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(54) **CONNECTING JOINT TUBE AND HEAT EXCHANGER HAVING SAME**

(57) The disclosure provides a connecting tube and a heat exchanger. The connecting tube is configured to be connected with flat tubes. The connecting tube includes: two connection sections and a bent section, the two connection sections are disposed at two ends of the bent section respectively, the two connection sections are connected with the bent section to form a U-shaped tube, and an end, far away from the bent section, of the connection section is provided with a connection port; and the connection port has a flat mouth structure. According to a technical solution provided by the disclosure, a technical problem that a manufacturing process of a flat tube in the art known to inventors is complicated can be solved.

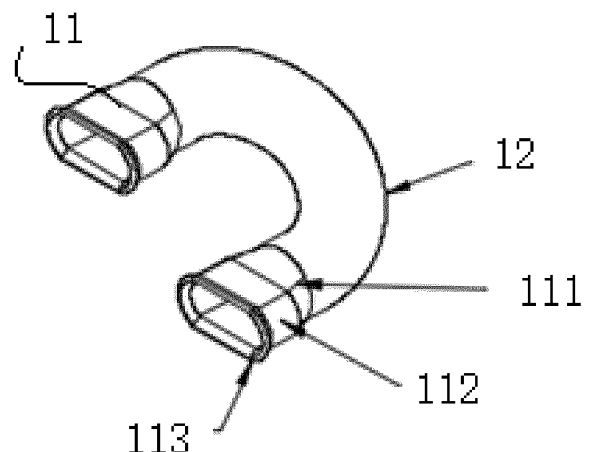


Fig. 1

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## Description

### Cross-Reference to Related Application

[0001] The present disclosure claims priority to Chinese Patent Application No. 202121194724.6 (entitled "Connecting Tube and Heat Exchanger"), and filed on May 31, 2021, the contents of which are hereby incorporated by reference in its entirety.

### Technical Field

[0002] The present disclosure relates to the technical field of heat exchangers, in particular to a connecting tube and a heat exchanger.

### Background

[0003] At present, staggered double-row microchannel heat exchangers in the art known to inventors include two staggered rows of flat tubes, that is, front row of flat tubes and rear row of flat tubes are spaced by a certain height and are not on the same plane.

[0004] Two independent core structures are adopted in the staggered double-row heat exchangers in the art known to inventors and are connected through a bent section to form a complete flat tube. In this way, a manufacturing process of the flat tube is complicated, which is not conducive to reduction of manufacturing cost of the flat tube.

### Summary

[0005] A main objective of the disclosure is to provide a connecting tube and a heat exchanger for solving a technical problem that a manufacturing process of a flat tube in the art known to inventors is complicated.

[0006] In order to achieve the above purpose, the disclosure provides a connecting tube. The connecting tube is configured to be connected with flat tubes. The connecting tube includes: two connection sections and a bent section, the two connection sections are disposed at two ends of the bent section respectively, the two connection sections are connected with the bent section to form a U-shaped tube, and an end, far away from the bent section, of each of the two connection sections is provided with a connection port; and the connection port has a flat mouth structure.

[0007] In some embodiments, the bent section is a round tube, each of the two connections section includes a transition zone and a flat tube zone, an end, connected with the bent section, of the transition zone is provided with a round mouth, and an end, connected with the flat tube zone, of the transition zone is provided with a flat mouth.

[0008] In some embodiments, each of the two connection sections further includes a connection flange, and the connection flange is disposed at an end, far away

from the transition zone, of the flat tube zone.

[0009] In some embodiments, the connection flange is folded towards an outer side of the connecting tube.

[0010] In some embodiments, the two connection sections are disposed at an interval, and a projection of one connection section on a central plane of an other connection section is disposed to be staggered from the central plane of the other connection section.

[0011] In some embodiments, a longitudinal distance between the two connection sections is set as  $H1$ , and  $5\text{ mm} < H1 \leq 15\text{ mm}$ ; and/or, a transverse distance between the two connection sections is set as  $W$ , and  $12\text{ mm} < W \leq 45\text{ mm}$ .

