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(54) A HEAT EXCHANGER MANIFOLD

(57) A manifold (100) for a heat exchanger (200) includes a cover portion (10) and a header portion (20). The cover portion (20) includes a first and a second wall (10a) and (10b) connected by a connecting wall (10c) to define an opening (30) and an enclosure. The header portion (20) and the cover portion (10) together defines the manifold (100) that receives fluid through an inlet (12) formed on the first wall (10a). The header portion (20) includes slots (22) to receive tubular elements (40) therein to configure fluid communication between the manifold (100) and the tubular elements (40). The cover portion (10) includes at least one baffle (14) disposed therein that is spaced from and covers at least a portion of the inlet (12). The baffle (14) with at least one concave section facing the inlet (12) is disposed between the inlet (12) and the second wall (10b).

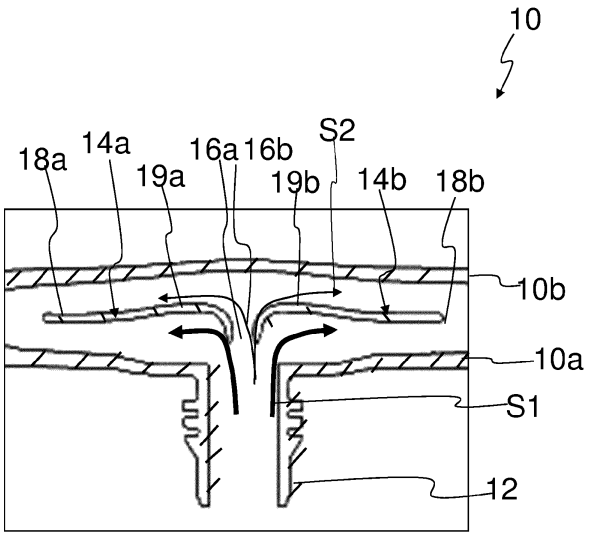

FIG. 4

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Description

FIELD OF INVENTION

[0001] The present invention relates to a heat exchanger, more particularly, the present invention relates to a header-tank assembly of a heat exchanger used in a vehicle.

BACKGROUND

[0002] A conventional heat exchanger, for example a radiator for use in a vehicle includes at least a header-tank assembly. Each header-tank assembly includes a tank, a header and a gasket disposed between the tank and the header. The tank includes foot portions formed along a periphery of an open end of the tank, particularly, along longitudinal and lateral sides of the tank. The header is complementary to, is aligned to and secured with respect to the open end of the tank by crimping. The header includes a plurality of tabs disposed along periphery thereof, particularly, along longitudinal and lateral sides thereof. The tabs disposed along periphery of the header are crimped to respective foot portions of the tank to configure crimping connection between the header and the tank. The header further includes a plurality of openings formed thereon to receive a plurality of heat exchange tubes. The tank receives a first heat exchange fluid, often, pressurized heat exchanging fluid. The tank in conjunction with the corresponding header distributes the first heat exchange fluid to and collects of the first heat exchange fluid from the heat exchange tubes. Particularly, the first heat exchange fluid ingresses the tank via an inlet, is distributed to the heat exchange tubes and passes through the heat exchange tubes. As the fluid passes through the heat exchange tubes, the fluid undergoes heat exchange with a second heat exchange fluid around the heat exchange tubes. The first heat exchange fluid after undergoing heat exchange with the second heat exchange fluid as the first heat exchange fluid passes through the heat exchange tubes is collected in a second tank and egresses out of the second tank through an outlet. In case the heat exchanger is a condenser, the header and the tank are integrally formed together to define the manifolds. The heat exchange tubes are separated by fins that retard flow of the second heat exchange fluid outside the heat exchange tubes to improve the heat exchange between fluid flowing inside and outside the heat exchange tubes.

[0003] Referring to the FIG. 1, a first longitudinal wall 1a and a second longitudinal wall 1b of the tank 1 are disposed close to each other to avoid pressure drop. However, with such configuration the fluid entering inside the inlet tank 1 through the inlet 2 formed on the first longitudinal wall 1a of the inlet tank 1 strikes opposite second longitudinal wall 1b of the inlet tank 1, creating splash "S" and resulting in pressure drop of the fluid, as the fluid enters the tank 1 through the inlet 2. Further, fluid entering through the inlet 2 and striking the opposite wall 1b of the tank results in energy loses due to vortex formation. The energy losses and pressure drop in turn cause non-uniform distribution of fluid along length of the inlet tank 1, thereby resulting in the insufficient fluid supply to the heat exchange tubes, particularly, to the heat exchange tubes that are farthest from the inlet 2. The non-uniform distribution of the fluid to the heat exchange tubes lead to reduced efficiency and performance of the heat exchanger and thermal stresses due to high temperature gradients between the tubes.

