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(54) A TUBE FOR A HEAT EXCHANGER

(57) A flat tube for a heat exchanger comprises a plurality of walls forming a fluid passage through which a fluid flows, at least one inner fin provided in the fluid passage and at least one protrusion protruding towards the inner fin, is provided in the fluid passage. The flat tube comprises a flat first wall, a flat second wall parallel to the first wall and two side walls joining the first wall and the second wall. The at least one inner fin is meandering between the first wall and the second wall of the flat tube. The at least one protrusion is protruding from the at least one of the two side walls and is configured to at least partially block the flow of fluid in the vicinity of the at least one of the two side walls.

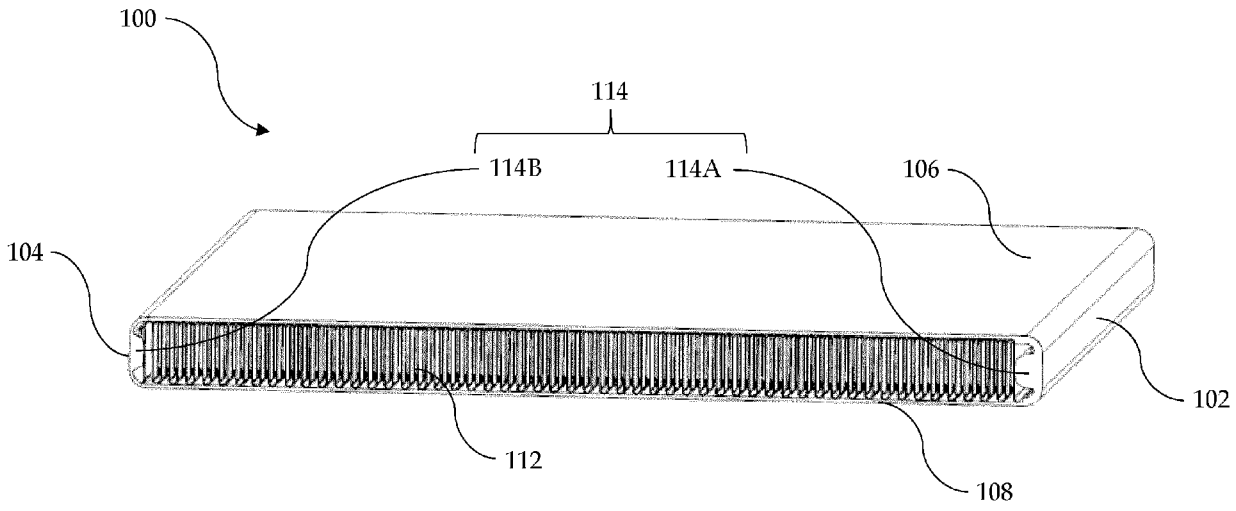

FIG. 3

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Description

TECHNICAL FIELD

[0001] The present invention relates to a tube for a heat exchanger. In particular, the present invention relates to a tube for a heat exchanger that comprises an inner fin.

BACKGROUND

[0002] Generally, a heat exchanger comprises a plurality of flat tubes through which a first fluid flows. The first fluid flowing inside the flat tube exchanges heat with a second fluid flowing outside the flat tube. The flat tube comprises two longer sides joined by two shorter sides. The flat tube further comprises an inner fin to increase heat exchange of the first fluid with the second fluid. The inner fin provided inside the flat tube is in contact with the two longer sides of the flat tube. The inner fin provided inside the flat tube further may not be in contact with at least one of the two shorter sides of the flat tube due to some reasons like welding joint, shorter width upon forming and so on. Therefore, the first fluid may flow through a space between the inner fin and the at least one of the two shorter sides of the flat tube that is not in contact with the inner fin and consequently, the heat exchange performance is reduced.

SUMMARY

[0003] An objective of the present invention is to provide a flat tube for a heat exchanger that alleviates the problems in the prior arts. To be more precise, an objective of the present invention is to block a space between an inner fin and at least one of two short sides of the flat tube that is not in contact with the inner fin.

[0004] Another objective of the present invention is to guide a fluid flowing in the flat tube towards the inner fin.