[0012] In some embodiments, the two connection sections are disposed at an interval, and a projection of one connection section on a central plane of the other connection section is disposed to coincide with the central plane of the other connection section.

[0013] In some embodiments, a longitudinal distance between the two connection sections is set as  $H2$ , and  $5\text{ mm} < H2 \leq 15\text{ mm}$ .

[0014] In some embodiments, a length of the bent section is set as  $L1$ , and  $15\text{ mm} \leq L1 \leq 35\text{ mm}$ ; and/or, a length of each of the two connection sections is set as  $L2$ , and  $0\text{ mm} < L2 \leq 8\text{ mm}$ ; and/or, a width of the connection port is set as  $d$ , and  $5\text{ mm} \leq d \leq 30\text{ mm}$ ; and/or, a height of the connection port is set as  $h$ , and  $1.3\text{ mm} \leq h \leq 4.5\text{ mm}$ ; and/or, a diameter of the bent section is set as  $\phi A$ , and  $5\text{ mm} \leq \phi A \leq 15.88\text{ mm}$ .

[0015] According to another aspect of the disclosure, a heat exchanger is provided. The heat exchanger includes a plurality of flat tubes, and the plurality of flat tubes are disposed at intervals; and a connecting tube, where the connecting tube is the connecting tube provided above, and the connecting tube is disposed between two adjacent flat tubes, such that the two adjacent flat tubes are in communication with each other through the connecting tube.

[0016] By applying the technical solution of the disclosure, the connecting tube is disposed between two adjacent flat tubes, such that two flat tubes can be conveniently connected with each other, a bent flat tube is formed, and the manufacturing process of the bent flat tube is simplified. In view of that, according to the technical solution provided by the disclosure, the technical problem that the manufacturing process of the flat tube in the art known to inventors is complicated can be solved.

### Brief Description of the Drawings

[0017] As a constituent part of the disclosure, the drawings of the description are used to provide further understanding of the disclosure, and exemplary examples of the disclosure and their specification serve to explain the disclosure, and do not constitute improper limitation to the disclosure. In the accompanying drawings:

Fig. 1 illustrates a schematic structural diagram of a connecting tube according to an example of the disclosure;

Fig. 2 illustrates a front view of a structure in Fig. 1;

Fig. 3 illustrates a top view of the structure in Fig. 1;

Fig. 4 illustrates a left view of the structure in Fig. 1;

Fig. 5 illustrates a schematic structural diagram of a connecting tube according to another example of the disclosure;

Fig. 6 illustrates a front view of a structure in Fig. 5;

Fig. 7 illustrates a top view of the structure in Fig. 5;

Fig. 8 illustrates a left view of the structure in Fig. 5;

Fig. 9 illustrates a schematic structural diagram of a heat exchanger according to an example of the disclosure; and

Fig. 10 illustrates an enlarged view of portion A in Fig. 9.

**[0018]** The accompanying drawings include the following reference numerals:

10. connecting tube; 11. connection section; 111. transition zone; 112. flat tube zone; 113. connection flange; 12. bent section; and 20. flat tube.

#### **Detailed Description of the Embodiments**

**[0019]** It is to be noted that the embodiments and features in the embodiments of the disclosure may be combined with each other without conflict. The disclosure will be described in detail below with reference to the accompanying drawings and the embodiments.

**[0020]** As shown in Figs. 1-8, some embodiments of the present disclosure provides a connecting tube 10. The connecting tube 10 is configured to be connected to a flat tube 20. The connecting tube 10 includes: two connection sections 11 and a bent section 12, the two connection sections 11 are disposed at two ends of the bent section 12 respectively, the two connection sections 11 are connected with the bent section 12 to form a U-shaped tube structure, and an end, far away from the bent section 12, of each of the two connection sections 11 is provided with a connection port; and the connection port has a flat mouth structure.

