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(54) **HEAT EXCHANGER FLAT TUBE AND HEAT EXCHANGER HAVING SAME**

(57) Provided are a heat exchanger flat tube and a heat exchanger having same. The heat exchanger flat tube comprises a first plate member and a second plate member arranged opposite to the first plate member. A fluid channel is formed between the second plate member and the first plate member. The fluid channel has an inlet and an outlet. A throttling structure is provided between the first plate member and the second plate mem-

ber. The throttling structure is in communication with the fluid channel. The throttling structure is located at the inlet. The throttling structure comprises multiple bent sections in sequential communication. The technical solution provided by the present application can solve the technical problem in the art in which the throttling performance of a heat exchanger flat tube is poor.

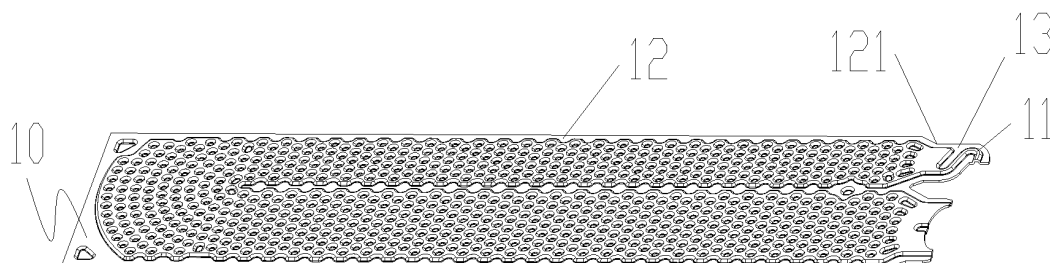


Fig. 1

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Description

Cross-Reference to Related Application

[0001] The present disclosure claims priority to Chinese Patent Application No. 202010567679.8, filed to the China National Intellectual Property Administration on June 19, 2020 and entitled "Heat Exchange Flat Tube and Heat Exchanger".

Technical Field

[0002] The present disclosure relates to a technical field of heat exchanger devices, and in particular to a heat exchange flat tube and a heat exchanger.

Background

[0003] At present, a fluid channel and a convex hull structure are disposed in a heat exchange flat tube in the art known to inventors, and a certain turbulent flow effect can be achieved on a fluid medium in the fluid channel through the convex hull structure. Generally, an inlet part of the heat exchange flat tube is inserted into a flow collecting pipe to enable the fluid channel to communicate with the flow collecting pipe, and in the art known to inventors, the inlet part is mostly located at an end of the heat exchange flat tube and is of a hole-shaped structure.

[0004] However, in such a case, throttling at the inflow position is not facilitated, and the throttling effect of the heat exchange flat tube is poor.

Summary

[0005] Some embodiments of the present disclosure provide a heat exchange flat tube and a heat exchanger, so as to solve a technical problem that the throttling effect of a heat exchange flat tube is poor in the art known to inventors.

[0006] Some embodiments of the present disclosure provide a heat exchange flat tube, which includes: a first plate body; a second plate body, which is disposed opposite to the first plate body, a fluid channel is formed between the second plate body and the first plate body, and the fluid channel is provided with an inlet and an outlet; a throttling structure is disposed between the first plate body and the second plate body, the throttling structure communicates with the fluid channel, the throttling structure is located at the inlet, and the throttling structure includes a plurality of bent sections which communicate in sequence.

[0007] In some embodiments, the throttling structure includes a first throttling groove, which is formed in the first plate body.

[0008] In some embodiments, the first throttling groove includes a first groove section, a first arc-shaped connecting section, a second groove section and a second arc-shaped connecting section which sequentially com-

municate, a throttling opening of the first throttling groove is disposed in an end, away from the first arc-shaped connecting section, of the first groove section, the second arc-shaped connecting section is located at the inlet, and an end, away from the second groove section, of the second arc-shaped connecting section forms a flow outlet of the first throttling groove.

[0009] In some embodiments, the first plate body includes a first main plate and a first throttling plate, the first throttling plate is disposed at an end of the first main plate, and the first throttling groove is disposed on the first throttling plate; the second plate body includes a second main plate and a second throttling plate, the second throttling plate is disposed at an end of the second main plate; and the second main plate and the first main plate are oppositely disposed, and the second throttling plate and the first throttling plate are oppositely disposed, so that a first throttling channel is formed by the first throttling groove and the second throttling plate.

[0010] In some embodiments, the throttling opening of the first throttling groove is located on a side portion of the first main plate.

[0011] In some embodiments, a first bent part is disposed at a side portion of the first main plate, a second bent part is disposed at a side portion of the second main plate, the second bent part and the first bent part are oppositely disposed to form a clamping part, a clamping opening which is cooperated with the clamping part is disposed on a flow collecting pipe, and the clamping part is clamped at the clamping opening to enable the first throttling groove to be inserted into the flow collecting pipe.

[0012] In some embodiments, the throttling structure further includes a second throttling groove, the second throttling groove is disposed on the second plate body, the second throttling groove is located in the inlet, the second throttling groove communicates with the fluid channel, and the second throttling groove and the first throttling groove are oppositely disposed, so that a second throttling channel is formed by the second throttling groove and the first throttling groove.

[0013] In some embodiments, a first preset angle is formed between a circulation direction of the flow outlet of the first throttling groove and a circulation direction in the fluid channel; and/or a second preset angle is formed between a circulation direction of a flow outlet of the second throttling groove and the circulation direction in the fluid channel.

[0014] In some embodiments, the fluid channel is a U-shaped channel, the inlet and the outlet are located at the same end of the heat exchange flat tube and disposed at an interval, and the throttling opening of the first throttling groove is disposed towards a side close to the inlet.

[0015] Some embodiments of the present disclosure disclose a heat exchanger, including a heat exchange flat tube, which is the heat exchange flat tube provided above.