[0005] To achieve the above objectives, the present invention herein provides a flat tube for a heat exchanger. The flat tube for the heat exchanger for a flow of a fluid comprising: a longitudinal axis along which the flat tube extends; a first wall being substantially flat, a second wall being substantially flat and parallel to the first wall and two side walls joining the first wall and the second wall, wherein the first wall, the second wall and the two side walls together form a hollow profile of the flat tube, thereby forming a fluid passage for the flow of the fluid; at least one inner fin provided in the fluid passage, is meandering substantially transversely to the longitudinal axis between the first wall and the second wall; and at least one protrusion protruding from the at least one of the two side walls, is configured to at least partially block the flow of fluid in the vicinity of the at least one of the two side walls.

[0006] In one aspect, a tip portion of the at least one protrusion is in contact with the inner fin.

[0007] In another aspect, the tip portion of the at least one protrusion is not in contact with the inner fin.

[0008] In another aspect, the at least one protrusion comprises a guiding means configured to guide the fluid towards the inner fin.

[0009] In another aspect, the guiding means has a curved shape.

[0010] In another aspect, the at least one protrusion is provided proximate to an inlet of the flat tube.

[0011] In another aspect, the at least one protrusion is a dimple.

[0012] In another aspect, a plurality of protrusions are provided in the at least one of the two side walls.

[0013] In another aspect, all protrusions from the plurality of protrusions are identical.

[0014] In another aspect, at least one protrusion from the plurality of protrusions is different compared to other protrusions from the plurality of protrusions.

[0015] In another embodiment, the present invention herein provides a heat exchanger. The heat exchanger comprises: at least one flat tube according to any one of the above embodiments.

[0016] According to the above embodiments, the flat tube comprises at least one protrusion protruding from the at least one of the two side walls of the flat tube. Further, the at least one protrusion comprises the guiding means configured to guide the fluid towards the inner fin. Therefore, the at least one protrusion at least partially blocks the flow of fluid in the vicinity of the at least one of the two side walls, and guides the fluid towards the inner fin.

BRIEF DESCRIPTION OF DRAWINGS

[0017] Other characteristics, details and advantages of the invention can be inferred from the description of the invention hereunder. A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained, as the same becomes better understood by reference to the following description when considered in connection with the accompanying figures, wherein:

FIG. 1 illustrates a flat tube for a heat exchanger, in accordance with an embodiment of the present invention;

FIG. 2 illustrates an exploded view of the flat tube of FIG. 1;

FIG. 3 illustrates a sectional view of the flat tube of FIG. 1, at the plane A-A';

FIG. 4 illustrates an enlarged view of a protrusion without an inner fin of the flat tube of FIG. 3; and

FIG. 5 illustrates an enlarged view of the protrusion with the inner fin of the flat tube of FIG. 3.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0018] It must be noted that the figures disclose the invention in a detailed enough way to be implemented, the figures helping to better define the invention, if need be. The invention should however not be limited to the embodiments disclosed in the description.

[0019] In the present description, some elements or parameters may be indexed, such as a first element and a second element. In this case, unless stated otherwise, this indexation is only meant to differentiate and name elements that are similar but not identical. No idea of priority should be inferred from such indexation, as these may be switched without betraying the invention. Additionally, this indexation does not imply any order in mounting or use of the elements of the invention.

[0020] FIG. 1 illustrates a flat tube 100 for a heat exchanger, in accordance with an embodiment of the present invention. FIG. 2 illustrates an exploded view of the flat tube 100 of FIG. 1. The flat tube 100 for the heat exchanger comprises a fluid passage 110 through which a fluid flows, at least one inner fin 112 provided in the fluid passage 110 and at least one protrusion 114 protruding towards the inner fin 112, is provided in the fluid passage 110.

[0021] In one embodiment, the tube 100 for the heat exchanger can comprise a longitudinal axis L1 along which the flat tube 100 extends. The flat tube 100 can comprise a plurality of walls 102, 104, 106, 108 forming the fluid passage 110 through which the fluid flows. The flat tube 100 for the heat exchanger can comprise the at least one inner fin 112 provided in the fluid passage 110, wherein the fluid flows across the at least one inner fin 112 in the fluid passage 110. The flat tube 100 for the heat exchanger can comprise the at least one protrusion 114 protruding towards the inner fin 112, wherein the at least one protrusion 114 is protruding from the at least one wall 102, 104 from the plurality of walls 102, 104, 106, 108 of the flat tube 100.

