(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 615 397 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.07.2013 Bulletin 2013/29

(51) Int Cl.:
F28D 1/053 *(2006.01)* ***F28F 9/02*** *(2006.01)*

(21) Application number: **13151435.8**

(22) Date of filing: **16.01.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **16.01.2012 KR 20120004993**

(71) Applicant: **Samsung Electronics Co., Ltd**
Gyeonggi-do 443-742 (KR)

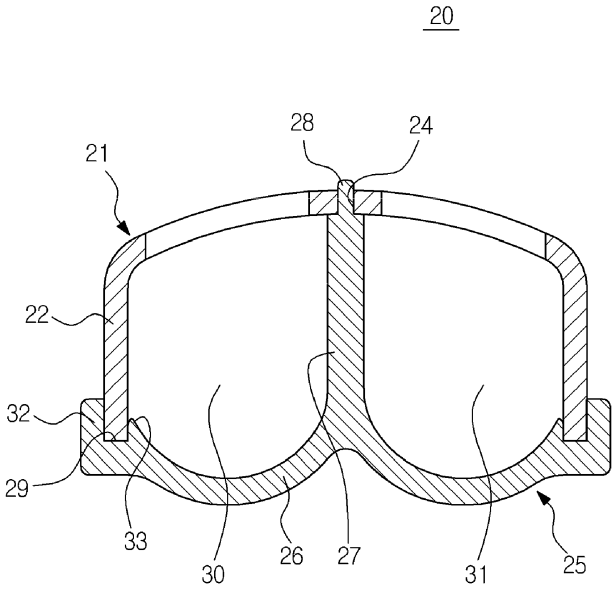
(72) Inventors:
- **Seo, Kang Tae**
  Gyeonggi-do (KR)
- **Lee, Hye Won**
  Gyeonggi-do (KR)
- **Gaku, Hayase**
  Gyeonggi-do (KR)

(74) Representative: **Walaski, Jan Filip**
Venner Shipley LLP
200 Aldersgate
London
EC1A 4HD (GB)

(54) Header unit and heat exchanger having the same

(57) A header unit having an improved assembly method of a body and a header and a heat exchanger having the same, capable of preventing a body from being incompletely bonded to a cover at an inner side of the header as a result of the instability of a manufacturing process, and thus capable of preventing the leaking of the refrigerant in between two tanks at an inside of the header. The heat exchanger includes a body, and a cover coupled to the body, wherein the body includes a base part forming a bottom surface of the body, and a middle partition protruding from the base part, and the cover includes a coupling groove to which the middle partition of the body is coupled while passing through the coupling groove.

FIG. 3



EP 2 615 397 A2

Description

[0001] The present invention relates to a header unit of a heat exchanger, and more particularly, to a header unit having an improved assembly method of a body and a header, and a heat exchanger having the same.

[0002] In general, an air conditioner is a system configured to control the heat and the humidity of the surrounding air. The heat exchange with the surrounding air is implemented by a simple cooling cycle.

[0003] The cooling cycle may be composed of a compressor, a condenser, an expansion valve, and an evaporator. The high-temperature, high-pressure refrigerant that is exited from the compressor exchanges heat with outside air at the condenser, and is phase-changed into low-temperature refrigerant, and by passing through the expansion valve afterwards, is phase-changed into low-temperature, low-pressure refrigerant. After the above, the low-temperature, low-pressure refrigerant enables indoor air to be cooled by exchanging heat with the indoor air at the evaporator.

[0004] The heat exchanger is distinguished into a heat exchanger configured to be used for automobiles and a heat exchanger configured to be used at households, depending on the place where the heat exchanger is being used. The heat exchanger configured to be used for automobiles and the heat exchanger configured to be used at households are provided with different types of refrigerants, and depending on the place at which the heat exchanger is installed, are different in operating environment such as air flow and flow rate. Thus, each heat exchanger is designed to have different material and a different size, so that each heat exchanger may be provided with an optimal heat-exchanging efficiency.

[0005] The heat exchanger includes a plurality of fins disposed in a way to be spaced from each other, and tubes configured to guide refrigerant and installed in a way to make contact with the plurality of fins, so that the air being introduced from an outside may pass through and exchange heat with the fins, and thereby a cooling operation or a heating operation may take place.

[0006] The heat exchanger, depending on the shape of the fins and the shape of the tubes, as well as the coupling relationship of the fins and the tubes, may be distinguished into a fin-and-tube type heat exchanger and a parallel-flow-type heat exchanger.

[0007] Typically, the fin-and-tube type heat exchanger is configured to use a method of stacking pressed fins and of press-fitting a plurality of circular-shape tubes to the stacked fins, and the parallel-flow-type heat exchanger is configured to bond a corrugate-shape fin in between flat elliptical-shape tubes by use of a brazing method. In general, the parallel-flow-type heat exchanger, when compared to the fin-and-tube type heat exchanger, is superior in terms of heat exchange efficiency.

[0008] For the assembly of the header unit of a conventional heat exchanger, the inner side of a cover is bonded to the body through a brazing by a surface contact, but the checking of whether the bonding has normally taken place after the brazing is difficult. In addition, in a case when the bonding has not normally taken place, a leak of refrigerant may occur in between two tanks, and thereby the reliability of the assembly may be reduced.

[0009] Therefore, it is an aspect of the present disclosure to provide a header unit having an improved assembly structure of a cover and a body, and a heat exchanger having the same.

[0010] Additional aspects of the disclosure will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the disclosure.

[0011] In accordance with one aspect of the present disclosure, a header unit includes a body and a cover. The cover may be coupled to the body. The body may include a base part and a middle partition. The base part may form a bottom surface of the body. The middle partition may be protrudedly formed from the base part. The cover may include a coupling groove to which the middle partition of the body is coupled while passing through the coupling groove.