[0016] By adoption of the technical solution, the throt-

ting structure is disposed on the heat exchange flat tube, and the throttling structure communicates with the fluid channel, so that liquid can enter the fluid channel after being throttled through the plurality of bent sections of the throttling structure, then throttling resistance can be increased, and the throttling effect can be better enhanced. Therefore, through the technical solution provided by the present disclosure, the technical problem that the throttling effect of a heat exchange flat tube in the art known to inventors is poor can be solved.

Brief Description of the Drawings

[0017] The drawings forming a part of the application in the specification are adopted to provide a further understanding to the present disclosure. Some embodiments of the present disclosure are adopted to explain the application and not intended to form improper limits to the application. In the drawings:

Fig. 1 illustrates a schematic structure diagram of a first plate body provided according to some embodiments of the present disclosure;

Fig. 2 illustrates a schematic structure diagram of a second plate body provided with a second throttling groove provided according to some embodiments of the present disclosure;

Fig. 3 illustrates a schematic structure diagram of a second plate body not provided with a second throttling groove provided according to some embodiments of the present disclosure;

Fig. 4 illustrates a schematic structure diagram of a heat exchange flat tube provided with a first throttling groove and a second throttling groove provided according to some embodiments of the present disclosure;

Fig. 5 illustrates an enlarged schematic diagram of A in Fig. 4;

Fig. 6 illustrates a schematic structure diagram of a heat exchange flat tube provided with a first throttling groove provided according to some embodiments of the present disclosure;

Fig. 7 illustrates an enlarged schematic diagram of B in Fig. 6;

Fig. 8 illustrates schematic structure diagrams of a heat exchange flat tube and a flow collecting pipe provided according to some embodiments of the present disclosure;

Fig. 9 illustrates a schematic structure diagram of a heat exchanger provided according to some embod-

iments of the present disclosure;

Fig. 10 illustrates a schematic structure diagram of a heat exchanger at another angle provided according to some embodiments of the present disclosure;

Fig. 11 illustrates an enlarged schematic diagram of C in Fig. 10.

Fig. 12 illustrates a schematic structure diagram of an exploded view of a heat exchanger provided according to some embodiments of the present disclosure;

[0018] The above drawings include the following reference signs:

10, First plate body; 11, First throttling groove; 111, First groove section; 112, First arc-shaped connecting section; 113, Second groove section; 114, Second arc-shaped connecting section; 115, Throttling opening; 12, First main plate; 121, First bent part; 13, First throttling plate; 20, Second plate body; 21, Second main plate; 211, Second bent part; 22, Second throttling plate; 23, Second throttling groove; 30, Flow collecting pipe; 40, Fin; 50, Side plate; 60, Connecting pipe.

Detailed Description of the Embodiments

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

[0020] As shown in Figs. 1-8, Embodiment 1 of the present disclosure provides a heat exchange flat tube including a first plate body 10 and a second plate body 20. The second plate body 20 and the first plate body 10 are oppositely disposed, specifically, the first plate body 10 and the second plate body 20 may be welded together, a fluid channel is formed between the second plate body 20 and the first plate body 10, and the fluid channel is provided with an inlet and an outlet. A throttling structure is disposed between the first plate body 10 and the second plate body 20, the throttling structure communicates with the fluid channel, the throttling structure is located at the inlet, and the throttling structure includes a plurality of bent sections which communicate in sequence.

[0021] By adoption of the heat exchange flat tube provided by the embodiment, the throttling structure is disposed on the heat exchange flat tube, and communicates with the fluid channel. Therefore, liquid entering the heat exchange flat tube is throttled through the plurality of bent sections of the throttling structure, and then the throttled liquid enters the fluid channel. By adoption of the arrangement, the throttling resistance can be increased to improve the throttling effect, so that a refrigerant in a flow collecting pipe 30 can be mixed more fully and distributed more uniformly to each heat exchange flat tube, and the

heat exchange flat tube in the embodiment is particularly suitable for being applied to an evaporator. Therefore, through the heat exchange flat tube provided by the embodiment, the technical problem that the throttling effect of a heat exchange flat tube in the art known to inventors is poor can be solved. Meanwhile, the situation that the throttling structure is too long in the length direction can be avoided through the plurality of bent sections, and then the situation that the overall length of the heat exchange flat tube is excessively increased is avoided.

[0022] In some embodiments, the throttling structure includes a first throttling groove 11, which is disposed on the first plate body 10. By adoption of the structural arrangement, liquid can be conveniently throttled through the first throttling groove 11, the circulation area of the first throttling groove 11 is far smaller than that in the fluid channel, so that the throttling effect can be guaranteed.

[0023] In some embodiments, the first throttling groove 11 can be of a strip-shaped groove structure, and the first throttling groove 11 can also be of an arc-shaped groove structure.

[0024] In some embodiments, the first throttling groove 11 includes a first groove section 111, a first arc-shaped connecting section 112, a second groove section 113 and a second arc-shaped connecting section 114 which sequentially communicate, a throttling opening 115 of the first throttling groove 11 is disposed at the end, away from the first arc-shaped connecting section 112, of the first groove section 111, the second arc-shaped connecting section 114 is located at the inlet, and the end, away from the second groove section 113, of the second arc-shaped connecting section 114 forms a flow outlet of the first throttling groove 11. The throttling opening 115 of the first throttling groove 11 forms a flow inlet of the heat exchange flat tube, and liquid enters the first throttling groove 11 from the throttling opening 115 to achieve throttling.

[0025] In some embodiments, the first groove section 111, the first arc-shaped connecting section 112, the second groove section 113 and the second arc-shaped connecting section 114 form an S-like structure, so that the effective throttling length of the throttling structure can be ensured under the condition that the overall length of the heat exchange flat tube is not increased, and the throttling effect can be improved. Meanwhile, the first arc-shaped connecting section 112 and the second arc-shaped connecting section 114 are disposed, so that the situation that liquid flows unsmoothly at a bent position can be avoided, and liquid can smoothly flow into the fluid channel.

