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(54) **A HEAT EXACHANGER**

(57) The present invention provides a heat exchanger for a vehicle that includes a first header, a second header, a first tank, a second tank, heat exchange tubes, a second tube and an intermediate tube. The first tank includes an inlet and an outlet, adapted to be coupled to the first header. The second tank is adapted to be coupled to the second header. Further, the heat exchange tubes is deployed in parallel to each other between the first header and the second header. Further, the adjacent tubes of the plurality of heat exchange tubes form first tubes. The second tube disposed between the first header and the second header, is in fluidic communication with the first set of tubes. Further, the intermediate tube located between the second tube and the first tubes, is configured to block the fluid communication between the first tank and the second tank.

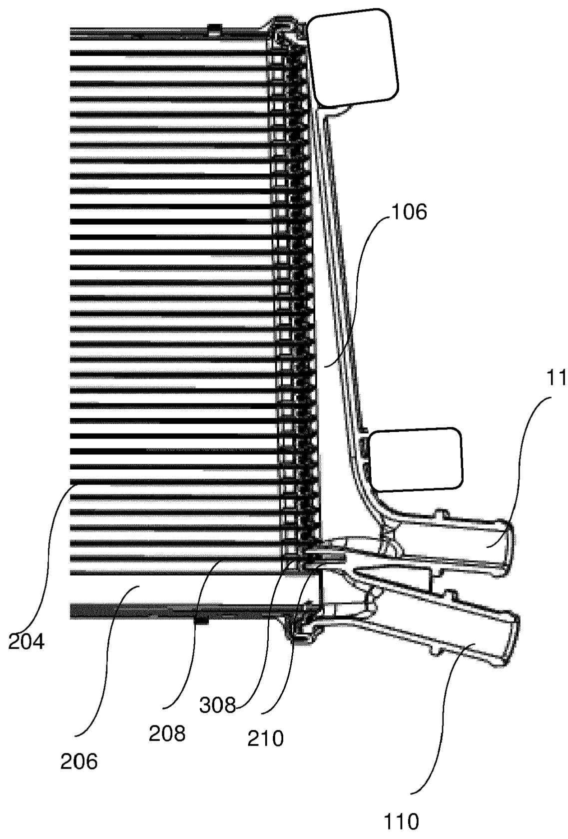

FIG.7

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Description

[0001] The present invention relates to a heat exchanger, more particularly, to a compact heat exchanger for use in a vehicle.

[0002] A vehicle generally includes a number of heat exchangers, such as for example a radiator, evaporator and a condenser. The heat exchanger for use in the vehicle is required to be packaged in a limited space due to space constraints and accordingly, is required to be compact. Generally, compactness of the heat exchanger is achieved by limiting the size of a core of the heat exchanger, particularly, either by limiting the length of the heat exchange tubes or by reducing the number of heat exchange tubes. Usually, in case of decreased length of the heat exchange tubes the pressure drop is decreased, whereas in case of decreased number of tubes the pressure drop is increased. With increased pressure drop across the heat exchanger core, problems with flow of a first heat exchange fluid across the heat exchanger core arises, particularly, a higher capacity pump is required to cause the first heat exchange fluid to flow across the heat exchanger core, thereby increasing the overall cost of the coolant loop.

[0003] In order to address the problems with flow of the first heat exchange fluid across the heat exchanger core and inefficient performance of the heat exchanger due to decrease in internal pressure drop across the heat exchanger core, an additional tube is connected between an inlet tank and an outlet tank of the heat exchanger. In case of an I-flow or Z-flow, the inlet tank and the outlet tank are disposed on opposite sides of the heat exchanger core. Whereas in case of the U-flow the inlet tank and the outlet tank are disposed along same side of the heat exchanger core and an intermediate tank is disposed on a side opposite to the side on which the inlet tank and outlet tank are disposed. Accordingly, the additional tube configures fluid communication between intermediate tank and outlet tank in case of U-flow and inlet and outlet tank in case of I flow or Z flow. The additional tube has larger cross section compared to the individual heat exchanger tube, consequently the flow rate through the additional tube is greater than through the heat exchange tube of the core. The main function of the additional tube is fluid communication between the inlet tank and the outlet tank, while providing a robust reinforcement of the structure due to its shape. Although there is some extent of heat exchange between the first heat exchange fluid flowing through the additional tube and air flowing outside the additional tube, such heat exchange is limited or minimal. More specifically, the additional tube forms a return flow passage from the intermediate tank to the outlet tank, in case the heat exchange tubes along with the additional tube are configuring U-flow.

[0004] Similarly, the additional tube forms flow passage from the inlet tank to the outlet tank, in case the heat exchange tubes along with the additional tube are configuring I flow or Z flow. The additional tube is of rectangular cross section that provides limited pressure drop there across. The transition of flow from the additional tube to an outlet pipe through the outlet tank is not smooth and causes flow/ energy losses. Further, the outlet tank and the outlet pipe faces packing issues. More specifically, the rectangular cross-section of the additional tube provides a robust reinforcement to the whole structure of the heat exchanger at low cost. During the operational mode of the heat exchanger, the sub-components contract and expand multiple times. Although the additional tube improves the pressure drop across the heat exchange tubes, the presence of such tube may cause thermal shock failure due to temperature gradient between the additional tube and the other heat exchange tubes during thermal shock cycle conditions. Further, low heat exchange between additional tube and surroundings may cause higher temperature of additional tube than temperature of the other heat exchange tubes, so the additional tube may expand more than of the other tubes, thereby causing stress on the heat exchange tubes. Such stress may reduce service life of the heat exchanger.

