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Jeon

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(54) **HEADER TANK OF HEAT EXCHANGER**

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F28D 1/053 (2006.01)

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(58) **Field of Classification Search**
CPC F28F 9/0246; F28D 1/05391
See application file for complete search history.

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(57) **ABSTRACT**

The present invention relates to a header tank provided in a heat exchanger having a two-row structure in which core parts are provided in two rows, and to a header tank having a structure in which a first tank is coupled to a header, and a second tank is coupled to be spaced apart from the first tank at a predetermined interval, such that condensate water condensed on surfaces of the core parts may be discharged between the first tank and the second tank, thereby satisfying all of pressure resistance of the header tank, temperature distribution of the core parts, and cooling performance of the heat exchanger.

14 Claims, 10 Drawing Sheets

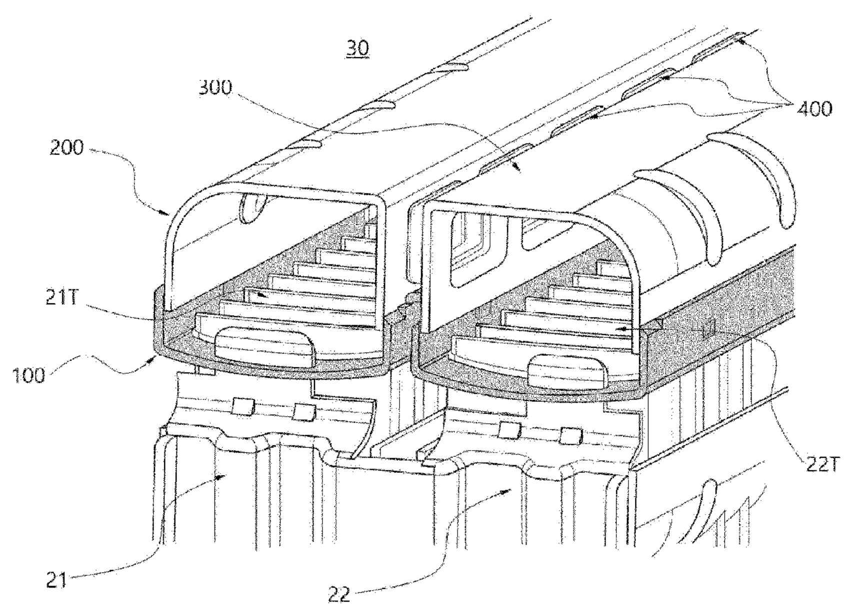

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FIG. 1

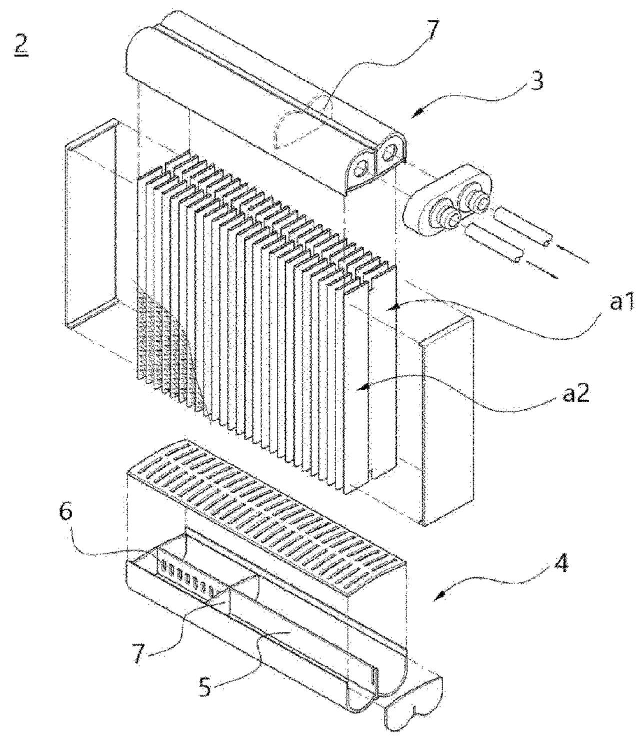


FIG. 2

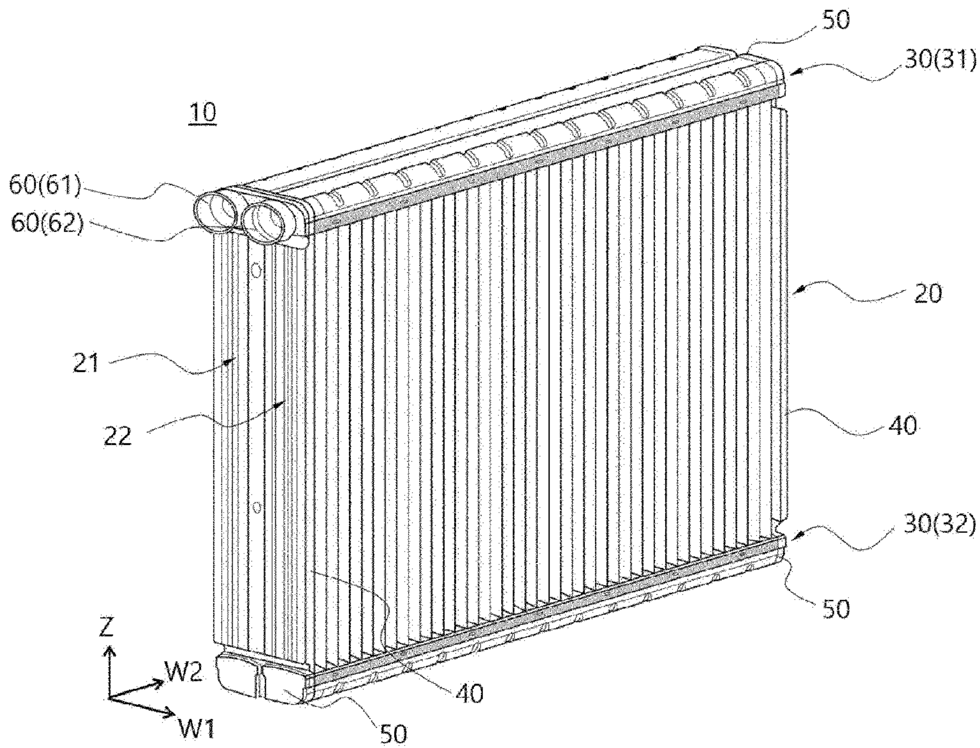


