudinal direction by D2 described later), and is thereafter press-fit in the longitudinal direction of the flat tube 3A to be inserted into a long hole (between a and f) of the first slit 11, thereby causing the end portion of the flat tube 3A to abut on the fourth abutting portion h. Insertion of the flat tube 3B is similar to the above.

[0045] In this configuration, although the insertion operation includes two actions, both sides in the width direction of the flat tubes 3 (3A and 3B) are able to be restricted by the long holes of the first and second slits 11 and 12, and thus maintaining the positioning condition becomes easier.

[0046] Here, referring to Figs. 11 and 12, regarding the front end and the rear end in the slit hole direction of the end portions f and g on the retreating region (inclined portions 1d and 1 e) side of the first and second slits 11 and 12, where it is assumed that:

the plate thickness of the flat tube 3 is D1;
the distance in the retreating direction from the facing surface of the flat tube to the front end is D2; and
the distance from the rear end to the end portion of the flat tube is D3,

$$D2 \geq D1 \text{ and } D3>0,$$

preferably,

$$D2>D1 \text{ and } D3>0$$

are set.

[0047] By setting D2≥D1, preferably, D2>D1, regarding the first and second slits 11 and 12 of the header tank 1, when the flat tubes 3 (3A and 3B) are inserted from the side of the header tank 1, a large insertion margin is achieved. Therefore, insertion from the side becomes easy, thereby facilitating automation. Particularly, this is effective in a case in which the plate thickness of the header tank 1 is thin.

In addition, by setting D3>0, during brazing of the flat tubes 3 (3A and 3B) inside the header tank 1, the brazing filler material may be prevented from getting into the flat tubes 3 (3A and 3B) during brazing. When the brazing filler material gets into the tubes, the flow of the cooling medium is impeded.

[0048] Also in the third embodiment, assembly may be similarly performed using the first specific assembly method or the second specific assembly method described above.

[0049] The illustrated embodiments only exemplify the present invention, and of course the above-described embodiments are merely illustrative, and various improvements and modifications may be made by those skilled in the art within the scope of the claims.

REFERENCE SIGNS LIST

[0050]

1, 2	Header tank
1a, 2a	Facing surface
1b, 2b	Side surface
1c, 2c	Side surface
a, a'	First abutting portion
b, c	Second abutting portion
d, e	Third abutting portion
h, i	Fourth abutting portion
3, 3A, 3B	Flat tube
4	Corrugated fin
5	Partition wall
6	First passage
7	Second passage
8	Communication hole
11	First slit
12	Second slit

Claims

1. A heat exchanger comprising:

a pair of header tanks which extend in parallel; and
a plurality of flat tubes which communicate with the pair of header tanks and are lined up in two parallel rows,
wherein communication portions of the header tank which communicate with the flat tubes include:

a first slit which is formed over a region that retreats, from a center portion side in a width direction of a facing surface of the header tank which faces the other header tank that forms the pair, in a direction opposite to a facing direction from the center portion on one end portion side in the width direction; and
a second slit which is formed over a region that retreats, from the center portion side in the width direction of the facing surface, in a direction opposite to the facing direction from the center portion on the other end portion side in the width direction,

wherein end portions of the flat tubes are able to be inserted from the side surface side of the header tanks into the first and second slits of the header tanks, and
wherein the flat tubes abut, in the width direction thereof, on first abutting portions of end portions on the center portion side of the facing surface of the first and second slits.

2. The heat exchanger according to claim 1, wherein the retreating region is a side surface of the header tank.

3. The heat exchanger according to claim 1, wherein the retreating region is a connection portion between the facing surface and the side surface of the header tank.

4. The heat exchanger according to claim 3, wherein the connection portion forms a rounded portion.

5. The heat exchanger according to claim 3, wherein the connection portion forms an inclined portion having a chamfered shape.

6. The heat exchanger according to claim 1, wherein end portions on the retreating region side of the first and second slits are provided at right angles from the end portions of the center portion side of the facing surface, and
wherein the flat tubes abut, in the longitudinal direction thereof, on second abutting portions of end portions on the retreating region side of the first and second slits.

7. The heat exchanger according to claim 6, wherein a step is provided in the end portions on the retreating region side of the first and second slits on which the flat tubes abut in the longitudinal direction thereof, so that third abutting portions on which the flat tubes abut in the width direction are formed, and a height of the step is less than a height of the facing surface.

8. The heat exchanger according to claim 1, wherein end portions on the retreating region side of the first and second slits are provided to be parallel to the end portions on the center portion side of the facing surface, and
wherein the flat tubes, in the longitudinal direction thereof, passes through the first and second slits and abut on fourth abutting portions in the header tanks.

9. The heat exchanger according to claim 8, wherein, regarding front end and rear end in a slit hole direction of the end portions on the retreating region side of the first and second slits, where it is assumed that:

a plate thickness of the flat tube is D1;
a distance in a retreating direction from the facing surface of the flat tube to the front end is D2; and
a distance from the rear end to the end portion of the flat tube is D3,
$D2 \geq D1$ and $D3 > 0$are set.