[0022] In one aspect, the plurality of walls 102, 104, 106, 108 of the flat tube 100 can have a polygon shape. In one example, the plurality of walls 102, 104, 106, 108 of the flat tube 100 can have a rectangle shape with a first wall 106 being substantially flat, a second wall 108 being substantially flat and parallel to the first wall 106 and two side walls 102, 104 joining the first wall 106 and the second wall 108.

[0023] In another aspect, the inner fin 112 provided in the flat tube 100, can be meandering substantially transversely to the longitudinal axis L1 between the first wall 106 and the second wall 108 of the flat tube 100. In another example, the inner fin 112 provided in the flat tube 100, can be in contact with the first wall 106 and the second wall 108 of the flat tube 100. The inner fin 112 provided in the flat tube 100, cannot be in contact with at least one of the two side walls 102, 104 of the flat tube 100 due to some reasons like welding joint, reduced width upon forming and so on.

[0024] In another aspect, the at least one protrusion 114 can be protruding from at least one of the two side walls 102, 104 of the flat tube 100. In another example, the at least one protrusion 114 can be protruding from one side wall 102 of the flat tube 100. In another example, the at least one protrusion 114 can be protruding from two side walls 102, 104 of the flat tube 100. In another aspect, the at least one protrusion 114 can be formed in the tube 100 by any type of manufacturing process. In another example, the at least one protrusion 114 and the tube 100 can be made as a single part. The at least one protrusion 114 can be formed in the tube 100 when the tube 100 is manufactured, for example, by forming process. In another example, the at least one protrusion 114 and the tube 100 can be made as separate parts and then can be connected together.

[0025] FIG. 3 illustrates a sectional view of the flat tube 100 of FIG. 1, at the plane A-A'. FIG. 4 illustrates an enlarged view of the protrusion 114 without the inner fin 112 of the flat tube 100 of FIG. 3. FIG. 5 illustrates an enlarged view of the protrusion 114 with the inner fin 112 of the flat tube 100 of FIG. 3. In another aspect, the at least one protrusion 114 can be configured to at least partially block the flow of fluid in the vicinity of the at least one of the two side walls 102, 104. In another aspect, the at least one protrusion 114 can significantly block a space between the inner fin 112 and the at least one of the two side walls 102, 104 of the flat tube 100. In another example, the at least one protrusion 114 protruding from the at least one of the two side walls 102, 104 of the flat tube 100, can comprise a tip portion that can be in contact with the inner fin 112. In another example, the tip portion of the at least one protrusion 114 protruding from the at least one of the two side walls 102, 104 of the tube 100, cannot be in contact with the inner fin 112.

[0026] In another aspect, the at least one protrusion 114 can comprise a guiding means configured to guide the fluid towards the inner fin 112. In another aspect, the guiding means can have any shape adapted to guide the fluid towards the inner fin 112. In another example, the guiding means can have a curved shape. As a result, the fluid can be guided to flow across the fin 112 and not bypass the fin 112. In another aspect, the at least one protrusion 114 can have any shape that is protruding from the at least one of the two side walls 102, 104 of the flat tube 100. In another example, the at least one protrusion 114 can be a dimple. In another example, the at least one protrusion 114 can be a curved rib.

[0027] In another aspect, a plurality of protrusions 114 can be protruding from the at least one of the two side walls 102, 104 of the flat tube 100. In another example, the plurality of protrusions 114 can be protruding from one side wall 102 of the flat tube 100. In another example, the plurality of protrusions 114 can be protruding from two side walls 102, 104 of the flat tube 100.

[0028] In another aspect, the plurality of protrusions 114 can comprise a first plurality of protrusions 114A and

a second plurality of protrusions 114B. In another example, the first plurality of protrusions 114A can be protruding from one side wall 102 of the flat tube 100 and the second plurality of protrusions 114B can be protruding from another side wall 104 of the flat tube 100. In another aspect, the first plurality of protrusions 114A can be identical or different compared to the second plurality of protrusions 114B. In another example, the first plurality of protrusions 114A can be identical to the second plurality of protrusions 114B in terms of characteristics such as shape, interval and so on. In another example, the first plurality of protrusions 114A can be different compared to the second plurality of protrusions 114B in terms of at least one characteristics such as shape, interval and so on.