[0012] The middle partition may include a first middle partition extended from the base part and a second middle partition extended from the first middle partition. The second middle partition may have a width narrower than a width of the first middle partition.

[0013] The second middle partition may be coupled to the coupling groove of the cover while passing through the coupling groove.

[0014] The second middle partition may be protruded by passing through the coupling groove of the cover.

[0015] The middle partition of the body may include at least one step part that includes a predetermined section having a height lower than a height of an other section of the step part.

[0016] The cover may be provided with a joint part at a position corresponding to the at least one step part of the middle partition.

[0017] The second middle partition may be protrudedly formed at the first middle partition. The coupling groove of the cover may have a width of about 1mm or above and about 2 mm or below.

[0018] The middle partition may have a width of about 2mm or above and about 3mm or below.

[0019] The base part of the body may include a mounting groove. The cover may include a support part. At least one portion of the support part of the cover may be inserted into the mounting groove.

[0020] The mounting groove of the body may include an outside partition part and an inside partition part that are protrudedly formed from the base part.

[0021] The outside partition part may be formed by being protruded to be higher than the inside partition part.

[0022] In accordance with another aspect of the present disclosure, a heat exchanger includes a first header unit, a second header unit, a plurality of flat-type micro-channel tubes and a plurality of plate-shape fins.

The first header unit may allow a refrigerant inlet pipe and a refrigerant outlet pipe to be connected thereto. The second header unit may be disposed in parallel to the first header unit while being spaced apart from the first header unit by a predetermined distance. The plurality of flat-type micro-channel tubes may be arranged in a front row and a rear row in between the first header unit and the second header unit, the plurality of flat-type micro-channel tubes having a micro channel. The plurality of plate-shape fins may be provided with slots arranged in a front row and a rear row, so that the flat-type micro-channel tubes of the front row and the rear row are inserted into the slots. Each of the first header unit and the second header unit may include a body and a cover. The cover may be coupled to the body. The body may include a middle partition that may be configured to divide the first header unit into a first header and a second header, and to divide the second header unit into a third header and a fourth header, while the cover includes a coupling groove. The middle partition may be coupled to the coupling groove of the cover.

[0023] The middle partition may include a first middle partition and a second middle partition. The first middle partition may be extended from a base part that forms a bottom surface of the body. The second middle partition may be protrudedly formed from the first middle partition.

[0024] At least one portion of the second middle partition may be protruded by passing through the coupling groove of the cover.

[0025] The middle partition of the body may include at least one step part that includes a predetermined section having a height lower than a height of an other section of the step part. The cover may be provided with a joint part at a position corresponding to the at least one step part of the middle partition.

[0026] The first header unit may be divided into the first header and the second header by the middle partition, and a refrigerant inlet pipe may be connected to one of the first header and the second header, while a refrigerant outlet pipe may be connected to the remaining one of the first header and the second header.

[0027] The heat exchanger may further include at least one partition panel installed lengthwise along the body and the cover, wherein at least one portion of the partition panel may be inserted into the middle partition of the body.

[0028] As described above, a header unit and a heat exchanger having the same can prevent a middle partition of a body from being incompletely bonded to an inner side of a cover as a result of the instability of a manufacturing process, and in a case when the middle partition of the body and the inner side of the cover are incompletely bonded to each other, a manufacturer may be able to detect such, and thus a manufacturing of a defected product having a possibility of refrigerant leaking to an outside may be prevented in advance.

[0029] These and/or other aspects of the disclosure will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

FIG. 1 is a perspective view schematically illustrating a heat exchanger in accordance with one embodiment of the present disclosure;

FIG. 2 is a perspective view illustrating a header unit in accordance with one embodiment of the present disclosure;

FIG. 3 is a cross-sectional view illustrating an assembled state of a body and a cover in accordance with one embodiment of the present disclosure;

FIG. 4 is a perspective view of a body of the header unit in accordance with one embodiment of the present disclosure;

FIG. 5 is a perspective view illustrating a coupled state of a refrigerant inlet port and a refrigerant outlet port at the header unit in accordance with one embodiment of the present disclosure;

FIG. 6 is a cross-sectional view illustrating an assembled state of a body and a cover in accordance with another embodiment of the present disclosure; and

FIG. 7 is a cross-sectional view of an assembled state of a body and a cover in accordance with still another embodiment of the present disclosure.

[0030] Reference will now be made in detail to the embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout.

[0031] FIG. 1 is a perspective view schematically illustrating a heat exchanger in accordance with one embodiment of the present disclosure.

[0032] As illustrated in FIG. 1, a heat exchanger 1 may be used to exchange heat with indoor air. Particularly, a condenser installed at a building is distinguished from a condenser being installed at an automobile. In a case of the condenser being installed at an automobile, automobile-purpose refrigerant, such as R-12 or R-134a, which is provided with a maximum operating pressure for a cooling-purpose only of x 3: 60-70 kg/cm^2, is used. However, in the case of the heat exchanger 1 illustrated in FIG. 1, refrigerant of a household-purpose air conditioner, such as R-22 or R-410A, which is provided with a maximum operating pressure for a cooling/heating-purpose of x 3: 130-140 kg/cm^2, is used. Depending on the type of refrigerant and the addition of the cooling/heating functions as the above, a difference may occur with respect to the pressure of the gas being used, and thus heat exchangers are provided with different shapes and structures. Hereinafter, the heat exchanger 1 is using the refrigerant of a household-purpose air conditioner, such as R-22 or R-410A.

[0033] The heat exchanger 1 includes a pair of header units 10 and 20, and micro-channel tubes 2 and 3 as well as fins 7 disposed in between the pair of header units 10 and 20. The header unit of the pair of the header units

10 and 20 positioned at a lower side is referred to as a first header unit 20, and the header unit of the pair of the header units 10 and 20 positioned at an upper side is referred to as a second header unit 10.