[0026] In some embodiments, the first plate body 10 includes a first main plate 12 and a first throttling plate 13, the first throttling plate 13 is disposed at the end of the first main plate 12, and the first throttling groove 11 is disposed on the first throttling plate 13. The second plate body 20 includes a second main plate 21 and a second throttling plate 22, and the second throttling plate 22 is disposed at the end of the second main plate 21. The

second main plate 21 and the first main plate 12 are oppositely disposed, and the second throttling plate 22 and the first throttling plate 13 are oppositely disposed, so that the first throttling groove 11 and the second throttling plate 22 form a first throttling channel.

[0027] In some embodiments, the second throttling plate 22 here is of a flat plate structure, and a circulation face of the first throttling channel formed is of a semi-circulation cross-sectional structure.

[0028] In some embodiments, the throttling opening 115 of the first throttling groove 11 is located on the side portion of the first main plate 12. In some embodiments, the first throttling plate 13 is a plate with an arc-shaped protrusion, the shape of the second throttling plate 22 is the same as that of the first throttling plate 13, the throttle opening 115 of the first throttling groove 11 is located at the position of the arc-shaped protrusion of the first throttling plate 13, and the throttling opening 115 of the first throttling groove 11 is located on the side portion of the arc-shaped protrusion. By adoption of the structural arrangement, the position of the first throttling groove 11 can conform to the structural shapes of the first throttling plate 13 and the second throttling plate 22.

[0029] In some embodiments, a first bent part 121 is disposed at the side portion of the first main plate 12, a second bent part 211 is disposed at the side portion of the second main plate 21, the second bent part 211 and the first bent part 121 are oppositely disposed to form a clamping part, a clamping opening which is cooperated with the clamping part is disposed on the flow collecting pipe 30, and the clamping part is clamped at the clamping opening to enable the first throttling groove 11 to be inserted into the flow collecting pipe 30. The first bent part 121 is provided with a first bent opening and a second bent opening which are oppositely disposed, and the first bent opening and the second bent opening are oppositely located in two sides of the first main plate 12; and the second bent part 211 is provided with a third bent opening and a fourth bent opening which are oppositely disposed, and the third bent opening and the fourth bent opening are oppositely located on two sides of the second main plate 21. In some embodiments, in order to facilitate clamping, the structure of the first bent part 121 is the same as the structure of the second bent part 211. By adopting the structural arrangement, the heat exchange flat tube can be conveniently connected with the flow collecting pipe 30, so that the stability of the structural arrangement is improved.

[0030] In some embodiments, the throttling structure further includes a second throttling groove 23, the second throttling groove 23 is disposed on the second plate body 20, the second throttling groove 23 is located in the inlet, the second throttling groove 23 communicates with the fluid channel, and the second throttling groove 23 and the first throttling groove 11 are oppositely disposed, so that a second throttling channel is formed by the second throttling groove 23 and the first throttling groove 11. Compared with the first throttling channel, the circulation

area of the second throttling channel is increased, namely, the throttling area is increased, and a circulation face of the second throttling channel may be a full-circulation cross section. By adoption of the structural arrangement, the throttling effect can be improved, a refrigerant can be mixed more fully, so that the refrigerant can be distributed into each heat exchange flat tube more uniformly.

[0031] In some embodiments, the structure of the first throttling groove 11 and the structure of the second throttling groove 23 can be completely the same, or the structure of the first throttling groove 11 and the structure of the second throttling groove 23 can be different as long as at least part of the first throttling groove 11 and at least part of the second throttling groove 23 communicate to form the second throttling channel.

[0032] In some embodiments, the structure of the second plate body 20 here is the same as that of the first plate body 10, the second throttling groove 23 is disposed on the second throttling plate 22, and both the first throttling plate 13 and the second throttling plate 22 are disposed on the flow collecting pipe 30 in use, so that pre-throttling is achieved in the flow collecting pipe 30 by the first throttling plate 13 and the second throttling plate 22 to better improve the throttling effect.

[0033] In some embodiments, a first preset angle is formed between the circulation direction of the flow outlet of the first throttling groove 11 and the circulation direction in the fluid channel; and a second preset angle is formed between the circulation direction of the flow outlet of the second throttling groove 23 and the circulation direction in the fluid channel. By adoption of the structural arrangement, a refrigerant in the first throttling groove 11 and the second throttling groove 23 can conveniently flow into the fluid channel. The circulation direction of the flow channel extend in the extending direction of the plate body, and due to the fact that the throttling structure is provided with the plurality of oppositely disposed bent sections, the flow outlet deviates from the center line of the main plate body, that is, the flow outlet is disposed at the end of the main plate body, and the flow outlet is disposed at the position close to the side portion. In such a case, if the circulation direction of the flow outlet of the first throttling groove 11 is consistent with the direction in the fluid channel, and the circulation direction of the flow outlet of the second throttling groove 23 is also consistent with the direction in the fluid channel, liquid throttled by the throttling structure cannot be fully and uniformly supplemented to each part of the fluid channel, the refrigerant cannot be uniformly distributed to each part of the fluid channel, and better heat exchange of the refrigerant is not facilitated. A first preset angle is formed between the circulation direction of the flow outlet of the first throttling groove 11 and the circulation direction in the fluid channel, and a second preset angle is formed between the circulation direction of the flow outlet of the second throttling groove 23 and the circulation direction in the fluid channel, due to the inclined structure, the refrigerant can enter the fluid channel at a certain angle,

so that the refrigerant can be fully filled into the fluid channel, the distribution uniformity of the refrigerant is improved, and the heat exchange effect is improved.