FIG. 3

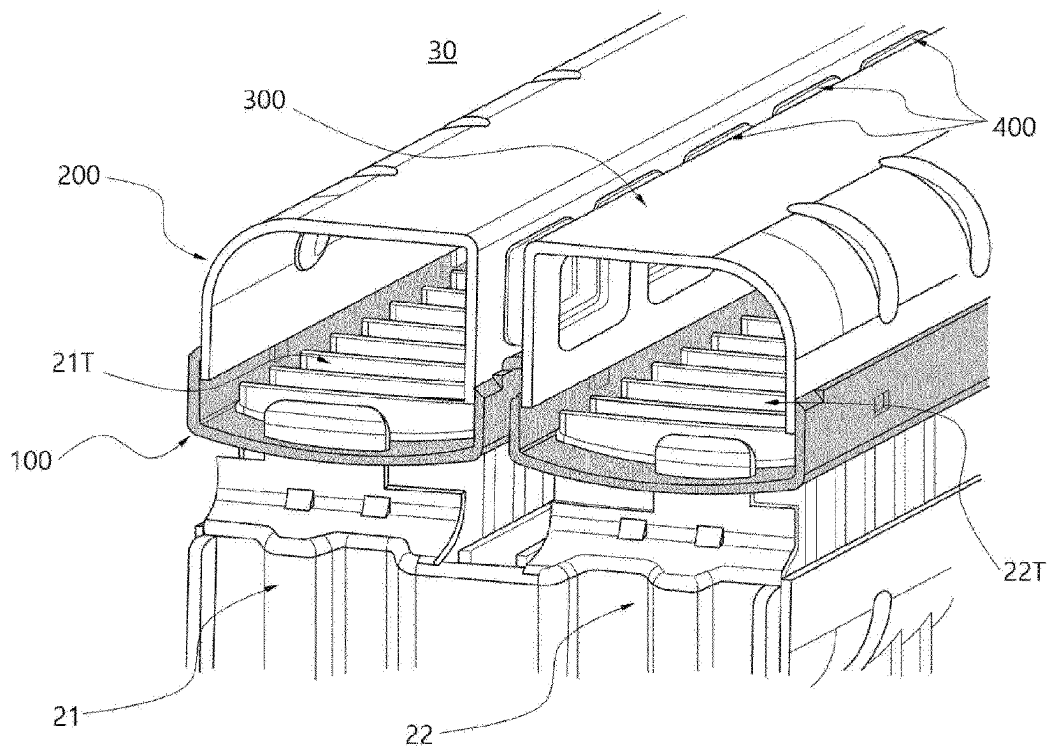


FIG. 4

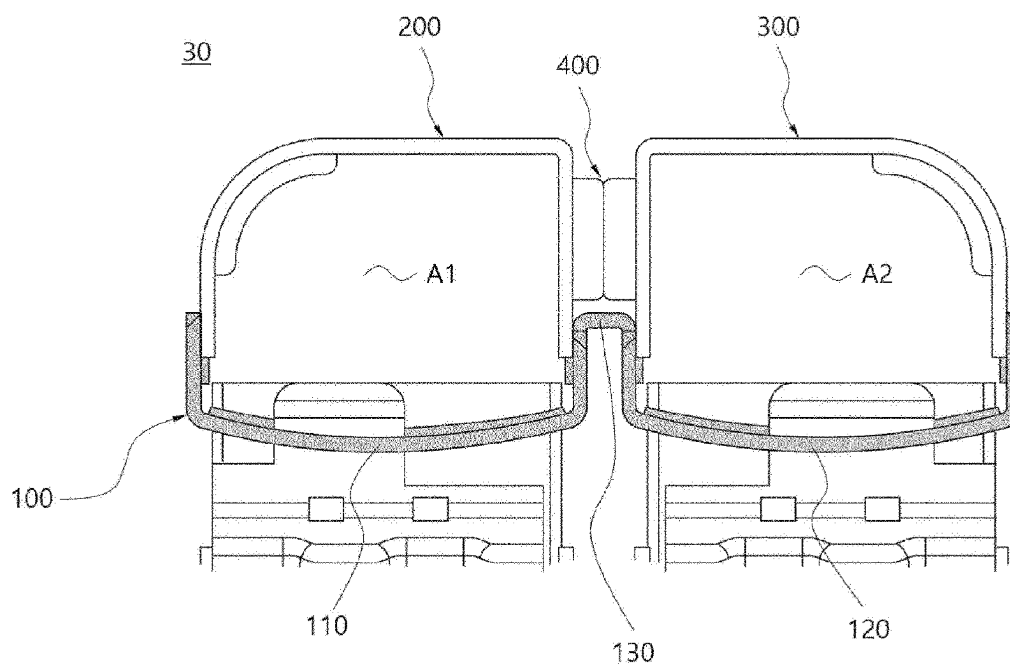


FIG. 5

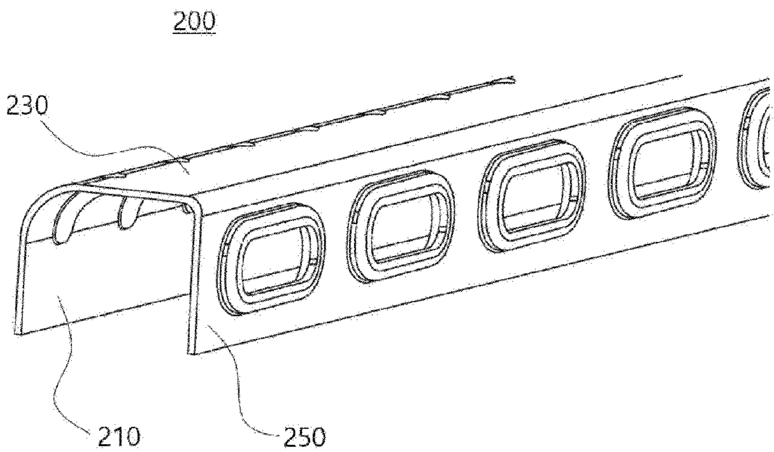


FIG. 6

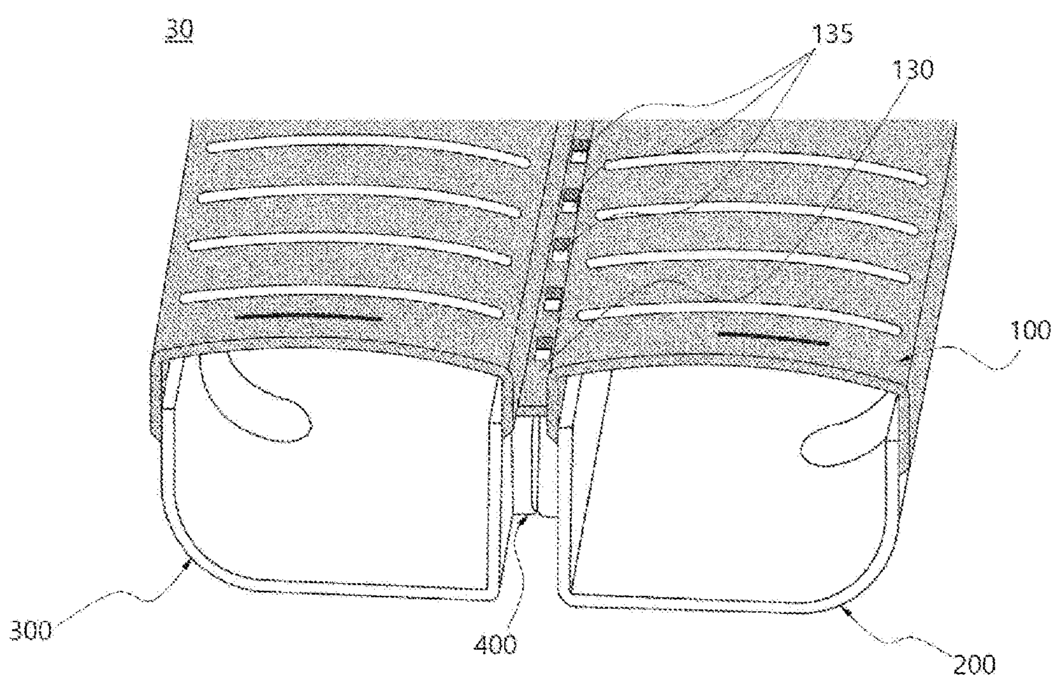


FIG. 7

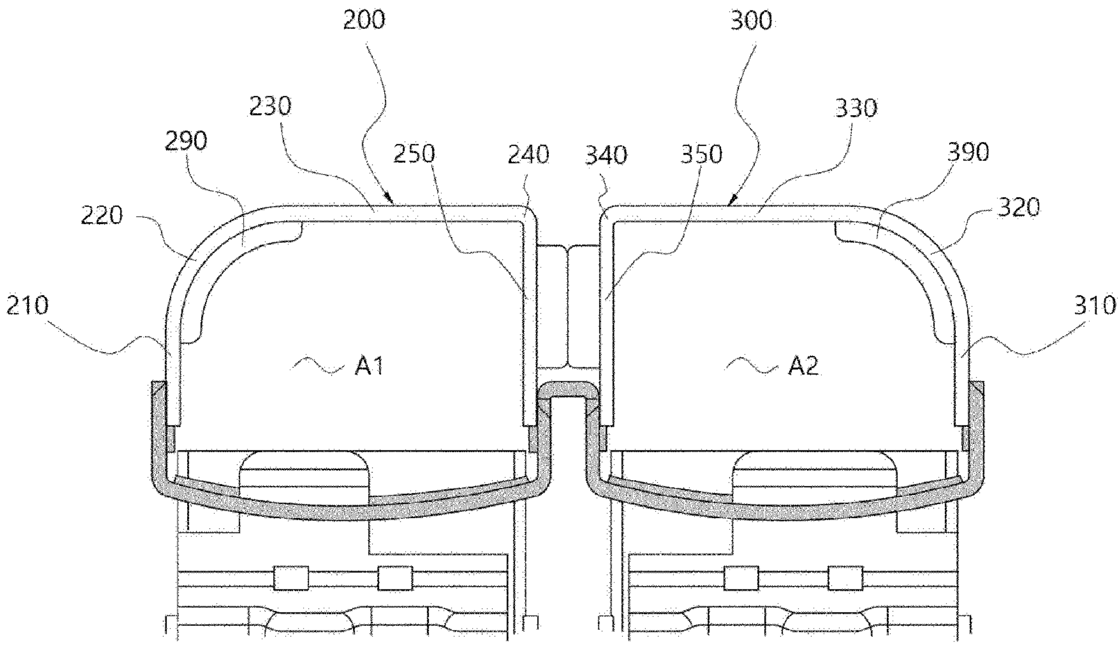

200
300
230
330
290
250
240
340
350
390
220
320
210
310
A1
A2

FIG. 8

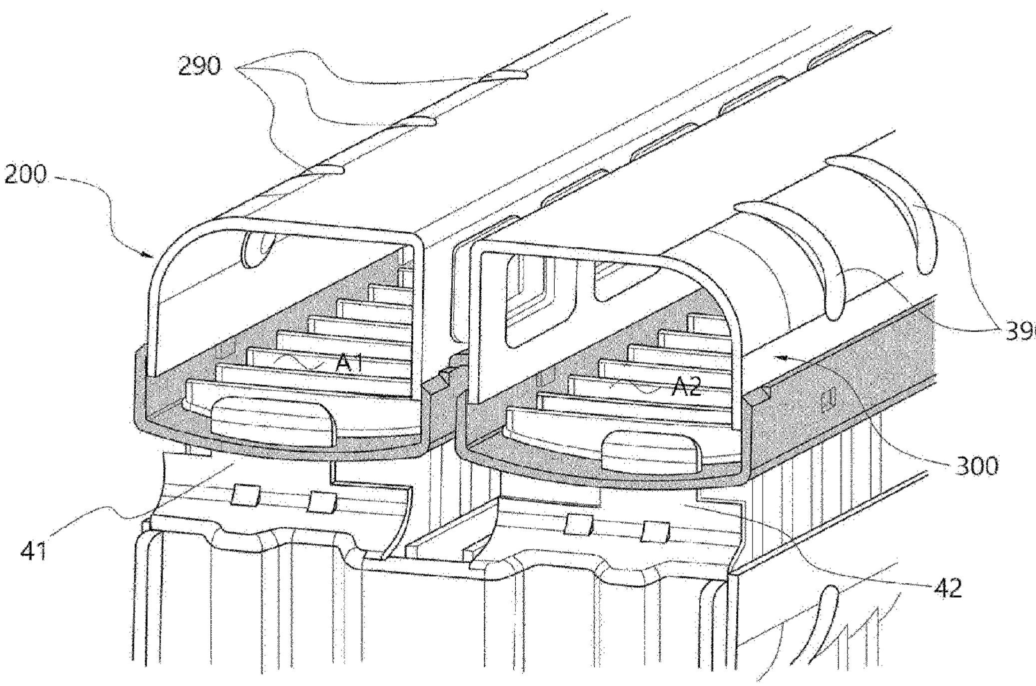

290
200
A1
A2
390
300
41
42

FIG. 9

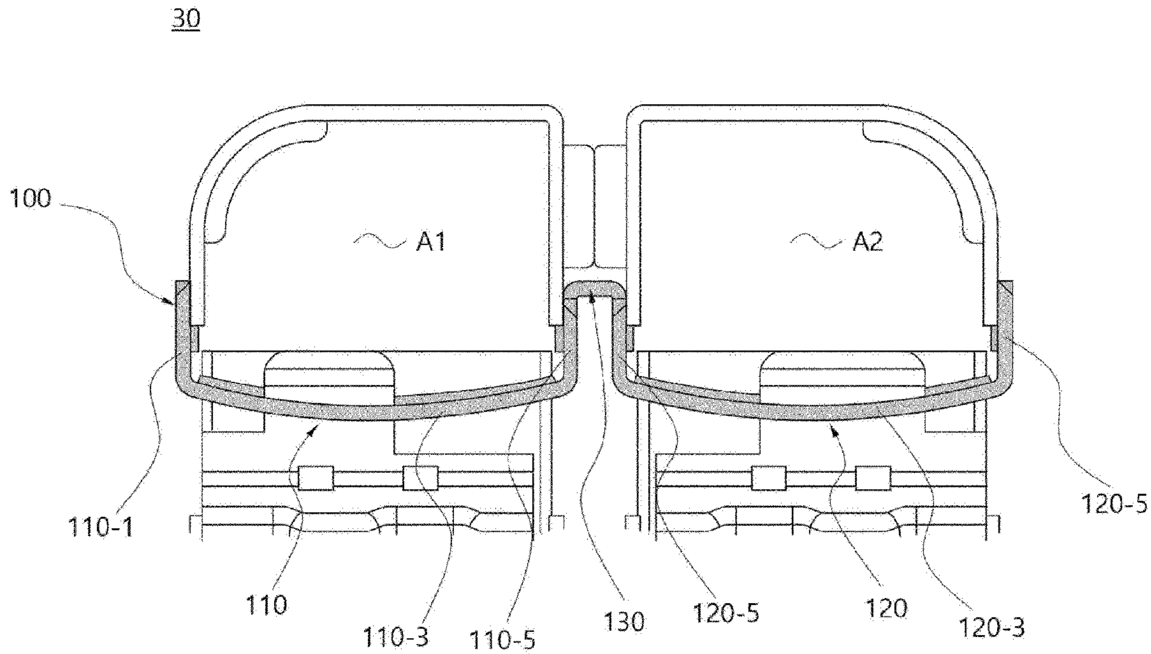

30
100
A1
A2
110-1
110
110-3
110-5
130
120-5
120
120-3
120-5

FIG. 10

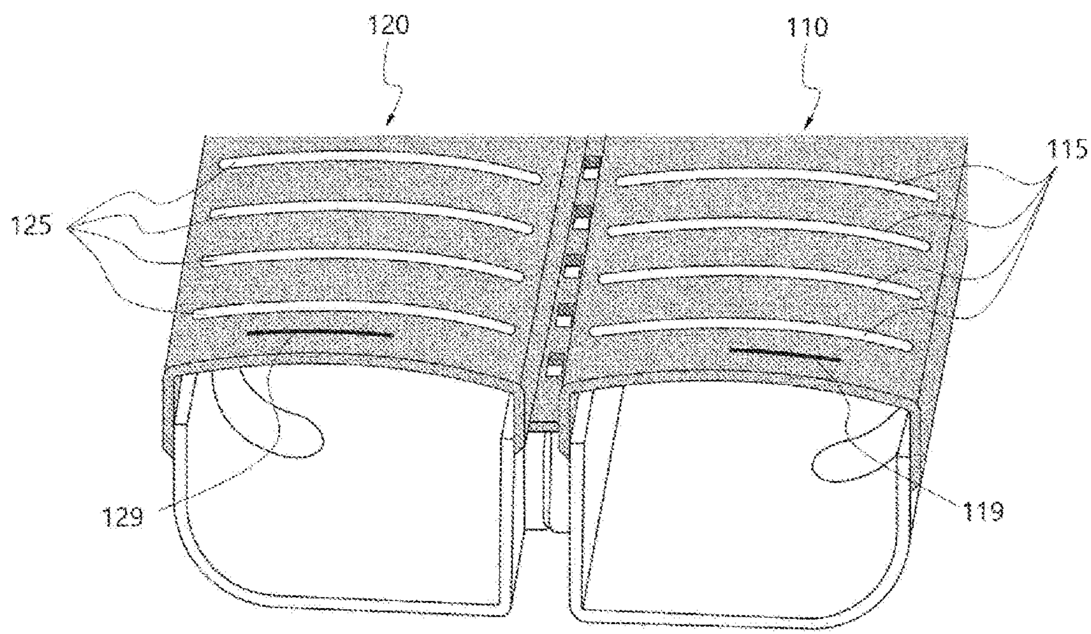

120
110
115
125
129
119

FIG. 11

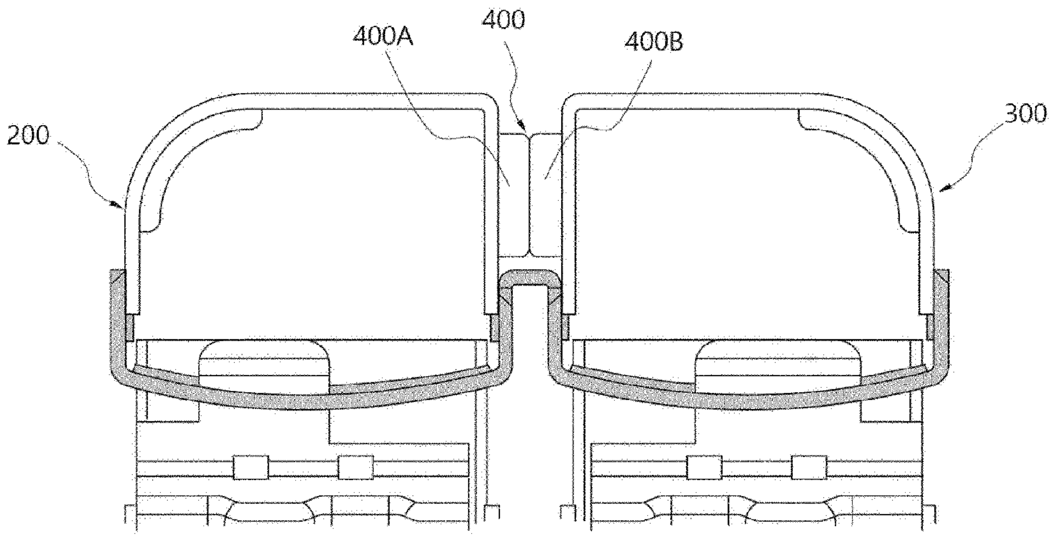


FIG. 12