[0004] The conventional header-tank assembly fails to provide any solution to problems such as for example, non-uniform distribution of fluid in heat exchange tubes arising due to pressure drop and energy losses due to fluid impinging the tank walls and fluid not properly being directed to the tubes. Further, none of the conventional heat exchanger addresses the problems such as for example, thermal stresses due to high temperature gradient between the tubes.

[0005] Accordingly, there is a need for a header-tank assembly for a heat exchanger that prevents energy losses and pressure drop in fluid traversing there through to ensure uniform distribution of fluid in heat exchange tubes. Further, there is need for a heat exchanger and a header-tank assembly therefor that ensures low temperature gradient between tubes to address problems due to high temperature gradient between the tubes.

OBJECTS

[0006] An object of the present invention is to provide a header-tank assembly for a heat exchanger that obviates the problems faced by conventional header-tank assembly.

[0007] Another object of the present invention is to provide a header-tank assembly for a heat exchanger that ensures uniform distribution of fluid in heat exchange tubes by preventing pressure drop and energy losses due to fluid directly impinging tank walls.

[0008] Yet another object of the present invention is to provide a header-tank assembly for a heat exchanger that ensures high efficiency and performance of the heat exchanger.

[0009] 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 which are similar but not identical. No idea of priority should be inferred from such indexation, as these terms 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.

SUMMARY

[0010] A manifold is disclosed in accordance with an embodiment of the present invention. The manifold in-

cludes a cover portion and a header portion. The cover portion includes a first wall and a second wall along opposite longitudinal sides of the cover portion. The opposite longitudinal sides are connected by a connecting wall to define an opening and an enclosure. The header portion in conjunction with the cover portion defines manifold that receives fluid entering therein through an inlet formed on the first wall. The header portion includes a plurality of slots to receive tubular elements therein to configure fluid communication between the manifold and the tubular elements to deliver fluid to the tubular elements. The cover portion further includes at least one baffle disposed therein. The baffle being spaced from and covering at least a portion of the inlet. The baffle with at least one concave section facing the inlet is disposed between the inlet and the second wall to act as barrier there-between and directs fluid to sections of manifold on both sides of the inlet.

[0011] Generally, cover portion and the header portion are separately formed as tank and header respectively that are assembled together by crimping to form a header-tank assembly.

[0012] Particularly, the baffle extends from the connecting wall towards the opening of the cover portion.

[0013] More specifically, the baffle is centrally disposed between the walls.

[0014] Preferably, the baffle is facing the inlet that is centrally disposed on the cover portion.

[0015] In accordance with an embodiment of the present invention, there are two baffles extending in opposite directions with respect to the inlet.

[0016] Generally, the first baffle and the second baffle are of equal length.

[0017] Alternatively, the first baffle and the second baffle are of different lengths based on position of the inlet on the inlet cover portion and outlet on outlet cover portion disposed opposite to the inlet cover portion.

[0018] Particularly, each baffle includes a first section aligned to the inlet and a second section orthogonal to the inlet, with concave interface between the first section and the second section and facing the inlet.

BRIEF DESCRIPTION

[0019] 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 detailed description when considered in connection with the accompanying figures, wherein:

FIG. 1 illustrates a schematic representation of a conventional manifold, wherein the fluid entering the manifold via an inlet impinges on a wall opposite the inlet;

FIG. 2 illustrates an isometric view of a heat exchanger formed with a manifold in accordance with an embodiment of the present invention;

FIG. 3 illustrates a schematic representation of a cover portion of the manifold of **FIG.2** from underside and depicting internal details of the cover portion;

FIG. 4 illustrates a schematic representation of the manifold with internal baffle to prevent splash and distribute fluid to the manifold; and

FIG. 5 illustrates a sectional view of a heat exchanger depicting internal details of the manifold with the baffle.