[0005] Accordingly, there is a need for a heat exchanger with features incorporated in either of an inlet tank, or an outlet tank to improve internal pressure drop across an additional tube and improve fluid flow through the additional tube. Further, there is a need for a heat exchanger that permits use of lower capacity pump for fluid flow between the inlet tank and the outlet tank. Further, there is another need to features incorporated in the heat exchanger that reduces stress generated on heat exchange tubes and increases service life of the heat exchanger. Further, there is need for a heat exchanger that exhibits improved efficiency and performance due to decreased internal pressure drop across the whole heat exchange due to integration of additional tube.

[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.

[0007] In view of the foregoing, an embodiment of the invention herein provides a heat exchanger for a vehicle. The heat exchanger includes a first header, a second header, a first tank, a second tank, and a plurality of heat exchange tubes. The first tank includes an inlet and an outlet, adapted to be coupled to the first header. The second tank positioned opposite to the first tank, is adapted to be coupled to the second header. Further, the plurality of heat exchange tubes is deployed in parallel to each other between the first header and the second header. Further, the adjacent tubes of the plurality of heat exchange tubes providing a fluidal communication between the first tank and the second tank form a first set of tubes. The heat exchanger further includes at least one second tube and at least one intermediate tube. The at least one second tube is having substantially rectangular cross section, disposed between the first header and the second header. Further, the second tube is in fluidic communication with the first set of tubes through the second tank. Further, the at least one intermediate tube disposed between the first header and the second header, is configured to block the fluid communication between the first tank and the second tank, characterized in that, the intermediate tube is located between the second tube and the first set of tubes.

[0008] Further, the first tank includes a pair of baffles configured to receive one end of the intermediate tube to fluidly isolate the first tank and the second tank.

[0009] In one embodiment, the pair of baffles is provided in between the inlet and the outlet formed in the first tank.

[0010] Further, both the first header and the second header comprises slots to receive respective ends of the first set of tubes and the second tube.

[0011] Further, each of the first header and the second header includes an opening, complementary to the cross section of the intermediate tube, to receive respective ends of the intermediate tube.

[0012] In one embodiment, the opening is provided in-line to the inlet formed in the first tank to enable fluid flow into the second tube.

[0013] In another embodiment, the pair of baffles is adapted to be fluid-tight contact with the first header corresponding to the slot receiving the intermediate tube.

[0014] In one embodiment, the intermediate tube is non-heat exchange tube.

[0015] In one example, the cross-section of the second tube is larger than of the cross-section of the tube forming the first set of tubes.

[0016] Further, the second tube is provided at an end of the heat exchanger and the inlet is provided on the first tank in-line to the second tube.

[0017] Further, the first tank and the second tank are crimped to the first header and the second header respectively.

[0018] In one embodiment, the heat exchanger further includes a gasket provided on each of the first header and the second header to enable fluid tight connection between the first and second headers and the first and second tanks respectively.

[0019] Further, the inlet and the outlet formed in the first tank are proximal with each other.

[0020] In one embodiment, the second tube is a reverse flow tube.

[0021] In another embodiment, the first tank is of variable cross-section and the cross-section is decreasing in a direction distal from the inlet and the outlet.

[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 perspective view of the heat exchanger, in accordance with an embodiment of the present invention;

Fig. 2 is an exploded view of the heat exchanger of Fig. 1;

Figs 3 and 4 illustrate perspective views of a first tank and a second tank of the heat exchanger of Fig. 2 respectively;

Fig. 5 illustrates a perspective view of a first header of the heat exchanger of Fig. 2;

Fig. 6 illustrates an exploded view of the heat exchanger of Fig 1, showing the first tank that is isolated from the heat exchanger; and

Fig. 7 illustrates a cross-sectional view of the first tank of Fig. 1 coupled to the first header, in which one end of the heat exchange tubes and the second tube are received therein.

[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.

[0024] The present invention relates a heat exchanger provided with an intermediate tube to reduce temperature gradient difference across heat exchange tubes provided in the heat exchanger. Generally, the heat exchanger is provided with a reverse flow tube to improve internal pressure drop across the heat exchange tubes provided in the heat exchanger. The reverse flow tube may not efficiently contribute on heat exchange, however, it contribute minimal heat exchange between the fluid flowing into the heat exchange tubes and fluid flowing around the heat exchange tubes. Further, the fluid flowing into the reverse flow tube may be of higher temperature than the fluid flowing in other heat exchange tubes, so the reverse flow tube may expand more than of the other heat exchange tubes, thereby causing stress on the other heat exchange tubes. Such stress may reduce service life of the heat exchanger. To obviate such problems an intermediate tube is provided between the reverse flow tube and other heat exchange tubes. The intermediate tube may be a dead tube that does not contribute in heat exchange function. The intermediate tube may reduce the temperature gradient difference between the reverse flow tube and other heat exchange tubes, thereby compensating difference in temperature gradient between the reverse flow tube and the other heat exchange tubes.