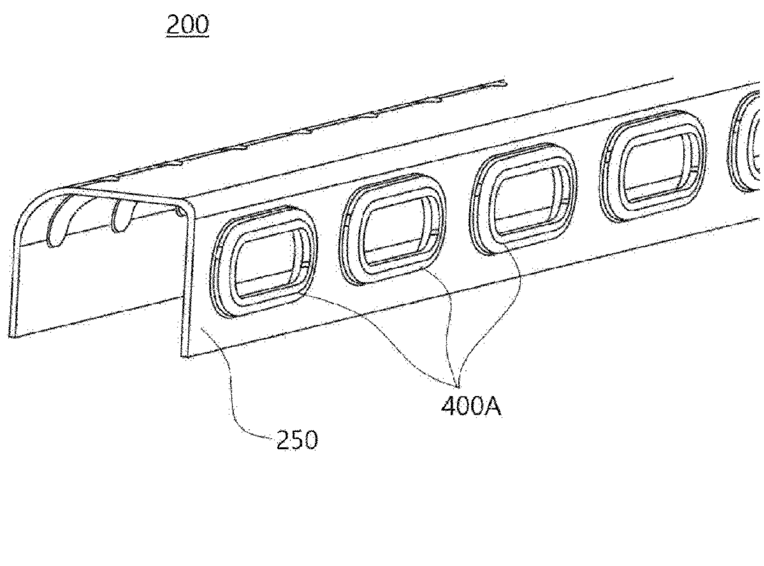


FIG. 13

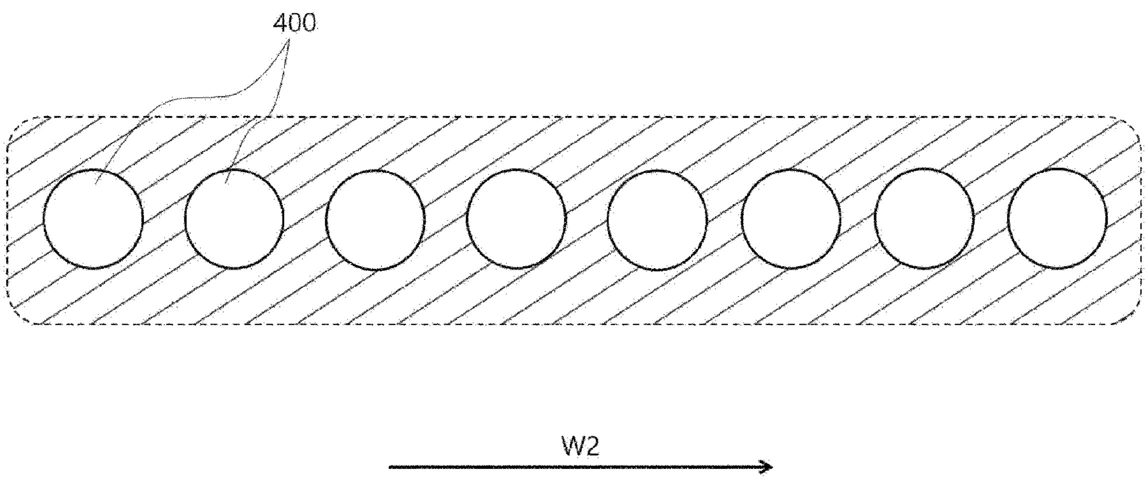


FIG. 14

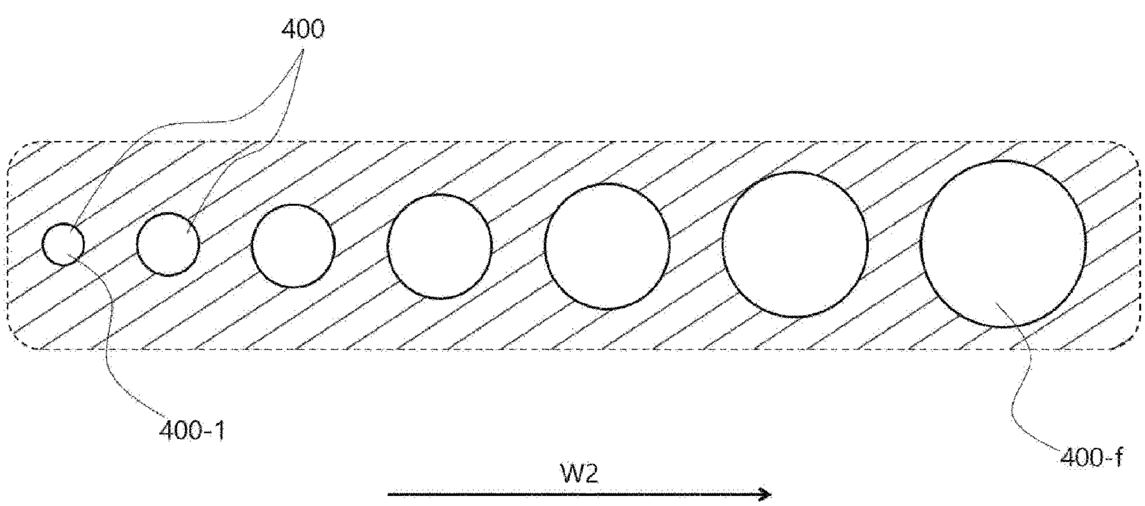


FIG. 15

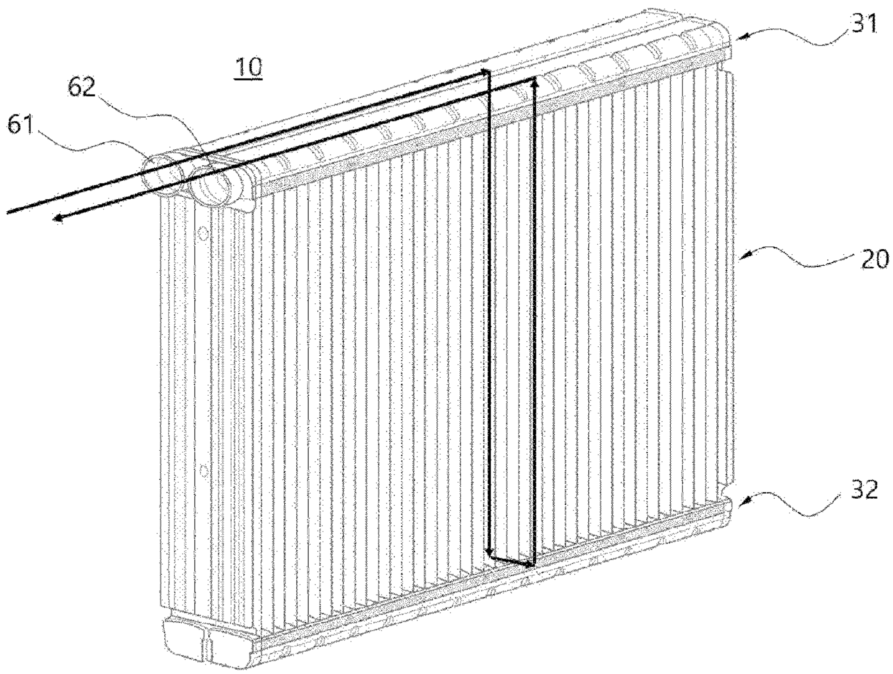
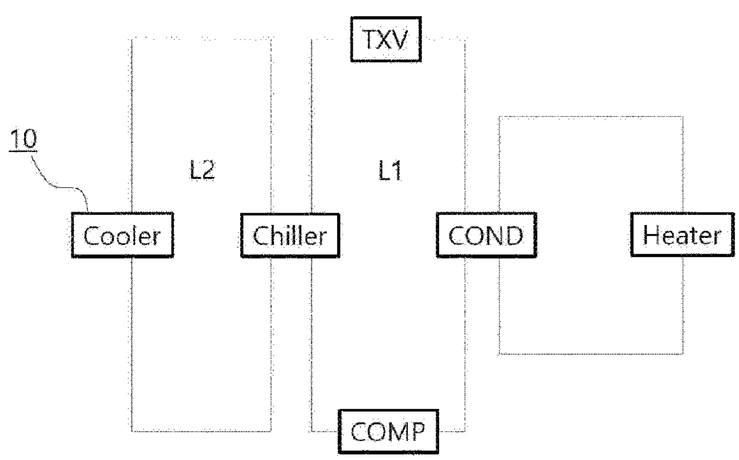


FIG. 16



HEADER TANK OF HEAT EXCHANGER

CROSS REFERENCE TO RELATED APPLICATIONS

This patent application is a national phase under 35 U.S.C. § 371 of International Patent Application No. PCT/KR2022/001474 filed Jan. 27, 2022, which claims the benefit of priority from Korean Patent Application No. 10-2021-0014917 filed Feb. 2, 2021, each of which is hereby incorporated herein by reference in its entirety for all purposes.