[0029] According to the above-described embodiments, the flat tube 100 comprises at least one protrusion 114 protruding from the at least one of the two side walls 102, 104 of the flat tube 100. Further, the at least one protrusion 114 comprises the guiding means configured to guide the fluid towards the inner fin 112. Therefore, the at least one protrusion 114 at least partially blocks the flow of the fluid in the vicinity of the at least one of the two side walls 102, 104, and guides the fluid towards the inner fin 112.

[0030] All the above-described embodiments are just to explain the present invention while more embodiments and combinations thereof might exist. Hence, the present invention should not be limited to the above-described embodiments alone.

Claims

1. A flat tube (100) for a heat exchanger for a flow of a fluid comprising:

a longitudinal axis (L1) along which the flat tube (100) extends;
a first wall (106) being substantially flat, a second wall (108) being substantially flat and parallel to the first wall (106) and two side walls (102, 104) joining the first wall (106) and the second wall (108), wherein the first wall (106), the second wall (108) and the two side walls (102, 104) together form a hollow profile of the flat tube (100), thereby forming a fluid passage (110) for the flow of the fluid;
at least one inner fin (112) provided in the fluid passage (110), is meandering substantially transversely to the longitudinal axis (L1) between the first wall (106) and the second wall (108); and
at least one protrusion (114) protruding from the at least one of the two side walls (102, 104), is configured to at least partially block the flow of fluid in the vicinity of the at least one of the two side walls (102, 104).

2. The flat tube (100) as claimed in preceding claim, wherein a tip portion of the at least one protrusion (114) is in contact with the inner fin (112).

3. The tube (100) as claimed in claim 1, wherein the tip portion of the at least one protrusion (114) is not in contact with the inner fin (112).

4. The flat tube (100) as claimed in claim 2 or 3, wherein the at least one protrusion (114) comprises a guiding means configured to guide the fluid towards the inner fin (112).

5. The flat tube (100) as claimed in preceding claim, wherein the guiding means has a curved shape.

6. The flat tube (100) as claimed in any one of preceding claims, wherein the at least one protrusion (114) is provided proximate to an inlet of the flat tube (100).

7. The flat tube (100) as claimed in any one of preceding claims, wherein the at least one protrusion (114) is a dimple.

8. The flat tube (100) as claimed in any one of preceding claims, wherein a plurality of protrusions (114) are provided in the at least one of the two side walls (102, 104).

9. The flat tube (100) as claimed in preceding claim, wherein all protrusions (114A, 114B) from the plurality of protrusions (114) are identical.

10. The flat tube (100) as claimed in claim 8, wherein at least one protrusion (114A) from the plurality of protrusions (114) is different compared to other protrusions (114B) from the plurality of protrusions (114).