[0034] The first header unit 20 and the second header unit 10 are disposed on top of one another while having a predetermined distance between them. On the opposing surfaces of the first header unit 20 and the second header unit 10 that are facing each other, tube coupling parts (not shown), which are perforated while having the sizes that correspond to the cross sections of the micro-channel tubes 2 and 3 so that the micro-channel tubes 2 and 3 are coupled to the tube coupling parts, are formed.

[0035] The first header unit 20 and the second header unit 10 each include a front tank 30 and a rear tank 31 that are separated by middle partitions 27 and 28, and the front tank 30 and the rear tank 31 each may be divided into an upper portion and a lower portion by a baffle (not shown).

[0036] In between the first header unit 20 and the second header unit 10, the micro-channel tubes 2 and 3, which are configured to guide refrigerant by communicating the first header unit 20 with the second header unit 10, are installed.

[0037] The micro-channel tubes 2 and 3 are the paths through which refrigerant passes. The refrigerant is circulated while being compressed or expanded inside an air conditioner, thereby enabling a cooling/heating. The micro-channel tubes 2 and 3 are spaced apart by a predetermined distance in a vertical manner, and may be arranged into two rows having a front row and a rear row.

[0038] Meanwhile, the first header unit 20 is connected to a refrigerant inlet pipe 4 configured to inlet refrigerant, and a refrigerant outlet pipe 5 configured to discharge a refrigerant having completed heat exchange while passing through the micro-channel tubes 2 and 3. Although the refrigerant inlet pipe 4 and the refrigerant outlet pipe 5 in accordance with one embodiment of the present disclosure are provided at the first header unit 20, the present disclosure is not limited hereto.

[0039] The fins 7 are installed to be in contact with the micro-channel tubes 2 and 3, and may be provided in a way that a portion configured to discharge or absorb heat may be widened. The heat of the refrigerant that flows at an inside of the micro-channel tubes 2 and 3 is delivered to the air flowing at the surroundings of the fins 7 by passing through the micro-channel tubes 2 and 3 and the fins 7, and is easily radiated to an outside. On the contrary, the heat of the air flowing at the surroundings of the fins 7 is easily delivered to the refrigerant by passing through the fins 7 and the micro-channel tubes 2 and 3 in the same manner as above.

[0040] The fins 7 are disposed in parallel to the flow direction of the air while having a certain distance from each other. By the above, the air, without having much of resistance against the fins 7, may flow while exchanging heat by grazing on the surface of the fins 7.

[0041] On the surfaces of the fins 7, louvers (not shown) or slits (not shown) may be formed so that the heat transfer efficiency may be increased by enlarging the area of the fin 7 that makes contact with air. Both of the louvers and the slits may be formed.

[0042] FIG. 2 is a perspective view illustrating a header unit in accordance with one embodiment of the present disclosure, FIG. 3 is a cross-sectional view illustrating a cross section of an assembled state of a body and a cover in accordance with one embodiment of the present disclosure, and FIG. 4 is a perspective view of a body of the header unit in accordance with one embodiment of the present disclosure. As illustrated in FIGS. 2 to 4, the header units 10 and 20 each are provided with a body 25 assembled to a cover 21.

[0043] The body 25 is composed of a base part 26 forming a bottom surface, and middle partitions 27 and 28 protrudedly formed from the base part 26. As illustrated on the drawing, the base part 26 of the body 25 may be formed in the shape of "ω," but not limited hereto. By the middle partitions 27 and 28 of the body 25, the space within the body may be divided into a front tank 30 and a rear tank 31.

[0044] The cover 21 may include a support part 22. The cover 21 is provided to have a cross sectional shape of an approximate letter C tilting to one side. In addition, the cover 21 may include a coupling groove 23 into which the middle partitions 27 and 28 of the body 25 may penetratively be inserted. The width of the coupling groove 23 may be about 1mm or above and about 2mm or below.

[0045] The middle partitions 27 and 28 of the body 25 are protruded from a center of the base part 26 toward an upper side direction, and are inserted into the support part 22. An upper end of the middle partitions 27 and 28 may be protruded toward an outer side of the cover 21 by passing through the coupling groove 23 of the cover 21. The widths of the middle partitions 27 and 28 each may be about 2mm or above and about 3mm or below, such that the middle partitions 27 and 28 are inserted into the coupling groove 23 of the cover 21, and at the same time, to secure the strength with respect to the inner pressure of the refrigerant.

[0046] The middle partitions 27 and 28 of the body 25 are bonded to the cover 21 through a brazing method, and for such, at the surroundings of the coupling groove 23 of the cover 21, welding material may be provided. The middle partition 27 provided at the first header unit 20 divides the first header unit 20 into a first header and a second header while sealing the first header and the second header with respect to each other. The middle partition 27 provided at the second header unit 10 divides the second header unit 10 into a third header and a fourth header while sealing the third header and the fourth header with respect to each other.

[0047] At an edge of each side of the body 25, a mounting groove 29 may be provided. The support part 22 of the cover 21 is inserted into the mounting groove 29 of the body 25. That is, the mounting groove 29 of the body

25 is composed of an outside partition part 32 and an inside partition part 33 to form a groove having a predetermined depth, and in between the outside partition part 32 and the inside partition part 33, the support part 22 of the cover 21 is inserted. The outside partition part 32, when compared to the inside partition part 33, protrudes further towards an upper side from the base part 26. As the above, the structure of the body 25 supporting the outer surface and the inner surface of the cover 21 may be capable of securing the strength with respect to the inner pressure of the refrigerant.