TECHNICAL FIELD

The present invention relates to a header tank of a heat exchanger, and more specifically, to a header tank provided in a heat exchanger having a two-row structure in which core parts are provided in two rows, the header tank having a structure in which a first tank is coupled to a header, and a second tank is coupled to be spaced apart from the first tank at a predetermined interval, such that condensate water condensed on surfaces of the core parts may be discharged between the first tank and the second tank, thereby satisfying all of pressure resistance of the header tank, temperature distribution of the core parts, and cooling performance of the heat exchanger.

BACKGROUND ART

An air conditioning device for a vehicle refers to an internal device for a vehicle installed for the purpose of cooling or heating a vehicle interior in the summer or winter season or ensuring front and rear visual fields for a driver by removing frost or the like formed on a windshield in rainy or cold weather. The air conditioning device typically has both a heating system and a cooling system and cools, heats, or ventilates the vehicle interior by selectively introducing outside air or inside air, heating or cooling the air, and then blowing the air into the vehicle interior.

A general refrigeration cycle of the air conditioning device includes an evaporator configured to absorb heat from the periphery, a compressor configured to compress a refrigerant, a condenser configured to discharge heat to the periphery, and an expansion valve configured to expand the refrigerant. In the refrigeration cycle of the cooling system, a gaseous refrigerant, which is introduced into the compressor from the evaporator, is compressed into a high-temperature, high-pressure refrigerant by the compressor, and the compressed gaseous refrigerant is liquefied while passing through the condenser, such that liquefaction heat is discharged to the periphery. The liquefied refrigerant is converted into low-temperature, low-pressure wet saturated vapor while passing through the expansion valve again. Thereafter, the refrigerant is introduced into the evaporator again and cools ambient air by absorbing vaporization heat from the periphery while being vaporized. Therefore, the vehicle interior is cooled by this process.

The condenser, the evaporator, and the like used in the cooling system are representative heat exchangers. There have been many consistent research efforts to create more effective heat exchange between the air outside the heat exchanger and a heat exchange medium in the heat exchanger, i.e., the refrigerant. The efficiency of the evaporator has the most direct effect on the cooling of the vehicle interior. Therefore, various types of structural research and development have been particularly carried out to improve the heat exchange efficiency of the evaporator.

One of the improved structures to improve the heat exchange efficiency of the evaporator is an evaporation structure having a two-row structure in which cores including tubes and fins are doubly provided to define first and second rows that are spaces in which the refrigerant flows. FIG. **1** is an exploded perspective view of an evaporator having a two-row structure in the related art. As illustrated, in an evaporator **2** having a two-row structure in the related art, a header tank **3** disposed at an upper side and a header tank **4** disposed at a lower side are provided in two rows by being partitioned by a partition wall. The connect first and second rows a**1** and a**2** provided to constitute flow paths in which a refrigerant flows, a communication hole **6** may be formed in a partition wall **5** that partitions the first and second rows a**1** and a**2**.

However, because the header tank does not have a drain hole at a portion corresponding to a position between the first row and the second row, there is a problem in that condensate water, which is created on refrigerant tubes and fins that constitute the evaporator, is hardly discharged smoothly during the heat exchange.

DOCUMENT OF RELATED ART

(Patent Document 1) Korean Patent No. 1344521 (Dec. 17, 2013)

DISCLOSURE

Technical Problem

The present invention has been made in an effort to solve the above-mentioned problem, and an object of the present invention is to provide a header tank or a structure thereof, which is a header tank provided in a heat exchanger having a two-row structure in which core parts are provided in two rows, the header tank having a structure in which a first tank is coupled to a header, and a second tank is coupled to be spaced apart from the first tank at a predetermined interval, such that condensate water condensed on surfaces of the core parts may be discharged between the first tank and the second tank.

Another object of the present invention is to provide a header tank having a structure capable of satisfying all of pressure resistance of the header tank, temperature distribution of air discharged from a heat exchanger, and cooling performance of the heat exchanger.

Technical Solution

A header tank according to an example of the present invention is provided in a heat exchanger having a two-row structure including a first-row tube and a second-row tube spaced apart from each other at a predetermined interval in a width direction and includes: a header provided at one end of the first-row tube and one end of the second-row tube based on a longitudinal direction and including a first header part coupled to one end of the first-row tube, a second header part coupled to one end of the second-row tube, and a header central part configured to connect the first header part and the second header part; a first tank coupled to the first header part to define a first internal space; a second tank spaced apart from the first tank at a predetermined interval and coupled to the second header part to define a second internal space; and a plurality of communication pipes provided between the first tank and the second tank and configured to allow the first internal space and the second internal space to communicate with each other, in which the plurality of communication pipes is disposed to be spaced apart from one another at predetermined intervals in the width direction.

The header tank may be provided at a lower side of the heat exchanger, and condensate water may be discharged between the first and second tanks spaced apart from each other and between the communication pipes spaced apart from one another.

The header central part may have a plurality of through-holes formed through the header central part and spaced apart from one another at predetermined intervals, and the condensate water may be discharged through the plurality of through-holes.

The communication pipes may each have a circular shape.

An upper outer edge of the first tank, which connects an outer side surface and an upper surface of the first tank, may be formed in a rounded shape, and an upper outer edge of the second tank, which connects an outer side surface and an upper surface of the second tank, may be formed in a rounded shape.

A plurality of first ribs, which is indented toward the inside of the first internal space, may be formed on the upper outer edge of the first tank and spaced apart from one another at predetermined intervals in the width direction, and a plurality of second ribs, which is indented toward the inside of the second internal space, may be formed on the upper outer edge of the second tank and spaced apart from one another at predetermined intervals in the width direction.

An upper inner edge of the first tank, which connects the upper surface and an inner side surface of the first tank, may be formed in a right-angled shape, and an upper inner edge of the second tank, which connects the upper surface and an inner side surface of the second tank, may be formed in a right-angled shape.

A central portion of a lower surface of the first header part based on the width direction may have a rounded shape curved toward the first-row tube, and a central portion of a lower surface of the second header part based on the width direction may have a rounded shape curved toward the second-row tube.

First support insertion holes may be formed at two opposite ends of a lower surface of the first header part based on the width direction, first supports protruding from a core part housing of the heat exchanger in a direction of the first header part may be fixedly inserted into the first support insertion holes, second support insertion holes may be formed at two opposite ends of a lower surface of the second header part based on the width direction, and second supports protruding from the core part housing of the heat exchanger in a direction of the second header part direction may be fixedly inserted into the second support insertion holes.

The communication pipes may each be formed by coupling first and second pipes separated from each other, the first pipe may be integrated with the first tank and protrude in a direction from the first tank toward the second tank, and the second pipe may be integrated with the second tank and protrude in a direction from the second tank toward the first tank.

The first and second pipes may be symmetric to each other, and an end of the first pipe and an end of the second pipe may be in contact with each other.

A cross-sectional area of the first pipe may be larger than a cross-sectional area of the second pipe, a length of the first pipe may be longer than a length of the second pipe, and the second pipe may be inserted into the first pipe.

Cross-sectional areas of communication holes formed in the communication pipes may be equal to one another.

Cross-sectional areas of communication holes formed in the communication pipes may gradually increase in a direction from a communication pipe positioned at one end based on the width direction to a communication pipe positioned at the other end based on the width direction.

A coolant cooler according to another aspect of the present invention may include the header tank.

Advantageous Effects

According to the present invention, the first tank and the second tank are coupled to each other on the header and spaced apart from each other at a predetermined interval, such that condensate water on the surface of the core part may be discharged between the first and second tanks spaced apart from each other. The condensate water may be completely discharged to the outside of the heat exchanger through the through-hole formed in the central part of the header. Therefore, it is possible to ensure excellent drainage performance.

In addition, the upper outer edges of the first and second tanks are formed in a rounded shape, and the rib structure, which is indented inward, is applied to the edge, such that the pressure resistance of the header tank may significantly increase.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded perspective view of an evaporator having a two-row structure in the related art.

FIG. **2** is a perspective view of an entire heat exchanger according to an example of the present invention.

FIG. **3** is a perspective view of a header tank according to the example of the present invention.

FIG. **4** is a front view of the header tank according to the example of the present invention.

FIG. **5** is a perspective view of a first tank according to the example of the present invention.