DETAILED DESCRIPTION

[0020] The present invention envisages a manifold that is either formed as a one-piece construction or is formed by connecting multiple parts. In case the manifold is formed as a single part, the manifold includes a cover portion and a header portion that are integrally formed with respect to each other, for example, in case of a condenser. Alternatively, the manifold is formed by connecting separate header and cover that is in form of tank, the header and the tank are connected to each other by crimping, such as for example in case of a radiator. The tank or the cover is configured with at least one baffle disposed therein. The baffle is spaced away from and overlapping at least a portion of an inlet formed on a first longitudinal wall. The baffle divides fluid stream entering inside the manifold into two portions, one upstream of the baffle in fluid flow direction and another substantial section remaining downstream of the baffle in the fluid flow direction. The baffle directs the fluid entering the tank or the cover portion through the inlet to limit the fluid from directly striking the second wall opposite the inlet, thereby preventing splash. The baffle directs and distributes the fluid entering inside the manifold. Particularly, there are two baffle portions, each extending opposite to each other and directing the fluid to even the farthest tubes on both sides of the inlet to achieve uniform distribution of the fluid to the heat exchange tubes by the tank or cover portion. The two baffle portions are each directing fluid to the respective opposite sides of the inlet. With such configuration of the baffle, substantial portion of the fluid entering inside the manifold remains on the inlet side of the baffle and less fluid crosses the baffle. Such configuration of the tank or cover portion with baffle prevents pressure drop and energy losses by directing fluid entering the tank and by limiting the fluid from directly impinging on the wall opposite to the inlet. Further, configuration of the tank or cover portion with baffle formed therein achieves uniform fluid distribution in the heat exchange tubes and prevents thermal stresses induced due to high temperature gradient between the tubes. However, the present invention is not limited to a header tank assembly

for a vehicle heat exchanger only but is also applicable to any fluid flow apparatus used in vehicular and non-vehicular environments, where it is required to avoid problems such as non-uniform flow distribution and high temperature gradient due to pressure drop and energy losses of fluid.

[0021] FIG. 2 illustrates an isometric view of a heat exchanger 200 configured with an inlet manifold 100, hereinafter referred to as manifold 100 in accordance with an embodiment of the present invention. The heat exchanger 200 includes a pair of manifolds disposed on opposite sides of the heat exchanger 200 and in fluid communication with respect to each other by means of tubular elements, particularly, heat exchange tubes 40. The inlet manifold 100 includes an inlet 12 for ingress of a first fluid into the manifold 100. The first fluid received inside the inlet manifold 100 is uniformly distributed to the heat exchange tubes 40 in fluid communication with the inlet manifold 100. The first fluid flowing through the heat exchange tubes undergoes heat exchange with a second fluid flowing around the heat exchange tubes 40. The first fluid after undergoing heat exchange by passing through the heat exchange tubes 40 is collected in an outlet manifold and egresses through an outlet formed on the outlet manifold,

[0022] The manifold 100 is formed as a single part that includes a cover portion 10 and a header portion 20 that are integrally formed with respect to each other, for example, in case of a condenser. Alternatively, a header-tank assembly is used instead of the manifold 100, wherein the header-tank assembly includes a tank 10 and a header 20 that are assembled to each other by crimping, for example, in case of a radiator.

[0023] Irrespective of whether manifold or header-tank assembly is used to supply fluid to the heat exchange tubes, the cover portion or the tank 10 includes a first wall 10a, a second wall 10b a connecting wall 10c. The connecting wall 10c connects the spaced apart first wall 10a and the second wall 10b extending along opposite longitudinal sides of the cover portion 10 to define an opening and an enclosure.

[0024] The header portion 20 in conjunction with the cover portion or the tank 10 defines the manifold 100 that receives fluid entering therein through the inlet 12 formed on the first wall 10a. The header portion 20 includes a plurality of slots 22 that receives the tubular elements 40 therein to configure fluid communication between the manifold 100 and the tubular elements 40 to deliver fluid to the tubular elements 40.