[0025] Figs. 1 and 2 illustrate schematic representations of a heat exchanger 100, in accordance with an embodiment of the present invention. In this example, Fig. 1 is a perspective view of the heat exchanger 100 and Fig. 2 is an exploded view of the heat exchanger 100. The heat exchanger 100 includes a first header 102 and a second header 104 disposed opposite to the first header 102. Further, a plurality of heat exchange elements 202 deployed in parallel to each other between the first header 102 and the second header 104. The heat exchanger 100 further includes a first tank 106 and a second tank 108 opposite to the first tank 106. The first tank 106 is adapted to be coupled the first header 102 and the second tank 108 is adapted to be coupled the second header 104. The first tank 106 may include an inlet 110 and an outlet 112 fluidically isolated from the inlet 110. In other words, the first tank 106 may include a partition to fluidically isolate the area in the first tank 106 corresponding to the inlet 110 from the area in the first tank 106 corresponding to the outlet 112. In one embodiment, the inlet 110 and the outlet 112 formed in the first tank 106 are proximal with each other. Further, a cross-section of the first tank 106 corresponding to the inlet 110 is less than of the cross-section of the first tank 106 corresponding to the outlet 112. The inlet 110 is adapted to ingress a heat exchange fluid into the first tank 106 and the outlet 112 is adapted to egress the heat exchange fluid from the first tank 106. In one embodiment, the first tank 106 is crimped to the first header 102 and the second tank 108 is crimpled to the second header 104.

[0026] The plurality of heat exchange elements 202, hereinafter referred to as heat exchange tubes, is disposed between the first header 102 and the second header 104 to provide fluidal communication between the first tank 106 and the second tank 108. Further, adjacent tubes of the heat exchange tubes 202 form a first set of tubes 204. The heat exchanger 100 further includes at least one second tube 206 having substantially rectangular cross-section, disposed between the first header 102 and the second header 104. The second tube 206 can be a tubular element having rectangular section to increase the pressure drop there across, thereby improving the fluid flow through the second tube 206. In one embodiment, the second tube 206 is referred to as a reverse flow tube. The second tube 206 is in-line to the inlet 110 to receive the heat exchange fluid. The heat exchange tubes 202 forming the first set of tubes 204 receives the heat exchange fluid through the second tank 108. Thereafter, the heat exchange fluid is received in the first tank 106, corresponding to the outlet area. Further, temperature of the heat exchange fluid while entering into the second tube 206 is less as comparted to the heat exchange fluid flowing in the first set of tubes 204. Therefore, thermal expansion between the first set of tubes 204 and the second tube 206 is not same, thereby causing stress on the first set of tubes 204.

[0027] To avoid such stress, at least one intermediate tube 208 is introduced between the first set of tubes 204 and the second tube 206. The intermediate tube may be a dead tube that does not contribute in the heat exchange phenomenon; however, such tube reduces the stress generated on the first set of tubes 204. In one embodiment, the intermediate tube 208 may be integrally defined in the heat exchange tubes 202. In another embodiment, the intermediate tube 208 may be attached to the heat exchange tubes 202. The intermediate tube 208 is disposed between the first header 102 and the second header 104 of the heat exchanger 100. The intermediate tube 208 is configured to block the fluid communication between the first tank 106 and the second tank 108.

[0028] Figs 3 and 4 illustrate perspective views of the first tank 106 and the second tank 108 of the heat exchanger 100 of Fig. 2 respectively. Fig. 5 illustrates a perspective view of the first header 102 of the heat exchanger 100 of Fig. 2. The first tank 106 is crimped to the first header 102 that includes slots 302 to receive one end of the heat exchange tubes 202 forming the first set of tubs 204 and the intermediate tube 208. The first header 102 includes also an opening 304, complementary to the cross-section of the intermediate tube 208, to receive one end of the second tube 206 defining an entrance of the second tube 206. Similarly, the second header 104 also includes the slots and the opening complementary to the slots 302 and the opening 304 formed in the first header 102. The second tank 108 is crimped to the second header 104 that includes the slots 302 to receive opposite end of the heat exchange tubes 202 forming the first set of tubs 204 and the intermediate tubes 208. The second header 104 further includes the opening 304 to receive the opposite end of the second tube 206. The opening 304 provided in the first header 102 is in-line with the inlet 110 formed in the first tank 106 to enable fluid flow into the second tube 206. With such configuration, the heat exchange tubes 202 and the second tube 206 configure fluid communication between the inlet 110 and the outlet 112. Further, the first tank 106 includes a pair of baffles 210 configured to receive one end of the intermediate tube 208 to fluidically isolate the first tank 106 and the second tank 108. The pair of baffles 210 may be provided in between the inlet 110 and the outlet 112 of the first tank 106.

[0029] Fig. 6 illustrates an exploded view of the heat exchanger 100 of Fig 1, showing the first tank 106 that is isolated from the heat exchanger 100. The pair of baffles 210 provided in the first tank 106 is adapted to fluidically isolate the inlet 110 from the outlet 112 in the first tank 106. In other words, the pair of baffles 210 may act as barrier to restrict direct fluid flow from the inlet 110 to the outlet 112 in the first tank 106. Further, the pair of baffles 210 may block an entrance 308 of the intermediate tube 208, thereby restricting fluid flow from the first tank 106 to the second tank 108 through the intermediate tube 208. Further, the inlet 110 provided the first tank 106 is in fluid communication with and supplies the first heat exchange fluid received therein to the second tube 206. The second tube 206 receive the heat exchange fluid from the inlet 110 and deliver the heat exchange fluid to the second tank 108. Thereafter, the heat exchange tubes 202 forming the first set of tubes 204 receives the first heat exchange fluid and delivers to the outlet 112 formed in the first tank 106. Specifically, as the heat exchange fluid flows through the heat exchange tubes 202, the first heat exchange fluid undergoes heat exchange with another fluid, preferably air, flowing across and around the heat exchange tubes 202. The outlet 112 formed in the first tank 106 is in fluid communication with and receives the first heat exchange fluid collected in the second tank 108 through the heat exchange tubes 202.