**[0021]** By adopting such a structural arrangement, a connecting tube 10 is arranged, and the connecting tube 10 is disposed between two adjacent flat tubes 20, such that the two adjacent flat tubes 20 are conveniently connected with each other, a bent flat tube is formed, and the manufacturing process of the bent flat tube 20 is sim-

plified.

**[0022]** In some embodiments, the bent section 12 is a round tube, each of the two connection sections 11 includes a transition zone 111 and a flat tube zone 112, an end, connected with the bent section 12, of the transition zone 111 is provided with a round mouth, and an end, connected with the flat tube zone 112, of the transition zone 111 is provided with a flat mouth. By adopting such a structural arrangement, a transition zone 111 is arranged, such that smooth transition is facilitated, and a strength of the entire structure is improved. In addition, production, manufacturing and molding is facilitated, and an integrated molded structure is formed conveniently.

**[0023]** In some embodiments, each of the two connecting sections further includes a connection flange 113, and the connection flange 113 is disposed at an end, far away from the transition zone 111, of the flat tube zone 112. By adopting such a structural arrangement facilitates connection by the connection flange.

**[0024]** In some embodiments, the connection flange 113 is folded towards the outer side of the connecting tube 10, and is conveniently inserted at an outer side of the flat tube 20, such that assembly and disassembly are facilitated.

**[0025]** As shown in Figs. 1-4, the two connection sections 11 are disposed at an interval, and a projection of one connection section 11 on a central plane of the other connection section 11 is disposed to be staggered from the central plane of the other connection section 11. The connecting tube 10 is configured to be connected with flat tubes 20 in different rows, so as to cause flat tubes 20 in different rows to be in communication with each other.

**[0026]** In some embodiments, a longitudinal distance between the two connection sections 11 is set as  $H1$ , and  $5\text{ mm} < H1 \leq 15\text{ mm}$ .

**[0027]** In some embodiments, a transverse distance between the two connection sections 11 is set as  $W$ , and  $12\text{ mm} < W \leq 45\text{ mm}$ .

**[0028]** In some embodiments, a longitudinal distance between the two connection sections 11 is set as  $H1$ , and  $5\text{ mm} < H1 \leq 15\text{ mm}$ . A transverse distance between the two connection sections 11 is set as  $W$ , and  $12\text{ mm} < W \leq 45\text{ mm}$ .

**[0029]** In some embodiments, the longitudinal distance between the two connection sections 11 is set as  $H1$ , and  $5\text{ mm} < H1 \leq 15\text{ mm}$ .

**[0030]** The transverse distance between the two connection sections 11 is set as  $W$ ,  $12\text{ mm} < W \leq 45\text{ mm}$ . By adopting such a structural arrangement, a heat exchange effect can be improved and a heat loss can be reduced as much as possible on the basis that structural compactness of the flat tube 20 of the heat exchanger is improved.

**[0031]** As shown in Figs. 5-8, the two connection sections 11 are disposed at an interval, and a projection of one connection section 11 on a central plane of the other connection section 11 is arranged to coincide with the

central plane of the other connection section 11. The connecting tube 10 is configured to connect two adjacent flat tubes 20 among a plurality of flat tubes 20 in the same row, so as to communicate the plurality of flat tubes 20 in the same row.

**[0032]** In some embodiments, a longitudinal distance between the two connection sections 11 is set as  $H_2$ , and  $5\text{ mm} < H_2 \leq 15\text{ mm}$ . By adopting such a structural arrangement, a heat exchange effect is improved and a heat loss is reduced as much as possible on the basis that structural compactness of the flat tube 20 of the heat exchanger is improved.

**[0033]** In some embodiments, a length of the bent section 12 is set as  $L_1$ , and  $15\text{ mm} \leq L_1 \leq 35\text{ mm}$ ; and/or, a length of each of the two connection sections 11 is set as  $L_2$ , and  $0\text{ mm} < L_2 \leq 8\text{ mm}$ ; and/or, a width of the connection port is set as  $d$ , and  $5\text{ mm} \leq d \leq 30\text{ mm}$ ; and/or, a height of the connection port is set as  $h$ , and  $1.3\text{ mm} \leq h \leq 4.5\text{ mm}$ ; and/or, a diameter of the bent section 12 is set as  $\varphi A$ , and  $5\text{ mm} \leq \varphi A \leq 15.88\text{ mm}$ .