[0025] The cover portion 10 further includes at least one baffle 14 disposed therein. The baffle 14 is integrally formed with the cover portion 10 during the moulding of the cover portion 10. Alternatively, the baffle can be mounted inside the cover portion by using any other connection means such as for example screws and snap fit engagement. The baffle 14 being spaced from the inlet 12 and overlapping at least a portion of the inlet 12 directs the fluid entering the manifold 100 through the inlet 12 and limits the fluid striking the second wall 10b of the cover portion or the tank 10 opposite to the inlet 12, thereby preventing pressure drop and energy losses due to the splash. The baffle 14 divides fluid stream entering inside the manifold 100 into two portions, one upstream of the baffle 14 in fluid flow direction and another substantial section remaining downstream of the baffle 14 in the fluid flow direction. The baffle 14 with at least one concave section 19 facing the inlet 12 is disposed between the inlet 12 and the second wall 10b to act as barrier there-between. With the concave section of the baffle facing the inlet, substantial portion S1 of fluid entering the manifold 100 through the inlet 12 remains on the inlet side of the baffle 14 and minimum fluid forming fluid stream portion S2 crosses the baffle 14. The baffle 14 additionally directs fluid to sections of the manifold 100 on both sides of the inlet 12. Such configuration of the manifold 100 with the baffle 14 ensures uniform distribution of the fluid even to the tubular elements 40 that are farthest from the inlet 12. Accordingly, the temperature gradient between the heat exchange tubes 40 is controlled and problems of thermal stresses due to high temperature gradient between the tubes is avoided. With uniform flow distribution to the heat exchange tubes 40, the efficiency and performance of the heat exchanger 200 is improved. The baffle 14 extends from the connecting wall 10c towards the opening 30 of the cover portion 10. The baffle 14 is centrally disposed between the walls 10a and 10b. The baffle 14 is facing the inlet 12 centrally disposed on the cover portion 10. Generally, there are two baffles 14a and 14b extending in opposite directions with respect to the inlet 12 each directing fluid to different sections of the manifold 100 on both sides of the inlet 12. Referring to FIG. 3 of the accompanying drawings, the internal details of the cover portion 10 with the baffles 14a and 14b disposed therein is illustrated. **FIG. 5** illustrates a sectional view of the heat exchanger depicting internal details of the manifold with the baffle

[0026] In case the inlet 12 is disposed at the centre of the cover portion 10, the baffles 14a and 14b are of equal lengths. Alternatively, the first baffle 14a and the second baffle 14b are of different lengths based on position of the inlet 12 on the inlet cover portion 10 or inlet tank and position of outlet on the outlet cover portion or outlet tank. Generally, each baffle 14a, 14b follows a contoured profile as illustrated in FIG. 4, wherein a first section 16a, 16b of the baffle 14a, 14b is aligned to the inlet 12 and a second section 18a, 18b of the baffle 14a, 14b is orthogonal to the inlet 12, with concave interface 19a, 19b between the first section 16a, 16b and the second section 18a, 18b facing the inlet 12. The concave interface 19a, 19b further facilitates smooth flow from the first section 16a, 16b to the second section 18a, 18b without flow separation. However, the present invention is not limited to any particular configuration, number and placement of the baffles as far as the baffles are capable of preventing fluid entering inside the manifold through the inlet from striking the wall of the cover portion 10 opposite the

inlet and direct the fluid entering the manifold to sections of the manifold on opposite sides of the inlet.

[0027] Also is disclosed a heat exchanger 200 in accordance with an embodiment of the present invention. The heat exchanger 200 includes at least one manifold 100 as disclosed above and a plurality of tubular elements 40. The plurality of tubular element 40 are in fluid communication with the at least one manifold 100 to define the fluid flow pass for heat exchange.

[0028] Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that the invention may be practiced otherwise than as specifically described herein.

[0029] In any case, the invention cannot and should not be limited to the embodiments specifically described in this document, as other embodiments might exist. The invention shall spread to any equivalent means and any technically operating combination of means

Claims

1. A manifold (100) for a heat exchanger (200) comprising:

   • a cover portion (10) that comprises a first wall (10a) and a second wall (10b) along opposite longitudinal sides of the cover portion (10) and connected by a connecting wall (10c) to define an opening (30) and an enclosure;
   • a header portion (20) in conjunction with the cover portion (10) defines the manifold that receives fluid entering therein through an inlet (12) formed on the first wall (10a) of the cover portion (10), the header portion (20) comprises a plurality of slots (22) adapted to receive tubular elements (40) therein to configure fluid communication between the manifold (100) and the tubular elements (40) to deliver fluid to the tubular elements (40),
   characterized in that the cover portion (10) further comprises at least one baffle (14) disposed therein, the baffle (14) being spaced from and overlapping at least a portion of the inlet (12), the baffle (14) with at least one concave section (19) facing the inlet (12) is disposed between the inlet (12) and the second wall (10b) to act as barrier there-between and directs fluid to sections of manifold (100) on both sides of the inlet (12).