[0048] In accordance with one embodiment of the present disclosure, the middle partitions 27 and 28 may include a first middle partition 27 and a second middle partition 28, also referred to herein as a first partition portion 27 and a second partition portion 28, or as lower and upper parts 27, 28 of the middle partition. The first middle partition 27 is extended from the base part 26, and the second middle partition 28 is extended from the first middle partition 27. The second middle partition 28 is inserted by passing through the coupling groove 23 of the cover 21. The end portion of the second middle partition 28 may be protruded toward an outer side of the coupling groove 23. Since a step is formed at the second middle partition 28 such that the first middle partition 27 is formed, the coupling strength of the cover 21 and the body 25 may be increased. In addition, since the second middle partition 28 is narrower than the first middle partition 27, then when the cover 21 is assembled to the body 25, the lip formed by the step between the first middle partition 27 and the second middle partition 28 may serve as a stopper or seat for the cover.

[0049] As illustrated in FIG. 4, the middle partitions 27 and 28 of the body 25 may include at least one step part 34. The step part 34 refers to a portion including a predetermined section having a height lower than a height of the rest of the second middle partition 28. In other words, the second middle partition is discontinuously formed along the length of the first middle partition 27, with gaps 34 between lengths of the second middle partition 28.

[0050] In addition, the cover 21 is provided with a joint part 24, also referred to as a cover portion, at a position that corresponds to the step part 34 of the body 25. The joint part 24 is positioned in between the coupling grooves 23, and is present in a state of being blocked. Because of such, the deformation in between the cover 21 and the body 25 may be prevented. The joint part 24 may be integrally injection-molded with the cover 21 when the cover 21 is being injection-molded. In other words, the cover 21 may be an integral unit with a plurality of discrete coupling grooves 23 running along its length, the coupling grooves 23 receiving the middle partition 27, 28 of the body 25, and the cover portions 24 between the grooves 23 being arranged to fit into the step parts 34 formed in the middle partition 27, 28.

[0051] FIG. 5 is a perspective view illustrating a coupled state of a refrigerant inlet port and a refrigerant outlet port at the header unit in accordance with one embodiment of the present disclosure.

[0052] A plurality of partition panels are installed at both end portions of each of the header units 10 and 20, and enables each of the header units 10 and 20 to be sealed. In addition, the plurality of partition panels that is positioned at each of the header units 10 and 20 may be used such that the refrigerant is divided for circulation.

[0053] A plurality of refrigerant inlet pipes 4 may be provided, and may be connected to one of the both tanks of the first header unit 20. The refrigerant outlet pipe 5 may be connected to at least one of the tanks of the first header unit 20.

[0054] In between the refrigerant outlet pipe 5 and the support part 22, a first connection pipe 9 may be inserted. The refrigerant outlet pipe 5 is formed of, for example, copper while the cover 21 is formed of aluminum, and in order to prevent corrosion between the two materials, in between the cover 21 and the refrigerant outlet pipe 5, the first connection pipe 9 formed of, for example, stainless steel is provided.

[0055] In order for the refrigerant outlet pipe 5 to be solidly supported at the support part 22 of the cover 21, a first reinforcing member 6 configured to support the refrigerant outlet pipe 5 may be installed. The first reinforcing member 6 is formed with aluminum. The first connection pipe 9 is provided also in between the first reinforcing member 6 formed of aluminum and the refrigerant outlet pipe 5 formed of copper.

[0056] As for the refrigerant inlet pipe 4 to be solidly supported at the support part 22 of the cover 21, in addition to the first reinforcing member 6 that supports the refrigerant outlet pipe 5, a second reinforcing member (not shown) may be installed. The second reinforcing member (not shown) may be formed of aluminum. The second connection pipe 8 is provided also in between the second reinforcing member (not shown) formed of aluminum and the refrigerant inlet pipe 4 formed of copper.

[0057] The diameter of the refrigerant outlet pipe 5 may be formed to be greater than the diameter of the refrigerant inlet pipe 4, as to prevent the loss of pressure occurring when the volume of the refrigerant in a liquid state is increased as the refrigerant is changed into a gas state through the heat exchange. Through such, by reducing the flow resistance of the refrigerant, the refrigerant is made to flow smoothly.

[0058] FIG. 6 is a cross-sectional view illustrating a cross section of an assembled state of a body and a cover in accordance with another embodiment of the present disclosure, and FIG. 7 is a cross-sectional view of a cross section of an assembled state of a body and a cover in accordance with still another embodiment of the present disclosure. The embodiments of the present disclosure illustrated in FIG. 6 and FIG. 7 are the same as the embodiments of the present disclosure illustrated in FIGS. 1 to 5 except for the shapes of middle partitions 47, 67, and 68.

[0059] In the case of the embodiment of the present disclosure illustrated on FIG. 6, a step is not present at the middle partition 47. The shape of the middle partition is not needed to be modified, thereby having a benefit with respect to manufacturing the middle partition 47.

[0060] In the case of the embodiment of the present disclosure illustrated on FIG. 7, a protrusion part 68 is present at the middle partition 67. The protrusion part 68, just as similar to the second middle partition illustrated on FIGS. 1 to 5, may be able to serve as a stopper.

[0061] As above, the shape of the middle partition may be variously changed, and since the middle partition 47, 67 is inserted through coupling grooves 43 and 63 of covers 41 and 61, the normal coupling of the cover 41 and a body 45 may be determined during an assembly process. According to such, a product, which is provided with a possibility of refrigerant leaking in between front tanks 50 and 70 and rear tanks 51 and 71 that are provided at an inside of header units 40 and 60 when the cover 41 is not properly bonded to the body 45, may be prevented from being manufactured.

[0062] As discussed above, undescribed reference numerals 42, 62, 52, 72, 49, 69, 53, 73, 46 and 66 correspond to the support part 22, outside partition part 32, mounting groove 29, inside partition part 33 and base part 26 of the embodiments shown in FIGS. 1 to 5.

[0063] Although a few embodiments of the present disclosure have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles of the invention, the scope of which is defined in the claims.

Claims

1. A header unit (10, 20) for a heat exchanger, comprising:

a body (25, 45, 65); and
a cover (21, 41, 61) coupled to the body,
wherein the body comprises a base part (26, 46, 66) and a middle partition (27, 28, 47, 67), and the cover comprises a coupling groove (23) arranged to engage with the middle partition.