[0034] In some embodiments, a plurality of turbulent flow convex hulls which are arranged at intervals are disposed in the fluid channel, and the turbulent flow convex hulls can play a turbulent flow role on the refrigerant in the fluid channel, so that heat exchange can be better performed.

[0035] In some embodiments, the fluid channel is a U-shaped channel, the inlet and the outlet are disposed at the same end of the heat exchange flat tube and disposed at an interval, and the throttling opening 115 of the first throttling groove 11 is disposed towards the side close to the inlet. By adoption of the structure arrangement, the compactness of the structure arrangement can be improved, and the structure layout can be optimized.

[0036] In some embodiments, the first throttling groove 11 protrudes out of the outlet, so that the first throttling groove 11 can stretch into the flow collecting pipe 30, the first throttling groove 11 can conduct pre-throttling on the refrigerant in the collecting pipe 30, and the throttling effect is improved.

[0037] As shown in Figs. 9-12, In some embodiments of the present disclosure provides a heat exchanger, including a heat exchange flat tube, which is heat exchange flat tube provided by the above embodiments. The heat exchanger further includes a flow collecting pipe 30, a fin 40, a side plate 50 and a connecting pipe 60, the flow collecting pipe 30 is connected with the heat exchange flat tube so that the flow collecting pipe 30 can communicate with the fluid channel. The fin 40 is disposed on the heat exchange flat tube, the side plate 50 is disposed on the end of the heat exchange flat tube, and the connecting pipe 60 is disposed on the flow collecting pipe 30 so that connecting with other pieces to be connected can be realized through the connecting pipe 60.

[0038] From the above description, it can be seen that the above embodiment of the application achieves the following technical effects: the throttling resistance is increased, the throttling effect is enhanced, and the refrigerant in the flow collecting pipe is more fully mixed and more uniformly distributed into each heat exchange flat tube.

[0039] It is to be noted that terms used herein are for the purpose of describing specific implementation modes only and are not intended to be limiting of exemplary implementation modes according to the application. Unless otherwise directed by the context, singular forms of terms used herein are intended to include plural forms. Besides, it will be also appreciated that when terms "contain" and/or "include" are used in the description, it is indicated that features, steps, operations, devices, assemblies and/or a combination thereof exist.

[0040] Unless otherwise specified, relative arrangements of components and steps elaborated in these embodiments, numeric expressions and numeric values do not limit the scope of the application. Furthermore, it

should be understood that for ease of descriptions, the size of each part shown in the drawings is not drawn in accordance with an actual proportional relation. Technologies, methods and devices known by those of ordinary skill in the related art may not be discussed in detail. However, where appropriate, the technologies, the methods and the devices shall be regarded as part of the authorized description. In all examples shown and discussed herein, any specific values shall be interpreted as only exemplar values instead of limited values. Therefore, other examples of the exemplary embodiments may have different values. It is to be noted that similar marks and letters represent similar items in the following drawings. As a result, once a certain item is defined in one drawing, it is unnecessary to further discuss the certain item in the subsequent drawings.

[0041] In the descriptions of the application, it will be appreciated that locative or positional relations indicated by "front, back, up, down, left, and right", "horizontal, vertical, perpendicular, and horizontal", "top and bottom" and other terms are locative or positional relations shown on the basis of the drawings, which are only intended to make it convenient to describe the application and to simplify the descriptions without indicating or impliedly indicating that the referring device or element must have a specific location and must be constructed and operated with the specific location, and accordingly it cannot be understood as limitations to the application. The nouns of locality "inner and outer" refer to the inner and outer contours of each component.

[0042] For ease of description, spatial relative terms such as "over", "above", "on an upper surface" and "upper" may be used herein for describing a spatial position relation between a device or feature and other devices or features shown in the drawings. It will be appreciated that the spatial relative terms aim to contain different orientations in usage or operation besides the orientations of the devices described in the drawings. For example, if the devices in the drawings are inverted, devices described as "above other devices or structures" or "over other devices or structures" will be located as "below other devices or structures" or "under other devices or structures". Thus, an exemplar term "above" may include two orientations namely "above" and "below". The device may be located in other different modes (rotated by 90 degrees or located in other orientations), and spatial relative descriptions used herein are correspondingly explained.

[0043] In addition, it is to be noted that terms "first", "second" and the like are used to limit parts, and are only intended to distinguish corresponding parts. If there are no otherwise statements, the above terms do not have special meanings, such that they cannot be understood as limits to the scope of protection of the application.

[0044] The above is only the preferred embodiment of the application and not intended to limit the application. For those skilled in the art, the application may have various modifications and variations. Any modifications,

equivalent replacements, improvements and the like made within the spirit and principle of the application shall fall within the scope of protection of the application.

Claims

1. A heat exchange flat tube, comprising:

a first plate body (10);
a second plate body (20), which is disposed opposite to the first plate body (10), a fluid channel is formed between the second plate body (20) and the first plate body (10), and the fluid channel is provided with an inlet and an outlet;
wherein a throttling structure is disposed between the first plate body (10) and the second plate body (20), the throttling structure is communicated with the fluid channel, the throttling structure is located at the inlet, and the throttling structure comprises a plurality of bent sections which communicate in sequence.

2. The heat exchange flat tube as claimed in claim 1, wherein the throttling structure comprises a first throttling groove (11), and the first throttling groove (11) is disposed on the first plate body (10).

3. The heat exchange flat tube as claimed in claim 2, wherein the first throttling groove (11) comprises a first groove section (111), a first arc-shaped connecting section (112), a second groove section (113) and a second arc-shaped connecting section (114) which sequentially communicate, a throttling opening (115) of the first throttling groove (11) is disposed at an end, away from the first arc-shaped connecting section (112), of the first groove section (11), the second arc-shaped connecting section (114) is located at the inlet, and the end, away from the second groove section (113), of the second arc-shaped connecting section is provided with a flow outlet of the first throttling groove (11).