2. The manifold (100) as claimed in the previous claim, wherein the cover portion (10) and the header portion (20) are separately formed as tank and header respectively that are assembled together by crimping to form a header-tank assembly..

3. The manifold (100) as claimed in any of the preceding claims, wherein the baffle (14) extends from the connecting wall (10c) towards the opening (30) of the cover portion (10).

4. The manifold (100) as claimed in any of the preceding claims, wherein the baffle (14) is centrally disposed between the walls (10a) and (10b).

5. The manifold (100) as claimed in any of the preceding claims, wherein the baffle (14) is facing the inlet (12) centrally disposed on the cover portion (10).

6. The manifold (100) as claimed in any of the preceding claims, wherein there are two baffles (14a) and (14b) extending in opposite directions with respect to the inlet (12).

7. The manifold (100) as claimed in claim 6, wherein the first baffle (14a) and the second baffle (14b) are of equal length.

8. The manifold (100) as claimed in the claim 6, wherein the first baffle (14a) and the second baffle (14b) are of different lengths based on position of the inlet (12) on the inlet cover portion (10) and position of outlet on outlet cover portion disposed opposite to the inlet cover portion.

9. The manifold (100) as claimed in the claim 6, wherein each baffle (14a, 14b) comprises a first section (16a, 16b) aligned to the inlet (12) and a second section (18a, 18b) orthogonal to the inlet (12), with concave interface (19a, 19b) between the first section (16a, 16b) and the second section (18a, 18b) and facing the inlet (12).

10. A heat exchanger (200) comprising:

    • at least one manifold (100) as claimed in any of the preceding claims;
    • a plurality of tubular elements (40) adapted to be in fluid communication with the at least one manifold (100) to define the fluid flow pass for heat exchange.

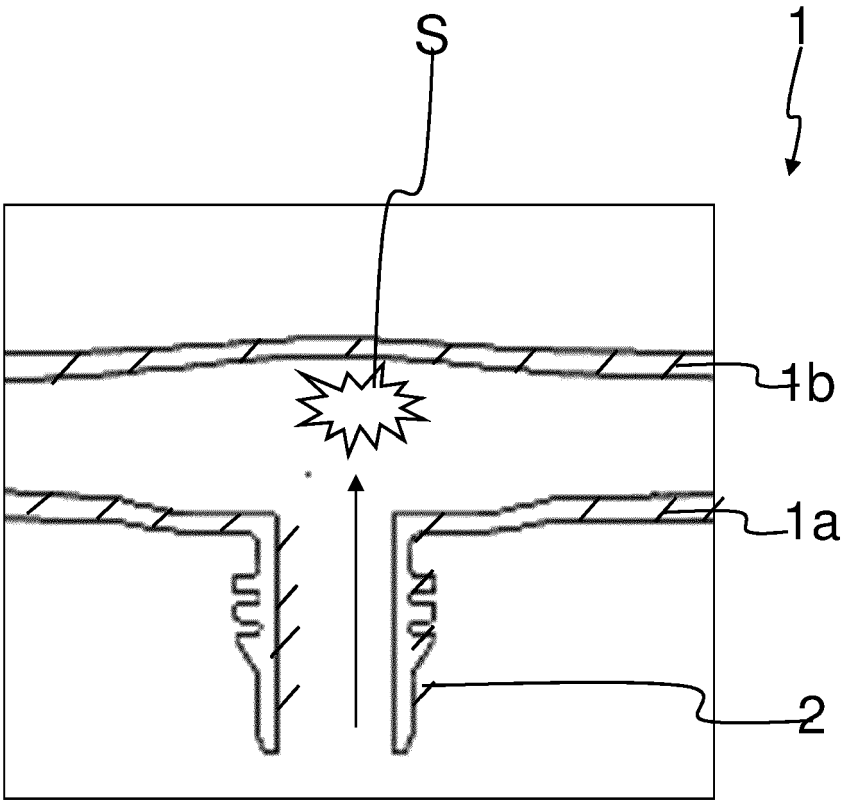

FIG. 1
(PRIOR ART)

