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(54) **HEAT EXCHANGER AND REFRIGERATION SYSTEM**

(57) The present invention provides a heat exchanger (100) and a refrigeration system (1000). The heat exchanger (100) includes a collecting pipe (10), and the collecting pipe (10) includes a plurality of pipe units (13). The plurality of pipe units (13) are sequentially stacked and connected, and each of the plurality of pipe units (13) includes a first section (131) and a second section (132). A diameter of the first section (131) is less than that of the second section (132), such that the first section (131) of one of adjacent two of the plurality of pipe units (13) is capable of inserting into the second section (132) of the other of adjacent two of the plurality of pipe units (13). An arc-shaped section (133) is provided between the first section (131) and the second section (132) of each of the plurality of pipe units (13), and the arc-shaped section (133) extends to a top of the second section (132) from a bottom of the first section (131), so that the first section (131) is connected to the second section (132).

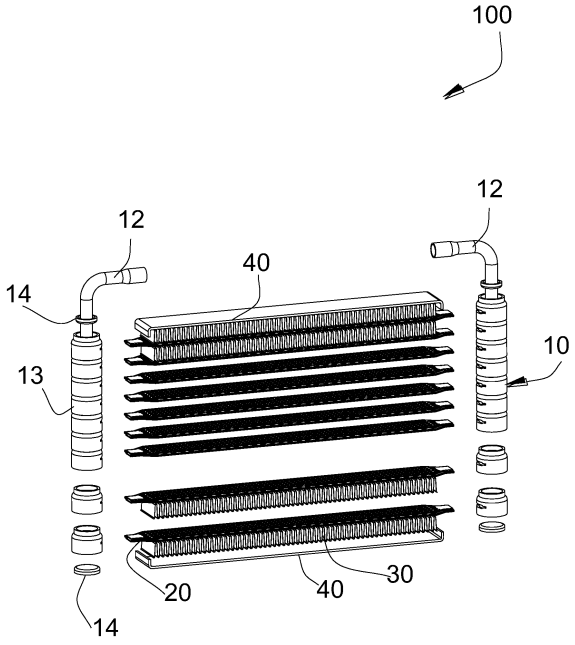

FIG. 1

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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims all benefits of the priority from China Patent Application No. 201922374776.0, filed on December 25, 2019, and titled "HEAT EXCHANGER AND REFRIGERATION SYSTEM" in the China National Intellectual Property Administration, the content of which is hereby incorporated by reference.

TECHNICAL FIELD

[0002] The present invention relates to a field of refrigeration technology, in particular, to a heat exchanger and a refrigeration system.

BACKGROUND

[0003] In a field of refrigeration technology, a heat exchanger, as an important one of four major components of a refrigeration system, plays a role of heat exchange with outside air.

[0004] In the prior art, a collecting pipe of the heat exchanger includes a plurality of pipe units, and stress concentration exists on the plurality of pipe units. Under an action of variable load, fatigue fracture is likely to occur, which affects a service life of the heat exchanger.

SUMMARY

[0005] According to various embodiments of the present invention, a heat exchanger is provided.

[0006] A heat exchanger includes a collecting pipe, and the collecting pipe includes a plurality of pipe units. The plurality of pipe units are sequentially stacked and connected, and each of the plurality of pipe units includes a first section and a second section. A diameter of the first section is less than that of the second section, such that the first section of one of adjacent two of the plurality of pipe units is capable of inserting into the second section of the other of adjacent two of the plurality of pipe units. An arc-shaped section is provided between the first section and the second section of each of the plurality of pipe units, and the arc-shaped section extends to a top of the second section from a bottom of the first section, so that the first section is connected to the second section.

[0007] The collecting pipe described above includes the plurality of pipe units, each of the plurality of pipe units is connected to a heat exchange pipe respectively. In a conventional art, when welding the heat exchanger in a brazing furnace, settlement may occur on the heat exchange pipe and the collecting pipe. The heat exchange pipe is lowered/sunk more serious than the collecting pipe, and these two pipes can not be lowered synchronously. However, in the present disclosure, the first section of one of adjacent two of the plurality of pipe units is inserted into the second section of the other of adjacent two of the plurality of pipe units, providing an expansion allowance for a sinking of each of the plurality of pipe units. So that the collecting pipe and the heat exchange pipe can be lowered/sunk synchronously, and welding efficiency can be improved. In addition, the arc-shaped section is provided between the first section and the second section of each of the plurality of pipe units, which can reduce a stress concentration at a joint between the first section and the second section, and prolong a service life of the heat exchanger.