[0030] The heat exchange tubes 202 and the second tube 206 connecting the inlet 110 and the outlet 112 configure either one of I-flow, U-flow and Z-flow between inlet 110 and the outlet 112. In one example, the first set of tubes 204 forms a return flow passage from the second tank 108 to the outlet 112, in case the heat exchange tubes 202 along with the second tube 206 are configuring U-flow. The main function of the second tube 206 is fluid communication between the first tank 106 and the second tank 108, instead of heat exchange. Although there is heat exchange between the heat exchange fluid flowing through the second tube 206 and air flowing outside the second tube 206, however, such heat exchange is limited. The second tube 206 is of rectangular cross section instead of circular section. In one embodiment, the second tube 206 is provided at end of the heat exchanger 100 and the inlet 110 is provided in the first tank 106 inline to the second tube 206. The heat exchanger 100 further includes a gasket 306 provided on each of the first header 102 and the second header 104 to enable fluid tight connection between the first and second headers 102, 104 and the first and second tanks 106, 108 respectively.

[0031] Further, the first tank 106 is of a variable cross-section and the cross-section is decreasing in a direction distal from the inlet 110 and the outlet 112. Similarly, the second tank 108 is of a variable cross-section and the cross-section is decreasing a direction distal from the area in the second tank 108 where the second tube 206 is received. With such configuration, the heat exchange fluid uniformly distributed in the heat exchange tubes 202. Such modifications in the first tank 106 and the second tank 108 allows to decrease the internal pressure drop across the heat exchange tubes 202 and promotes fluid flow through the heat exchange tubes 202 and the second tube 206, thereby enhancing the efficiency and performance of the heat exchanger 100.

[0032] Fig. 7 illustrates a cross-sectional view of the first tank 106 of Fig. 1 coupled to the first header 102, in which one end of the heat exchange tubes 202 and the second tube 206 are received therein. As shown in Fig. 7, the pair of baffles 210 is adapted to be in fluid-tight contact with the first header 102 corresponding to the slot receiving one end of the intermediate tube 208. Further, the entrance 308 of the intermediate tube 208 is received in between the pair of baffles 210, thereby closing the entrance 308 of the intermediate tube 208 and blocking the heat exchange fluid flow from the first tank 106 to the second tank 108 through the intermediate tube 208. Further, the intermediate tube 208 is having same cross-section as the heat exchange tubes 202 forming the first set of tubes 204. The intermediate tube 208 may be dead tube compensate the thermal expansion between the first set of tubes 204 and the second tube 206.

[0033] Initially, the heat exchange fluid may flow from the inlet 110 provided in the first tank 106 to the second tank 108 through the second tube 206. Thereafter, the heat exchange fluid may flow from the second tank 108 to the outlet 112 provided the first tank 106 through the first set of tubes 204 and simultaneously exchange heat with the air flowing around the heat exchange tubes 202. Due to such heat exchange between the first and second heat exchange fluids, the temperature of the heat exchange fluid flowing in the first set of tubes 204 is lower than the temperature of the heat exchange fluid flowing in the second tube 206. Therefore, thermal expansion of the second tube 206 is greater than of the first set of tubes 204, that creates stress on the first set of tubes 204. Further, the intermediate tube 208 provided between the first set of tubes 204 and the second tube 206 may reduce difference between temperature gradient of the first set of tubes 204 and the second tube 206. Due to such reduction in difference between temperature gradient of the first set of tubes 204 and the second tube 206, stress acting on the first set of tubes 204 is reduced, thereby increasing service life of the heat exchanger 100.

[0034] Several modifications and improvement might be applied by the person skilled in the art to a heat exchanger as defined above, and such modifications and improvements will still be considered within the scope and ambit of the present invention, as long as it is comprising a first tank having a pair of baffles, a second tank and heat exchange tubes with a dead tube.

[0035] 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 heat exchanger (100), comprising:

a first header (102);
a second header (104);
a first tank (106) comprising an inlet (110) and an outlet (112), adapted to be coupled to the first header (102);
a second tank (108) opposite to the first tank (106), adapted to be coupled to the second header (104);
a plurality of heat exchange tubes (202) de-

ployed in parallel to each other between the first header (102) and the second header (104), , wherein the adjacent tubes of the plurality of heat exchange tubes (202) providing a fluidal communication between the first tank (106) and the second tank (108) form a first set of tubes (204),

at least one second tube (206) having substantially rectangular cross section, disposed between the first header (102) and the second header (104), wherein the second tube (206) is in fluidic communication with the first set of tubes (204) through the second tank (108); and

at least one intermediate tube (208), disposed between the first header (102) and the second header (104), configured to block the fluid communication between the first tank (106) and the second tank (108), **characterized in that**, the intermediate tube (208) is located between the second tube (206) and the first set of tubes (204).

