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(54) A HEADER-TANK ASSEMBLY

(57) A heat exchanger (100) includes a first header tank assembly (10), a plurality of tubular elements (20) and a second header tank assembly (30). The first header tank assembly (10) receives fluid therein through an inlet nozzle (10a). The plurality of tubular elements (20) are in fluid communication with the first header tank assembly (10) to receive fluid distributed by the first header tank assembly (10). The second header tank assembly (20) collects fluid from the tubular elements (20) for egress through the outlet nozzle (30a) formed thereon. The second header tank assembly (30) further includes at least one by-pass channel (40) forming fluid communication between tubular elements (20a) with insufficient pressure difference there across and the outlet nozzle (30a).

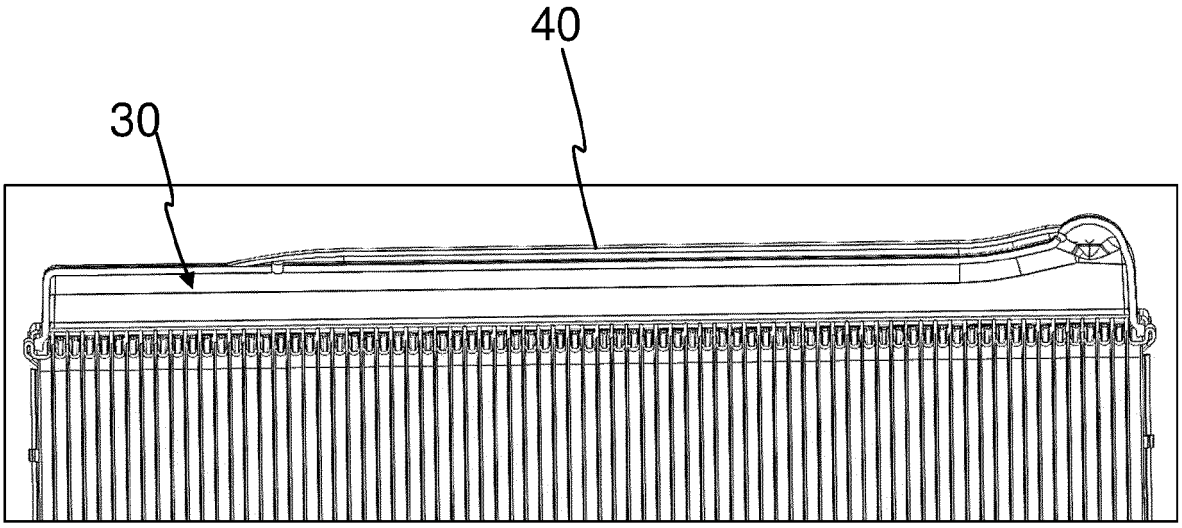

FIG. 5

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Description

FIELD

[0001] The present invention relates to a header-tank assembly. In particular, the present invention relates to a header-tank assembly for a vehicle heat exchanger.

BACKGROUND

[0002] Generally, a heat exchanger, for example, a radiator, includes header-tank assemblies configuring a first manifold 2 and a second manifold 4 on opposite sides of a heat exchanger core 6 defined by tubular elements 6a separated by fins 6b. The first manifold 2 and the second manifold 4 includes an inlet nozzle 2c and an outlet nozzle 4c for ingress and egress of the first heat exchange fluid respectively with respect to the heat exchanger 1. The first manifold 2 distributes first heat exchange fluid received thereby to the tubular elements, particularly, to one end of the tubular elements 6a. The second manifold 4 collects the first heat exchange fluid from the other end of the tubular elements 6a after the first heat exchange fluid had undergone heat exchange with a second heat exchange fluid, for example, air flowing across the tubular elements 6a as the first fluid passes through the tubular elements 6a. More specifically, the tubular elements 6a configure fluid communication between the first manifold 2 and the second manifold 4 for forming fluid flow pass between the first manifold 2 and the second manifold 4.

[0003] However, considering the placement of the inlet nozzle 2c and the outlet nozzle 4a and configuration of first and second tanks 2a and 4a of the first and second header-tank assembly, there is insufficient pressure difference across a few of the tubular elements, particularly, the tubular elements 6e that are distal from the inlet nozzle. Insufficient pressure difference across few of the end tubular elements 6e restricts fluid flow there-though and causes dead zones within the end tubular elements 6e, thereby causing insufficient heat exchange and adversely affecting the efficiency and performance of the heat exchanger 1. None of the prior art addresses the issue of non-uniform fluid flow and dead zone formation within the tubular elements due to insufficient pressure difference across few of the tubular elements.

[0004] Accordingly, there is a need for a header tank assembly for a heat exchanger that ensures uniform fluid distribution in tubular elements of the heat exchanger, thereby preventing dead zones within the heat exchanger. Further, there is a need for a header-tank assembly for a heat exchanger that promotes efficient heat exchange and ensures improved performance of the heat exchanger. Further, there is a need for a header tank assembly for a heat exchanger that prevents problems such as thermal stresses arising due to high temperature gradient due to non-uniform fluid flow in the tubular elements of the heat exchanger.

[0005] Yet another object of the present invention is to provide a header-tank assembly for a heat exchanger that is simple in construction and convenient to manufacture.

[0006] 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

[0007] A header-tank assembly includes a header and a tank assembled to each other to define a manifold either supplying heat exchange fluid to a bundle of tubular elements or collecting heat exchange fluid from the tubular elements after the heat exchange fluid underwent heat exchange while passing through the tubular elements. At least one of the header-tank assembly comprises at least one by-pass channel forming fluid communication between tubular elements with insufficient pressure difference there across and the corresponding inlet nozzle and the outlet nozzle.

[0008] Generally the by-pass channel forms fluid communication between at least one of the end tubular elements distal from the outlet nozzle and the outlet nozzle.

[0009] Specifically, the by-pass channel is disposed along at least one of inner side and outer side of the tank of the second header tank assembly.

[0010] Preferably, the by-pass channel includes at least one inlet that collects fluid from at least one of the tubular elements with insufficient pressure difference there across and at least one outlet that delivers fluid to the outlet nozzle.

[0011] Generally, the inlets are uniformly spaced with respect to each other.

[0012] Specifically, the by-pass channel is integrally formed with the tank during forming of the tank by molding process.

[0013] Further, the by-pass channel is having uniform cross section along the length thereof.

[0014] More specifically, the by-pass channel is disposed along at least one of the sidewalls and top wall of the tank.

[0015] In accordance with an embodiment of the present invention, the inner side of the tank is configured with directing ribs to direct fluid flow towards the inlet of the by-pass channel.

[0016] In according to one embodiment of the present invention, multiple bypass channels form fluid communication between tubular elements with insufficient pressure difference there across and the at least one outlet nozzle.