4. The heat exchange flat tube as claimed in claim 2, wherein the first plate body (10) comprises a first main plate (12) and a first throttling plate (13), the first throttling plate (13) is disposed at an end of the first main plate (12), and the first throttling groove (11) is disposed on the first throttling plate (13); the second plate body (20) comprises a second main plate (21) and a second throttling plate (22), and the second throttling plate (22) is disposed at an end of the second main plate (21); wherein the second main plate (21) and the first main plate (12) are oppositely disposed, and the second throttling plate (22) and the first throttling plate (13) are oppositely disposed, so that a first throttling channel is formed by the first throttling groove (11) and the second throttling plate

(22).

5. The heat exchange flat tube as claimed in claim 4, wherein the first throttling opening (115) of the first throttling groove (11) is located on a side portion of the first main plate (12). 5

6. The heat exchange flat tube as claimed in claim 4, wherein a first bent part (121) is disposed at a side portion of the first main plate (12), a second bent part (211) is disposed at a side portion of the second main plate (21), the second bent part (211) and the first bent part (121) are oppositely disposed to form a clamping part, a clamping opening which is cooperated with the clamping part is disposed on a flow collecting pipe, and the clamping part is clamped at the clamping opening to enable the first throttling groove (11) to be inserted into the flow collecting pipe. 10
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7. The heat exchange flat tube as claimed in claims 2-6, wherein the throttling structure further comprises a second throttling groove (23), the second throttling groove (23) is disposed on the second plate body (20), the second throttling groove (23) is located in the inlet, the second throttling groove (23) is communicated with the fluid channel, and the second throttling groove (23) and the first throttling groove (11) are oppositely disposed, so that a second throttling channel is formed by the second throttling groove (23) and the first throttling groove (11). 25
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8. The heat exchange flat tube as claimed in claim 7, wherein 35
 - a first preset angle is formed between a circulation direction of the flow outlet of the first throttling groove (11) and a circulation direction in the fluid channel; and/or
 - a second preset angle is formed between a circulation direction of a flow outlet of the second throttling groove (23) and the circulation direction in the fluid channel. 40

9. The heat exchange flat tube as claimed in claims 2-6, wherein the fluid channel is a U-shaped channel, the inlet and the outlet are located at the same end of the heat exchange flat tube and disposed at an interval, and the throttling opening (115) of the first throttling groove (11) is disposed towards the side close to the inlet. 45
50

10. A heat exchanger, comprising a heat exchange flat tube, which is the heat exchange flat tube according to any of claims 1-9. 55