2. The header unit of claim 1, wherein:

the middle partition comprises a first partition portion (27) extending from the base part and a second partition portion (28) extending from the first partition portion (27); and
the second partition portion (28) is narrower than the first partition portion (27).

3. The header unit of claim 2, wherein:

the second partition portion (28) is coupled to the coupling groove (23)and passes through the coupling groove.

4. The header unit of claim 3, wherein:

the second partition portion (28) protrudes through the coupling groove.

5. The header unit of any one of the preceding claims, wherein:

the middle partition comprises at least one step part (34) that comprises a predetermined section having a height lower than a height of other sections of the middle partition.

6. The header unit of claim 5, wherein:

the cover is provided with a joint part (24) at a position corresponding to the at least one step part of the middle partition.

7. The header unit of claim 1, further comprising a protrusion part (68) extending laterally from the middle partition (67), on which the cover (61) is seated.

8. The header unit of any one of the preceding claims, wherein:

the coupling groove of the cover has a width between 1mm and 2 mm.

9. The header unit of any one of the preceding claims, wherein:

the middle partition has a width between 2mm and 3mm.

10. The header unit of any one of the preceding claims, wherein:

the base part of the body comprises a mounting groove (29);
the cover comprises a support part (22); and
at least one portion of the support part is inserted into the mounting groove.

11. The header unit of claim 10, wherein:

the mounting groove comprises an outside partition part (32) and an inside partition part (33) that extend from the base part.

12. The header unit of claim 11, wherein:

the outside partition part extends higher than the inside partition part.

13. A heat exchanger, comprising:

a first header unit (20) to which a refrigerant inlet pipe and a refrigerant outlet pipe are connected;
a second header unit (10) disposed in parallel with and spaced apart from the first header unit;
a plurality of flat micro-channel tubes arranged in a front row and a rear row in between the first header unit and the second header unit, the plurality of flat micro-channel tubes having a micro channel; and
a plurality of plate-shape fins provided with slots arranged in a front row and a rear row, so that the flat micro-channel tubes of the front row and the rear row are inserted into the slots,
wherein each of the first header unit and the second header unit comprises a header unit according to any one of the preceding claims.

14. The heat exchanger of claim 13, wherein:

the first header unit is divided into the first header and the second header by the middle partition, and a refrigerant inlet pipe is connected to one of the first header and the second header, while a refrigerant outlet pipe is connected to the other of the first header and the second header.

15. The heat exchanger of claim 14, further comprising:

at least one partition panel installed lengthwise along the body and the cover,
wherein at least one portion of the partition panel is inserted into the middle partition of the body.