11. A heat exchanger comprising at least one flat tube (100) according to any of the preceding claims.

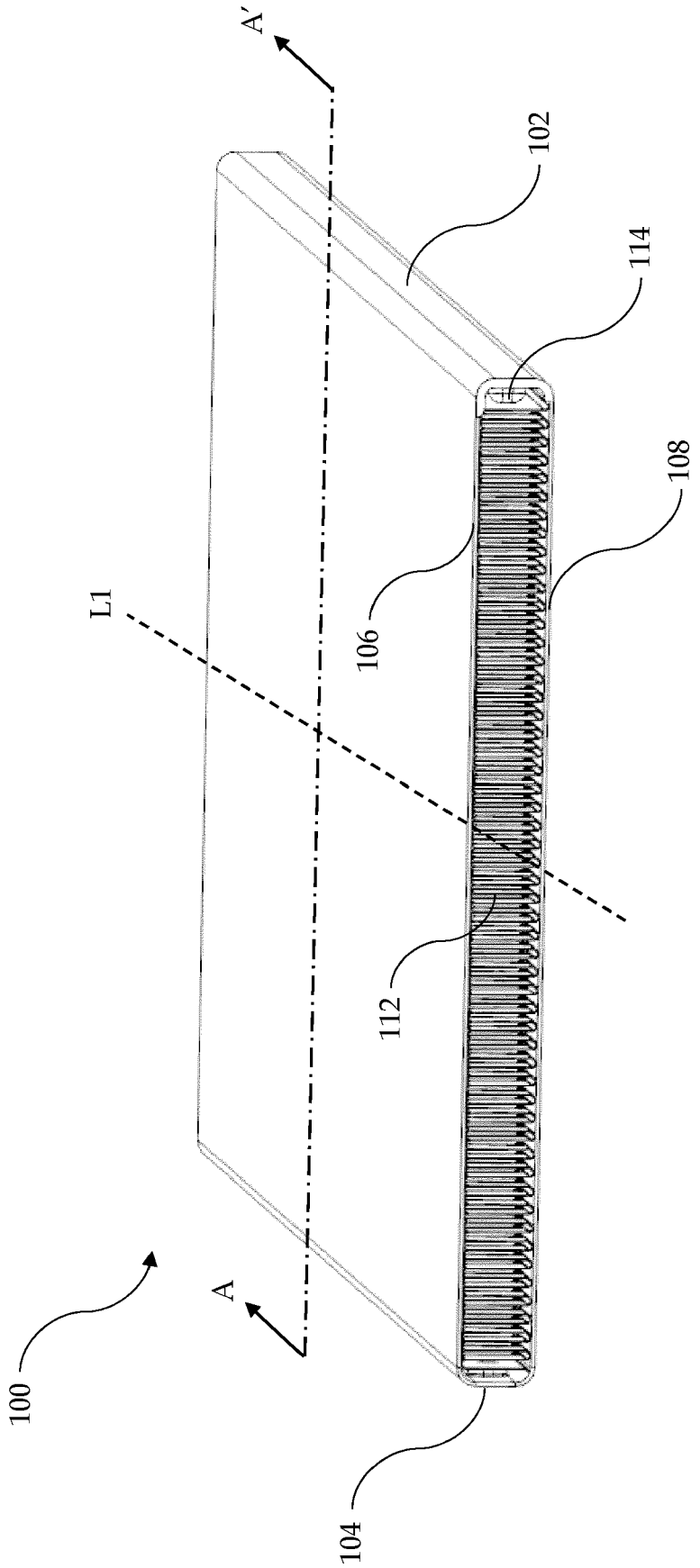

FIG. 1

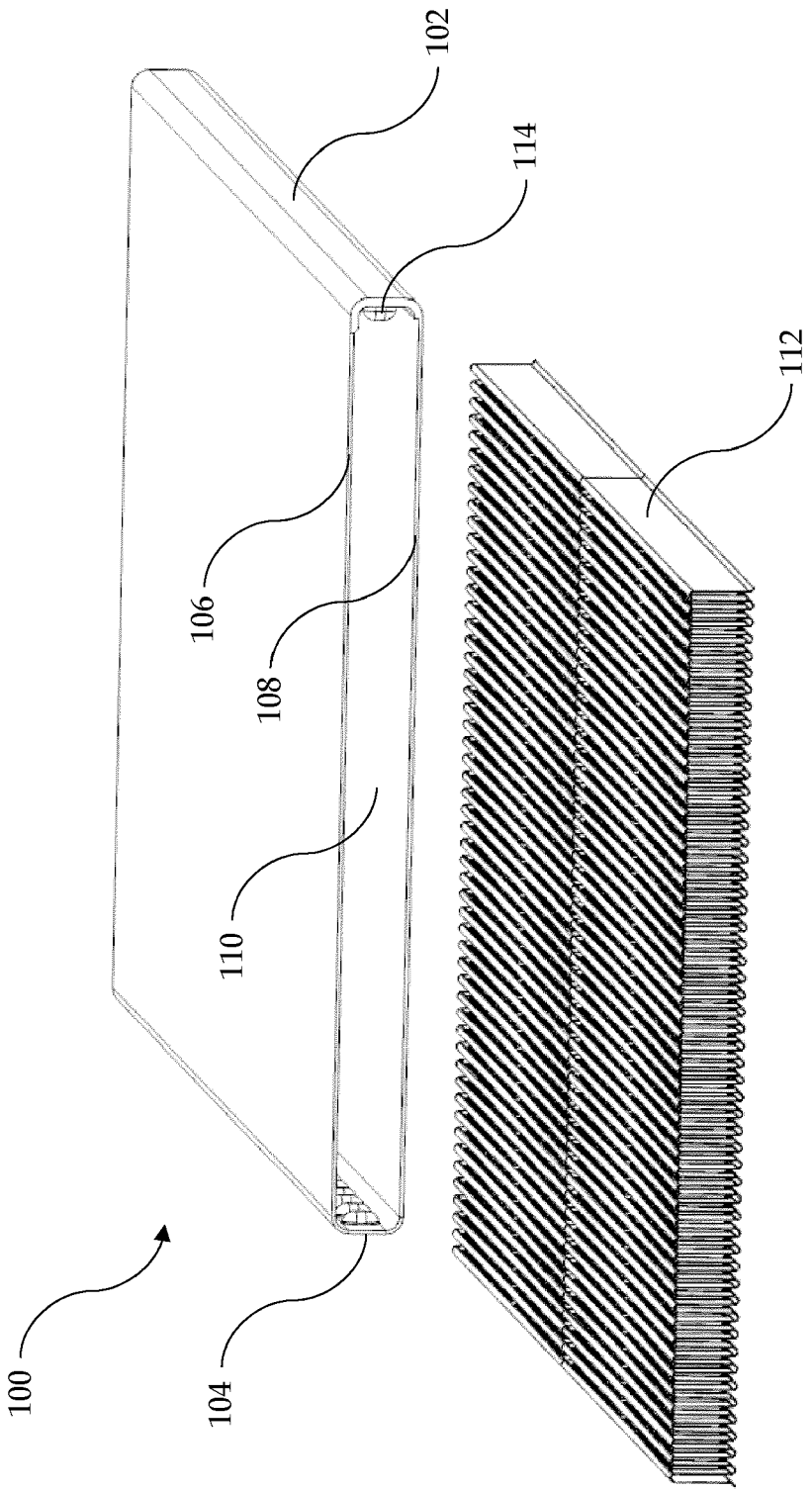

FIG. 2

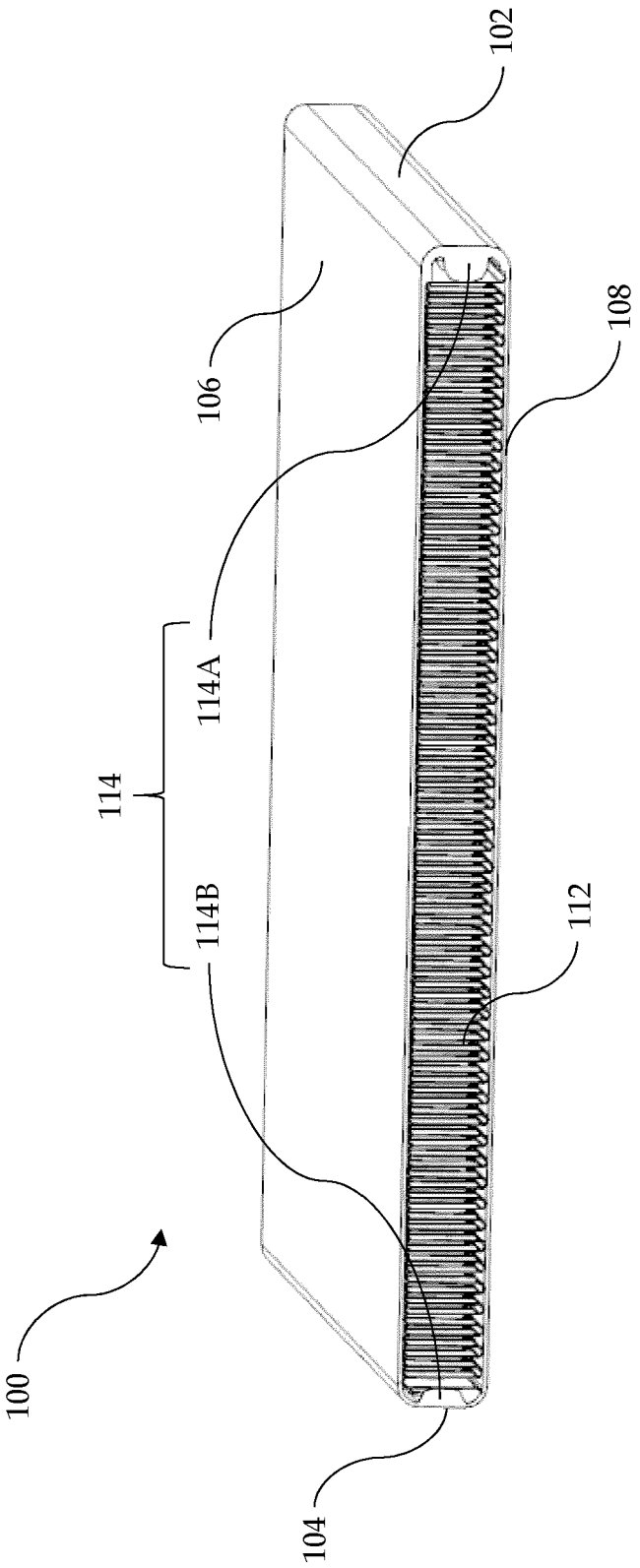

FIG. 3

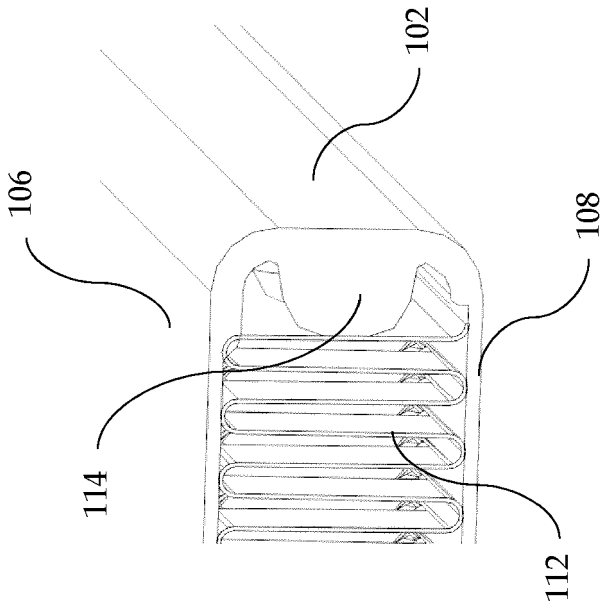

FIG. 5

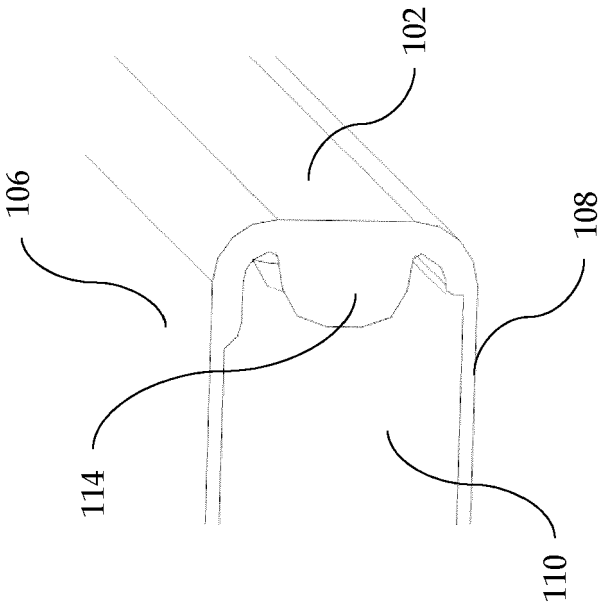

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 23 20 9181

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2004 061032 A (TOYO RADIATOR CO LTD) 26 February 2004 (2004-02-26) * figures 1-6 *	1-11	INV. F28F1/02
X	JP 2012 229853 A (SHOWA DENKO KK) 22 November 2012 (2012-11-22) * figures 2,3 *	1,3-6,8, 9,11	
X	JP 2005 214511 A (CALSONIC KANSEI CORP) 11 August 2005 (2005-08-11) * figure 124 *	1,3,4,6, 8,11	
A	EP 3 521 746 B1 (VALEO AUTOSYSTEMY SP ZOO [PL]) 19 April 2023 (2023-04-19) * the whole document *	1-11	

TECHNICAL FIELDS SEARCHED (IPC)

F28F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	5 April 2024	Jessen, Flemming

CATEGORY OF CITED DOCUMENTS

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2004061032 A	26-02-2004	NONE	
JP 2012229853 A	22-11-2012	NONE	
JP 2005214511 A	11-08-2005	NONE	
EP 3521746 B1	19-04-2023	CN 110118504 A	13-08-2019
		EP 3521746 A1	07-08-2019

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