[0017] Generally, the flow through bypass channel is

based on the pressure difference between tank outlet nozzle and the outlet of the tubular elements.

[0018] In accordance with an embodiment of the present invention, the by-pass channel is formed in the first header tank assembly for defining fluid communication between inlet nozzle and tubular elements with insufficient pressure difference there across.

[0019] In accordance with one embodiment the at least one outlet creates pressure difference thereacross to facilitate fluid flow from the by-pass channel to the nozzle.

[0020] In accordance with another embodiment, the header-tank assembly includes a connection portion at the interface between the by-pass channel and the nozzle to facilitate fluid flow from the by-pass channel to the nozzle.

[0021] Also is disclosed a heat exchanger in accordance with an embodiment of the present invention. The heat exchanger includes a first header tank assembly, a plurality of tubular elements and a second header tank assembly. The first header tank assembly receives fluid therein through an inlet nozzle. The plurality of tubular elements are in fluid communication with the first header tank assembly to receive fluid distributed by the first header tank assembly. The second header tank assembly collects fluid from the tubular elements for egress through the outlet nozzle formed thereon. The second header tank assembly further includes at least one by-pass channel forming fluid communication between tubular elements with insufficient pressure difference there across and the outlet nozzle.

BRIEF DESCRIPTION

[0022] 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 sectional view depicting internal details of a conventional header-tank assembly;

FIG. 2 illustrates an isometric view of a heat exchanger configured with a header-tank assembly of the present invention;

FIG. 3 illustrates a sectional view of a heat exchanger depicting internal details of a header-tank assembly thereof in accordance with one embodiment with a by-pass channel formed inside a manifold;

FIG. 4 illustrates a sectional view of the tank of the header-tank assembly of FIG. 3;

FIG. 5 illustrates a sectional view of a heat exchanger depicting internal details of the header-tank assembly thereof in accordance with another embodiment, wherein a by-pass channel is formed outside a manifold;

FIG. 6 illustrates a sectional view of the tank of FIG. 5; depicting enlarged view of an inlet and an outlet of the by-pass channel;

FIG. 7 illustrates an isometric view of the header-tank assembly in accordance with one embodiment with single outlet;

FIG. 8 illustrates a sectional view of the header-tank assembly of FIG. 7;

FIG. 9 illustrates an isometric view of the header-tank assembly in accordance with one embodiment with multiple outlets;

FIG. 10 illustrates a sectional view of the header-tank assembly of FIG. 9;

FIG. 11 illustrates a schematic representation of a header tank assembly in accordance with another embodiment, wherein outlet nozzle is disposed in the middle of the tank.

[0023] It must be noted that the figures disclose the invention in a detailed enough way to be implemented, said figures helping to better define the invention if needs be. The invention should however not be limited to the embodiment disclosed in the description.

DETAILED DESCRIPTION

[0024] Although the present invention is explained with example of a header-tank assembly for a radiator in the forthcoming description and the accompanying drawings, wherein an outlet manifold of the radiator is provided with at least one by-pass channel forming fluid communication between tubular elements with insufficient pressure difference there across and the outlet nozzle to ensure scavenging of air and uniform distribution of heat exchange fluid throughout the tubular elements. However, the present invention is also applicable for any header-tank assembly for a heat exchanger in a vehicular and non-vehicular environment.

[0025] Referring to FIG. 2, illustrated is a heat exchanger 100 configured with a header-tank assembly in accordance with an embodiment of the present invention. More specifically, the heat exchanger 100, for example, a radiator includes header-tank assemblies 10 and 30 configuring a first manifold and a second manifold on opposite sides of a heat exchanger core defined by tubular elements 20 separated by fins. The first manifold and the second manifold includes an inlet nozzle 10a and an outlet nozzle 30a for ingress and egress of the first

heat exchange fluid respectively with respect to the heat exchanger 100. The first manifold distributes first heat exchange fluid received thereby to the tubular elements 20 at one end of the tubular elements. The second manifold collects the first heat exchange fluid from the other end of the tubular elements 20 after the first heat exchange fluid had undergone heat exchange with a second heat exchange fluid flowing across the tubular elements 20, for example, air flowing across the tubular elements as the first fluid passes through the tubular elements 20. More specifically, the tubular elements 20 configure fluid communication between the first manifold and the second manifold for forming fluid flow pass between the first and the second manifolds.

[0026] The present invention is explained with example of an outlet header-tank assembly 30 illustrated in FIG. 3 - FIG. 10 that includes at least one bypass channel 40 forming fluid communication between tubular elements 20a with insufficient pressure difference there across and the corresponding outlet nozzle 30a. The by-pass channel 40 configures sufficient pressure difference across the tubular elements 20a proximal to the inlet 42 of the by-pass channel 40, thereby causing fluid flow there through and resulting in uniform fluid flow through all the tubular elements 20. Specifically, the bypass channel 40 forms fluid communication between at least one of the end tubular elements 20a distal from the outlet nozzle 30a and the outlet nozzle 30a. The by-pass channel 40 is of varying cross section, particularly, the bypass channel 40 is converging towards the outlet nozzle 30a in order to facilitate fluid flow through the by-pass channel 40. Also, an inner side 32a of the tank 32 is provided with features such as for example directing ribs to direct fluid flow towards the inlet 42 of the by-pass channel 40. In case the outlet nozzle 30a is disposed at one extreme end of the header tank assembly 30, the inlet 42 to the by-pass channel 40 is disposed proximal to the other extreme end of the header tank assembly 30 opposite to the outlet nozzle 30a. In case the outlet nozzle 30a is disposed in the middle of the header tank assembly 20, there can be two by-pass channels, referred to as the first and second by-pass channels 40a and 40b extending towards opposite sides of the outlet nozzle 30a as illustrated in FIG. 11. Particularly, the first and the second by-pass channels 40a and 40b receives fluid from respective first and second inlets 42a and 42b and delivers to outlet nozzle 30a. In such configuration, the first inlet 42a to the first by-pass channel 40a is disposed proximal to one end and the second inlet 42b to the second bypass channel 40b is disposed proximal to the other end of header-tank assembly 30.

[0027] In accordance with an embodiment, the bypass channel 40 is disposed along at least one of an inner side and outer side of the tank 32. The bypass channel 40 is disposed along either the inner side 32a of the tank 32 as illustrated in FIG. 3 and 4 of the accompanying FIGS or the outer side 32b of the tank 32 as illustrated in FIGS 5-8 of the accompanying FIGS. Particularly, by-pass channel 40 can be disposed along at least one of the sidewalls and top wall of the tank 32. Generally, the by-pass channel 40 is integrally formed with the tank 32 during forming of the tank 32 by molding. The by-pass channel of such configuration can be easily manufactured in a single step. Alternatively, the bypass channel 40 is separate from and secured to the tank 32 by using a snap fit connection, or any other connection means such as for example, screws and bolts.