**[0034]** In some embodiments, a length of the bent section 12 is set as  $L_1$ , and  $15\text{ mm} \leq L_1 \leq 35\text{ mm}$ ; a length of each of the connection sections 11 is set as  $L_2$ , and  $0\text{ mm} < L_2 \leq 8\text{ mm}$ ; a width of the connection port is set as  $d$ , and  $5\text{ mm} \leq d \leq 30\text{ mm}$ ; a height of the connection port is set as  $h$ , and  $1.3\text{ mm} \leq h \leq 4.5\text{ mm}$ ; and a diameter of the bent section 12 is set as  $\varphi A$ , and  $5\text{ mm} \leq \varphi A \leq 15.88\text{ mm}$ . By adopting such a structural arrangement, layout compactness of the entire structure is optimized, a heat exchanger effect is improved, and a heat loss is reduced conveniently.

**[0035]** In some embodiments, the connecting tube 10 is obtained by bending and flaring a circular tube. The connecting tube 10 is made of aluminum, composite aluminum or copper. The connecting tube 10 is applicable to a connection of the flat tubes 20, a simple implementation process and high precision of finished products are achieved, and applicability to a staggered double-row heat exchanger is achieved.

**[0036]** As shown in Figs. 9 and 10, in some embodiments, a heat exchanger is provided. The heat exchanger includes a plurality of flat tubes 20 and a connecting tube 10. The plurality of flat tubes 20 are disposed at intervals. A connecting tube 10 is the connecting tube 10 provided in the above embodiments, and the connecting tube 10 is disposed between two adjacent flat tubes 20, such that two adjacent flat tubes 20 are in communication with each other through the connecting tube 10.

**[0037]** In some embodiments, the connecting tube 10 is welded to the flat tube 20, such that design of a flow path of the heat exchanger is implemented.

**[0038]** From the above description, it can be seen that the above embodiments of the disclosure achieves the following technical effects: a simple implementation process and high precision of finished products are achieved.

**[0039]** It should be noted that the terms used herein are merely for describing specific embodiments, and are not intended to limit exemplary embodiments according

to the disclosure. As used herein, the singular form is also intended to include the plural form unless the context clearly indicates otherwise. Further, it should be understood that when the terms "comprise" and/or "include" are used in this description, the term denotes presence of features, steps, operations, devices, assemblies and/or their combinations.

**[0040]** Unless otherwise described specifically, relative arrangements, numeric expressions and values of components and steps set forth in these examples do not limit the scope of the disclosure. In addition, it should be understood that for the convenience of description, the dimensions of various parts shown in the accompanying drawings are not drawn according to the actual proportional relation. Technologies, methods and apparatuses known to those of ordinary skill in related fields cannot be discussed in detail, but in appropriate cases, the technologies, methods and apparatuses should be regarded as a constituent part of the granted description. In all instances shown and discussed herein, any specific value should be constructed as merely illustrative, but not limitative. As a result, other instances of exemplary examples can have different values. It should be noted that similar reference numerals and letters indicate similar items in the following accompanying drawings, and once defined in one accompanying drawing, an item is unnecessary to further define and explain in subsequent accompanying drawings.

**[0041]** In the description of the disclosure, it should be understood the orientation or positional relations indicated by the orientation terms such as "front", "rear", "up", "down", "left", "right", "transverse", "vertical", "perpendicular", "horizontal", "top", and "bottom" are based on the orientation or positional relations shown in the accompanying drawings, are merely for facilitating the description of the disclosure and simplifying the description, rather than indicating or implying that an apparatus or element referred to must have a particular orientation or be constructed and operated in a particular orientation in the absence of contrary description, and cannot be understood as limitation to the disclosure accordingly. The orientation terms "inside" and "outside" refer to inside and outside relative to outlines of components.