10. The heat exchanger according to claim 9, wherein, regarding D1 and D2, $D2 > D1$ is set.

11. A method of assembling a heat exchanger, comprising:

a first process of arranging flat tubes in a first row so that end portions in a width direction thereof are on an upper side;
a second process of fitting first slits on one side surface side of a pair of header tanks with both end portions of the flat tubes in the first row from above; and
a third process of fitting flat tubes in a second row into second slits on the other side surface side of the pair of header tanks from above.

12. The method of assembling the heat exchanger according to claim 11, wherein in the third process, the upper ends of the pair of header tanks are opened to the outside before fitting the flat tubes in the second row into the second slits of the pair of header tanks, and are closed after the fitting.

13. A method of assembling a heat exchanger, comprising:

a first process of arranging a pair of header tanks so that one side surface side of the pair of header tanks are on an upper side;
a second process of fitting both end portions of flat tubes in a first row into first slits on the one side surface side of the pair of header tanks;
a third process of turning over the pair of header tanks and the flat tubes in the first row which fit with each other; and
a fourth process of fitting flat tubes in a second row into second slits on the other side surface side of the pair of header tanks from above.

14. The method of assembling the heat exchanger according to claim 13, wherein, in the fourth process, the upper ends of the pair of header tanks are opened to the outside before fitting the flat tubes in the second row into the second slits of the pair of header tanks, and are closed after the fitting.

FIG.1

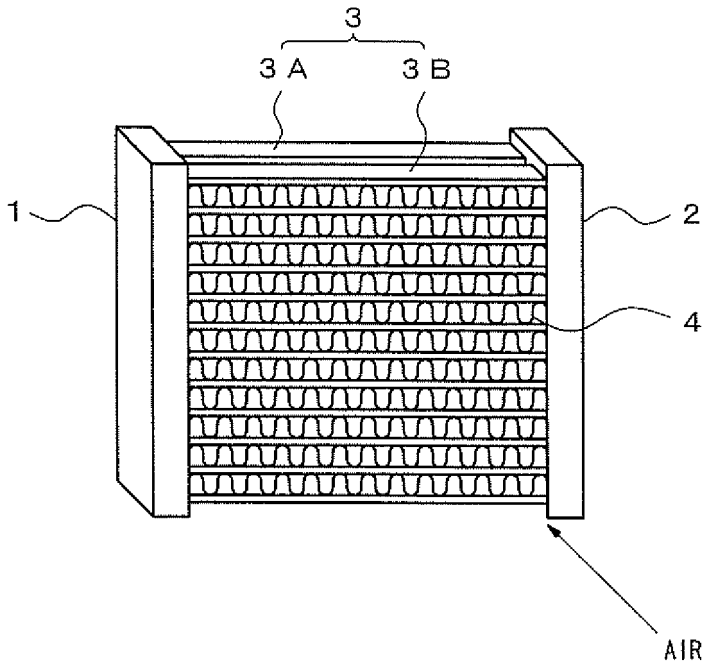
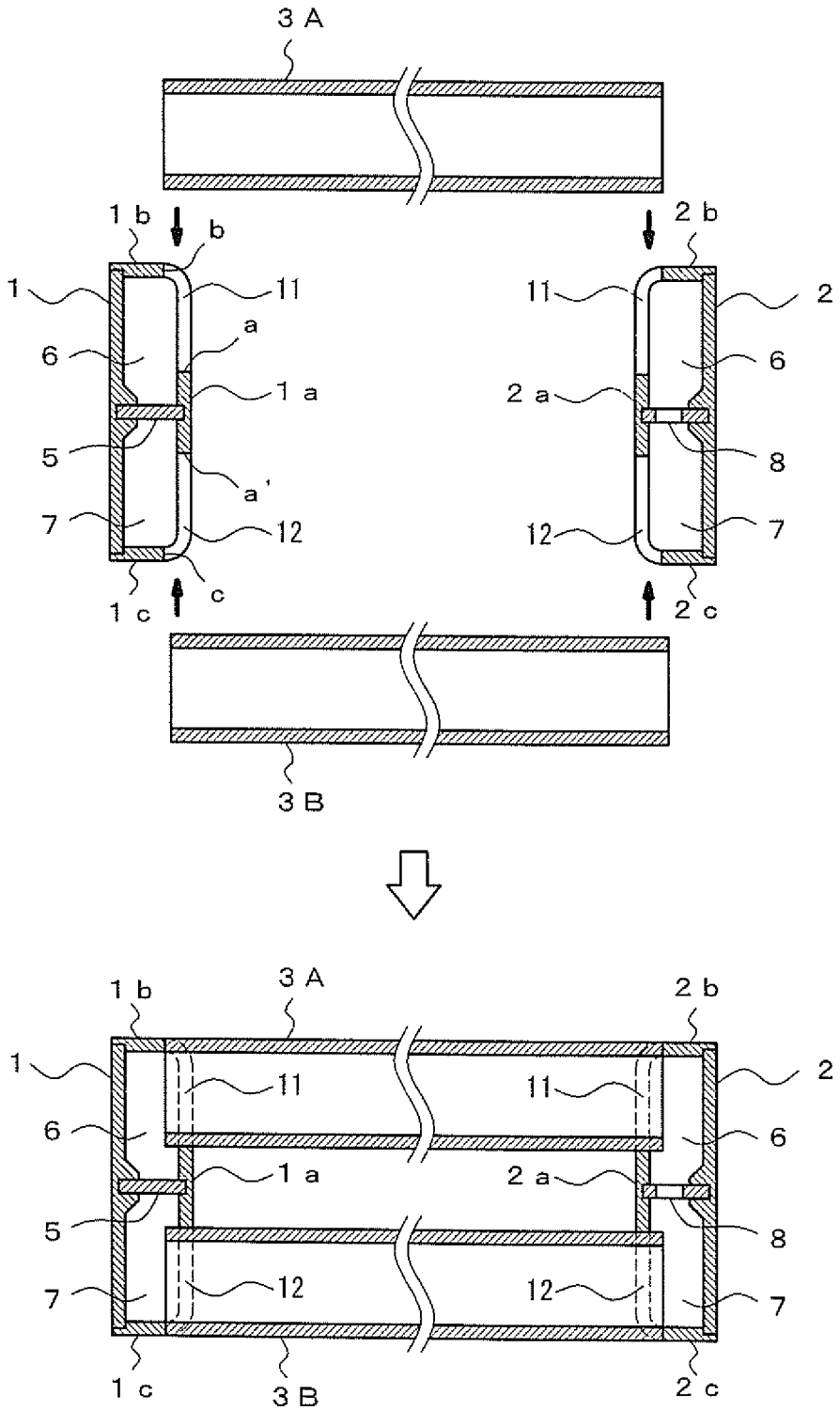