[0028] In accordance with one embodiment of the present invention, the bypass channel 40 is having uniform cross section along the length thereof. Alternatively, the by-pass channel 40 can have non-uniform cross section along length thereof. Further, there can be multiple by-pass channels 40 forming fluid communication between tubular elements 20a with insufficient pressure difference there across and the outlet nozzle 30a. However, the present invention is neither limited to configuration, placement, number of by-pass channel disposed inside or outside the manifold as far as the bypass channel forms fluid communication between tubular elements with insufficient pressure difference there across and the corresponding outlet nozzle.

[0029] Generally, the by-pass channel 40 includes at least one inlet 42 and at least one outlet 44. The inlet 42 collects fluid from at least one of the end tubular elements 20a and the outlet 44 delivers fluid to the outlet nozzle 30a as illustrated in FIG. 6. In accordance with an embodiment, the by-pass channel 40 includes multiple inlets 42 as illustrated in FIG.7 and FIG. 8. In case the by-pass channel 40 includes multiple inlets 42 forming fluid flow passages A depicted by arrows to the by-pass channel 40. The inlets 42 are disposed proximal to the multiple tubular elements 20a with insufficient pressure difference there across to collect fluid from such tubular elements 20a and the outlet 44 forming fluid flow passage B to the outlet nozzle 30a delivers the fluid collected from the multiple inlets 42 to the outlet nozzle 30a through the outlet 44. Accordingly, the by-pass channel forms fluid communication between the tubular elements 20a with insufficient pressure difference there across and the outlet nozzle 30a.

[0030] In accordance with still another embodiment of the present invention, the by-pass channel 40 includes multiple outlets 44. The inlets 42 are uniformly spaced with respect to each other, each inlet corresponding to region inside the header-tank assembly proximal to tubular elements 20a with insufficient pressure difference there across. However, the present invention is not limited to any particular configuration, placement and spacing between the inlets as long as the inlets are capable of collecting the fluid inside the bypass channel 40 from regions of the header tank assembly proximal to tubular elements 20a with insufficient pressure difference there across. Similarly, the outlets 44 can be uniformly spaced with respect to each other. However, the present invention is not limited to any particular configuration, placement and spacing between the outlets as long as the

outlets are capable of delivering the fluid received in the bypass channel to the outlet nozzle. The flow through bypass 40 is based on the pressure difference between tank outlet nozzle 30a and the outlet of the tubular elements 20, 20a.

[0031] Also is disclosed a heat exchanger 100 in accordance with an embodiment of the present invention. The heat exchanger includes a first header tank assembly 10, a plurality of tubular elements 20 and a second header tank assembly 30. The first header tank assembly 10 receives fluid therein through an inlet nozzle 10a. The plurality of tubular elements 20 are in fluid communication with the first header tank assembly 10 to receive fluid distributed by the first header tank assembly 10. The second header tank assembly 30 collects fluid from the tubular elements 20 for egress through the outlet nozzle 30a formed thereon. The second header tank assembly 30 further includes at least one by-pass channel 40 forming fluid communication between tubular elements 20a with insufficient pressure difference there across and the outlet nozzle 30a.

[0032] In accordance with another embodiment, the by-pass channel 40 can be formed in the first header tank assembly 10 for defining fluid communication between inlet nozzle 10a and tubular elements 20a with insufficient pressure difference there across.

[0033] In accordance with one embodiment the at least one outlet 44 creates pressure difference thereacross to facilitate fluid flow from the by-pass channel 40 to the nozzle 10a, 30a. More specifically, the by-pass channel is converging towards the at least one outlet 44 in direction of fluid flow.

[0034] In accordance with another embodiment, the header-tank assembly 10, 30 includes a connection portion 50 at the interface between the by-pass channel 40 and the nozzle 10a. 30a to facilitate fluid flow from the by-pass channel 40 to the nozzle 10a, 30a. The connection portion 50 connects and configures fluid communication between the by-pass channel 40 to the nozzle 10a, 30a. More specifically, the connection portion 50 is diverging away from the at least one outlet 44 in the direction of fluid flow.

[0035] Such configuration of the by-pass channel 40, the at least one outlet 44 and connection portion connecting and configuring fluid communication between the by-pass channel 40 to the nozzle 10a, 30a achieves dual objective of uniform distribution of the fluid through the core and evacuation of fluid, particularly, the coolant with bubbles or air-entrapped coolant/ air saturated coolant from the heat exchanger.

[0036] 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 header-tank assembly (10, 30) comprising a header (12, 32) and a tank (14, 34) assembled to each other to define a manifold (16, 36) either supplying heat exchange fluid to a bundle of tubular elements (20) or collecting heat exchange fluid from the tubular elements (20) after the heat exchange fluid underwent heat exchange while passing through the tubular elements (20),
characterized in that at least one of the header-tank assembly (10) and (30) comprises at least one by-pass channel (40) forming fluid communication between tubular elements (20a) with insufficient pressure difference there across and the corresponding inlet nozzle (10a) and the outlet nozzle (30a).

2. The header-tank assembly (10, 30) as claimed in previous claim, wherein the by-pass channel (40) forms fluid communication between at least one of the end tubular elements (20a) distal from the outlet nozzle (30a) and the outlet nozzle (30a).

3. The header-tank assembly (10, 30) as claimed in any of the preceding claims, wherein the by-pass channel (40) is disposed along at least one of inner side (32a) and outer side (32b) of the tank (32) of the second header tank assembly (30).

4. The header-tank assembly (10, 30) as claimed in any of the preceding claims, wherein the by-pass channel (40) comprises at least one inlet (42) adapted to collect fluid from at least one of the tubular elements (20a) with insufficient pressure difference there across and at least one outlet (44) adapted to deliver fluid to the outlet nozzle (30a).

5. The header-tank assembly (10, 30) as claimed in claim 4, wherein the inlets (42) are uniformly spaced with respect to each other.

6. The header-tank assembly (10, 30) as claimed in any of the preceding claims, wherein the by-pass channel (40) is integrally formed with the tank (32) during forming of the tank (32) by molding process.

7. The header-tank assembly (10, 30) as claimed in any of the preceding claims, wherein the by-pass channel (40) is having uniform cross section along the length thereof.

8. The header-tank assembly (10, 30) as claimed in any of the preceding claims, wherein the by-pass channel (40) is disposed along at least one of the sidewalls and top wall of the tank (32).

9. The header-tank assembly (10, 30) as claimed in

claim 3, wherein the inner side (32a) of the tank (32) is configured with directing ribs to direct fluid flow towards the inlet (42) of the by-pass channel (40).