FIG. **6** is a perspective view of the header tank according to the example of the present invention when viewed from below.

FIG. **7** is a view illustrating FIG. **4** again.

FIG. **8** is a view illustrating FIG. **3** again.

FIG. **9** is a view illustrating FIG. **4** again.

FIG. **10** is a view illustrating FIG. **6** again.

FIG. **11** is a view illustrating FIG. **4** again.

FIG. **12** is a view illustrating FIG. **5** again.

FIG. **13** is a view illustrating lateral cross-sections of communication pipes according to the example of the present invention.

FIG. **14** is a view illustrating lateral cross-sections of communication pipes according to another example of the present invention.

FIG. **15** is a view illustrating a refrigerant flow path of the heat exchanger according to the example of the present invention.

FIG. **16** is a view illustrating an example of a secondary loop cooling system.

EXPLANATION OF REFERENCE NUMERALS AND SYMBOLS

10: Heat exchanger

20: Core part

30: Header tank
100: Header
110: First header part
120: Second header part
130: Header central part
200: First tank
290: First rib
300: Second tank
390: Second rib
400: Communication pipe
400A: First pipe
400B: Second pipe

BEST MODE

Hereinafter, the present invention will be described with reference to the accompanying drawings.

FIG. **2** is a perspective view of an entire heat exchanger according to an example of the present invention. A heat exchanger **10** of the present invention may be a heat exchanger having a two-row structure in which first and second row tubes spaced apart from each other at a predetermined interval in a width direction W**1**. As illustrated, the heat exchanger **10** of the present invention may broadly include core parts **20** positioned at a central portion, and upper and lower header tanks **31** and **32** respectively provided at upper and lower sides of the core parts. In FIG. **2**, Z indicates a height direction of the heat exchanger, and W**1** and W**2** respectively indicate width directions of the heat exchanger.

The core part **20** defines a region in which a working fluid (e.g., a refrigerant, a coolant, or a third working fluid, hereinafter, referred to as a 'refrigerant'), which flows in the heat exchanger, concentratedly exchanges heat with outside air. In general, the core part may include a plurality of tubes in which the refrigerant flows, and a plurality of fins interposed between the tubes. The present invention relates to the heat exchanger having the two-row structure in which the core parts **20** are provided in two rows. A first-row core part **21** and a second-row core part **22** are provided to be spaced apart from each other at a predetermined interval in the width direction W**1**. Therefore, the first-row core part **21** may include first-row tubes **21**T provided as a plurality of tubes disposed in the width direction W**2**, and a plurality of fins interposed therebetween. The second-row core part **22** may include second-row tubes **22**T provided as a plurality of tubes disposed in the width direction W**2**, and a plurality of fins interposed therebetween.

The header tanks **30** are respectively provided at the upper and lower sides of the core parts **20**. For example, the upper header tank **31** may receive the refrigerant from the outside and transfer the refrigerant to the tubes of the core parts. The lower header tank **32** may receive the refrigerant, which has performed heat exchange while passing through the tubes of the upper header tank **31**, and discharge the refrigerant to the outside.

Further, core part housings **40**, which are structures for supporting the core parts **20**, may be further provided at two opposite sides of the core part **20** based on the width direction W**2**. End caps **50** may be provided at two opposite sides of the header tank **30** in the width direction and define an internal space by closing ends of the header tank **30**. Refrigerant ports **60** may be further provided on at least one of the two opposite sides of the header tank **30** based on the width direction and include a refrigerant inlet port **61** through which the refrigerant is introduced into the header tank from the outside, and a refrigerant discharge port **62** through which the refrigerant is discharged to the outside from the inside of the header tank.

FIG. **3** is a perspective view of the header tank according to the example of the present invention, and FIG. **4** is a front view of the header tank according to the example of the present invention. FIGS. **3** and **4** respectively illustrate the header tank **30** provided at the upper side of the first-row core part **21** and the second-row core part **21**. As illustrated, the header tank **30** of the present invention may include a header **100**, a first tank **200**, a second tank **300**, and communication pipes **400** provided between the first tank **200** and the second tank **300**.

The header **100** is provided at one end of the first-row tube **21**T of the first-row core part **21** and one end of the second-row tube **22**T of the second-row core part **22** based on the longitudinal direction. The header **100** may include a first header part **110** coupled to one end of the first-row tube **21**T, a second header part **120** coupled to one end of the second-row tube **22**T, and a header central part **130** configured to connect the first header part **110** and the second header part **120**. In this case, one end based on the longitudinal direction may correspond to the upper or lower side of the core part **20**. Hereinafter, for convenience of description, the description will be focused on the header tank provided at the upper side. The header tank provided at the lower side will be separately described when necessary.

The first tank **200** is coupled to the first header part **110** to define a first internal space **1**A. The first tank **200** may be shaped such that an upper surface and two opposite surfaces, which are provided at two opposite sides of the upper surface, surround the first header part. FIG. **5** is a perspective view of the first tank according to the example of the present invention. As illustrated, the first tank **200** may have a structure including an outer side surface **210**, an upper surface **230**, and an inner side surface **250**.

The second tank **300** is coupled to the second header part **120** to define a second internal space **2**A and disposed to be spaced apart from the first tank **200** at a predetermined interval. Like the first tank, the second tank **300** may include an outer side surface **310**, an upper surface **330**, and an inner side surface **350**.

The communication pipe **400** serves to allow the first internal space **1**A, which is defined by the header **100** and the first tank **200**, and the second internal space **2**A, which is defined by the header **100** and the second tank **300**, to communicate with each other. The communication pipe **400** may be provided as a plurality of communication pipes **400** provided between the first tank **200** and the second tank **300**. In this case, the plurality of communication pipes **400** may be disposed to be spaced apart from one another at predetermined intervals in the width direction W**2**.

In the present invention as described above, unlike a configuration in the related art in which a header tank provided in a heat exchanger having a two-row structure generally includes a single header and a header tank coupled to the single tank and a partition wall provided in the header tank divides an internal space into two spaces, the header tank **30** of the present invention includes the header **100**, which is provided as one piece, and the first and second tanks **200** and **300**, which are provided as two pieces, such that the internal spaces **1**A and **2**A may be formed to be separated from each other by the tanks **200** and **300**. Further, the header tank **30** may have the structure in which the first tank **200** and the second tank **300** are spaced apart from each other at a predetermined interval, the plurality of communication pipes **400** is provided between the first and second tanks **200** and **300**, which are spaced apart from each other, and allows the first tank **200** and the second tank **300** to communicate with each other, and the communication pipes **400** are disposed to be spaced apart from one another in the width direction.

That is, in the present invention, the first tank **200** and the second tank **300** are spaced apart from each other in the width direction, the plurality of communication pipes **400** is provided between the first tank **200** and the second tank **300**, and the communication pipes **400** are disposed to be spaced apart from one another in the width direction, such that a gap may be formed between the first tank **200** and the second tank **300**. Therefore, according to the present invention, in case that the header tank **30** is provided at the lower side of the core part, condensate water, which is condensed on surfaces of the pipes and fins by the heat exchange in the core part, may be discharged through the gap formed between the first tank and the second tank.

In this case, the communication pipes **400** may each have a circular shape. Therefore, even though condensate water falls onto the communication pipe **400**, the condensate water may fall downward along a curved surface of the communication pipe by gravity without remaining on the communication pipe. Therefore, it is possible to further improve efficiency in discharging condensate water in the heat exchanger.

Meanwhile, in case that the header tank **30** is provided at the lower side of the core part, the condensate water, which is discharged while passing between the first tank **200** and the second tank **300**, meets the header **100** positioned below the first and second tanks **200** and **300**. In this case, in the present invention, a plurality of through-holes **135** is formed through the header central part **130** of the header **100** so as to penetrate the header central part **130** in an upward/downward direction and spaced apart from one another at predetermined intervals in the width direction **W2**, such that condensate water may be completely discharged to the outside of the heat exchanger through the through-holes **135**. FIG. **6** is a perspective view of the header tank according to the example of the present invention when viewed from below. As illustrated, the plurality of through-holes **135** may be formed in the header central part **130** and spaced apart from one another at predetermined intervals in the width direction **W2**. Therefore, condensate water, which falls onto the header central part while passing through the first tank and the second tank, may be completely discharged to the lower side of the heat exchanger.

As described above, the present invention provides the heat exchanger having the two-row structure with the structure capable of efficiently discharging condensate water, which is created in the core part of the heat exchanger, to the outside of the heat exchanger. Therefore, it is possible to solve a problem that may occur when condensate water remains in the heat exchanger, particularly between the header tanks without being discharged to the outside of the heat exchanger.

Hereinafter, specific structures of the header, the tank, and the communication pipe, which are the constituent elements of the header tank of the present invention, will be described.