FIG.2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2 b
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11
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a
6
6
1 a
2 a
5
8
a '
7
12
12
7
1 c
c
2 c
3 B
1 b
3 A
2 b
1
11
11
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6
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2 a
5
8
7
12
12
7
1 c
3 B
2 c

FIG.3

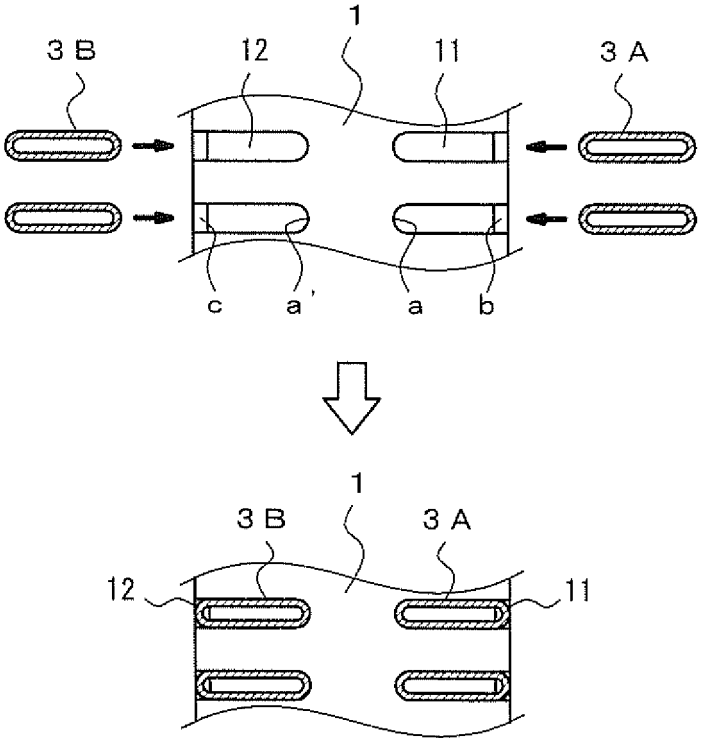
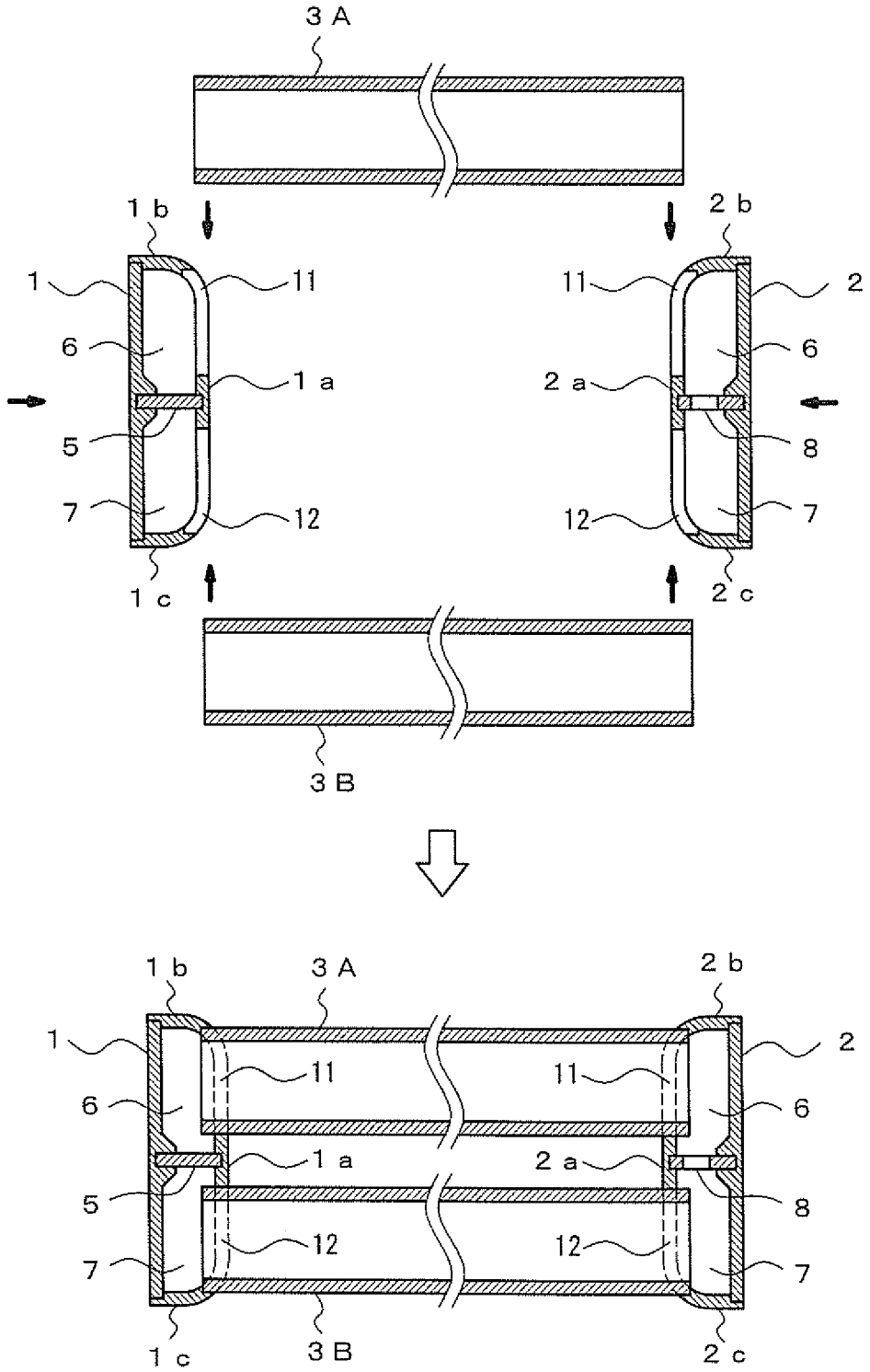