10. The header-tank assembly (10, 30) as claimed in any of the preceding claims comprises multiple by-pass channels (40) forming fluid communication between tubular elements (20a) with insufficient pressure difference there across and the at least one outlet nozzle (30a).

11. The header-tank assembly (10, 30) as claimed in any of the preceding claims, wherein the flow through bypass (40) is based on the pressure difference between tank outlet nozzle (30a) and the outlet of the tubular elements (20, 20a).

12. The header-tank assembly (10, 30) as claimed in any of the preceding claims, wherein the by-pass channel (40) is formed in the first header tank assembly (10) for forming fluid communication between inlet nozzle (10a) and tubular elements (20a) with insufficient pressure difference there across.

13. The header-tank assembly (10, 30) as claimed in claim 4, wherein the at least one outlet (44) is adapted create pressure difference thereacross to facilitate fluid flow from the by-pass channel to the nozzle (10a, 30a).

14. The header-tank assembly (10, 30) as claimed in any of the preceding claims, further comprises a connection portion (50) at the interface between the by-pass channel (40) and the nozzle (10a, 30) is adapted to facilitate fluid flow from the by-pass channel to the nozzle (10a, 30a).

15. A heat exchanger (100) comprising:

- a first header tank assembly (10) adapted to receive fluid therein through an inlet nozzle (10a);
- a plurality of tubular elements (20) adapted to be in fluid communication with the first header tank assembly (10) to receive fluid distributed by the first header tank assembly (10);
- a second header tank assembly (30) adapted to collect fluid from the tubular elements (20) for egress through the outlet nozzle (30a) formed thereon,

characterized in that the second header tank assembly (30) further comprises at least one by-pass channel (40) forming fluid communication between tubular elements (20a) with insufficient pressure difference there across and the outlet nozzle (30a).

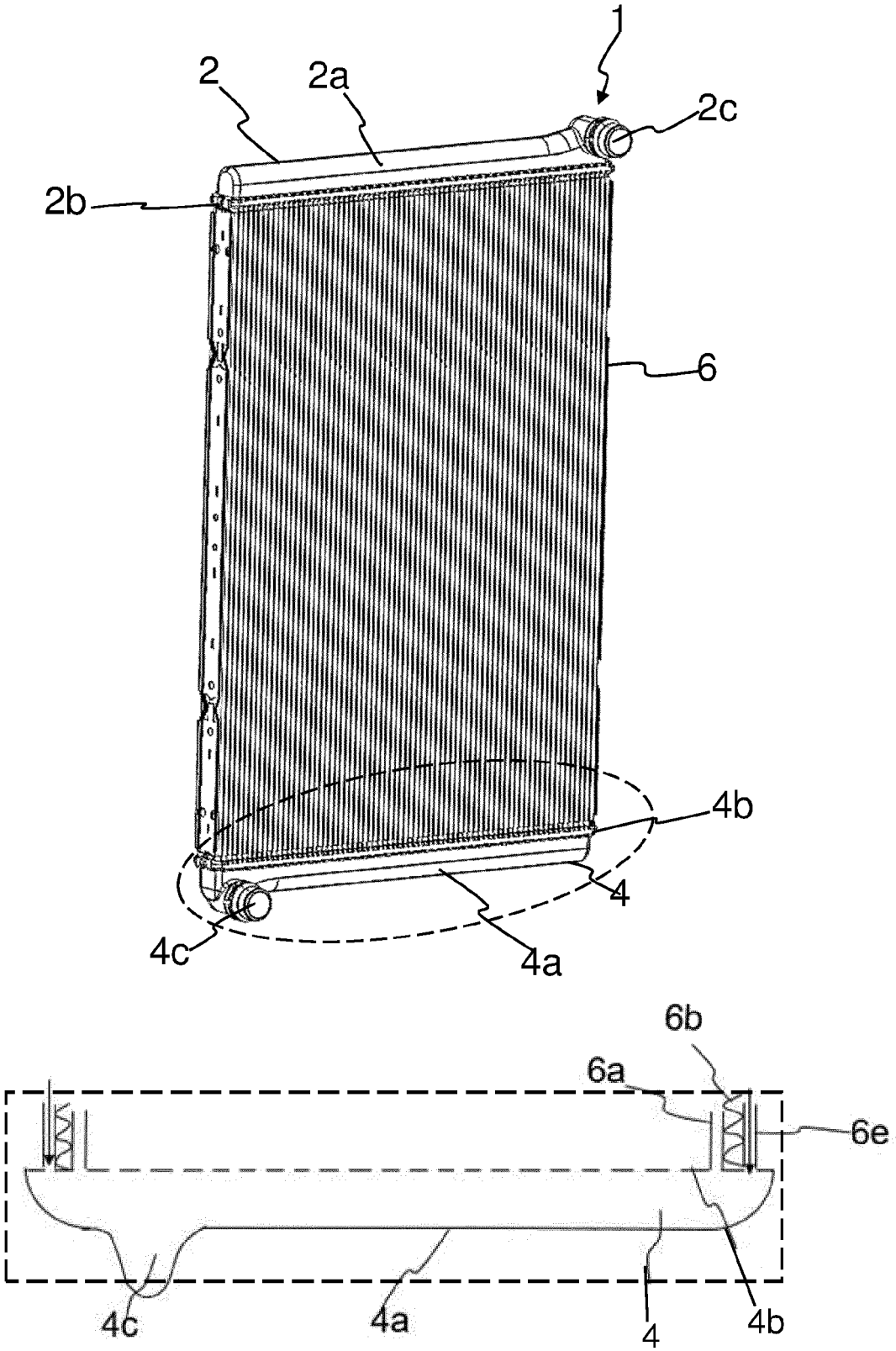


FIG. 1

(PRIOR ART)