First, the tank of the present invention will be described in more detail. FIG. **7** is a view illustrating FIG. **4** again. The first tank **200** may include the outer side surface **210**, the upper surface **230**, and the inner side surface **250**. In this case, an upper outer edge **220**, which connects the outer side surface **210** and the upper surface **230** of the first tank, may be formed in a rounded shape. Like the first tank, the second tank **300** may include the outer side surface **310**, the upper surface **330**, and the inner side surface **350** of the second tank. Like the first tank, an upper outer edge **320**, which connects the outer side surface **310** and the upper surface **330** of the second tank, may be formed in a rounded shape. Because the upper outer edges **220** and **320** of the first and second tanks **200** and **300** are formed in a rounded shape, pressure resistance of the first and second tanks may be improved. Therefore, it is possible to reduce thicknesses of the first and second tanks and define a maximally large internal space in the header tank.

In addition, in the present invention, rib structures may be further applied to the first and second tanks to further improve the pressure resistance of the first and second tanks. More specifically, FIG. **8** is a view illustrating FIG. **3** again. A plurality of first ribs **290** may be formed on the upper outer edge **220** of the first tank **200** and spaced apart from one another at predetermined intervals in the width direction, and the first rib **290** may be indented toward the inside of the first internal space **1A**. Like the first tank, the second tank **300** may also have a plurality of second ribs **390** formed on the upper outer edge **320** of the second tank **300**. This is to ensure structural rigidity of the tank by indenting a predetermined region of the upper outer edge inward in case that the upper outer edge is formed in a circularly rounded shape. Therefore, it is possible to further improve the pressure resistance of the first and second tanks.

In addition, with reference to FIGS. **7** and **8**, an upper inner edge **240**, which connects the upper surface **230** and the inner side surface **250** of the first tank **200**, is formed in a right-angled shape. Like the first tank, the second tank **300** may also have an upper inner edge **340** that is formed in a right-angled shape and connects the upper surface **330** and the inner side surface **350** of the second tank **300**. In this case, the right-angled shape has a physical meaning and of course means that two surfaces substantially define a right angle without meaning the perpendicular. Because the upper inner edges of the first and second tanks are each formed in a right-angled shape as described above, it is possible to maximize sizes of the first and second internal spaces defined by coupling the header and the first and second tanks. Therefore, it is possible to maximally ensure a refrigerant accommodation capacity in the header tank within a limited space.

Next, the header of the present invention will be described in more detail. FIG. **9** is a view illustrating FIG. **4** again. The header **100** of the present invention may be provided as one piece and have the structure in which the first header part **110**, the central part **130**, and the second header part **120** are connected. The first header part **110** may include an outer side surface **110-1**, a lower surface **110-3**, and an inner side surface **110-5**. Like the first header part, the second header part **120** may also include an outer side surface **120-1**, a lower side surface **120-3**, and an inner side surface **120-5**.

In this case, as illustrated, the lower surface **110-3** of the first header part **110** may have a central portion based on the width direction, and the central portion may have a rounded shape curved toward the first-row tube. Like the first header part, the lower surface **120-3** of the second header part **120** may have a central portion based on the width direction, and the central portion may have a rounded shape curved toward the second-row tube. Further, the lower surface **110-3** of the first header part may have first-row tube insertion holes **115** into which the tubes of the first-row tubes are respectively inserted. Like the first header part, the lower surface **120-3** of the second header part may have second tube insertion holes **125** into which the tubes of the second-row tubes are respectively inserted.

In case that the lower surface of the header is formed in a rounded shape as described above, a folded type tube using a rolling material may be smoothly inserted into the header. Because the tubes penetrate the insertion holes formed in the header and communicate with the internal space of the header tank, coupling properties between the tubes and the header tank may be improved.

In addition, in the header part of the present invention, first support insertion holes **119** may be formed at two opposite ends of the lower surface **110-3** of the first header part based on the width direction W**2**, and first supports **41** protruding from the core part housing in the direction of the first header part may be fixedly inserted into the first support insertion holes **119**. Like the first header part, second support insertion holes **129** may be formed at two opposite ends of the lower surface **120-3** of the second header part based on the width direction, and second supports **42** protruding from the housing in the direction of the second header part may be fixedly inserted into the second support insertion holes **129**. Therefore, it is possible to strongly support the core part by increasing a coupling force between the core part and the header tank and minimize a degree to which the core part is separated from the header tank or deformed in position by external impact or the like. FIG. **10** is a view illustrating FIG. **6** again and illustrating the tube insertion holes **115** and **125** and the support insertion holes **119** and **129**.

Next, the communication pipe **400** of the present invention will be described in more detail. FIG. **11** is a view illustrating FIG. **4** again, and FIG. **12** is a view illustrating FIG. **5** again. The plurality of communication pipes **400** in the present invention is each configured by coupling first and second pipes **400**A and **400**B that are separated from each other. In this case, the first pipe **400**A may be integrated with the first tank and protrude in a direction from the first tank toward the second tank. The second pipe **400**B may be integrated with the second tank and protrude in a direction from the second tank toward the first tank. The first and second pipes **400**A and **400**B may each have a hollow shape and be structured to communicate with each other through communication holes respectively formed in the inner side surface **250** of the first tank and the inner side surface **350** of the second tank.

In this case, the first pipe **400**A and the second pipe **400**B may be symmetric to each other. As illustrated in FIG. **11**, the communication pipe **400** may be provided as an end of the first pipe **400**A and an end of the second pipe **400**B are in contact with each other. For example, the symmetric shape may mean that the first and second pipes are identical in shape and length. Because the first and second pipes are symmetric to each other as described above, the first and second tanks may be manufactured to have the same shape, which may improve manufacturability.

Alternatively, a cross-sectional area of the first pipe **400**A may be larger than a cross-sectional area of the second pipe **400**B, and a length of the first pipe **400**A may be longer than a length of the second pipe **400**B, such that the communication pipes **400** of the present invention may each be formed by inserting and coupling the second pipe **400**B into the first pipe **400**A. Because the first pipe and the second pipe are different in shape from each other, the first tank and the second tank need to be separately manufactured, which may somewhat cause a loss in terms of manufacturability. However, the structure in which the first pipe and the second pipe are coupled by insertion may increase a coupling force between the first tank and the second tank. Further, there is an advantage in that a separate structure for coupling the first tank and the second tank may be excluded, which may reduce the number of coupling components and the number of coupling processes in terms of the entire heat exchanger.

Meanwhile, in the present invention, the communication holes formed in the communication pipes **400** may have the same cross-sectional area. That is, FIG. **13** is a view illustrating lateral cross-sections of the communication pipes according to the example of the present invention. As illustrated, the cross-sectional areas of all the communication holes in the communication pipes disposed side by side in a direction from one side to the other side may be equal to one another.

Alternatively, the cross-sectional areas of the communication holes formed in the communication pipes **400** may gradually increase in a direction from a communication pipe **400-1**, which is positioned at one end based on the width direction, to a communication pipe **400-*f*** positioned at the other end based on the width direction W**2**. FIG. **14** is a view illustrating lateral cross-sections of communication pipes according to another example of the present invention. As illustrated, the cross-sectional areas of the communication pipes may gradually increase in the direction from one side to the other side based on the width direction W**2**. Because the refrigerant is introduced through the refrigerant inlet port, the amount of refrigerant becomes larger and the pressure of the refrigerant becomes higher as the distance from the refrigerant inlet port decreases. Therefore, the refrigerant needs to be transferred toward the side opposite to and distant from the refrigerant inlet port, i.e., from one side to the other side in the header tank so that the refrigerant may uniformly pass through the core part. Therefore, as the heat exchange area of the core part increases, the heat exchange efficiency of the heat exchanger may increase. To this end, in the present invention, an area of the communication hole of the communication pipe close to the refrigerant inlet port is small, and an area of the communication hole of the communication pipe distant from the refrigerant inlet port is large, such that a circulation area of the refrigerant may increase, which may efficiently distribute the refrigerant in the heat exchanger.

FIG. **15** is a view illustrating a refrigerant flow path in the heat exchanger according to the example of the present invention. As illustrated, the refrigerant may be introduced into the first internal space of the upper header tank **31** from the outside through the refrigerant inlet port **61** provided at one side of the upper header tank **31**, and the refrigerant introduced into the first internal space may pass through the first-row tube of the core part **20** and then be introduced into the first internal space of the lower header tank **32**. The refrigerant introduced into the first internal space of the lower header tank **32** may be introduced into the second internal space of the lower header tank **32** through the communication pipe of the lower header tank **32**, and the refrigerant introduced into the second internal space of the lower header tank **32** may pass through the second-row tube of the core part **20** and then be introduced into the second internal space of the upper header tank **31**. The refrigerant introduced into the second internal space of the upper header tank **31** may be discharged to the outside through the refrigerant discharge port **62** provided at one side of the upper header tank **31**. In this case, although not illustrated separately, in case that the upper header tank **31** has the refrigerant inlet port and the refrigerant discharge port as described in the above-mentioned example, the communication pipe of the upper header tank **31** may, of course, have a structure having the closed inside.