2. The heat exchanger (100) as claimed in claim 1, wherein the first tank (106) comprises a pair of baffles (210) configured to receive one end of the intermediate tube (208) to fluidly isolate the first tank (106) and the second tank (108).

3. The heat exchanger (100) as claimed in claim 2, wherein the pair of baffles (210) is provided in between the inlet (110) and the outlet (112) formed in the first tank (106).

4. The heat exchanger (100) as claimed in any of the preceding claims, wherein both the first header (102) and the second header (104) comprises slots (302) to receive respective ends of the first set of tubes (204) and the second tube (206).

5. The heat exchanger (100) as claimed in claim 4, wherein each of the first header (102) and the second header (104) comprises an opening (304), complementary to the cross section of the intermediate tube (208), to receive respective ends of the intermediate tube (208).

6. The heat exchanger (100) as claimed in claim 5, wherein the opening (304) is provided in-line to the inlet (110) formed in the first tank (106) to enable fluid flow into the second tube (206).

7. The heat exchanger (100) as claimed in any of the preceding claims 4 to 6, wherein the pair of baffles (210) is adapted to be fluid-tight contact with the first header (102) corresponding to the slot (302) receiving the intermediate tube (208).

8. The heat exchanger (100) as claimed in any of the preceding claims, wherein the intermediate tube (208) is non-heat exchange tube.

9. The heat exchanger (100) as claimed in any of the preceding claims, wherein the cross-section of the second tube (206) is larger than of the cross-section of the tube (202) forming the first set of tubes (204).

10. The heat exchanger (100) as claimed in any of the preceding claims, wherein the second tube (206) is provided at an end of the heat exchanger (100) and the inlet (110) is provided on the first tank (106) inline to the second tube (206).

11. The heat exchanger (100) as claimed in any of the preceding claims, wherein the first tank (106) and the second tank (108) are crimped to the first header (102) and the second header (104) respectively.

12. The heat exchanger (100) as claimed in any of the preceding claims, further comprising a gasket (306) provided on each of the first header (102) and the second header (104) to enable fluid tight connection between the first and second headers (102, 104) and the first and second tanks (106, 108) respectively.

13. The heat exchanger (100) as claimed in any of the preceding claims, wherein the inlet (110) and the outlet (112) formed in the first tank (106) are proximal with each other.

14. The heat exchanger (100) as claimed in any of the preceding claims, wherein the second tube (206) is a reverse flow tube.

15. The heat exchanger (100) as claimed in any of the preceding claims, wherein the first tank (106) is of variable cross-section and the cross-section is decreasing in a direction distal from the inlet (110) and the outlet (112).