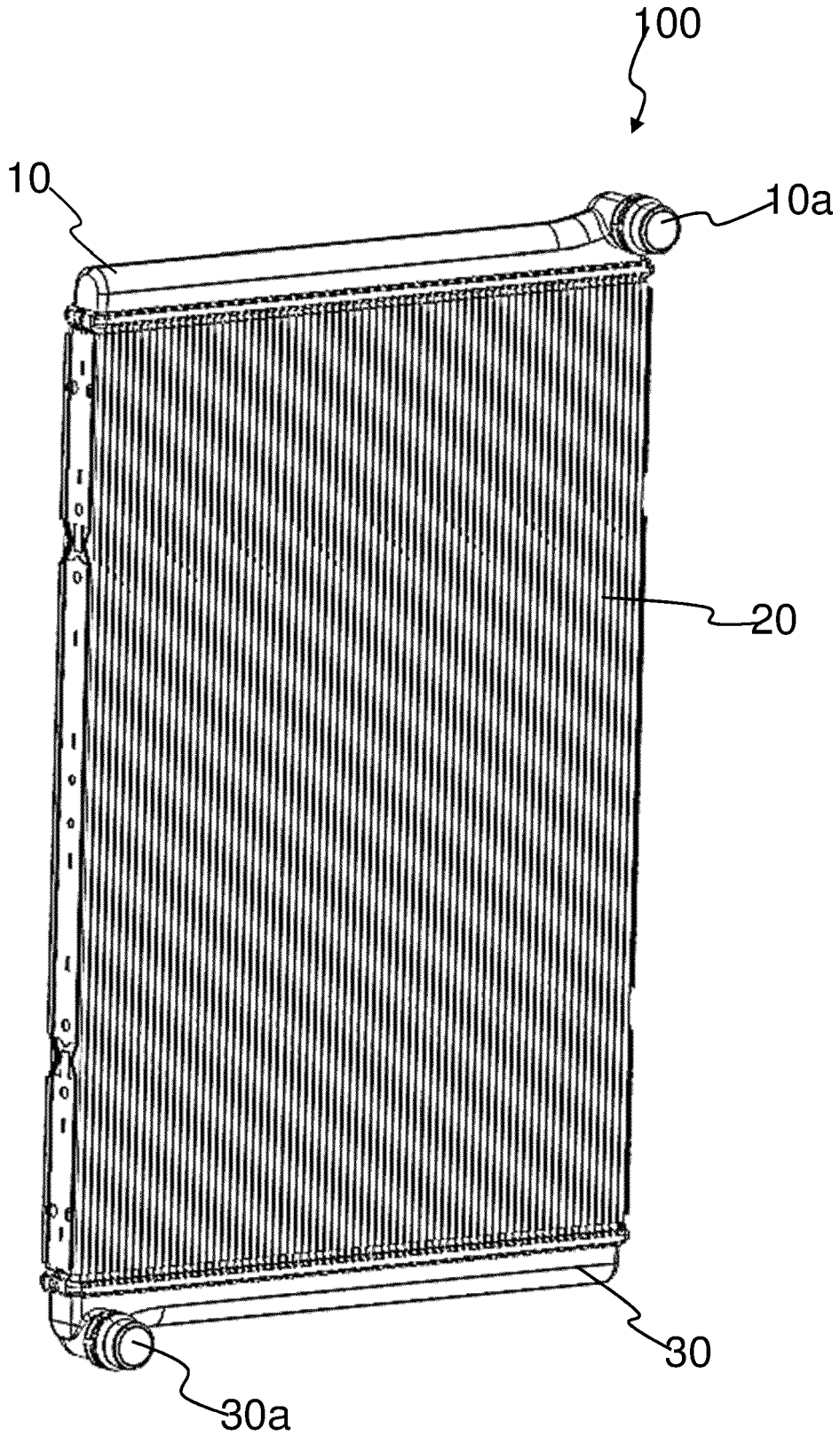


FIG. 2

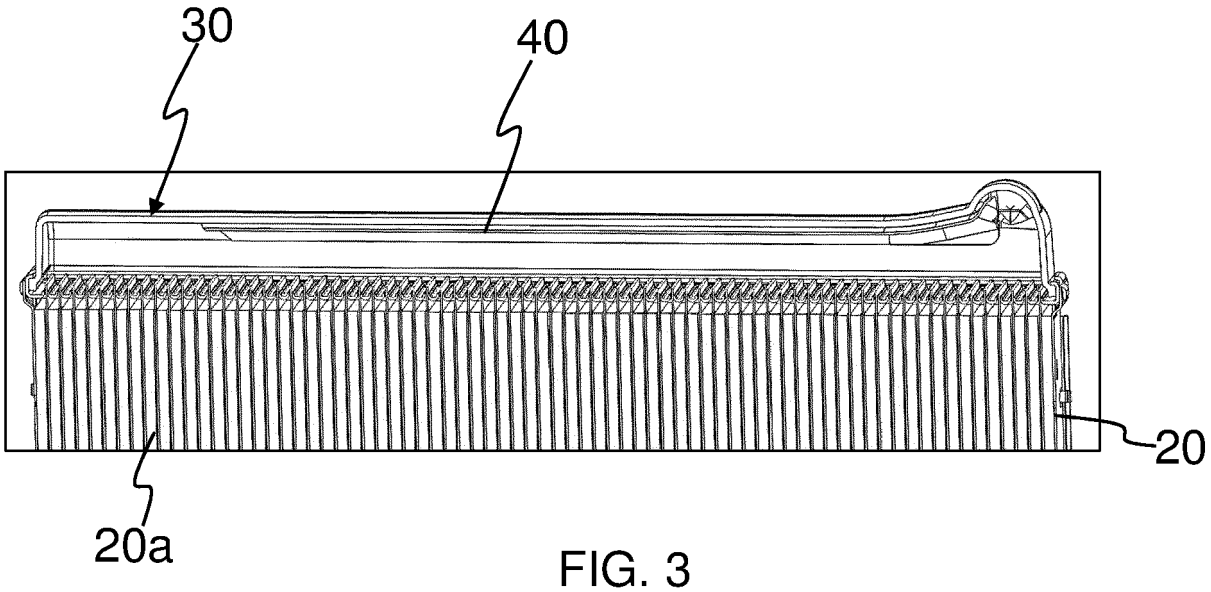


FIG. 3

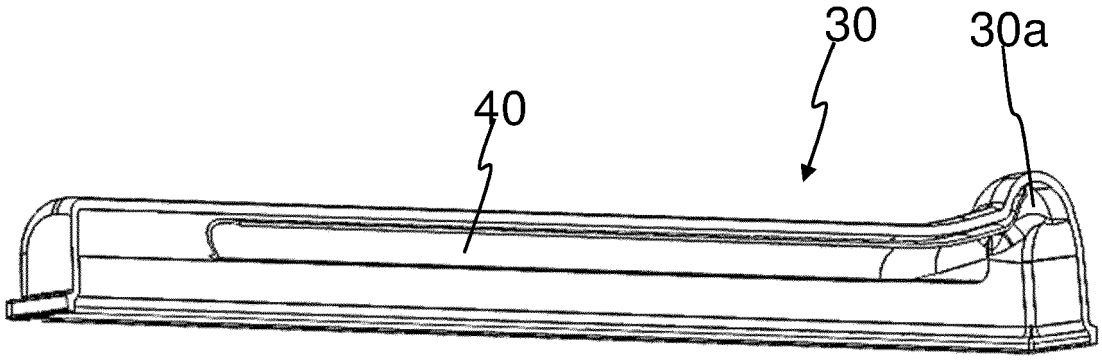