**[0042]** For the convenience of description, spatially relative terms such as "over", "above", "on an upper surface of" and "on" can be used herein to describe a spatial positional relation between a device or feature as shown in the figure and other devices or features. It should be understood that the spatially relative terms are intended to include different orientations in use or operation in addition to the orientation of the device depicted in the figure. For example, if the device in the accompanying drawing is inverted, the device that is described as "above another device or structure" or "over another device or structure" will be positioned as "below another device or structure" or "under another device or structure". As a result, the exemplary term "above" can include two orientations of "above" and "below". The device can also

be positioned in other different ways (rotated by 90 degrees or in other orientations), and spatial relative description used herein is explained accordingly.

**[0043]** In addition, it should be noted that the terms such as "first" and "second" are used for defining parts, and are merely used for conveniently distinguishing corresponding parts. The terms have no special meanings unless otherwise stated, and cannot be understood as limitation to the protection scope of the disclosure accordingly.

**[0044]** The above examples are merely preferred examples of the disclosure and are not intended to limit the disclosure, and for those skilled in the art, various modifications and changes can be made to the disclosure. Any modification, equivalent substitution, improvement, etc. made within the spirit and principles of the disclosure shall fall within the protection scope of the disclosure.

## Claims

1. A connecting tube, configured to be connected with flat tubes, and comprising:

two connection sections (11) and a bent section (12), the two connection sections (11) are disposed at two ends of the bent section (12) respectively, the two connection sections (11) are connected with the bent section (12) to form a U-shaped tube, and an end, far away from the bent section (12), of each of the two connection sections (11) is provided with a connection port; and  
the connection port has a flat mouth structure.

2. The connecting tube as claimed in claim 1, wherein the bent section (12) is a round tube, each of the two connection sections (11) comprises a transition zone (111) and a flat tube zone (112), an end, connected with the bent section (12), of the transition zone (111) is provided with a round mouth, and an end, connected with the flat tube zone (112), of the transition zone (111) is provided with a flat mouth.

3. The connecting tube as claimed in claim 2, wherein each of the two connection sections (11) further comprises a connection flange (113), and the connection flange (113) is disposed at an end, far away from the transition zone (111), of the flat tube zone (112).

4. The connecting tube as claimed in claim 3, wherein the connection flange (113) is folded towards an outer side of the connecting tube.

5. The connecting tube as claimed in claim 1, wherein the two connection sections (11) are disposed at an interval, and a projection of one connection section (11) on a central plane of an other connection section

(11) is disposed to be staggered from the central plane of the other connection section (11).

6. The connecting tube as claimed in claim 5, wherein

a longitudinal distance between the two connection sections (11) is set as  $H1$ , and  $5\text{ mm} < H1 \leq 15\text{ mm}$ ; and/or,  
a transverse distance between the two connection sections (11) is set as  $W$ , and  $12\text{ mm} < W \leq 45\text{ mm}$ .

7. The connecting tube as claimed in claim 1, wherein the two connection sections (11) are disposed at an interval, and a projection of one connection section (11) on a central plane of an other connection section (11) is disposed to coincide with the central plane of the other connection section (11).

8. The connecting tube as claimed in claim 7, wherein a longitudinal distance between the two connection sections (11) is set as  $H2$ , and  $5\text{ mm} < H2 \leq 15\text{ mm}$ .

9. The connecting tube as claimed in any one of claims 1-8, wherein

a length of the bent section (12) is set as  $L1$ , and  $15\text{ mm} \leq L1 \leq 35\text{ mm}$ ; and/or,  
a length of each of the two connection sections (11) is set as  $L2$ , and  $0\text{ mm} < L2 \leq 8\text{ mm}$ ; and/or,  
a width of the connection port is set as  $d$ , and  $5\text{ mm} \leq d \leq 30\text{ mm}$ ; and/or,  
a height of the connection port is set as  $h$ , and  $1.3\text{ mm} \leq h \leq 4.5\text{ mm}$ ; and/or,  
a diameter of the bent section (12) is set as  $\varphi A$ , and  $5\text{ mm} \leq \varphi A \leq 15.88\text{ mm}$ .