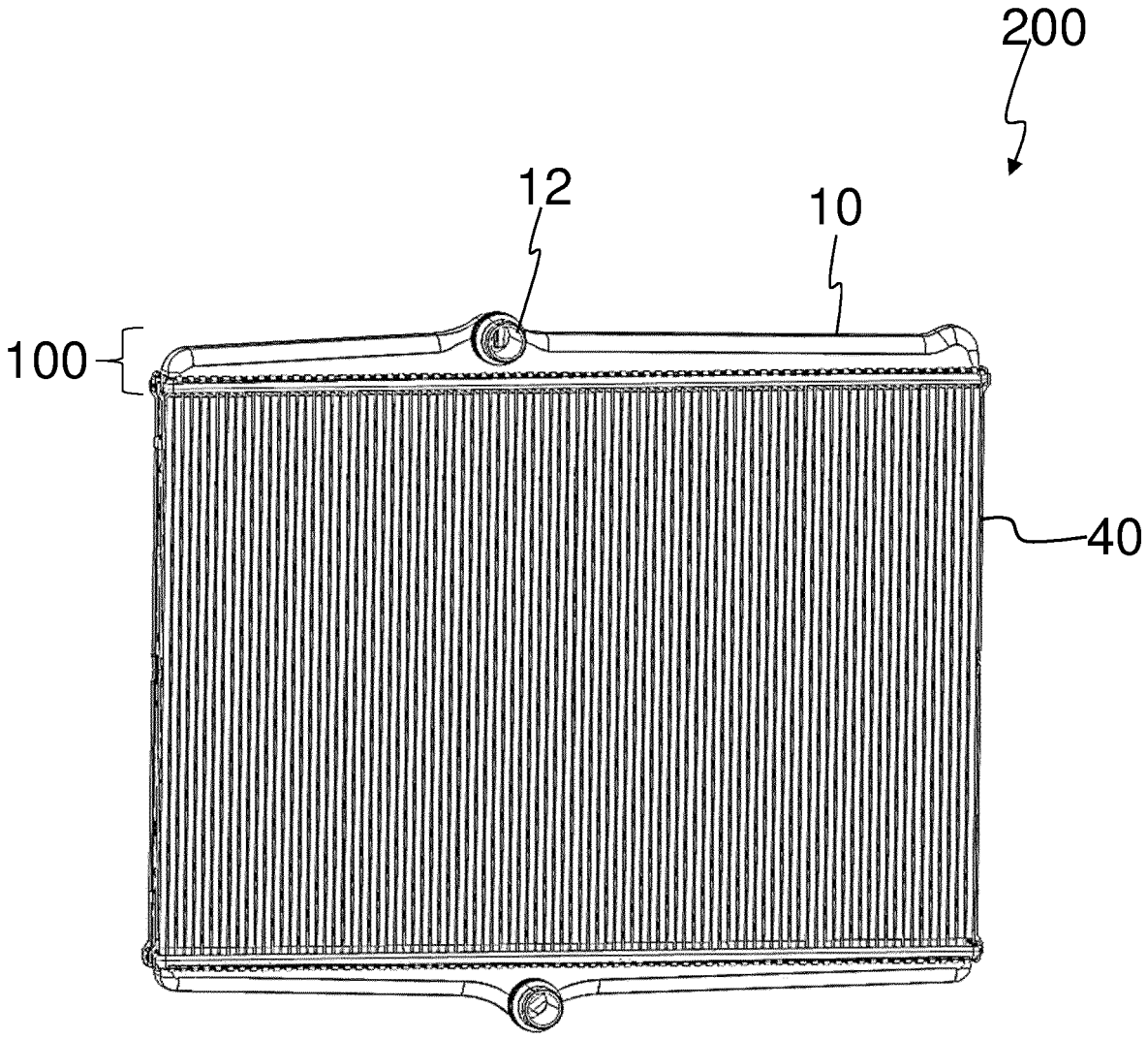

FIG. 2

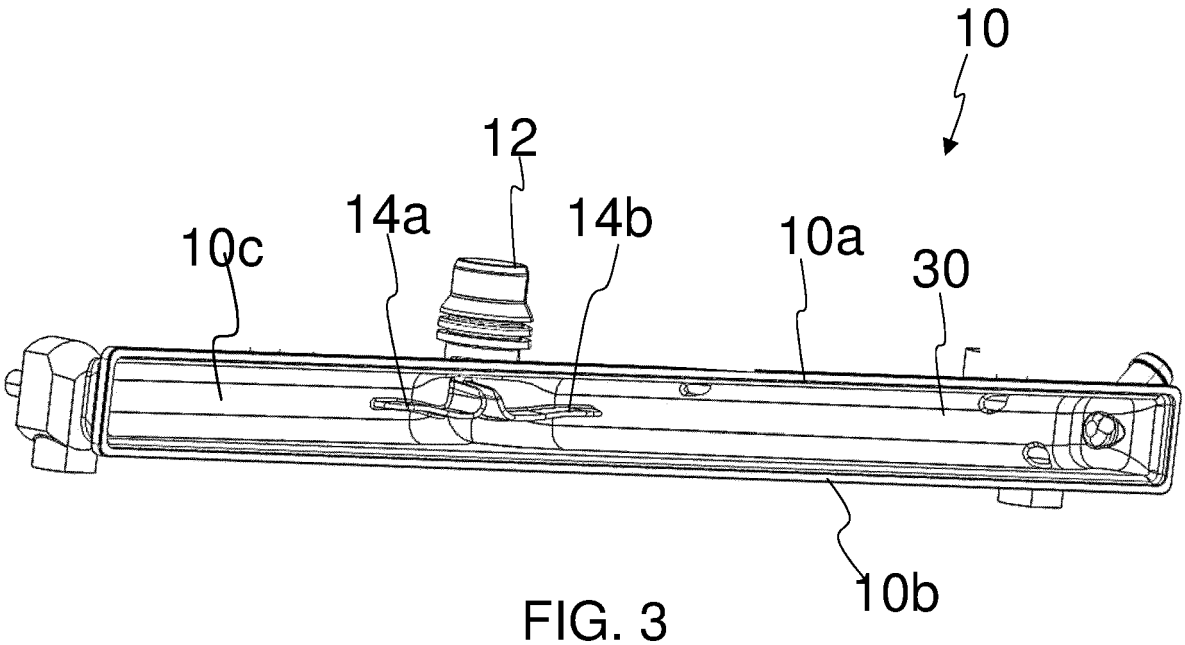

FIG. 3

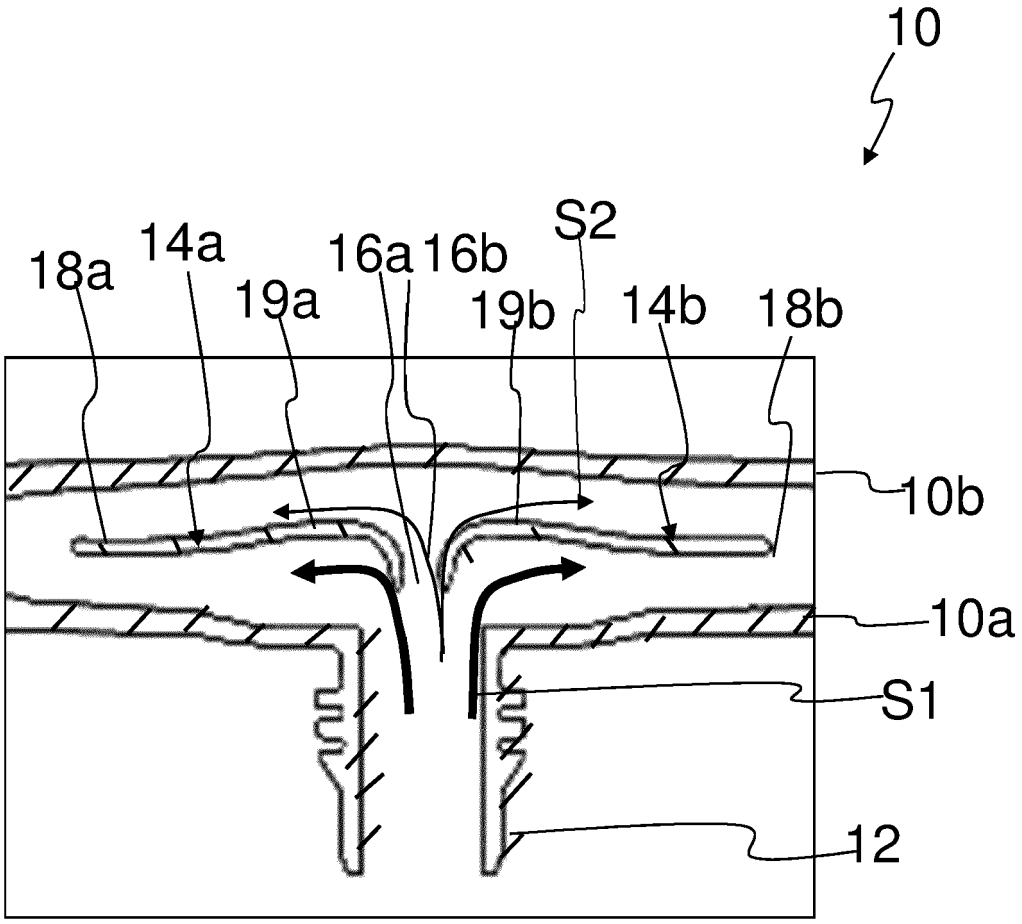