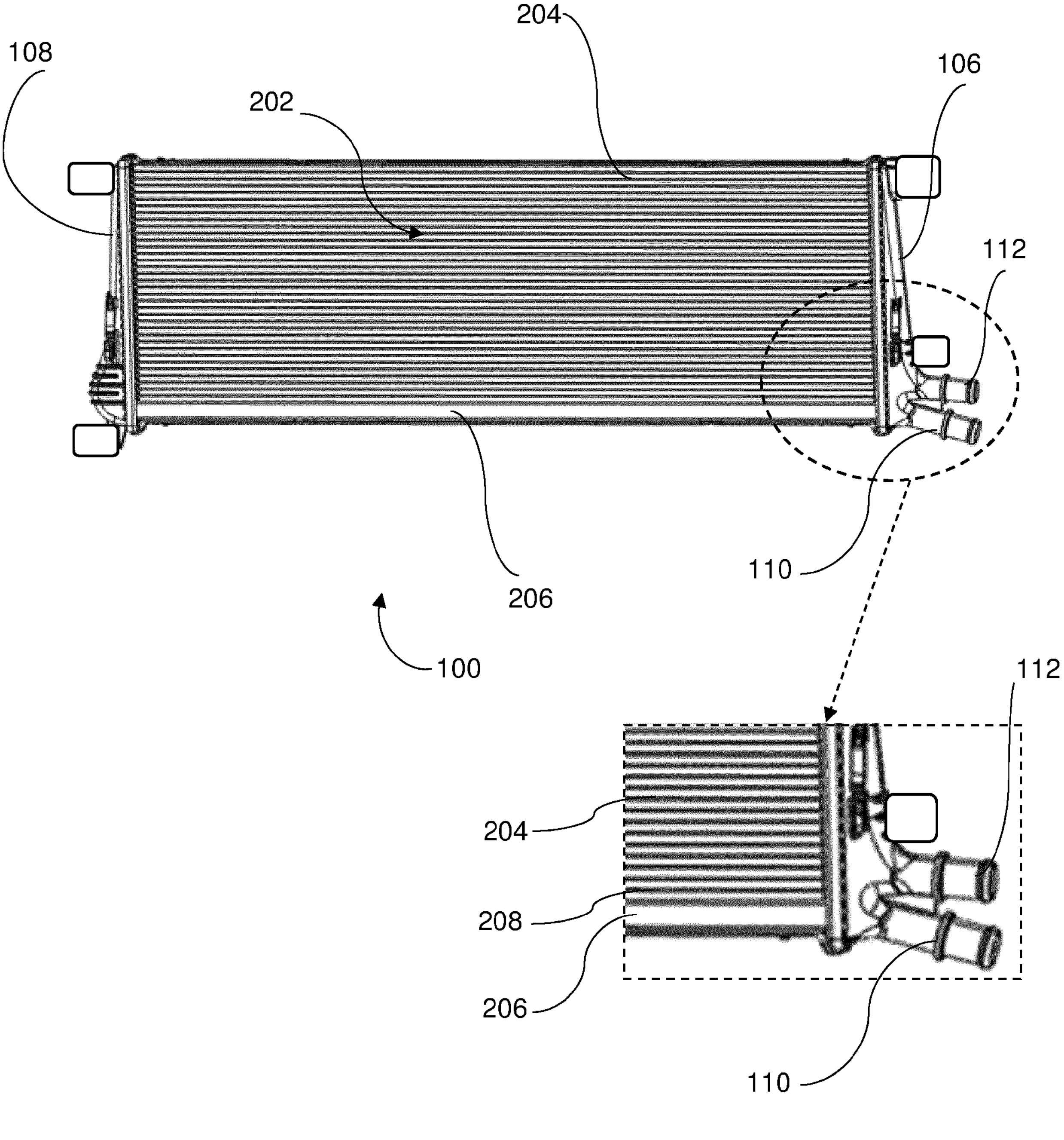

FIG. 1

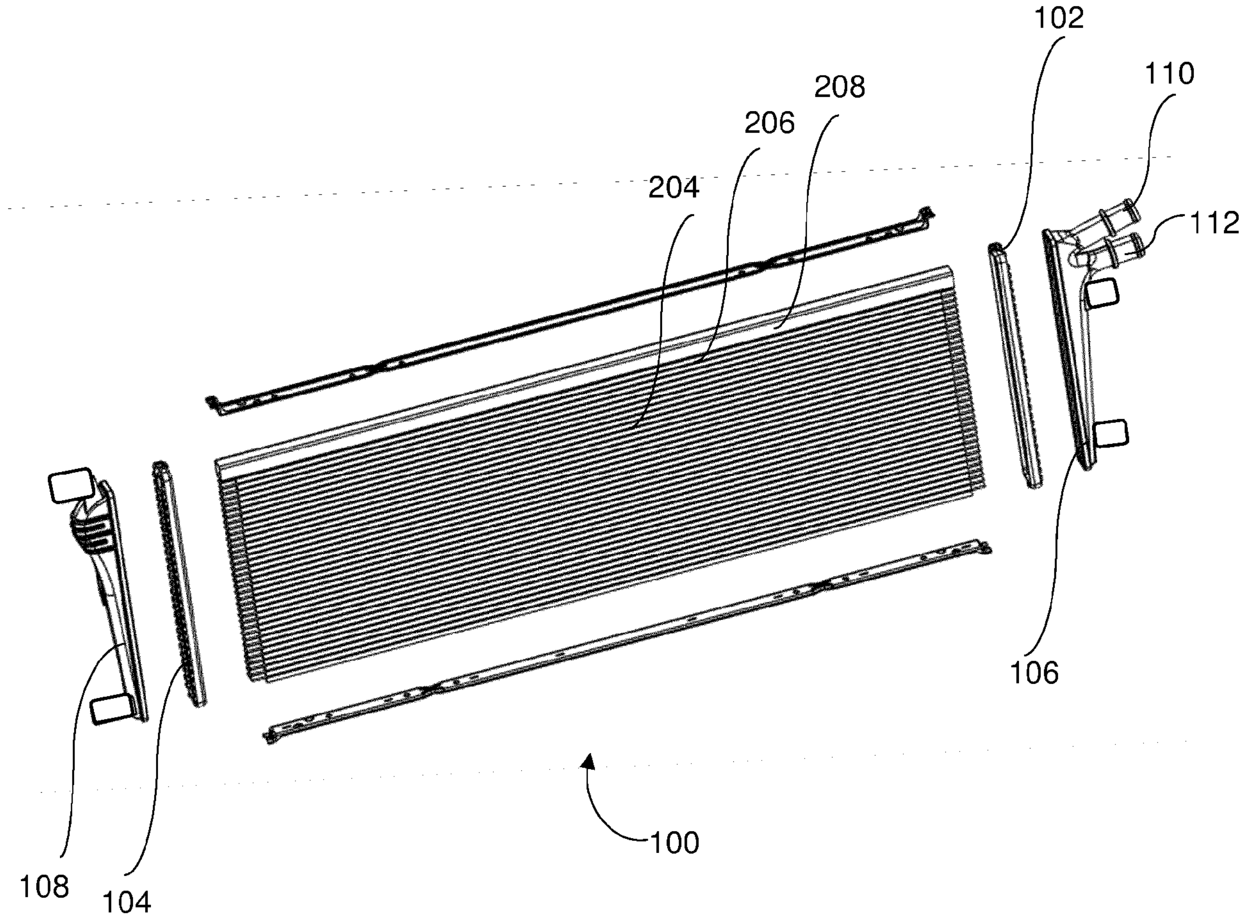

FIG. 2

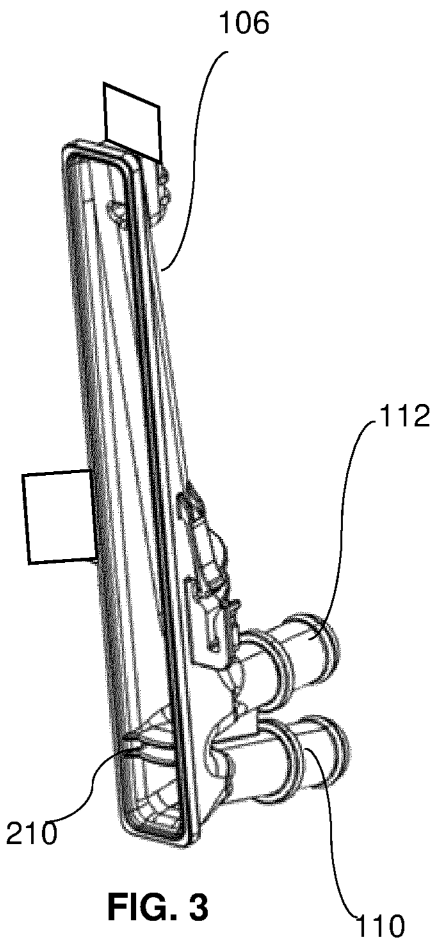

FIG. 3

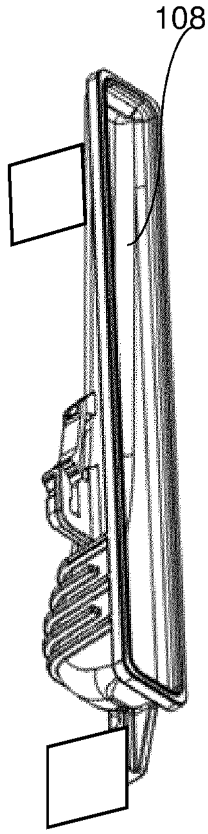

FIG. 4

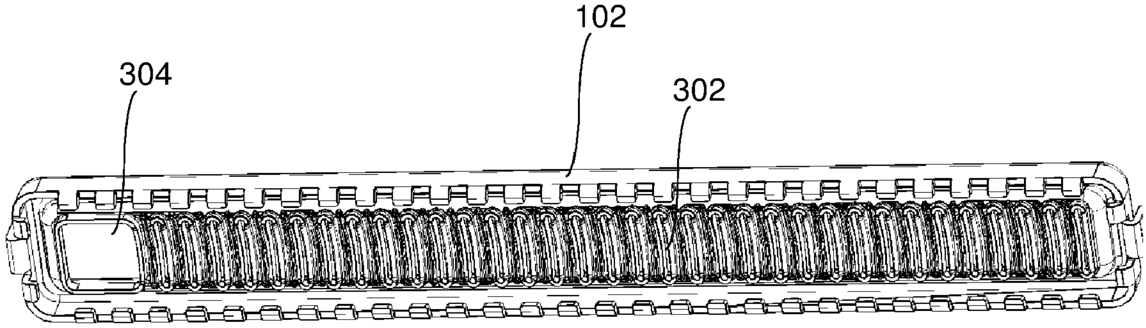

FIG. 5

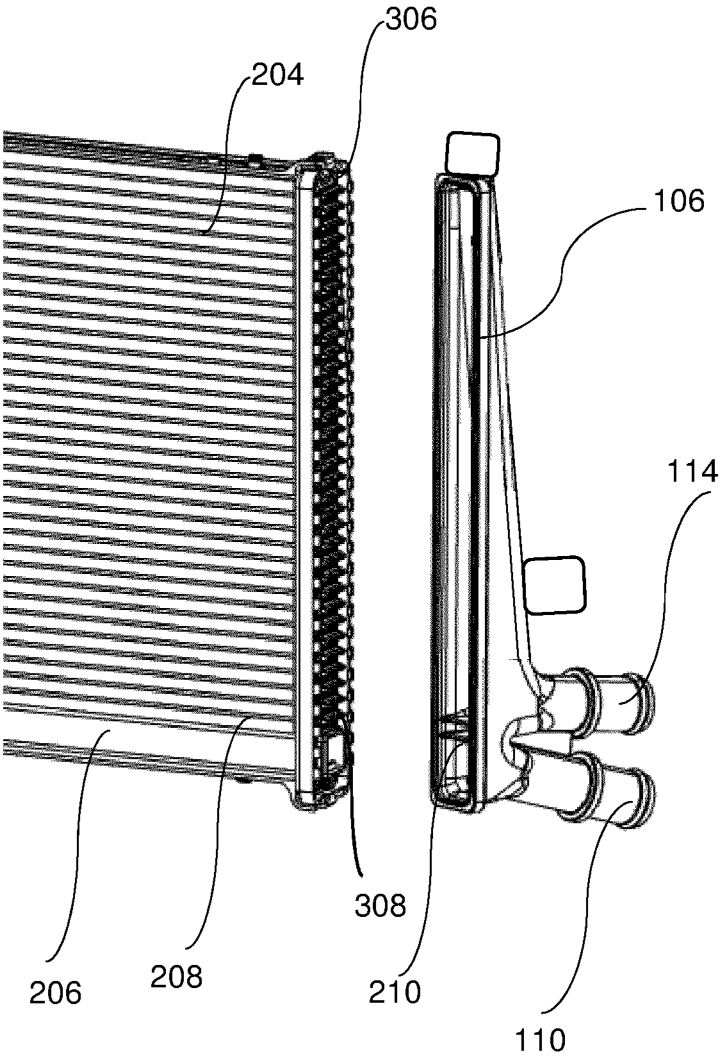

FIG.6

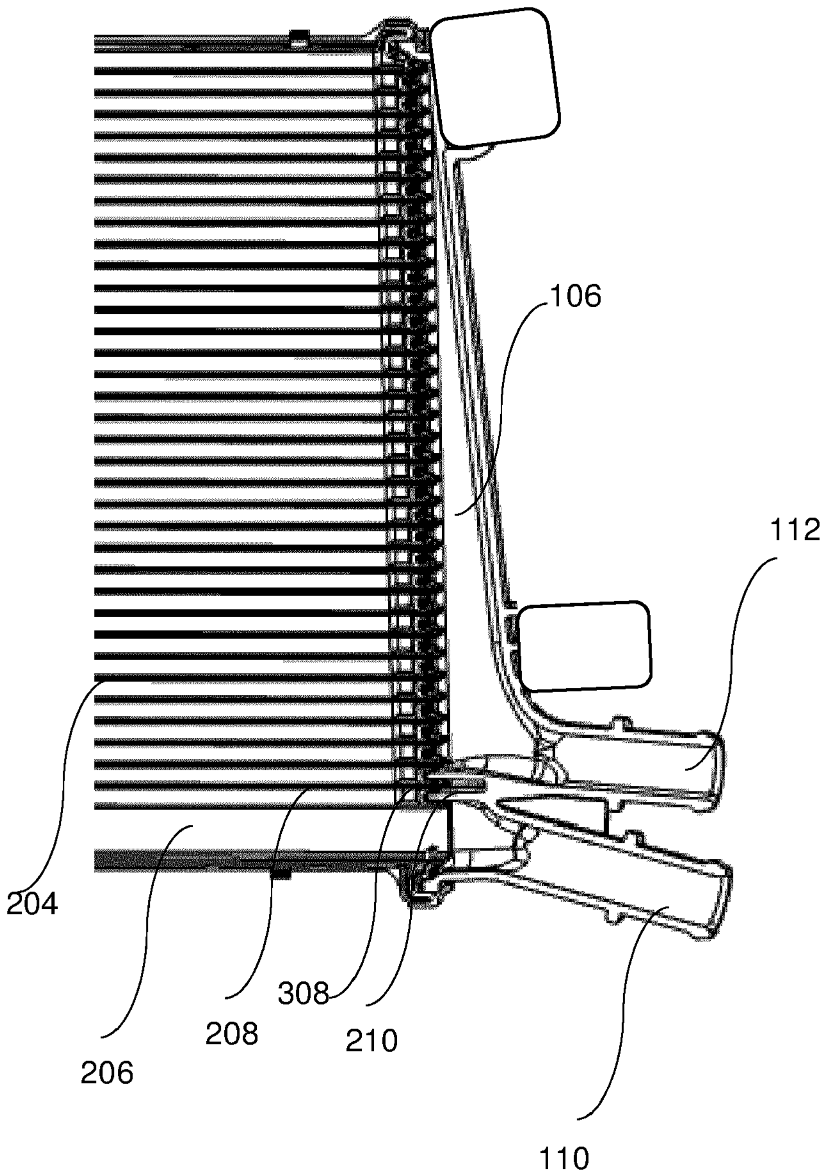

FIG.7

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EUROPEAN SEARCH REPORT

Application Number
EP 20 46 1548

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	US 2017/328637 A1 (PAROLA ANDREA [IT]) 16 November 2017 (2017-11-16) * paragraphs [0019] - [0035]; figures 1, 2 * -----	1-15	INV. F28D1/053 F28D21/00 F28F9/02 F28F9/00