FIG.4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6
1 a
2 a
5
8
7
12
12
7
1 c
2 c
3 B
1 b
3 A
2 b
1
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11
6
6
1 a
2 a
5
8
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12
7
7
1 c
3 B
2 c

FIG.5

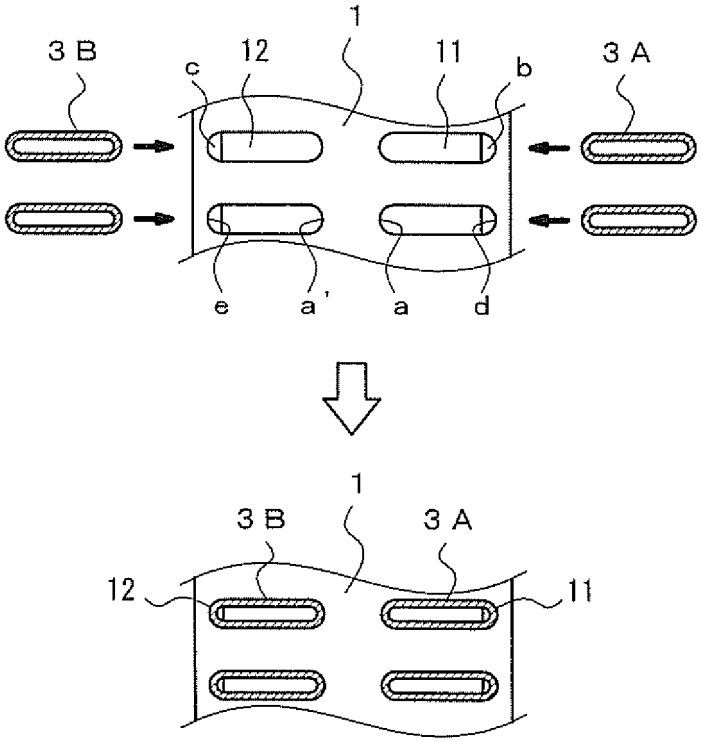


FIG.6

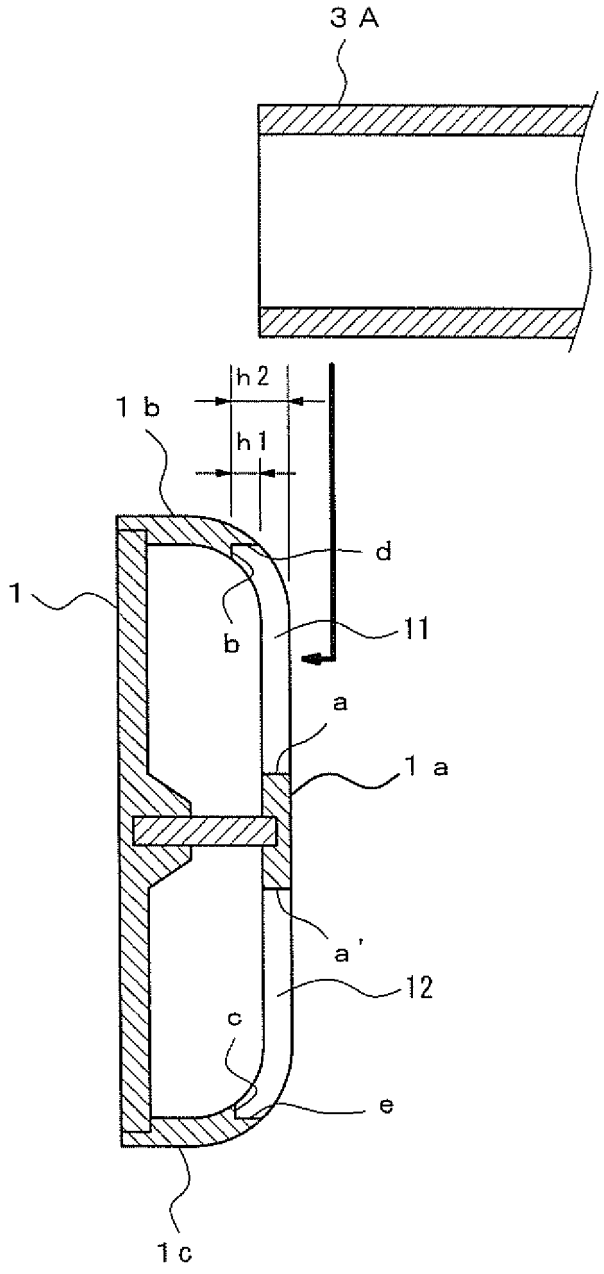
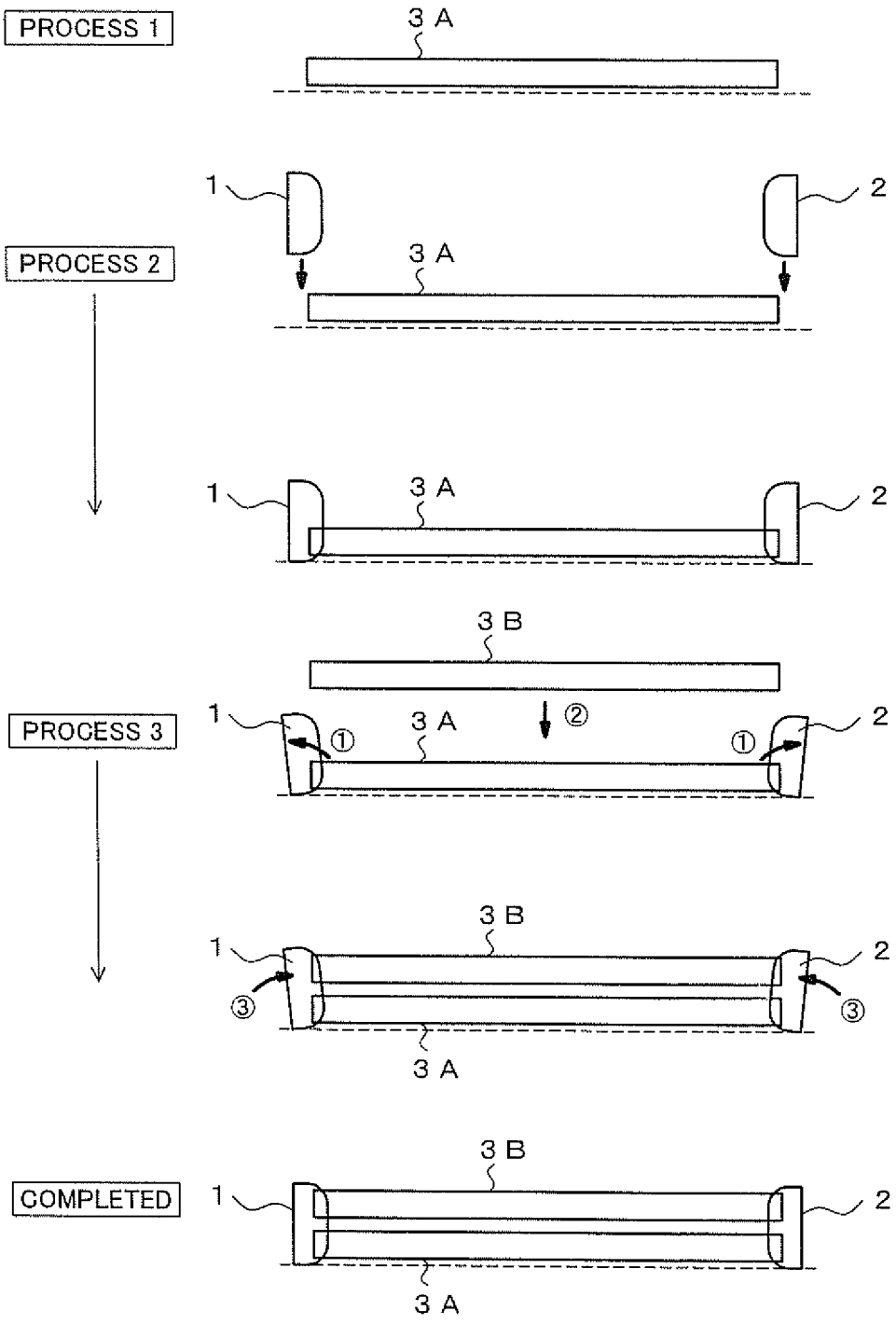