FIG. 1

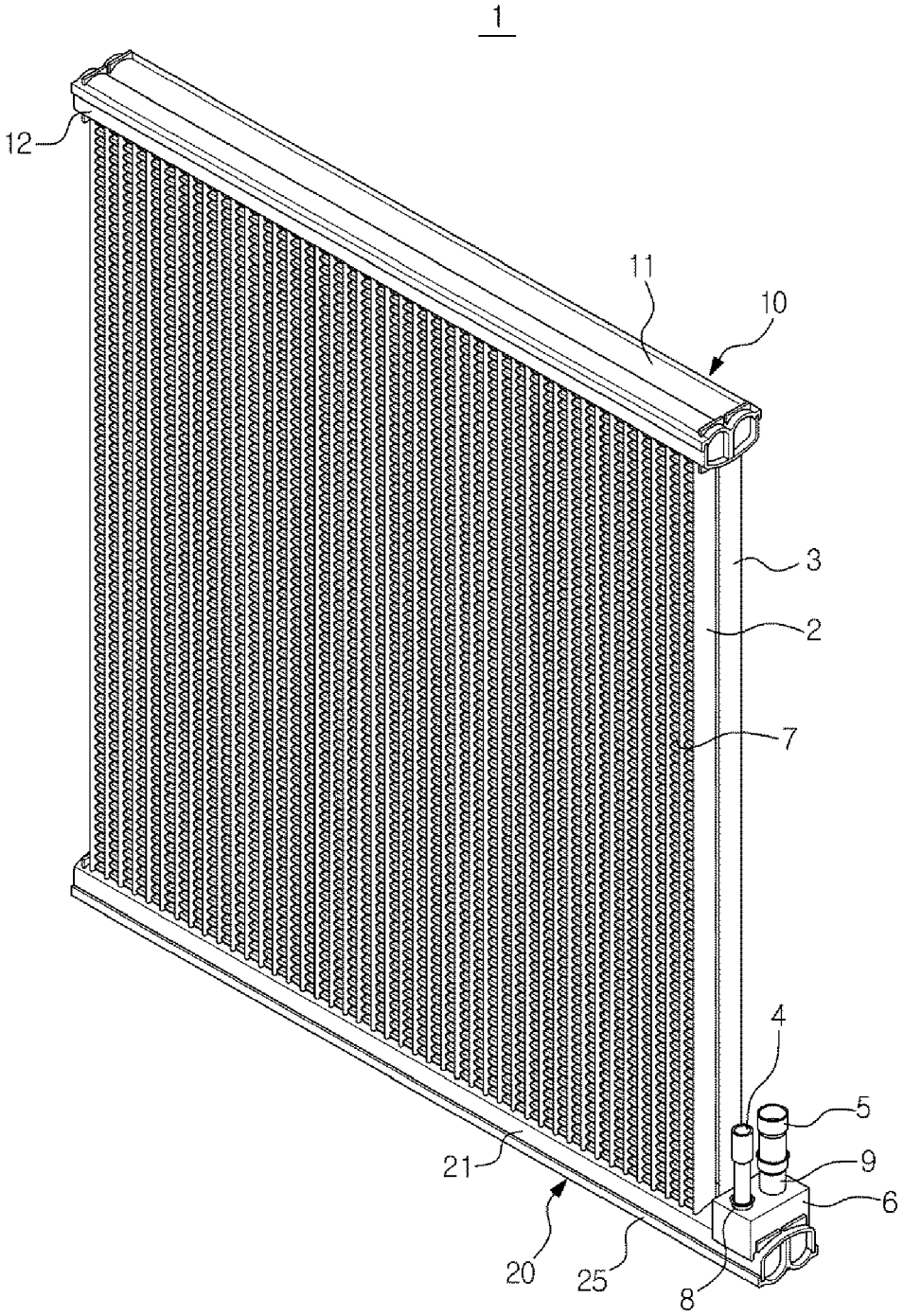


FIG. 2

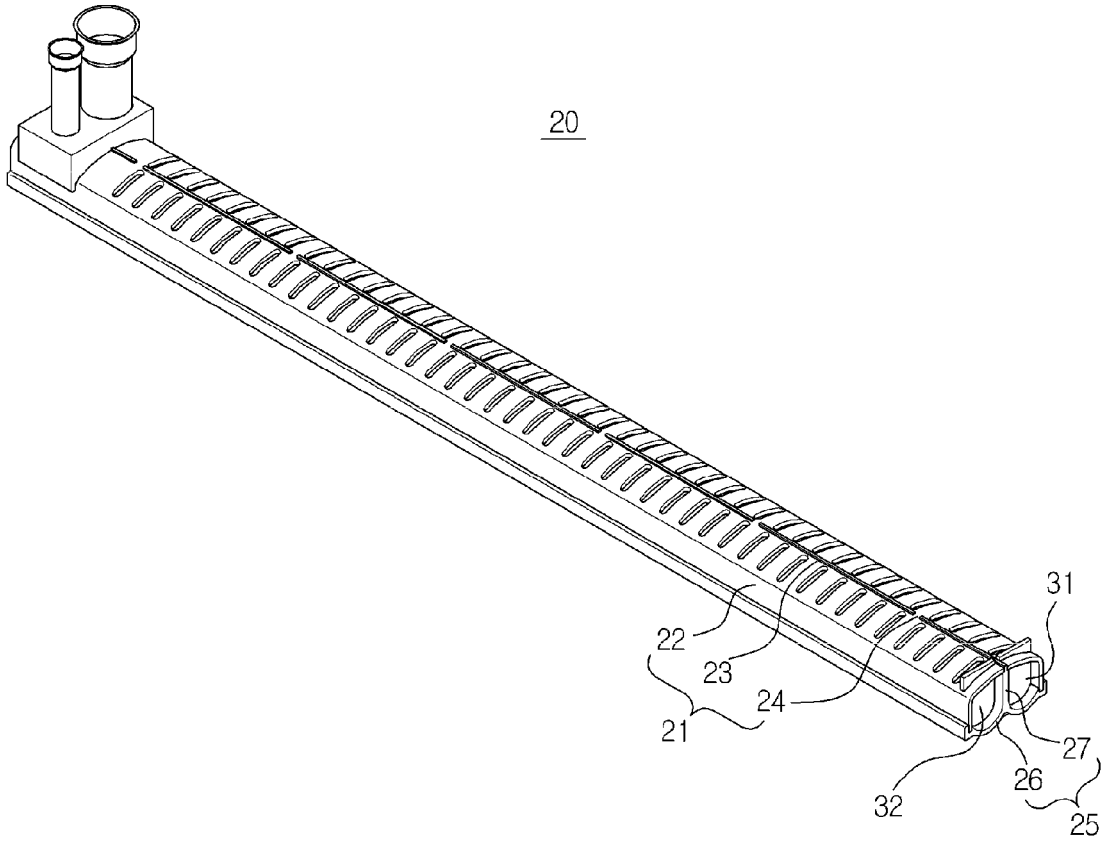