FIG. 4

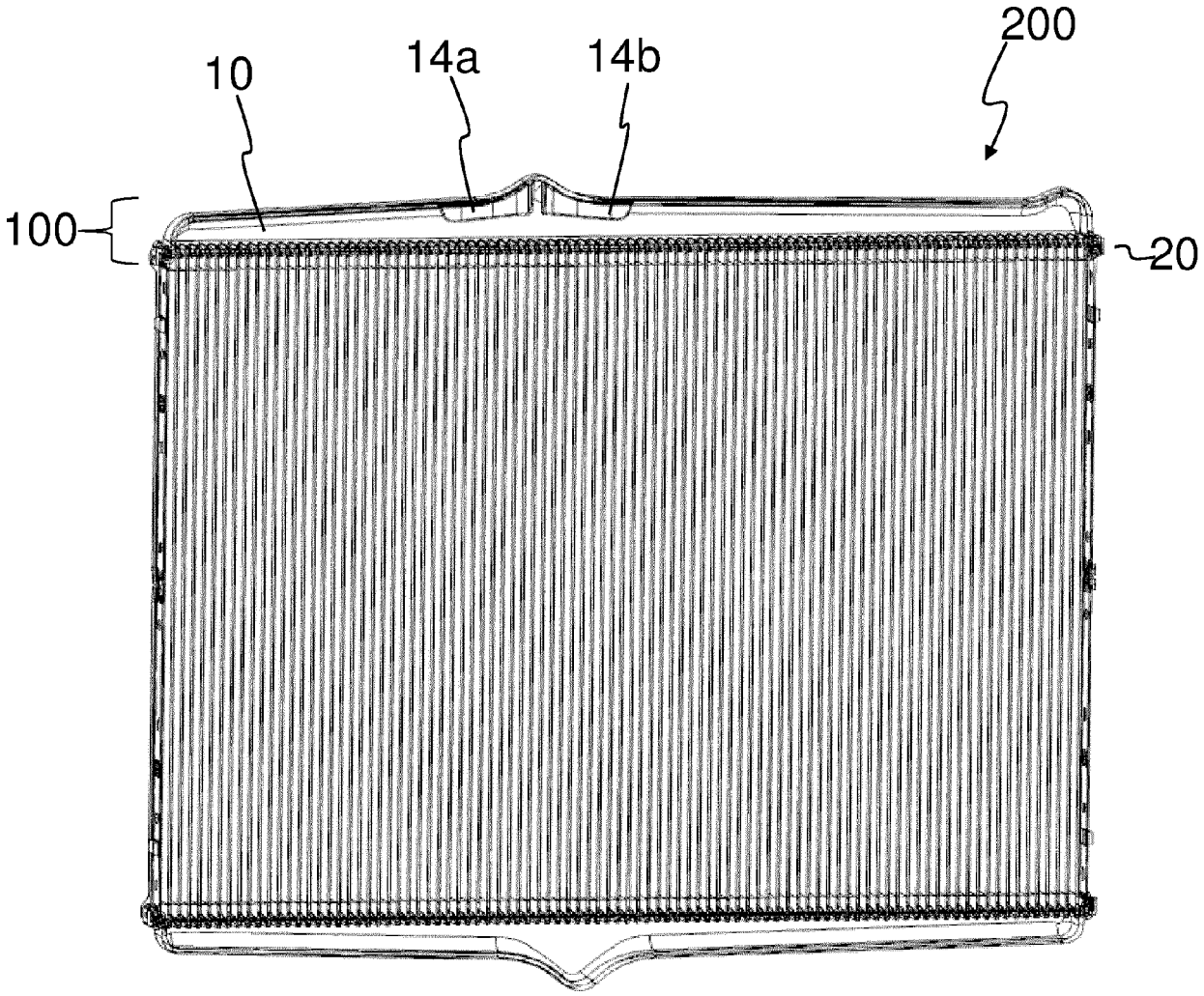

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 4487

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	7 December 2022	Mellado Ramirez, J

CATEGORY OF CITED DOCUMENTS

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