[0008] In one embodiment, a length of the first section along an axis of the collecting pipe is in a range of 2 mm to 6 mm. In this way, the length of the first section can be suitable. It is understood that a flow through the collecting pipe will be reduced if the length of the first section is too great, and it will not be possible to provide the expansion allowance for the sinking of the collecting pipe if a length of the second section is too small.

[0009] In one implementation, a gap is defined between the first section of the one of adjacent two of the plurality of pipe units and the second section of the other of adjacent two of the plurality of pipe units and in a size of 0.1 mm. In this way, the gap between an outer wall of the first section of the one of adjacent two of the plurality of pipe units and an inner wall of the second section of the other of adjacent two of the plurality of pipe units is in a size of 0.1 mm, which not only enables the first section of one of adjacent two of the plurality of pipe units to insert smoothly into the second section of the other of adjacent two of the plurality of pipe units, but also prevents the gap between the two from being too large and an occurrence of a lack of welding.

[0010] In one embodiment, in each of the plurality of pipe units, the first section, the arc-shaped section, and the second section are combined as an integrity structure. In this way, it is possible to simplify a welding process between the first section, the arc-shaped section, and the second section of each of the plurality of pipe units, while avoiding the occurrence of a lack of welding.

[0011] In one implementation, a radian of the arc-shaped section of each of the plurality of pipe units is the same. In this way, the radian of the arc-shaped section of each of the plurality of pipe units is the same, so that it is convenient to process.

[0012] In one embodiment, the first section is formed by an end of each of the plurality of pipe units via a narrowing-mouth process. In this way, the first section is formed by the end of each of the plurality of pipe units via the narrowing-mouth process, so that the process is simple.

[0013] In one embodiment, the heat exchanger further includes a plurality of heat exchange pipes, each of the plurality of pipe units is provided with a slot, and two ends of the plurality of heat exchange pipes are inserted into corresponding slot, resulting in the collecting pipe and the plurality of heat exchange pipes are in communication with each other.

[0014] In one embodiment, a top one and a bottom one of the plurality of pipe units are provide with an end cover respectively, and the end cover is configured for sealing the collecting pipe.

[0015] In one embodiment, the heat exchanger further includes a plurality of fins disposed between adjacent two of the plurality of heat exchange pipes and distributed from one end of the plurality of heat exchange pipes to the other end thereof. In this way, the fin is configured for accelerating a heat exchange between the heat exchanger and outside air.

[0016] A refrigeration system including a compressor, a throttling element, and the heat exchanger as described above is further provided. And the heat exchanger is connected and in communication with the compressor and the throttling element respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The accompanying drawings constituting a part of this invention are used to provide a further understanding of this invention, and the schematic embodiments of this invention and a description thereof are used to explain this invention and do not constitute an undue limitation of this invention.

[0018] In order to illustrate the technical solutions in embodiments of the present invention more clearly, the following briefly introduces the drawings that are used in the description of the embodiments. It is apparent that the drawings in the following description are only some of the embodiments of the present invention, for those of ordinary skill in the art, other drawings can also be obtained from these drawings without creative effort.

FIG. 1 is an exploded view of a heat exchanger in an embodiment.

FIG. 2 is a structural schematic diagram of a collecting pipe of a heat exchanger in an embodiment.

FIG. 3 is a section view of a collecting pipe of a heat exchanger in an embodiment.

FIG. 4 is a schematic diagram of a refrigeration system in an embodiment.

[0019] In the figures, 1000 represents a refrigeration system, 100 represents a heat exchanger, 10 represents a collecting pipe, 11 represents a slot, 12 represents a connecting pipe, 13 represents a pipe units, 131 represents a first section, 132 represents a second section, 133 represents an arc-shaped section, 14 represents an end cover, 20 represents a heat exchange pipe, 30 represents a fin, 40 represents a sideboard, 200 represents a compressor, and 300 represents a throttling element.

DETAILED DESCRIPTION

[0020] A clear and complete description of the technical solutions in the embodiments of the present invention will be given below in conjunction with the accompanying drawings in the embodiments of the present invention. It will be apparent that the described embodiments are only a part and not all of the embodiments of the present invention. Based on the embodiments in the present invention, all other embodiments obtained by those of ordinary skill in the art without creative work fall within the protection scope of the present invention.

[0021] It should be noted that when an element is referred to as being "arranged" on another element, it may be directly arranged on the other element or a further element may be presented between them. When an element is referred to as being "disposed" on another element, it may be directly disposed on the other element or a further element may be presented between them. When an element is referred to as being "fixed" to another element, it may be directly attached to the other element or a further element may be presented between them.

[0022] Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art of the present invention. The term "or/and" as used herein includes any and all combinations of one or more of the associated listed items.