FIG. 4

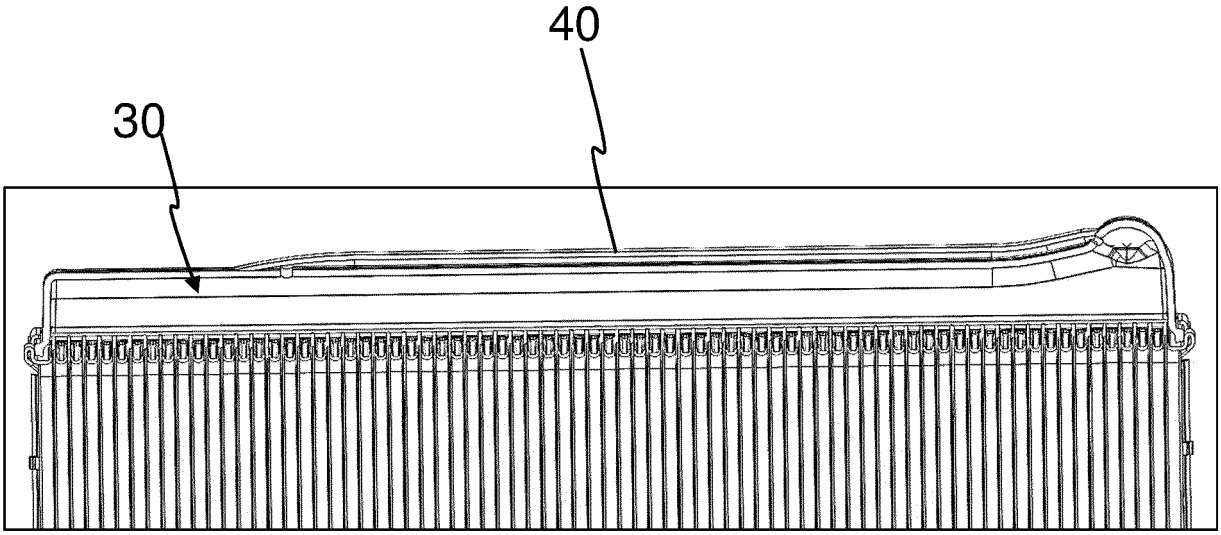


FIG. 5

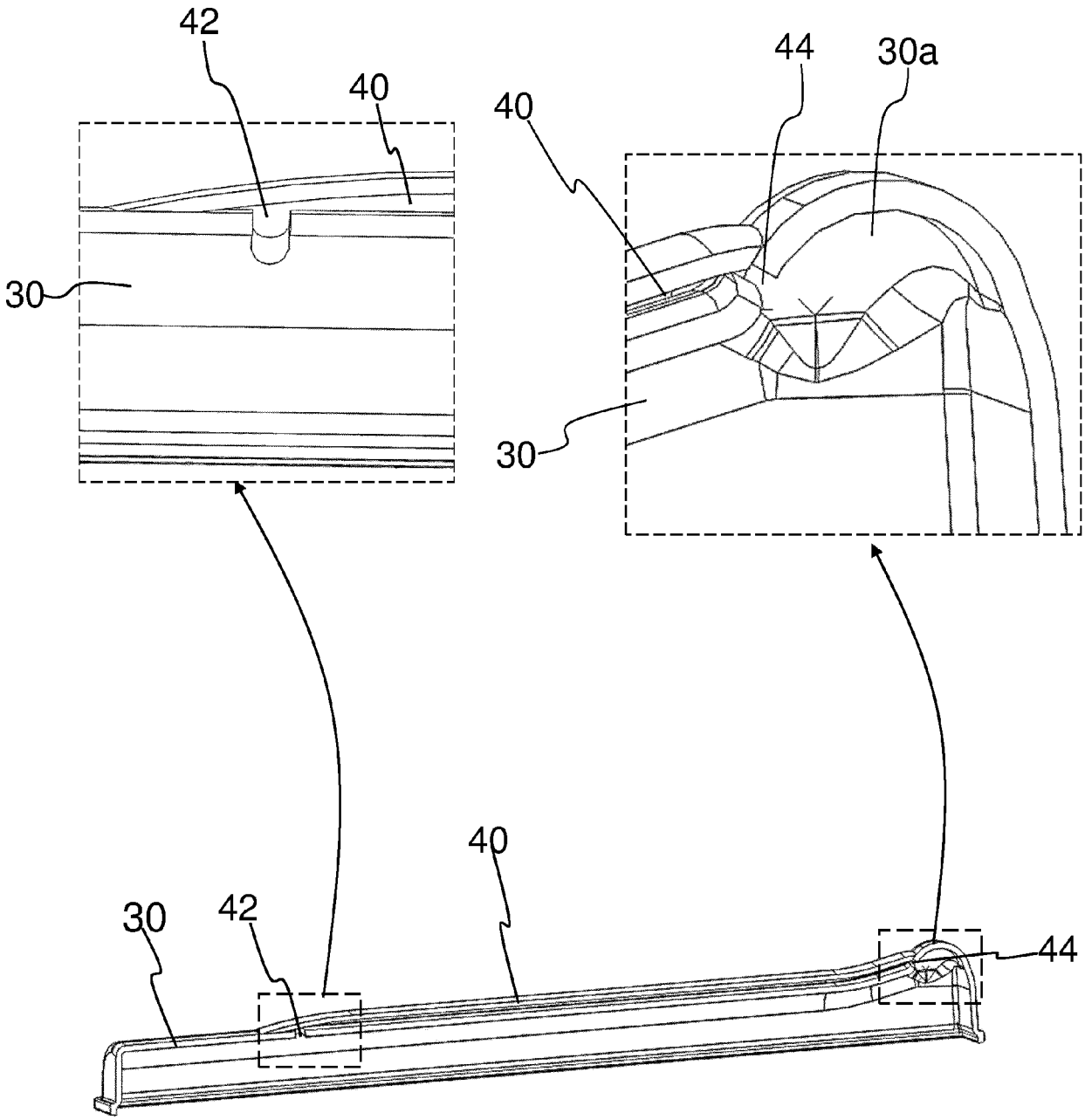


FIG. 6