10. A heat exchanger, comprising:

a plurality of flat tubes, and the plurality of flat tubes are disposed at intervals; and  
a connecting tube, wherein the connecting tube is the connecting tube as claimed in any one of claims 1-9, and the connecting tube is disposed between two adjacent flat tubes, the two adjacent flat tubes are in communication with each other through the connecting tube.

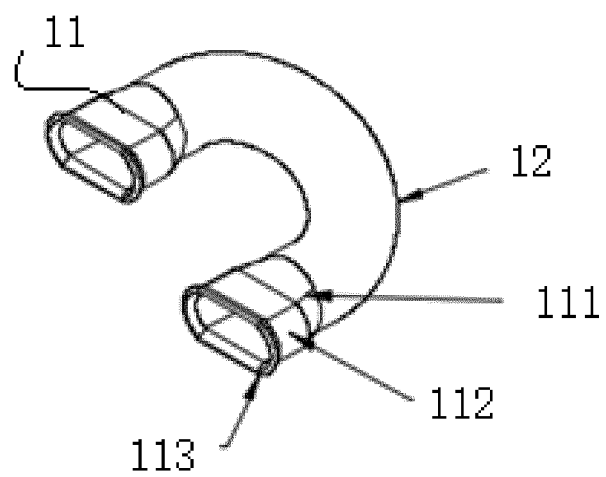


Fig. 1

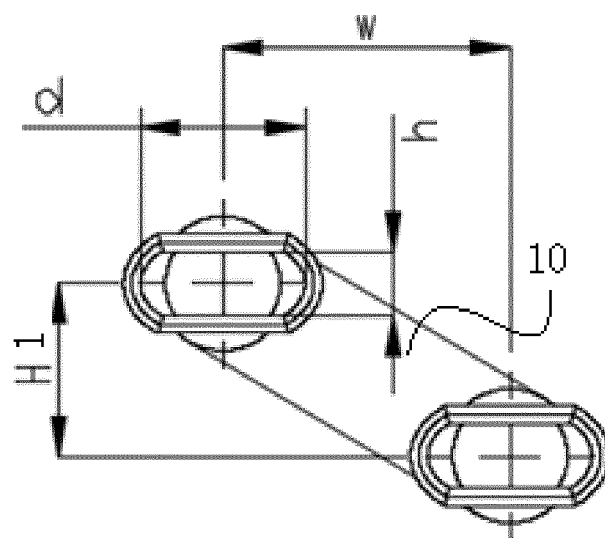


Fig. 2

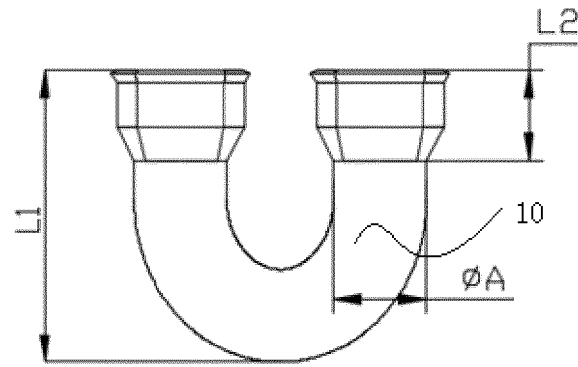


Fig. 3

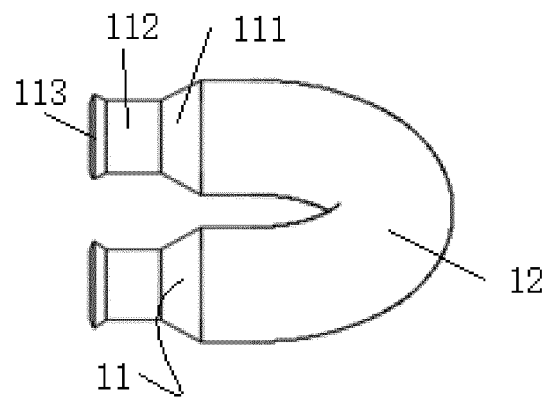


Fig. 4

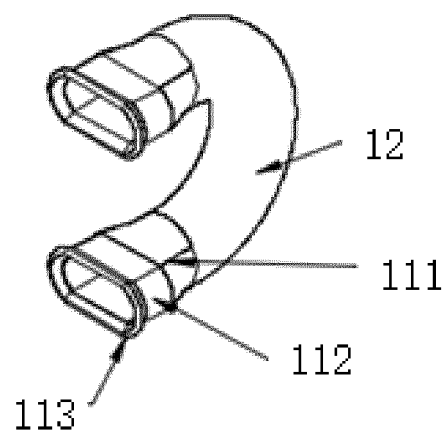


Fig. 5

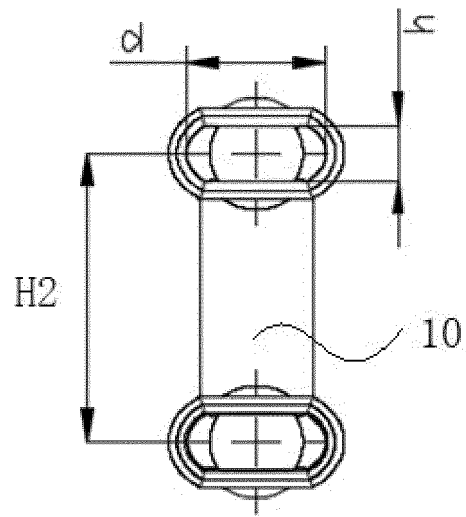


Fig. 6

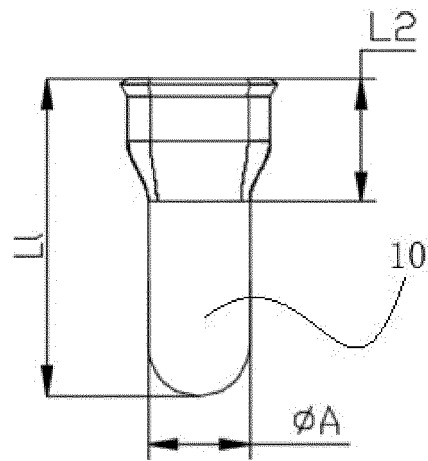


Fig. 7

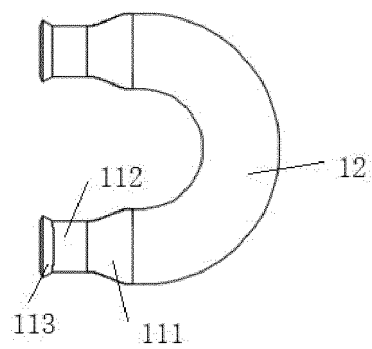


Fig. 8

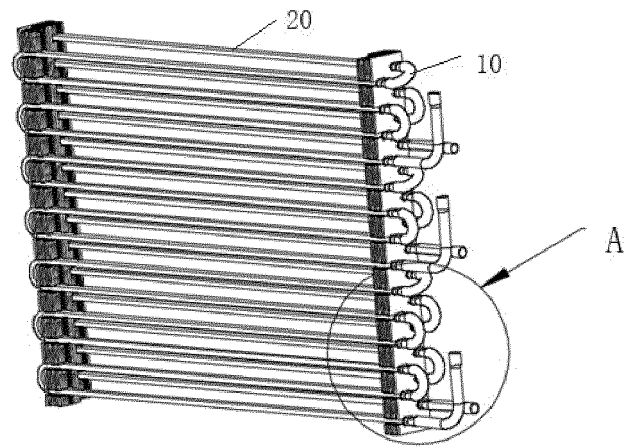


Fig. 9

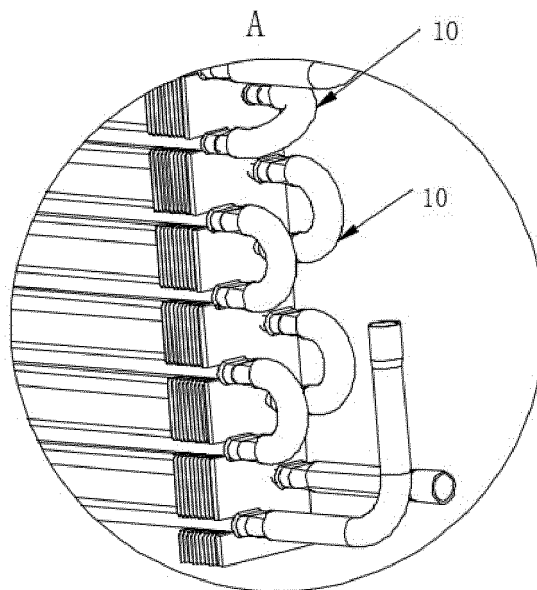


Fig. 10

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/096132

**A. CLASSIFICATION OF SUBJECT MATTER**

F28F 9/26(2006.01)i; F28D 1/053(2006.01)i; F25B 39/00(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)

F28; F24F; F25B

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, VEN, CNABS, CNKI: 连接管, 接头, U型, 扁管, 圆管, connect+, pipe?, joint?, U-shaped, flat pipe?, flat tube?, round

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                | Relevant to claim No. |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| PX        | CN 215766688 U (ZHEJIANG DUNAN THERMAL ENGINEERING TECHNOLOGY CO., LTD.) 08 February 2022 (2022-02-08)<br>claims 1-10                                             | 1-10                  |