FIG.7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PROCESS 2
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3 A
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3 B
PROCESS 3
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3 A
②
①
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3 B
1
2
③
③
3 A
3 B
COMPLETED
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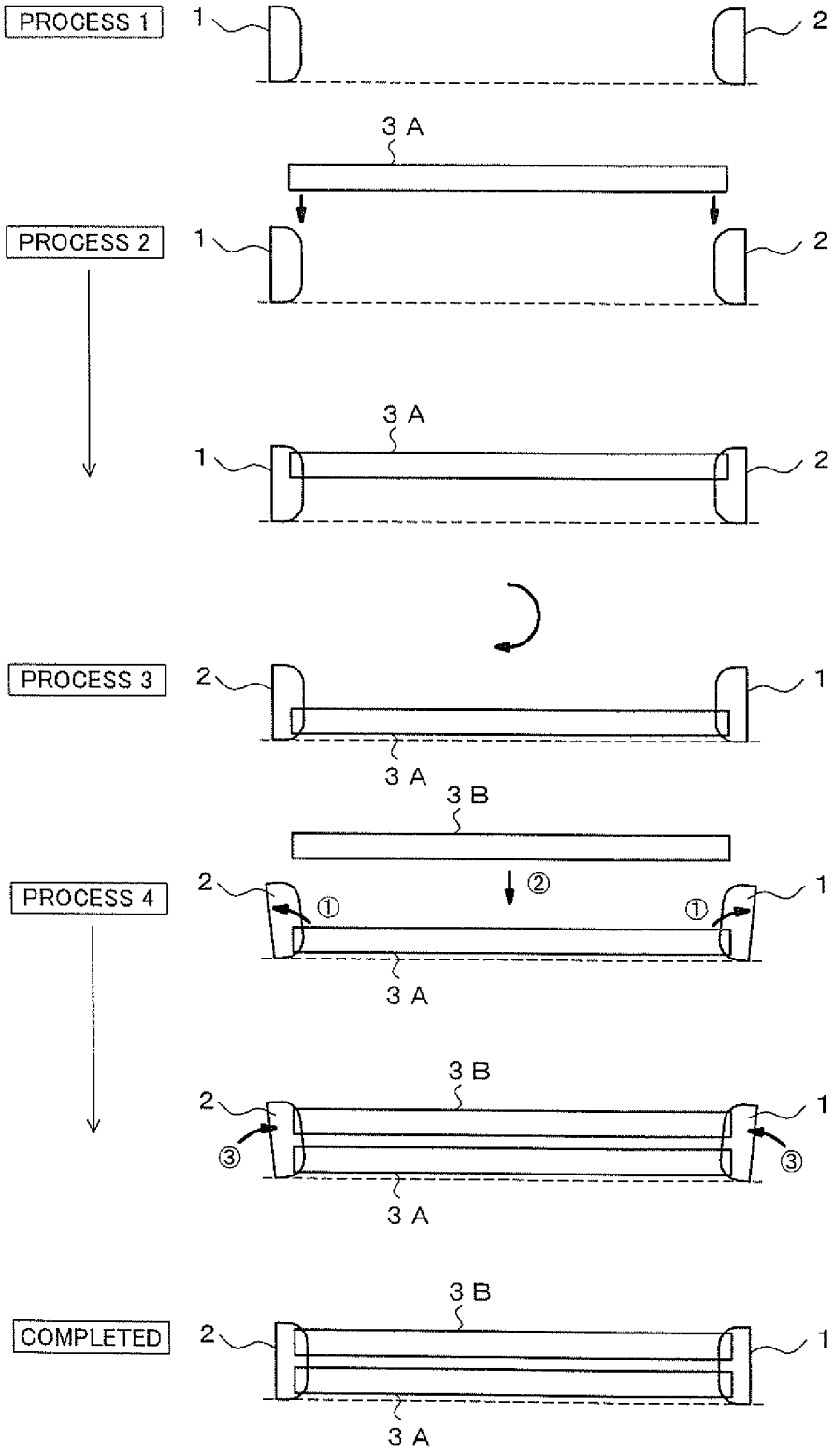
2
3 A

FIG.8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PROCESS 2
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3 A
1
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PROCESS 3
2
1
3 A
3 B
PROCESS 4
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①
②
①
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3 B
2
③
③
1
3 A
COMPLETED
3 B
2
1
3 A