FIG. 3

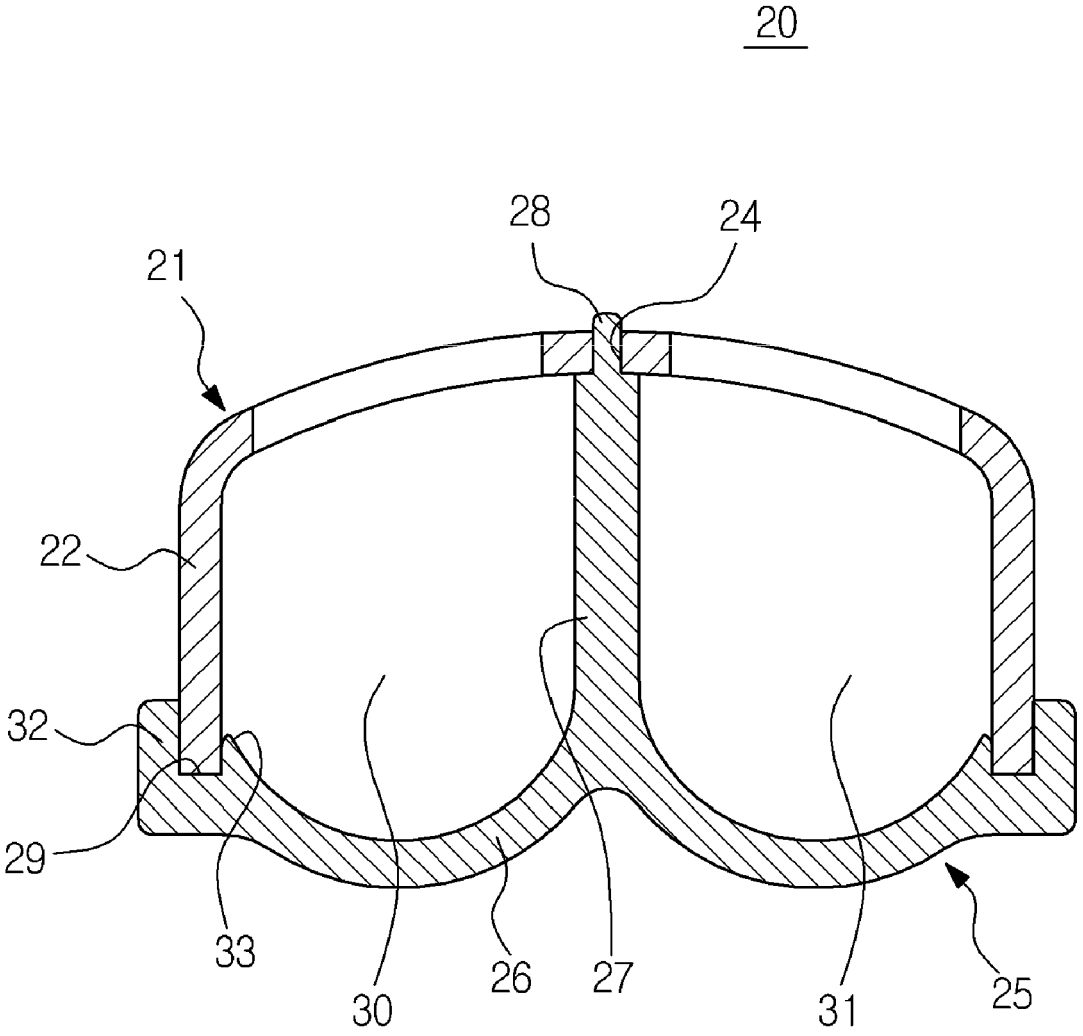


FIG. 4

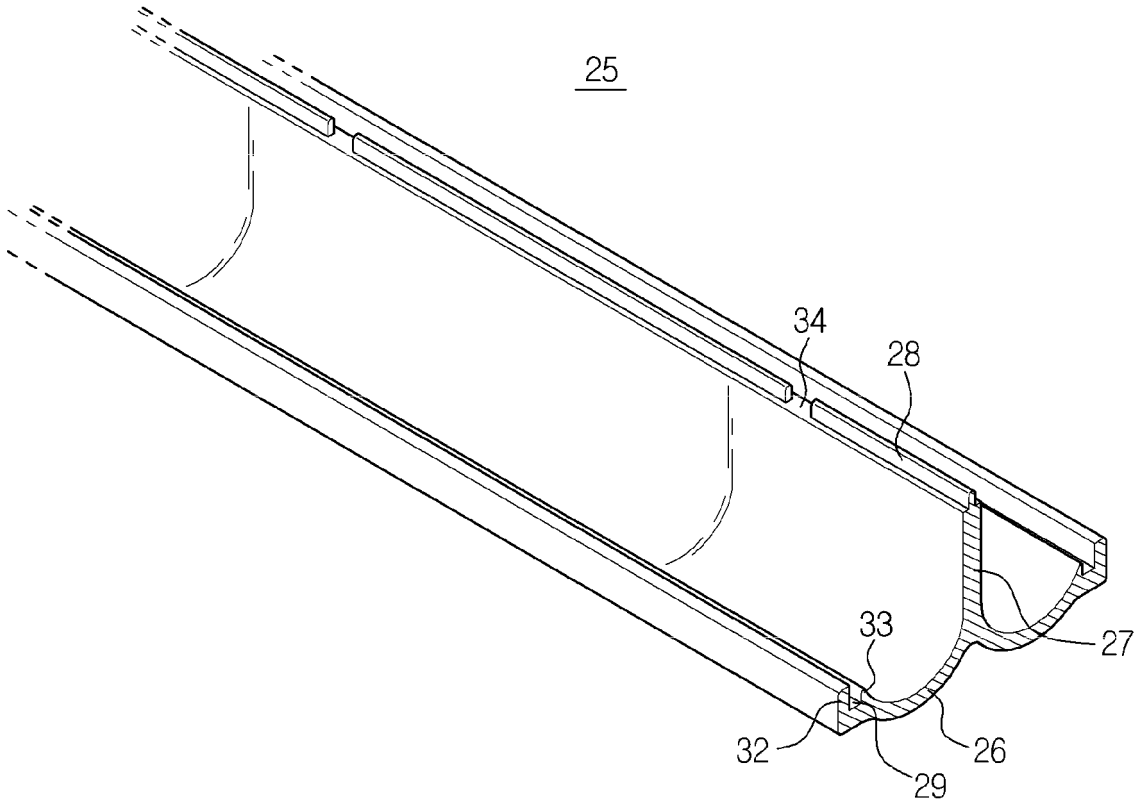