X	WO 2014/197960 A1 (VALEO SISTEMAS AUTOMOTIVOS [BR]) 18 December 2014 (2014-12-18) * paragraphs [0025] - [0029], [0036], [0037]; figures 1, 2, 6 * -----	1-15	
A	US 2019/063841 A1 (VALLEE NICOLAS [FR] ET AL) 28 February 2019 (2019-02-28) * the whole document * -----	1-15	
A	EP 3 361 204 A1 (RADIADORES ORDONEZ S A [ES]) 15 August 2018 (2018-08-15) * paragraphs [0025] - [0047]; figures 4b, 5, 6b, 7b, 8b * -----	1-15	
A	GB 1 479 093 A (BARRY WEHMILLER CO) 6 July 1977 (1977-07-06) * the whole document * -----	1-15	TECHNICAL FIELDS SEARCHED (IPC): F28D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	23 December 2020	Axters, Michael

CATEGORY OF CITED DOCUMENTS

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2017328637 A1	16-11-2017	NONE	
WO 2014197960 A1	18-12-2014	BR 102013014855 A2	28-07-2015
		CN 105473972 A	06-04-2016
		EP 3008416 A1	20-04-2016
		ES 2668929 T3	23-05-2018
		JP 2016521842 A	25-07-2016
		KR 20160113090 A	28-09-2016
		PL 3008416 T3	28-09-2018
		US 2016131430 A1	12-05-2016
		WO 2014197960 A1	18-12-2014
US 2019063841 A1	28-02-2019	EP 3384224 A1	10-10-2018
		FR 3044396 A1	02-06-2017
		US 2019063841 A1	28-02-2019
		WO 2017093340 A1	08-06-2017
EP 3361204 A1	15-08-2018	EP 3361204 A1	15-08-2018
		ES 2678468 A1	13-08-2018
		ES 2743041 T3	18-02-2020
GB 1479093 A	06-07-1977	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82