FIG.9

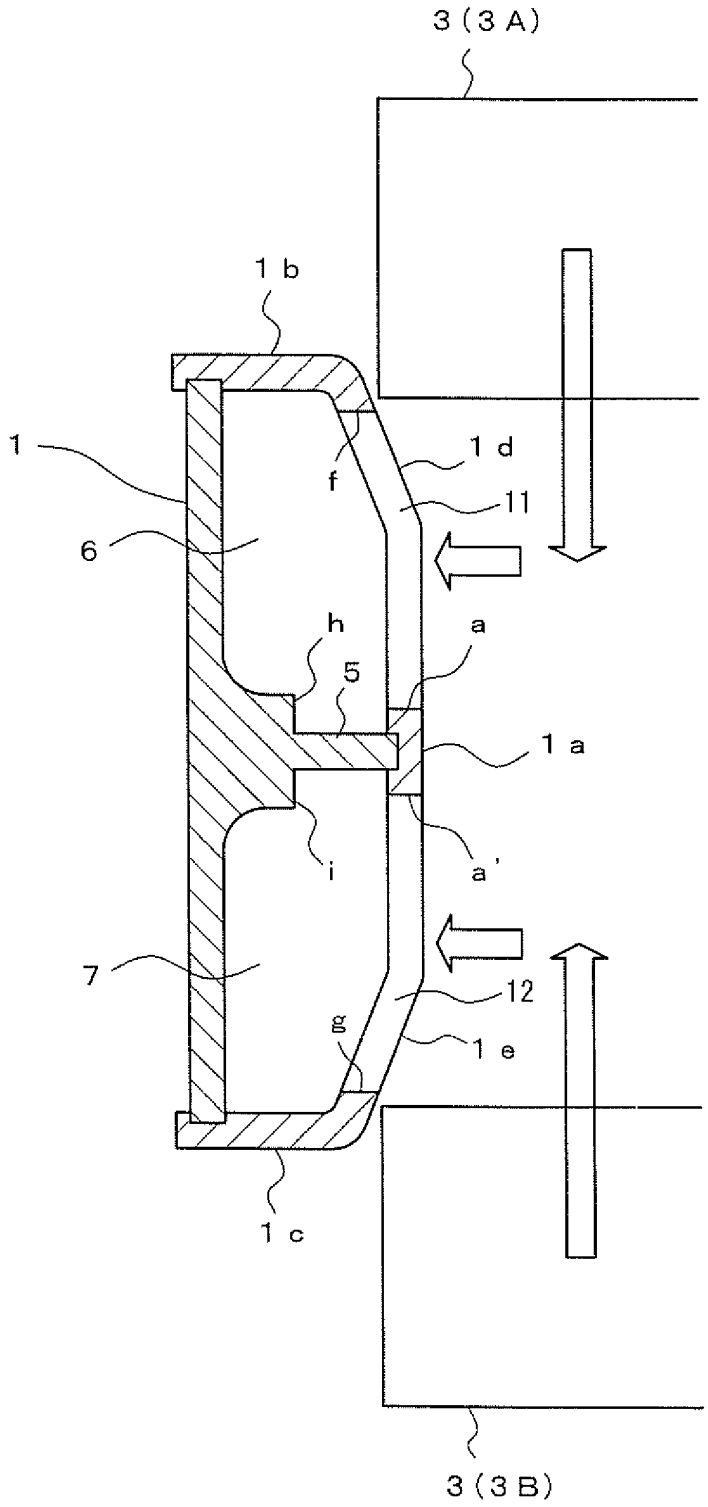


FIG.10

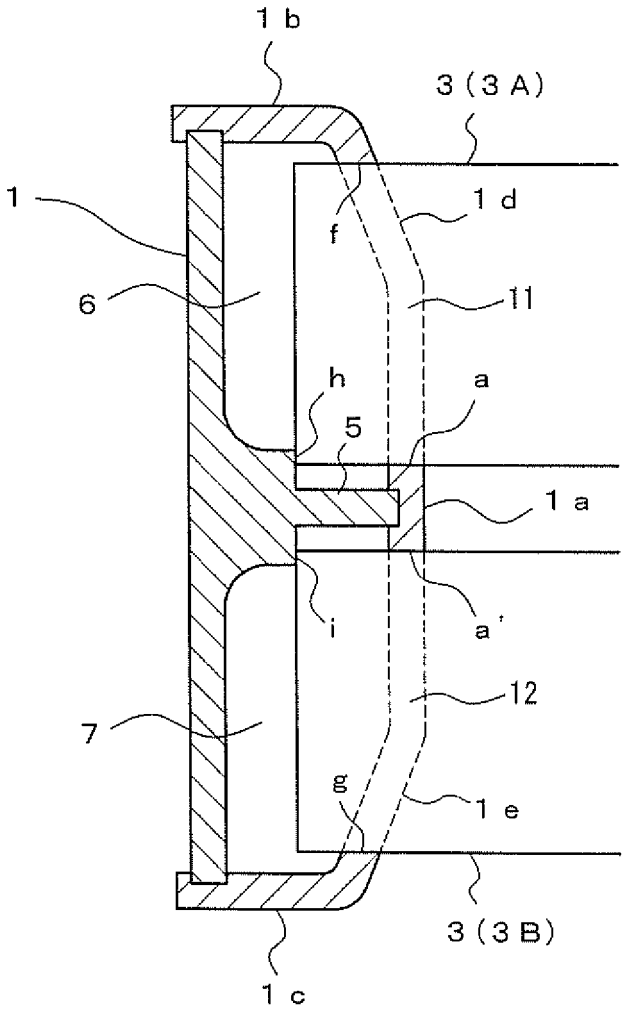


FIG.11

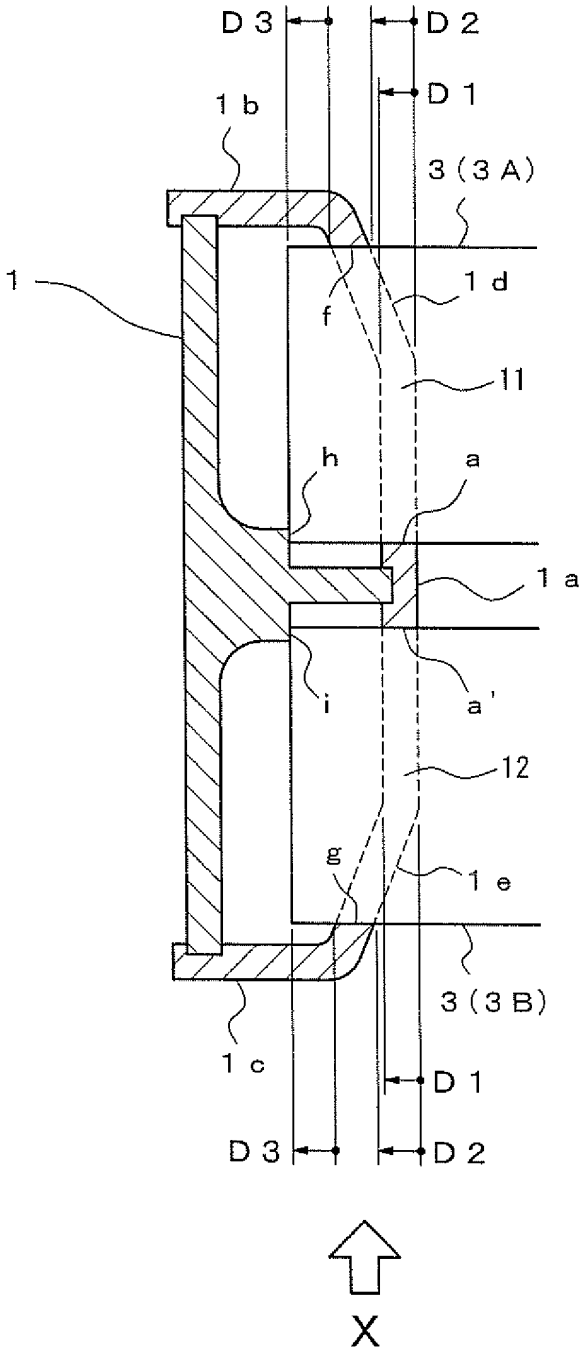
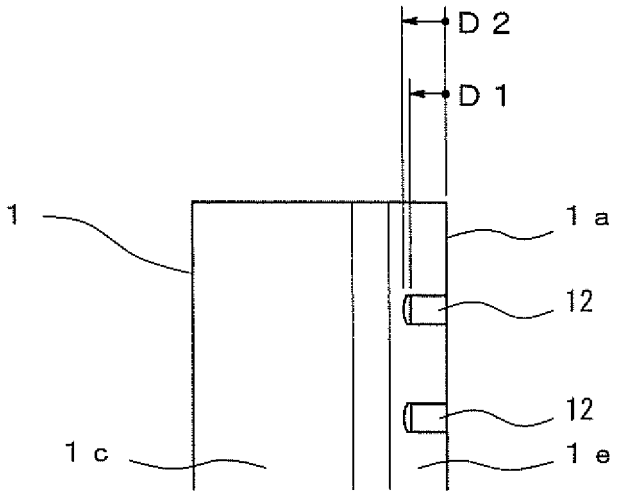


FIG.12



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/058763

A. CLASSIFICATION OF SUBJECT MATTER
F28F9/18(2006.01)i, *F28D1/053*(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)
F28F9/18, F28D1/053

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2011
Kokai Jitsuyo Shinan Koho 1971-2011 Toroku Jitsuyo Shinan Koho 1994-2011

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.
A	JP 2005-300137 A (Showa Denko Kabushiki Kaisha), 27 October 2005 (27.10.2005), fig. 2, 4, 6; paragraphs [0050] to [0057] & US 2007/0144721 A1 & EP 1654511 A1 & WO 2005/012823 A1 & KR 10-2006-0052945 A & AU 2004261893 A	1-14
A	JP 2005-265356 A (Japan Climate Systems Corp.), 29 September 2005 (29.09.2005), fig. 1; paragraphs [0030] to [0031] (Family: none)	1-14

☒ 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
23 May, 2011 (23.05.11)	07 June, 2011 (07.06.11)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/058763

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6564863 B1 (VALEO THERMIQUE MOTEUR), 20 May 2003 (20.05.2003), fig. 4 & JP 2002-543368 A & EP 1131594 A1 & WO 2000/066964 A1 & FR 2793014 A1 & ES 2306660 T	1-14
A	US 2005/0039900 A1 (VISTEON GLOBAL TECHNOLOGIES, INC.), 24 February 2005 (24.02.2005), entire text; all drawings & JP 2005-61826 A & GB 2405195 A & DE 102004040988 A1	1-14

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2003075024 A **[0003]**