[0023] Referring to FIG. 4, the present invention provides a refrigeration system 1000. The refrigeration system 1000 is applied to a cold chain system such as a household air conditioner, a refrigerator, a commercial air conditioner freezer, or a cold storage, or other occasions that need to reduce or raise a temperature of natural environment.

[0024] The refrigeration system 1000 includes a compressor 200, a throttling element 300 and a heat exchanger 100, and the compressor 200, the throttling element 300 and the heat exchanger 100 are connected to each other by pipelines. Other accessories such as liquid reservoirs and gas-liquid separators between the compressor 200, the throttling element 300 and the heat exchanger 100 can also be provided.

[0025] Referring to FIG. 1 to FIG. 3, the heat exchanger 100 includes a collecting pipe 10 and a plurality of heat exchange pipes 20. The collecting pipe 10 is disposed at both ends of the heat exchange pipe 20, respectively, and the plurality of heat exchange pipes 20 are arranged in parallel with each other. The collecting pipe 10 is provided with a plurality of slots 11, and the plurality of heat exchange pipes 20 are inserted into corresponding slot 11, resulting in the collecting pipe 10 and the plurality of heat exchange pipes 20 are in communication with each other. The number of the heat exchange pipes 20 corresponds to the number of the slots 11 one-to-one.

[0026] Specifically, the heat exchanger 100 further includes a plurality of fins 30 disposed between adjacent two of the plurality of heat exchange pipes 20, that is, a fin 30 is disposed between adjacent two of the plurality of heat exchange pipes 20. The plurality of fins 30 are distributed from one end of the plurality of heat exchange pipes to the other end thereof, thus enhancing a heat exchange between a medium in the heat exchange pipe

20 and the external environment.

[0027] Furthermore, the heat exchanger 100 further includes two sideboards 40, the two sideboards 40 are disposed on an outside of a top one and a bottom one of the plurality of fins 30 respectively, and fixed to the top one and the bottom one of the plurality of fins 30 respectively to protect them.

[0028] The collecting pipes 10 are located on both sides of the heat exchange pipe 20, that is, the number of the collecting pipes 10 is two, and an end of each of the collecting pipes 10 is provided with a connecting pipe 12, wherein one of the connecting pipes 12 is defined as an inlet connecting pipe 12, and the other thereof is defined as an outlet connecting pipe 12, and medium flows into the collecting pipes 10 by the inlet connecting pipe 12 and flows out the collecting pipe 10 by the outlet connecting pipe 12. When the heat exchanger 100 is used as a condenser, the medium in the heat exchange pipe 20 releases heat to outside environment via the plurality of fins 30. The inlet connecting pipe 12 is connected to an outlet of the compressor 200, and the outlet connecting pipe 12 is connected to an inlet of the throttling element 300. Of course, other accessories such as oil separators can be provided between the inlet connecting pipe 12 and the compressor 200, and other accessories such as reservoirs can be provided between the outlet connecting pipe 12 and the throttling element 300. When the heat exchanger 100 is used as an evaporator, the medium in the heat exchange pipe 20 absorbs heat from outside environment via the plurality of fins 30. The inlet connecting pipe 12 is connected to an outlet of the throttling element 300, the outlet connecting pipe 12 is connected to an inlet of the compressor 200. Of course, other accessories such as ball valves can be provided between the inlet connecting pipe 12 and the throttling element 300, and other accessories such as gas-liquid separators can be provided between the outlet connecting pipe 12 and the compressor 200.

[0029] Referring to FIG. 2 to FIG. 3, the collecting pipe 10 includes a plurality of pipe units 13, and the plurality of pipe units 13 are sequentially stacked and connected along an axis of the collecting pipe.

[0030] Specifically, each of the plurality of pipe units 13 includes a first section 131 and a second section 132, and a diameter of the first section 131 is less than that of the second section 132, such that the first section 131 of one of adjacent two of the plurality of pipe units 13 is capable of being inserted into and fixed to the second section 132 of the other of adjacent two of the plurality of pipe units 13 by welding process.

[0031] It is understood that before welding, surfaces of the collecting pipe 10 and the heat exchange pipe 20 are coated with a composite layer. It is necessary to explain that the composite layer is a brazing material. In a conventional art, during welding, the heat exchanger 100 is placed in a brazing furnace, and high temperature environment causes the brazing material to melt, so that the heat exchange pipe 20 and the collecting pipe 10 are lowered/sunk, and the heat exchange pipe 20 is lowered/sunk more significant than the collecting pipe 10. Two ends of the plurality of heat exchange pipes 20 are inserted into corresponding slot 11 of the collecting pipe 10 and restricted by a notch of the slot 11, a sinking in a middle of the heat exchange pipe 20 may be more serious than that of the both sides. An overall structure of the heat exchange pipe 20 may be deformed, and the heat exchange pipe 20 and the slot 11 may be also tilted, which can easily lead to virtual welding and desoldering during welding. However, in the present invention, the first section of one of adjacent two of the plurality of pipe units is inserted into the second section of the other of adjacent two of the plurality of pipe units, providing an expansion allowance for a sinking of each of the plurality of pipe units. So that the collecting pipe and the heat exchange pipe are lowered/sunk synchronously, and welding efficiency is improved.