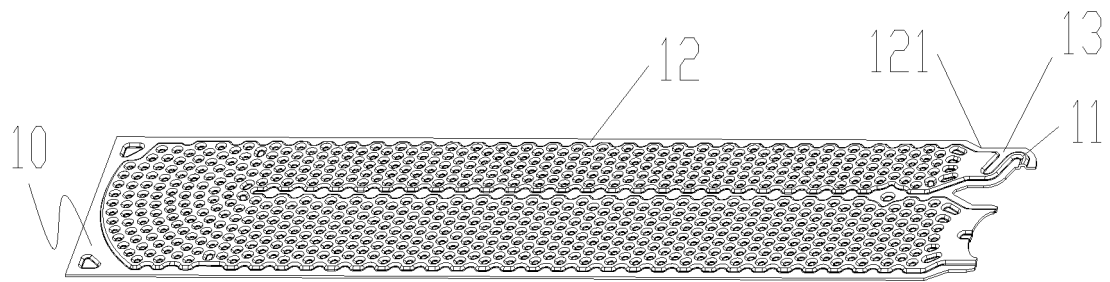


Fig. 1

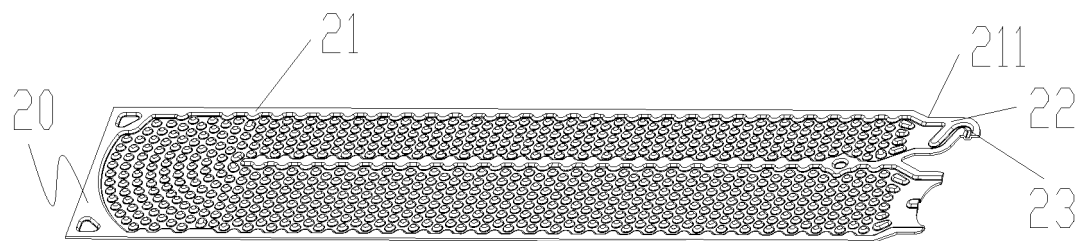


Fig. 2

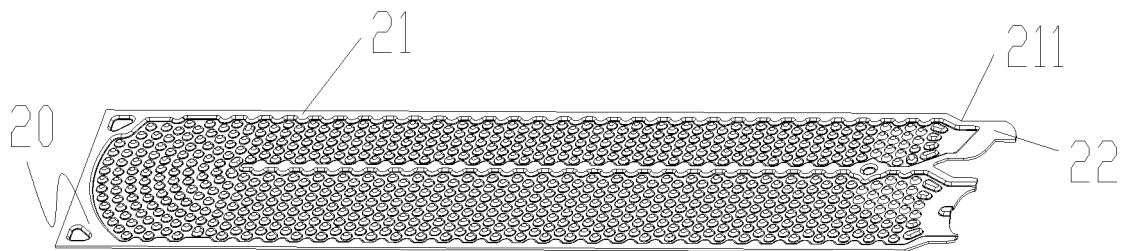


Fig. 3

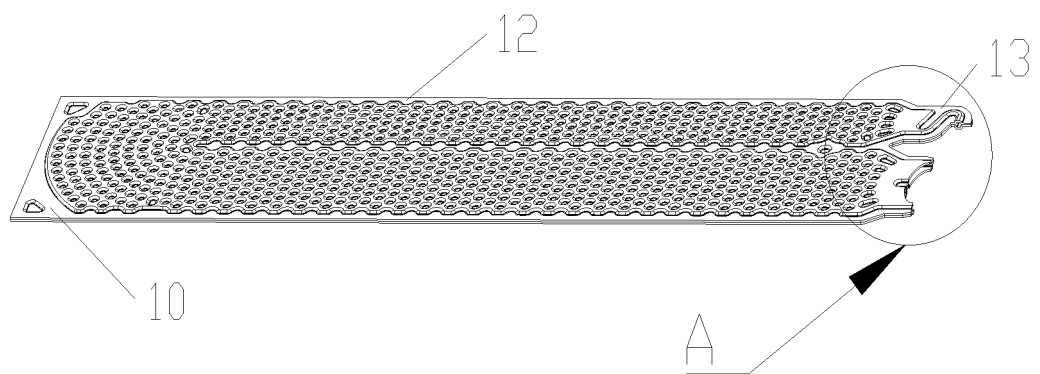


Fig. 4

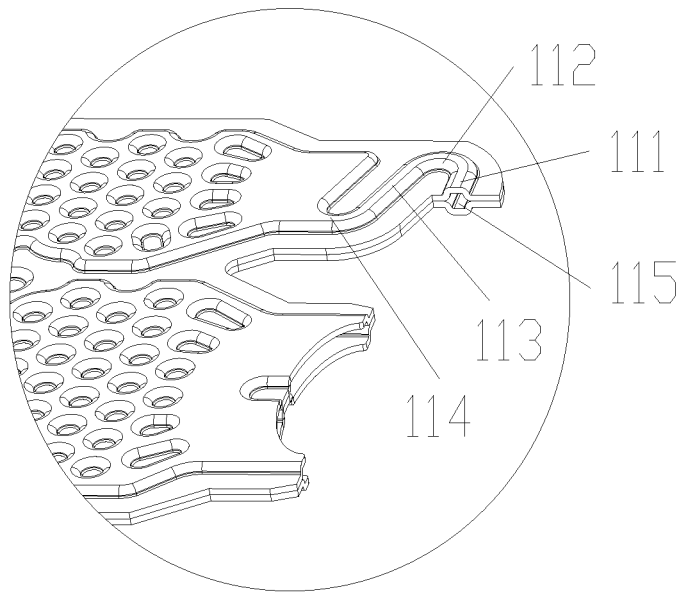


Fig. 5

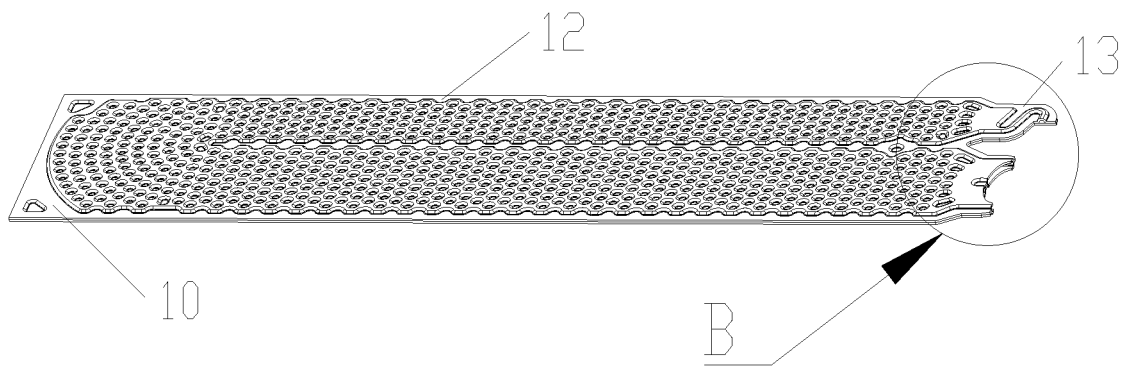


Fig. 6

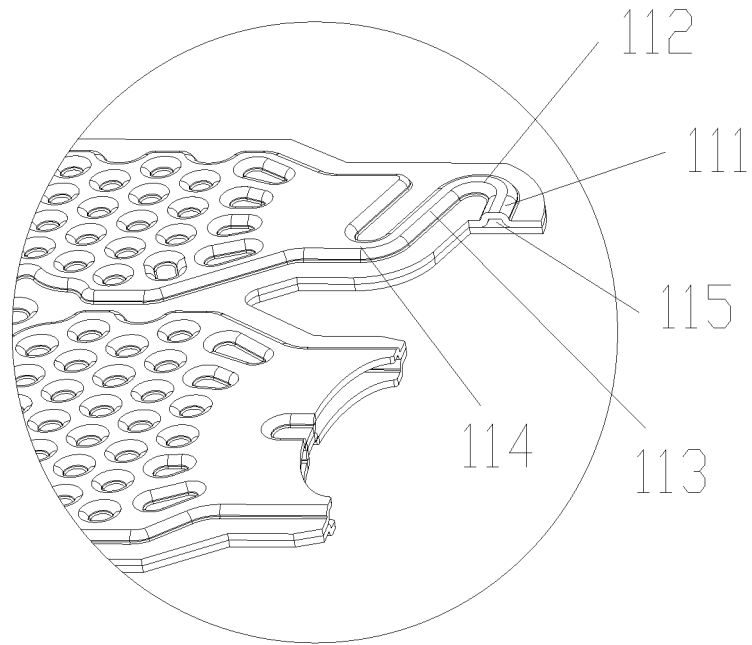


Fig. 7

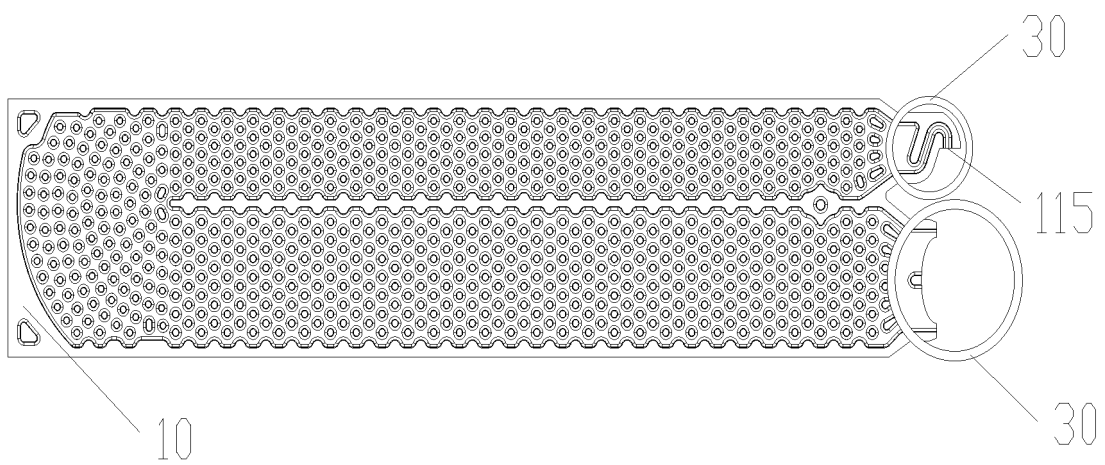


Fig. 8

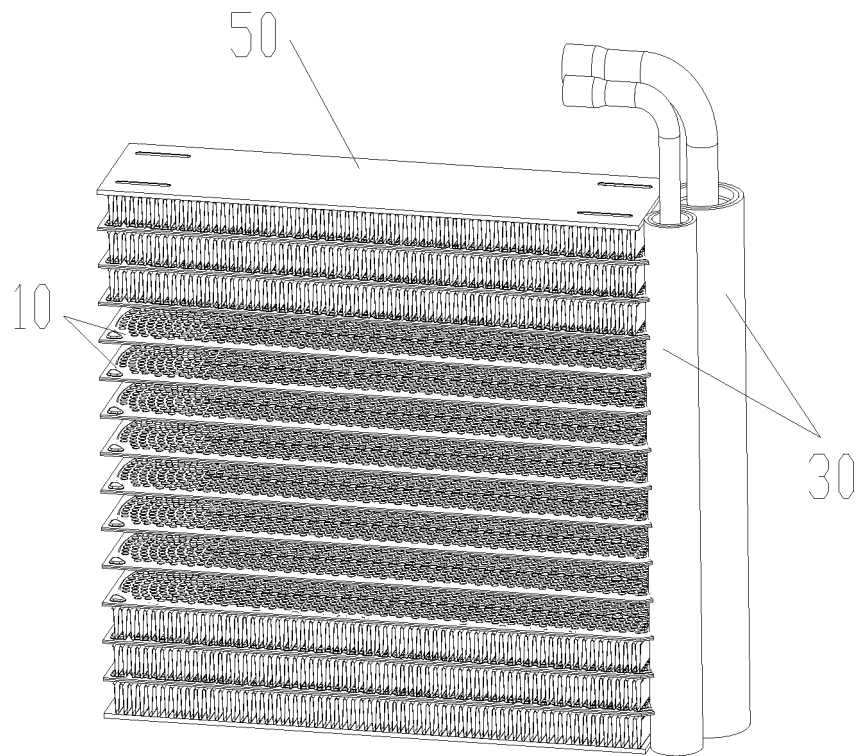


Fig. 9

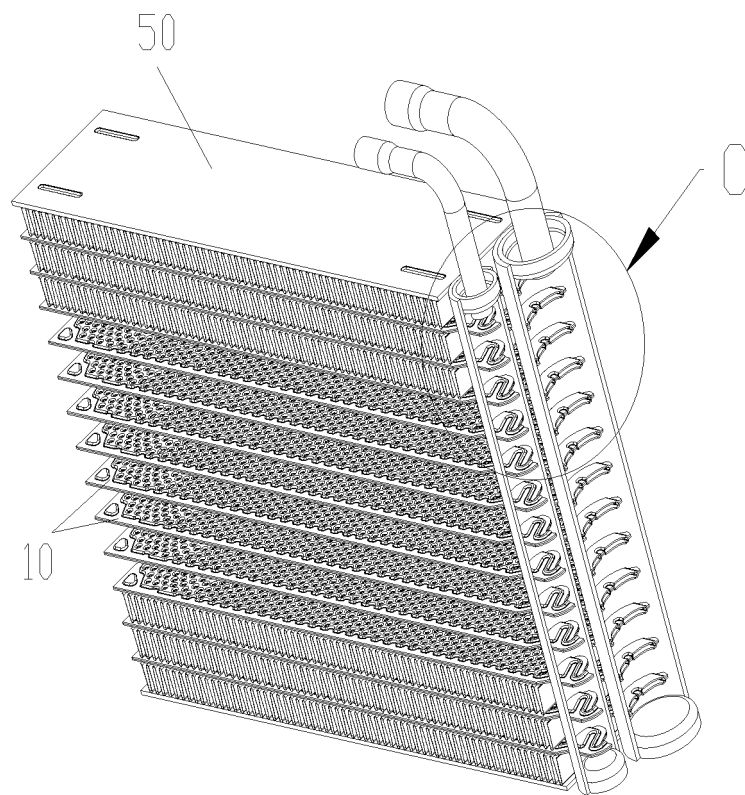


Fig. 10

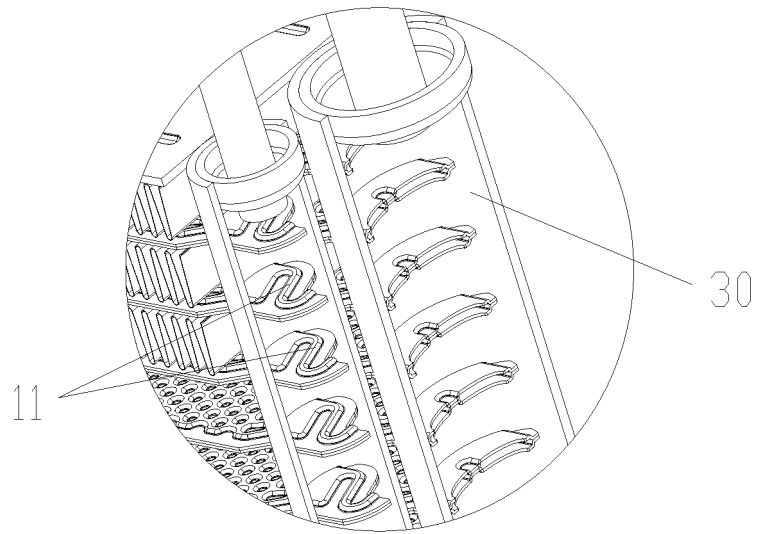


Fig. 11

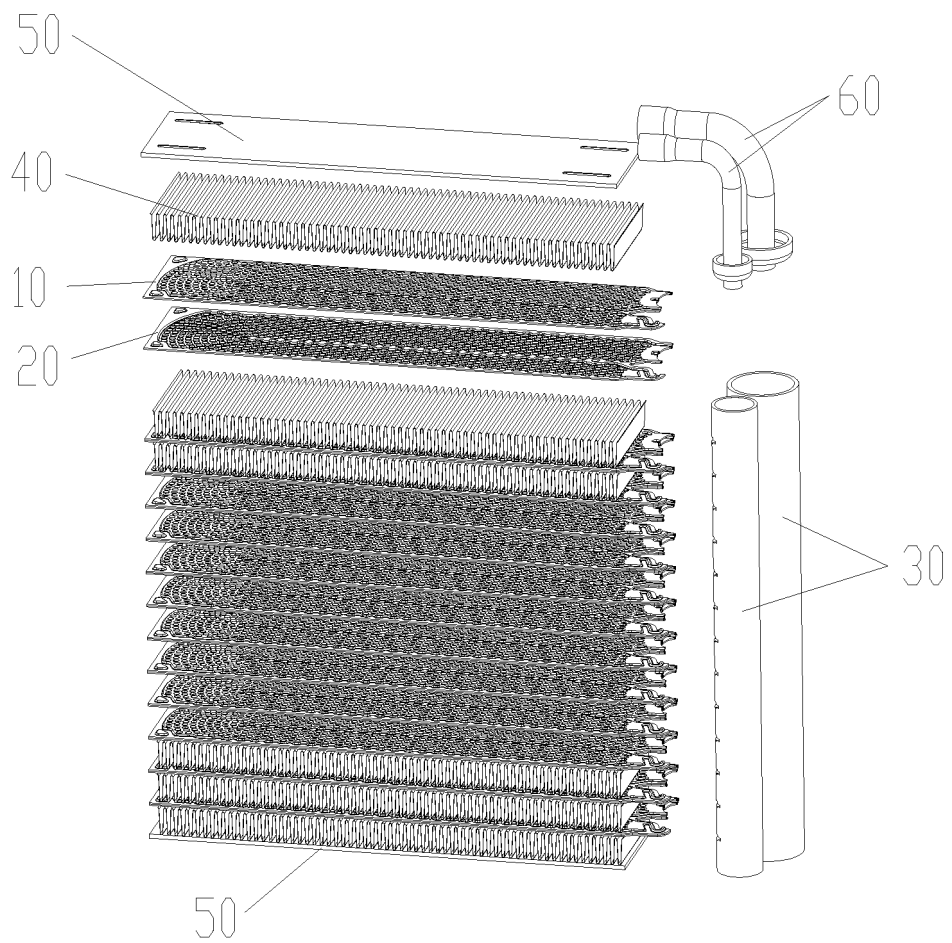


Fig. 12

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2021/091755

A. CLASSIFICATION OF SUBJECT MATTER		
F28F 3/08(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)		
F28F,F28D,F25B39		