| X         | CN 201964816 U (GOLDEN DRAGON PRECISE COPPER TUBE GROUP INC. et al.) 07 September 2011 (2011-09-07)<br>description, paragraphs [0003]-[0025], and figures 1 and 3 | 1-10                  |
| A         | CN 110686429 A (ZHEJIANG DUNAN THERMAL ENGINEERING TECHNOLOGY CO., LTD.) 14 January 2020 (2020-01-14)<br>entire document                                          | 1-10                  |
| A         | CN 210922277 U (ZHEJIANG DUNAN THERMAL ENGINEERING TECHNOLOGY CO., LTD.) 03 July 2020 (2020-07-03)<br>entire document                                             | 1-10                  |
| A         | CN 211876832 U (ZHEJIANG DUNAN THERMAL ENGINEERING TECHNOLOGY CO., LTD.) 06 November 2020 (2020-11-06)<br>entire document                                         | 1-10                  |
| A         | US 2014041843 A1 (LINDELL, E. et al.) 13 February 2014 (2014-02-13)<br>entire document                                                                            | 1-10                  |

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

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Date of the actual completion of the international search

18 August 2022

Date of mailing of the international search report

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Name and mailing address of the ISA/CN

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Authorized officer

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

**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

International application No.

**PCT/CN2022/096132**

| Patent document<br>cited in search report | Publication date<br>(day/month/year) | Patent family member(s) | Publication date<br>(day/month/year) |
|-------------------------------------------|--------------------------------------|-------------------------|--------------------------------------|
| CN 215766688 U                            | 08 February 2022                     | None                    |                                      |
| CN 201964816 U                            | 07 September 2011                    | None                    |                                      |
| CN 110686429 A                            | 14 January 2020                      | EP 3591324 A1           | 08 January 2020                      |
|                                           |                                      | US 2020011616 A1        | 09 January 2020                      |
| CN 210922277 U                            | 03 July 2020                         | CN 111442662 A          | 24 July 2020                         |
| CN 211876832 U                            | 06 November 2020                     | None                    |                                      |
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