[0032] Furthermore, an arc-shaped section is provided between the first section and the second section of each of the plurality of pipe units, and the arc-shaped section extends to a top of the second section from a bottom of the first section, thus avoiding a stress concentration due to the direct connection between the first section 131 and the second section 132. Since the medium inside the collecting pipe 10 is in a variable load, that is, an impact force of the medium inside the collecting pipe 10 on an inner wall of the collecting pipe 10 is not constant. Under a long-term impact of the medium or a vibrating environment, a direct connection between the first section 131 and the second section 132 will cause a joint between the first section 131 and the second section 132 to fracture due to the stress concentration. The arc-shaped section 133 can reduce the stress concentration between the two and prolong a service life of the heat exchanger 100.

[0033] Alternatively, a length of the first section 131 along an axis of the collecting pipe 10 is in a range of 2 mm to 6 mm. It is understood that a flow through the collecting pipe 10 will be reduced if the length of the first section 131 is too great, and it will not be possible to provide the expansion allowance for the sinking of collecting pipe 10 if a length of the second section 132 is too small. Therefore, 2 mm to 6 mm of the length of the first section 131 can be a suitable range. The length of the first section 131 can be 2 mm, 2.5 mm, 3 mm, 3.8 mm, 4 mm, 4.5 mm, 5 mm, 5.3 mm, 6 mm or any value between 2 mm to 6 mm.

[0034] Before welding, the first section 131 of one of adjacent two of the plurality of pipe units 13 is inserted into the second section 132 of the other of adjacent two of the plurality of pipe units 13, and a depth of a insertion part of the first section 131 is less than the length of the first section 131 to provide an expansion allowance for the sinking of each of the plurality of pipe units 13.

[0035] Preferably, in the present embodiment, the length of the first section 131 is 4 mm, and the depth of the insertion part of the first section 131 is 2 mm. In other

embodiments, the length of the first section 131 can be other values, and the depth of the insertion part of the first section 131 can be other values.

[0036] A gap is defined between the first section 131 of the one of adjacent two of the plurality of pipe units 13 and the second section 132 of the other of adjacent two of the plurality of pipe units 13 and in a size of 0.1 mm. It is understood that there is a slight gap between the first section 131 of the one of adjacent two of the plurality of pipe units 13 and the second section 132 of the other of adjacent two of the plurality of pipe units 13, which not only enables the first section 131 of one of adjacent two of the plurality of pipe units 13 to insert smoothly into the second section 132 of the other of adjacent two of the plurality of pipe units 13, but also prevents the gap between the two from being too large and an occurrence of lack of welding.

[0037] Furthermore, in each of the plurality of pipe units 13, the first section 131, the arc-shaped section 133, and the second section 132 are combined as an integrity structure. In this way, it is possible to simplify a welding process between the first section 131, the arc-shaped section 133, and the second section 132 of each of the plurality of pipe units 13, thus avoiding the occurrence of lack of welding and increasing reliability of the heat exchanger 100.

[0038] Referring to FIG. 3, the first section 131 is formed by an end of each of the plurality of pipe units 13 via a narrowing-mouth process. The process is simple and requires no additional welding.

[0039] Preferably, a length of each of the plurality of pipe units 13 is the same, a height of each of the plurality of pipe units 13 is all the same. The length of the first section 131 of each of the plurality of pipe units 13 is the same, an inner diameter of the first section 131 of each of the plurality of pipe units 13 is all the same, an outer diameter of the first section 131 of each of the plurality of pipe units 13 is the same. The length of the second section 132 of each of the plurality of pipe units 13 is the same, an inner diameter of the second section 132 of each of the plurality of pipe units 13 is all the same, an outer diameter of the second section 132 of each of the plurality of pipe units 13 is the same. A radian of the arc-shaped section 133 of each of the plurality of pipe units 13 is the same, and it is convenient to process. Of course, in other embodiments, according to different designs, the length and the height of each of the plurality of pipe units 13 can be different, the length, the inner diameter and the outer diameter of the first section 131 and the second section 132 of each section of the pipe unit 13 can also be different, and the radian of the arc-shaped section 133 of each of the plurality of pipe units 13 can also be different.