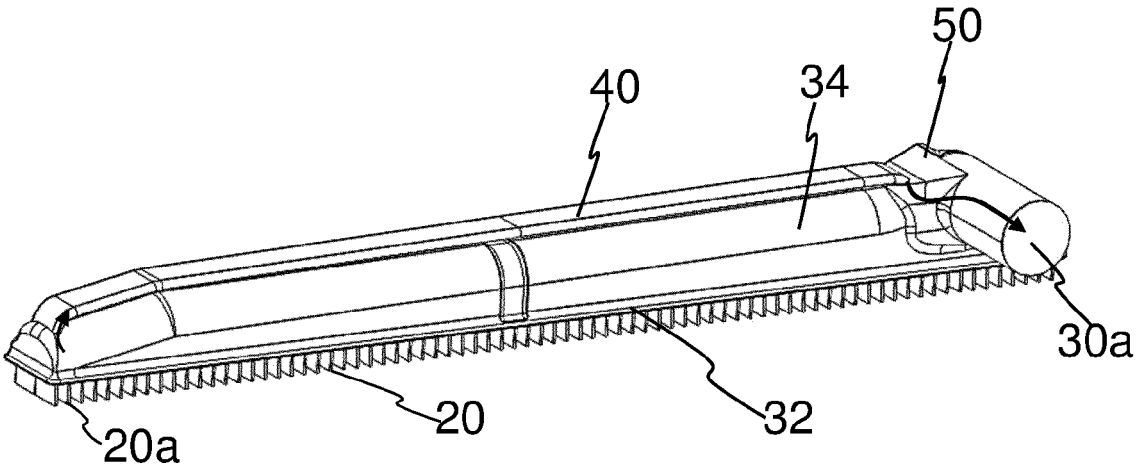


FIG. 7

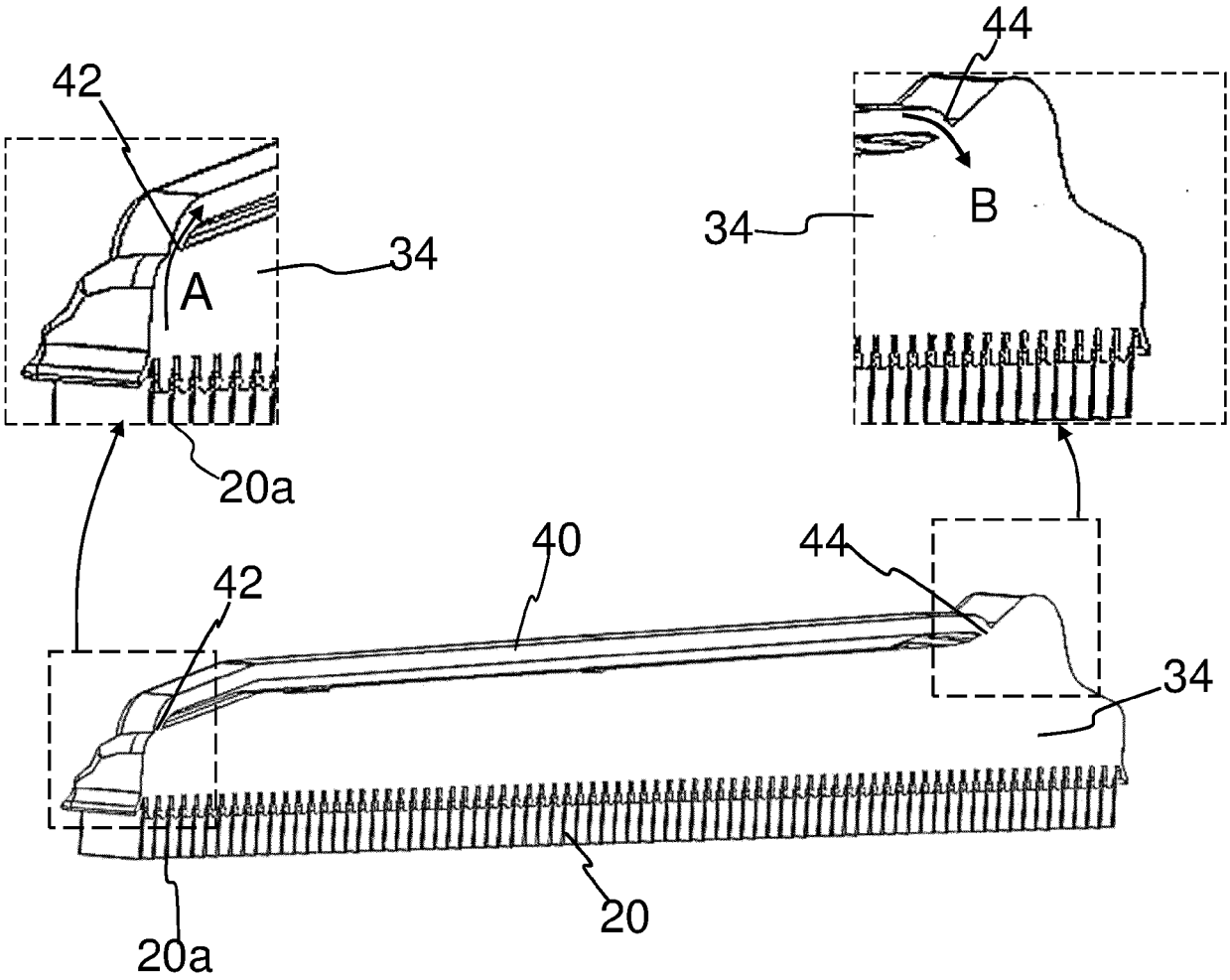
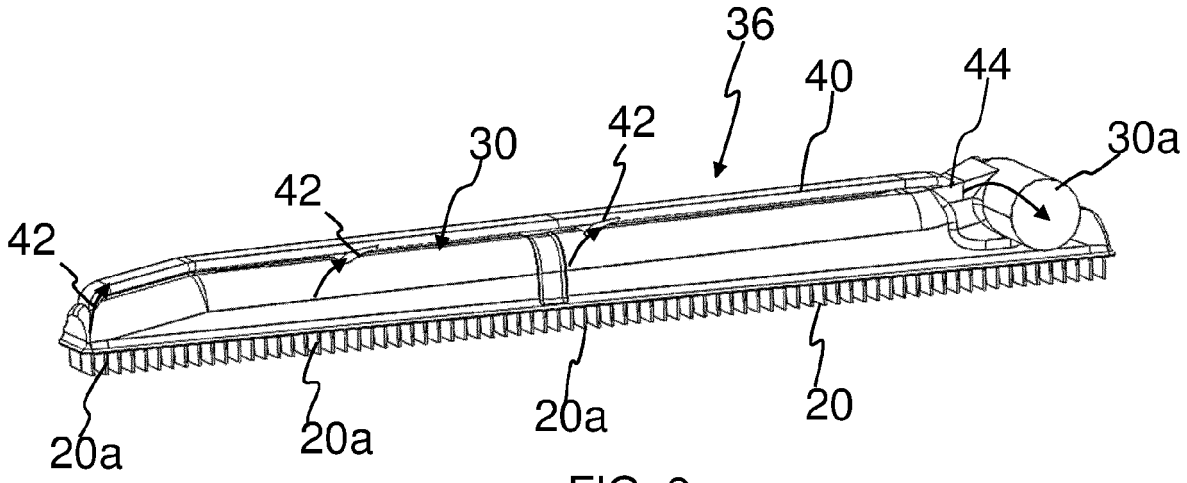