FIG. 5

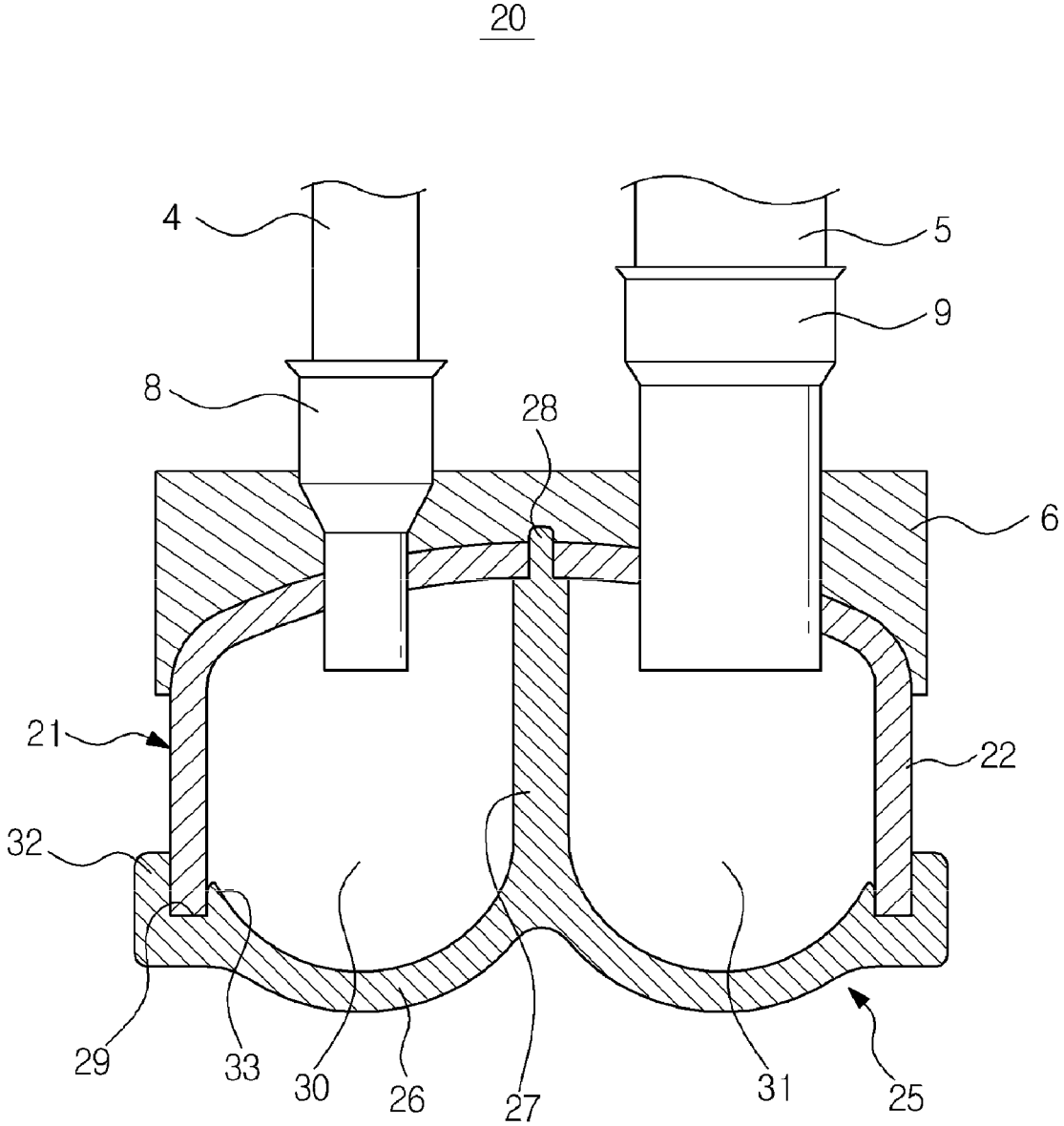


FIG. 6

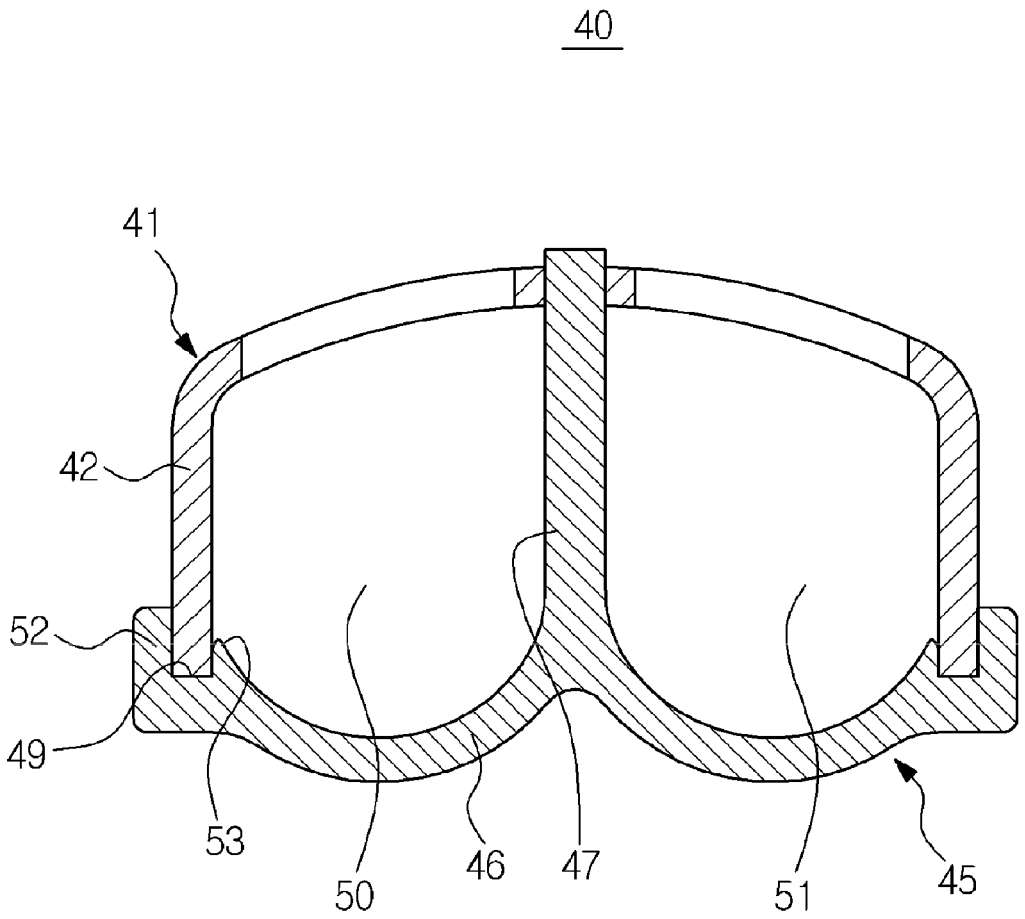


FIG. 7