[0040] A top one and a bottom one of the plurality of pipe units 13 are provide with an end cover 14 respectively, that is, both ends of the collecting pipe 10 are provided with the end cover 14. The end cover 14 is configured for sealing the collecting pipe 10 to prevent the medium inside the collecting pipe 10 from getting leakage.

[0041] During an assembly process, the first section 131 of one of adjacent two of the plurality of pipe units 13 is inserted into the second section 132 of the other of adjacent two of the plurality of pipe units 13, and surfaces of the collecting pipe 10 and the heat exchange pipe 20 are coated with the composite layer. Then the plurality of heat exchange pipes 20 are inserted into corresponding slot 11 and put into the brazing furnace for welding. The composite layer is melted due to high temperature, so that the heat exchange pipe 20 and the collecting pipe 10 may be lowered/sunk. The collecting pipe 10 has the expansion allowance due to a mutual insertion between the first section 131 and the second section 132 of the plurality of pipe units 13, so that the collecting pipe 10 and the heat exchange pipe 20 are lowered synchronously. After the composite layer is melted, the plurality of pipe units 13 and the heat exchange pipe 20 are welded into a whole.

[0042] During a working process, the arc-shaped section 133 between the first section 131 and the second section 132 can reduce the stress concentration at the joint between the first section 131 and the second section 132, which can prevent from breakage under a long-term use in the vibrating environment or the impact of the medium.

[0043] The technical features of the above-described embodiments may be combined in any combination. For the sake of brevity of description, not all possible combinations of the technical features in the above embodiments are described. However, as long as there is no contradiction between the combinations of these technical features, all should be considered as within the scope of this invention.

[0044] The above-described embodiments are merely illustrative of several embodiments of the present invention, and the description thereof is relatively specific and detailed, but is not to be construed as limiting the scope of the invention. It should be noted that a number of variations and modifications may be made by those skilled in the art without departing from the spirit and scope of the invention. Therefore, the scope of the invention should be determined by the appended claims.

Claims

1. A heat exchanger comprising a collecting pipe, wherein the collecting pipe comprises a plurality of pipe units, the plurality of pipe units are sequentially stacked and connected, each of the plurality of pipe units comprises a first section and a second section, and a diameter of the first section is less than that of the second section, such that the first section of one of adjacent two of the plurality of pipe units is capable of inserting into the second section of the other of adjacent two of the plurality of pipe units, **characterized in that**

an arc-shaped section is provided between the first section and the second section of each of the plurality of pipe units, and the arc-shaped section extends to a top of the second section from a bottom of the first section, so that the first section is connected to the second section.

2. The heat exchanger of claim 1, wherein a length of the first section along an axis of the collecting pipe is in a range of 2 mm to 6 mm.

3. The heat exchanger of claim 1, wherein a gap is defined between the first section of the one of adjacent two of the plurality of pipe units and the second section of the other of adjacent two of the plurality of pipe units and in a size of 0.1 mm.

4. The heat exchanger of claim 1, wherein in each of the plurality of pipe units, the first section, the arc-shaped section, and the second section are combined as an integrity structure.

5. The heat exchanger of claim 1, wherein a radian of the arc-shaped section of each of the plurality of pipe units is the same.

6. The heat exchanger of claim 1, wherein the first section is formed by an end of each of the plurality of pipe units via a narrowing-mouth process.

7. The heat exchanger of claim 1, further comprising a plurality of heat exchange pipes, each of the plurality of pipe units is provided with a slot, and two ends of the plurality of heat exchange pipes are inserted into corresponding slot, resulting in the collecting pipe and the plurality of heat exchange pipes are in communication with each other.

8. The heat exchanger of claim 1, wherein a top one and a bottom one of the plurality of pipe units are provide with an end cover respectively, and the end cover is configured for sealing the collecting pipe.

9. The heat exchanger of claim 7, further comprising a plurality of fins disposed between adjacent two of the plurality of heat exchange pipes and distributed from one end of the plurality of heat exchange pipes to the other end thereof.

10. A refrigeration system comprising a compressor, a throttling element, and the heat exchanger of any one of claims 1 to 9, wherein the heat exchanger is connected and in communication with the compressor and the throttling element respectively.