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)		
VEN, DWPI, CNABS, CNKI: 板, 扁管, 节流, 阻力, 弯折, 弯曲, throttle, pressure, bend+, curv+, flexure		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 212390891 U (ZHEJIANG DUNAN THERMAL TECHNOLOGY CO., LTD.) 22 January 2021 (2021-01-22) claim, description, paragraphs [0001]-[0045], figures 1-12	1-10
X	CN 209689424 U (ZHEJIANG DUNAN THERMAL TECHNOLOGY CO., LTD.) 26 November 2019 (2019-11-26) description, paragraphs [0037]-[0056], figures 1-9	1-10
A	CN 101788212 A (DANFOSS SANHUA (HANGZHOU) MICRO CHANNEL HEAT EXCHANGER CO., LTD.) 28 July 2010 (2010-07-28) entire document	1-10
A	US 5765393 A (WHITE CONSOLIDATED IND., INC.) 16 June 1998 (1998-06-16) 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 "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "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 "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
13 July 2021		29 July 2021
Name and mailing address of the ISA/CN		Authorized officer
China National Intellectual Property Administration (ISA/CN) No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088 China		
Facsimile No. (86-10)62019451		Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2021/091755

Patent document cited in search report			Publication date (day/month/year)		Patent family member(s)		Publication date (day/month/year)	
CN	212390891	U	22 January 2021		None			
CN	209689424	U	26 November 2019		None			
CN	101788212	A	28 July 2010		CN	101788212	B	25 April 2012
US	5765393	A	16 June 1998		None			

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202010567679 [0001]