FIG. 8


36
40
44
30a
42
30
42
42
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20a
20a
20

FIG. 9

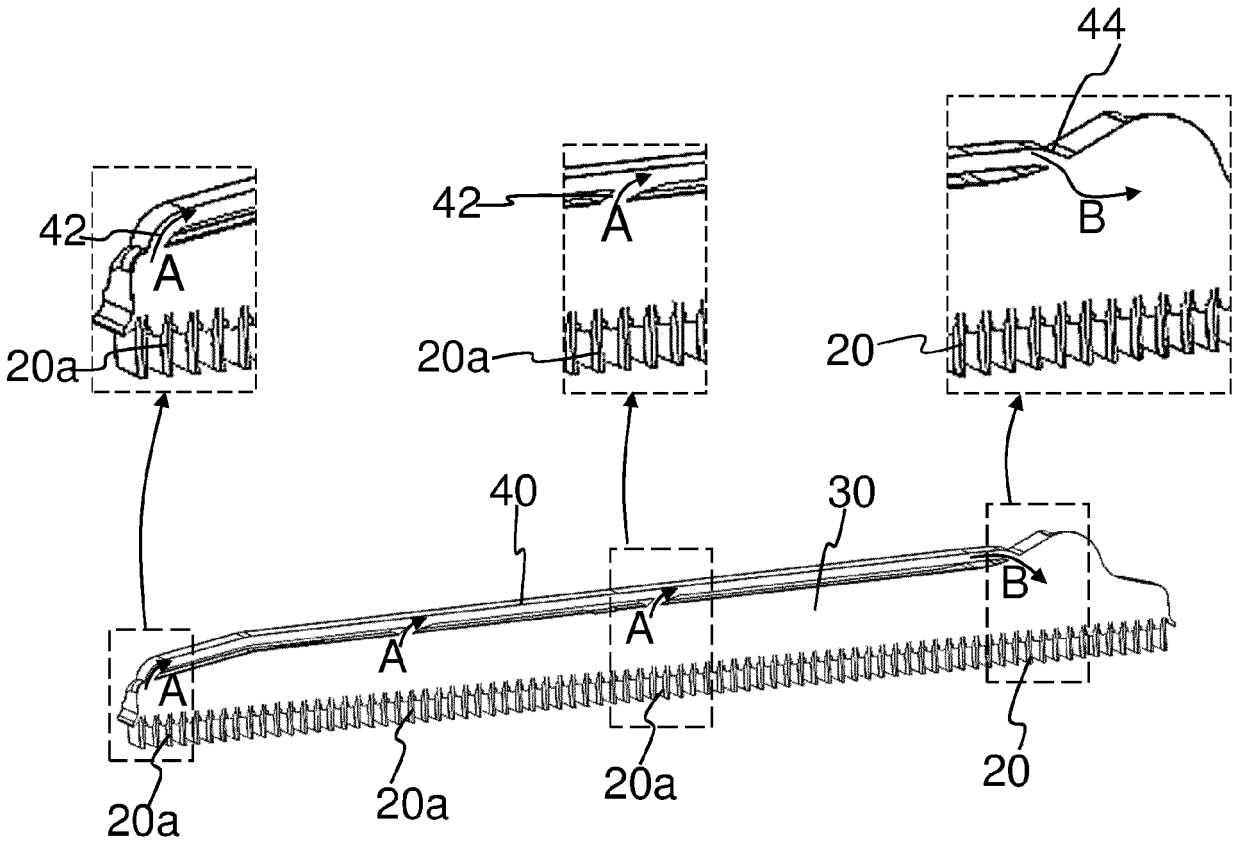
44
42
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FIG. 10

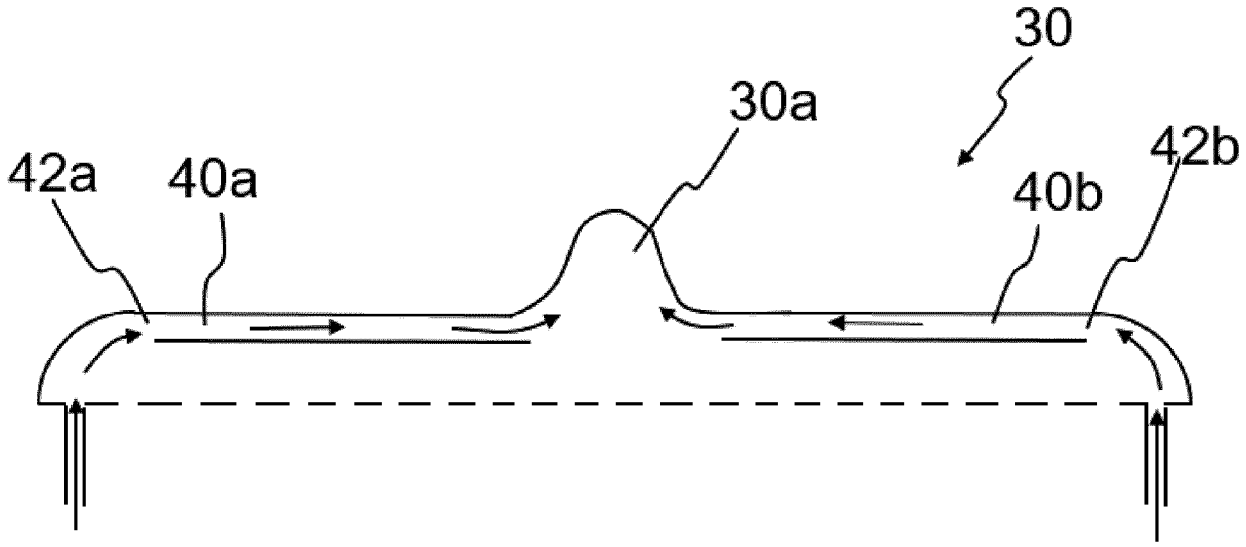

FIG. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 23 15 0852

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	DE 943 948 C (LICENTIA GMBH) 7 June 1956 (1956-06-07) * figure 2 *	1-15	INV. F28D1/053 F28F9/02
Y	EP 3 943 860 A1 (VALEO AUTOSYSTEMY SP ZOO [PL]) 26 January 2022 (2022-01-26) * figures *	1-15	
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			TECHNICAL FIELDS SEARCHED (IPC) F28F F28D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	21 June 2023	Mellado Ramirez, J

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 15 0852

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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21-06-2023

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