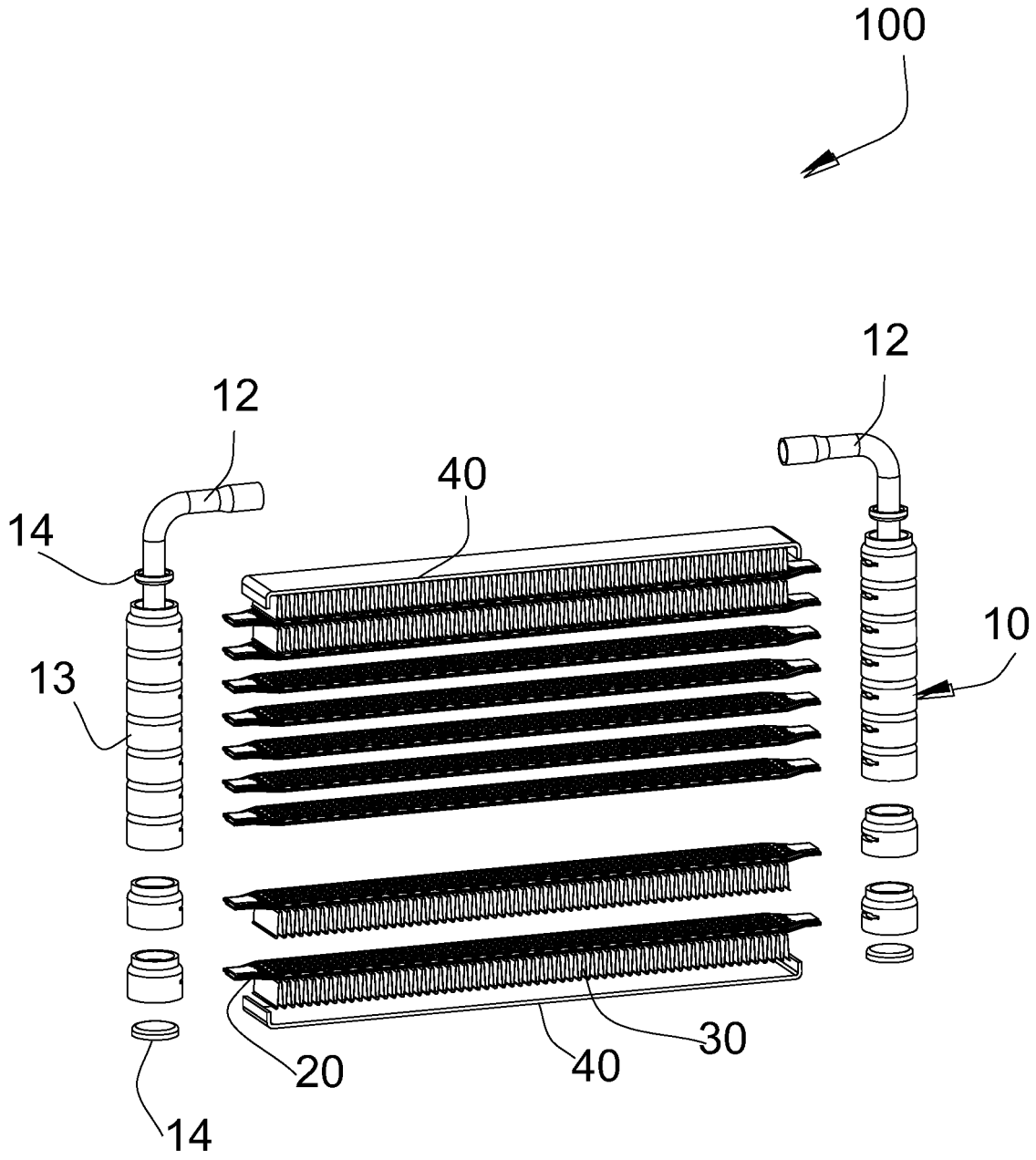

FIG. 1

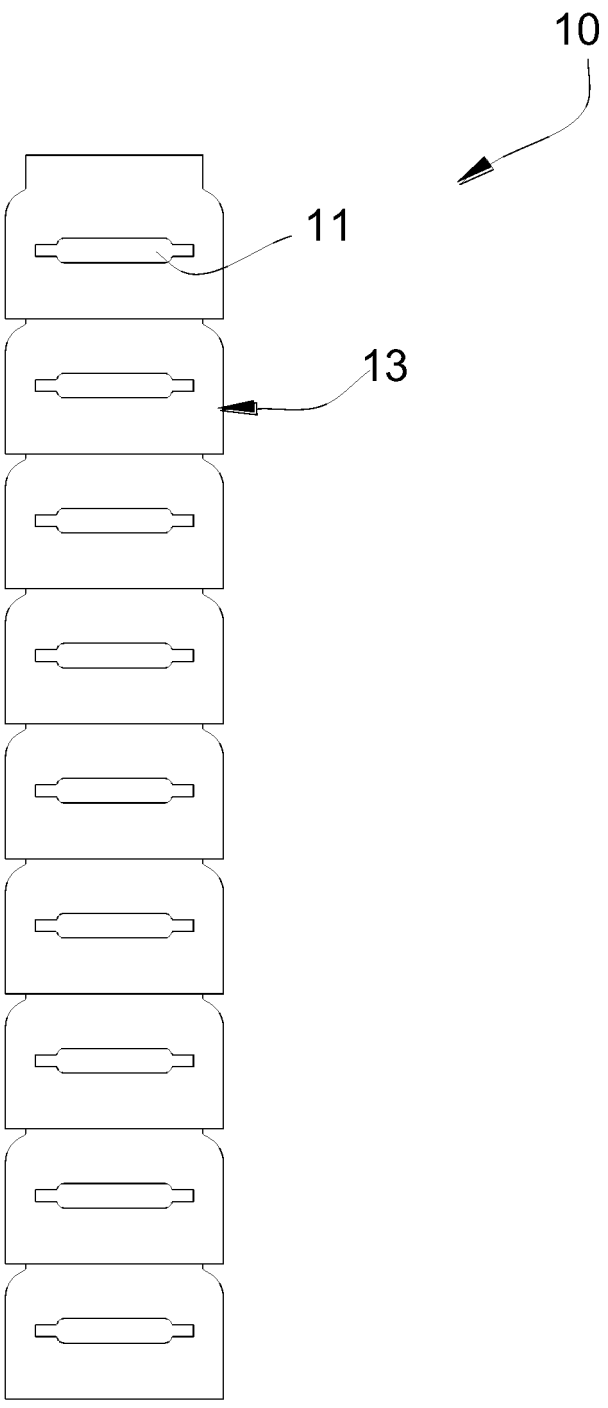

FIG. 2

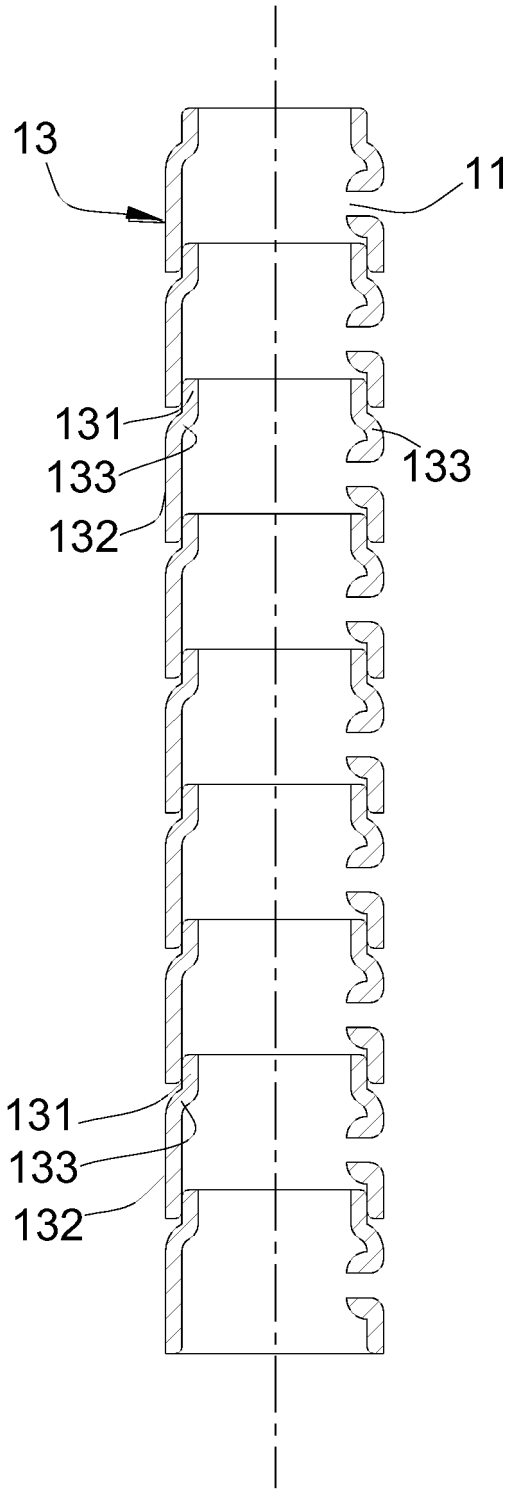

FIG. 3

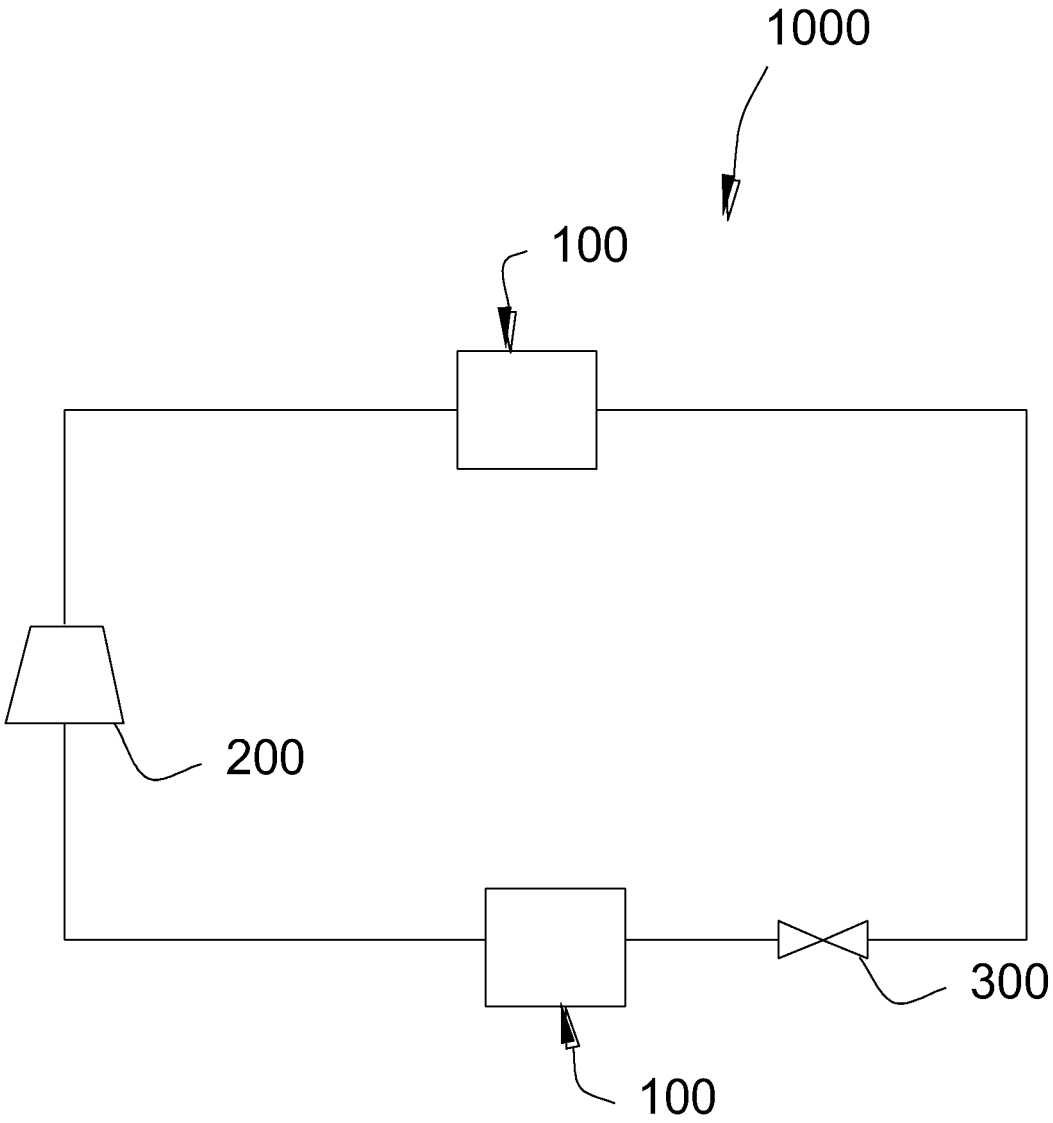

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/136137

A. CLASSIFICATION OF SUBJECT MATTER

F28F 9/02(2006.01)i; F28D 1/053(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)

F28D; ; F28F

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

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

DWPI, CJFD, CNABS, SIPOABS, CNTXT, USTXT, 盾安热工, 魏文建, 兰兆忠, 马文勇, 集流管, 多段, 弧形, 插入, 焊接; collecting pipe, header, part?, portion?, section?, segment?, multi+, plural+, several, arc+, curve?, insert+, weld+, solder+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	JP 1-203890 A (NIPPON DENSO CO.) 16 August 1989 (1989-08-16) description, pages 2-3, and figures 1-5	1-10
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A	JP 6-31689 B2 (NIPPON DENSO CO.) 27 April 1994 (1994-04-27) entire document	1-10
A	JP 2001-263989 A (KOBE STEEL LTD.) 26 September 2001 (2001-09-26) entire document	1-10
A	EP 1369658 A1 (VALMEX S.P.A.) 10 December 2003 (2003-12-10) entire document	1-10
A	FR 2858385 A1 (VALEO THERMIQUE MOTEUR S.A.) 04 February 2005 (2005-02-04) entire document	1-10

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search	Date of mailing of the international search report
24 February 2021	**12 March 2021**

Name and mailing address of the ISA/CN	Authorized officer
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Facsimile No. **(86-10)62019451**	Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/136137

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2020/136137

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