Hereinafter, a coolant cooler according to another aspect of the present invention will be described.

The heat exchanger of the present invention may be a coolant cooler used for a secondary loop cooling system that has been studied recently. FIG. **16** is a view illustrating an example of a secondary loop cooling system. The secondary loop cooling system may include a refrigerant circulation line L**1**, and a coolant line L**2** that cools an interior by using a coolant that exchanges heat with a refrigerant in a refrigerant circulation line. The coolant cooler may serve to cool air by using the cold coolant disposed in the coolant line L**2**. In this case, the present invention provides the coolant cooler disposed in the secondary loop cooling system, and the coolant cooler may include the above-mentioned header tank **30** of the present invention. More specifically, the coolant cooler may be a coolant cooler in which the header tank **30** is provided on at least one of the upper and lower sides of the core part of the coolant cooler.

In the case of the secondary loop cooling system, a temperature difference between inlet side air introduced into the coolant cooler and the coolant introduced into the coolant cooler under a cooling condition does not exceed 40 degrees. In the case of a hot water heater in a refrigerant cooling system in the related art, a temperature difference between the inlet side air and the refrigerant introduced into the heater is 70 degrees or more, such that sufficient heat dissipation performance may be provided even though the heater has a small heat exchange area. However, in the case of the secondary loop cooling system, the coolant cooler may provide a sufficient heat exchange area and a sufficient flow path length because of a relatively small temperature difference condition. The core part may have a multi-row structure to increase the flow path length. However, in case that the multi-row structure has three or more rows, an excessive amount of pressure drop at a coolant side may decrease the flow rate and the amount of heat dissipation. To appropriately satisfy the condition, the heat exchanger may have a two-row structure. Therefore, the heat exchanger of the present invention may have two-row structure as described above. In particular, in case that the heat exchanger is the coolant cooler, the coolant cooler may also have the two-row structure.

In this case, the coolant cooler of the present invention may exclude a baffle (see reference numeral **7** in FIG. **1**) that partitions the header tank internal space in the header tank and guides a flow of the refrigerant. That is, no baffle may be applied to the first and second internal spaces of the header tank of the present invention. Because a temperature of the coolant gradually increases as the coolant exchanges heat with air while passing through the cooler, a coolant inlet port region having a lowest temperature and a coolant port region having a highest temperature may overlap each other in case that a flow path of the two-row structure having no baffle is applied. Therefore, it is possible to uniformize the temperature distribution of the outlet side air discharged from the coolant cooler after exchanging heat with the coolant cooler.

Further, as described above, because of the small temperature difference condition in the secondary loop cooling system, the coolant cooler needs to have a sufficient heat exchange area. Therefore, the coolant cooler needs to be manufactured to have a larger size than the heater that is the coolant heat exchanger in the related art. In this case, because the fluidity of the coolant flowing in the coolant cooler increases, the coolant cooler needs to have high pressure resistance. To this end, as described above, in the cooling module of the present invention, the upper outer edge of each of the tanks is formed in a rounded shape, and the ribs are applied, such that the header tank with the ensured pressure resistance is applied. Therefore, the coolant cooler of the present invention may ensure the sufficient pressure resistance, such that the coolant cooler may be manufactured to have a large size. Therefore, it is possible to ensure the cooling performance at a level equal to that of the evaporator in the related art. Further, because the coolant flow path of the two-row structure having no baffle is applied, it is possible to ensure effective temperature distribution of the coolant in the core part.

While the embodiments of the present invention have been described with reference to the accompanying drawings, those skilled in the art will understand that the present invention may be carried out in any other specific form without changing the technical spirit or an essential feature thereof. Therefore, it should be understood that the above-described embodiments are illustrative in all aspects and do not limit the present invention.

What is claimed is:

1. A header tank, which is provided in a heat exchanger having a two-row structure comprising a first-row tube and a second-row tube spaced apart from each other at a predetermined interval in a width direction, the header tank comprising:

a header provided at one end of the first-row tube and one end of the second-row tube based on a longitudinal direction and comprising a first header part coupled to one end of the first-row tube, a second header part coupled to one end of the second-row tube, and a header central part configured to connect the first header part and the second header part;

a first tank coupled to the first header part to define a first internal space;

a second tank spaced apart from the first tank at a predetermined interval and coupled to the second header part to define a second internal space; and

a plurality of communication pipes provided between the first tank and the second tank and configured to allow the first internal space and the second internal space to communicate with each other,

wherein the plurality of communication pipes is disposed to be spaced apart from one another at predetermined intervals in the width direction,

wherein the communication pipes are each formed by coupling first and second pipes separated from each other, the first pipe is integrated with the first tank and protrudes in a direction from the first tank toward the second tank, and the second pipe is integrated with the second tank and protrudes in a direction from the second tank toward the first tank.

2. The header tank of claim **1**, wherein the header tank is provided at a lower side of the heat exchanger, and condensate water is discharged between the first and second tanks spaced apart from each other and between the communication pipes spaced apart from one another.

3. The header tank of claim **2**, wherein the header central part has a plurality of through-holes formed through the header central part and spaced apart from one another at predetermined intervals, and the condensate water is discharged through the plurality of through-holes.

4. The header tank of claim **2**, wherein the communication pipes each have a circular shape.

5. The header tank of claim **1**, wherein an upper outer edge of the first tank, which connects an outer side surface and an upper surface of the first tank, is formed in a rounded shape, and an upper outer edge of the second tank, which connects an outer side surface and an upper surface of the second tank, is formed in a rounded shape.

6. The header tank of claim 5, wherein a plurality of first ribs, which is indented toward the inside of the first internal space, is formed on the upper outer edge of the first tank and spaced apart from one another at predetermined intervals in the width direction, and a plurality of second ribs, which is indented toward the inside of the second internal space, is formed on the upper outer edge of the second tank and spaced apart from one another at predetermined intervals in the width direction.

7. The header tank of claim 5, wherein an upper inner edge of the first tank, which connects the upper surface and an inner side surface of the first tank, is formed in a right-angled shape, and an upper inner edge of the second tank, which connects the upper surface and an inner side surface of the second tank, is formed in a right-angled shape.

8. The header tank of claim 1, wherein a central portion of a lower surface of the first header part based on the width direction has a rounded shape curved toward the first-row tube, and a central portion of a lower surface of the second header part based on the width direction has a rounded shape curved toward the second-row tube.

9. The header tank of claim 1, wherein the first and second pipes are symmetric to each other, and an end of the first pipe and an end of the second pipe are in contact with each other.

10. The header tank of claim 1, wherein a cross-sectional area of the first pipe is larger than a cross-sectional area of the second pipe, a length of the first pipe is longer than a length of the second pipe, and the second pipe is inserted into the first pipe.

11. The header tank of claim 1, wherein cross-sectional areas of communication holes formed in the communication pipes are equal to one another.

12. The header tank of claim 1, wherein cross-sectional areas of communication holes formed in the communication pipes gradually increase in a direction from a communication pipe positioned at one end based on the width direction to a communication pipe positioned at the other end based on the width direction.

13. A coolant cooler comprising the header tank of claim 1.

14. A header tank, which is provided in a heat exchanger having a two-row structure comprising a first-row tube and a second-row tube spaced apart from each other at a predetermined interval in a width direction, the header tank comprising:

a header provided at one end of the first-row tube and one end of the second-row tube based on a longitudinal direction and comprising a first header part coupled to one end of the first-row tube, a second header part coupled to one end of the second-row tube, and a header central part configured to connect the first header part and the second header part;

a first tank coupled to the first header part to define a first internal space;

a second tank spaced apart from the first tank at a predetermined interval and coupled to the second header part to define a second internal space; and

a plurality of communication pipes provided between the first tank and the second tank and configured to allow the first internal space and the second internal space to communicate with each other,

wherein the plurality of communication pipes is disposed to be spaced apart from one another at predetermined intervals in the width direction,

wherein first support insertion holes are formed at two opposite ends of a lower surface of the first header part based on the width direction, first supports protruding from a core part housing of the heat exchanger in a direction of the first header part are fixedly inserted into the first support insertion holes, second support insertion holes are formed at two opposite ends of a lower surface of the second header part based on the width direction, and second supports protruding from the core part housing of the heat exchanger in a direction of the second header part direction are fixedly inserted into the second support insertion holes.

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