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(71) Applicant: **VALEO SYSTEMES THERMIQUES**
78320 Le Mesnil Saint-Denis (FR)

(72) Inventors:
- **GURBA, Maciej**
  32 050 Skawina (PL)
- **STRAMECKI, Tomasz**
  32 050 Skawina (PL)
- **MADRY, Krystian**
  32 050 Skawina (PL)
- **WRONA, Mateusz**
  32 050 Skawina (PL)
- **JAWORSKA, Katarzyna**
  32 050 Skawina (PL)
- **RUSEK, Filip**
  32 050 Skawina (PL)

(74) Representative: **Valeo Systèmes Thermiques**
Service Propriété Intellectuelle
8, rue Louis Lormand
La Verrière
78320 Le Mesnil Saint Denis (FR)

(54) A PLATE TYPE HEAT EXCHANGER

(57) A heat exchanger (100) includes alternately staked plates (10) and 20), first inlet and outlet (12) and (14), a second inlet and outlet (22) and (24). Each plate (10, 20) configures flow passages on opposite sides thereof. The plates (10, 20) are configured with a corresponding openings (10a, 20a) to define corresponding distribution and collection columns (40a, 50a) and (40b, 50b). The first inlet and outlet (12) and (14) and the second inlet and outlet (22) and (24) are in fluid communication with the corresponding fluid flow passages. One opening (10a, 20a) of at least one of the plates (10, 20) is blocked and the plates (10) and (20) includes at least one additional hole (10d, 20d). The first inlet and outlet (12) and (14), the second inlet and outlet (22) and (24) are arranged to configure cross flow between fluids in the respective flow passages.

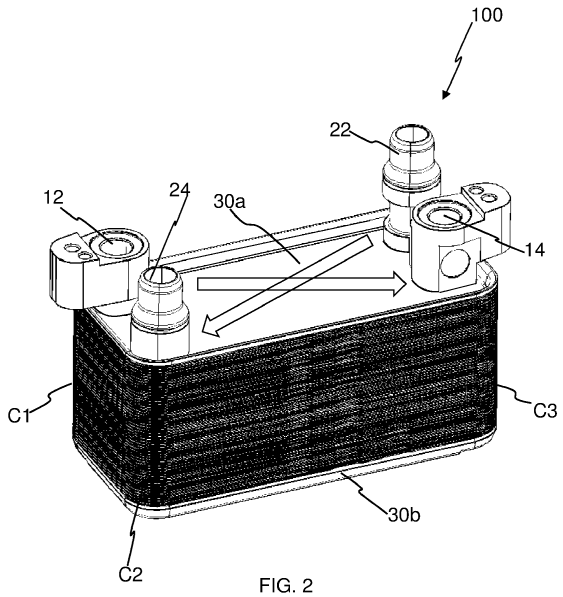

FIG. 2

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Description

FIELD OF INVENTION

[0001] The present invention relates to a plate type heat exchanger, particularly, the present invention relates to a plate type heat exchanger for a vehicle.

BACKGROUND

[0002] In some applications for automotive industry, the plate type heat exchangers are preferred because of their compact configuration. FIG. 1 illustrates a schematic representation of a conventional plate type heat exchanger 1 of a prior art WO2020251164A1. The plate type heat exchanger 1 generally includes first plates 2a, second plates 2b between end plates 2c. The conventional plate type heat exchanger 1 further includes a first inlet 3a, a first outlet 3b, a second inlet 3c and a second outlet 3d. The plates 2a and 2b are stacked alternately with respect to each other in overlapping manner between first and second closing plates 4a and 4b, respectively. The stack of first and the second plates 2a and 2b configure first fluid flow passages and second fluid flow passages on opposite sides of the individual first plate 2a and the second plate 2b for heat exchange between first fluid flowing through first fluid flow passages and second fluid flowing through the second fluid flow passages. Further, the first plates 2a and the second plates 2b are configured with a pair of first openings and a pair of second openings, respectively. The first openings define first distribution and collection columns. Similarly, the second openings define second distribution and collection columns, respectively. The first inlet 3a and the first outlet 3b are in fluid communication with the first fluid flow passages through the respective first distribution and collection columns for ingress and egress of the first fluid with respect to the first fluid flow passages. Similarly, the second inlet 3c and the second outlet 3d are in fluid communication with the second fluid flow passages through the respective second distribution and collection columns for ingress and egress of the first fluid with respect to the first fluid flow passages.

[0003] Generally, first fluid and second fluid flowing through the plate type heat exchanger follow u-flow through the plate type heat exchanger with an aim to achieve efficient heat exchange there between by increasing the flow path of the first and the second fluid. For configuring u-flow of first and second fluid, it is mandatory to place the first inlet 3a and the first outlet 3b on a first side and the second inlet 3c and the second outlet 3d on second side of the plate type heat exchanger 100 and opposite to the first side. Due to such configuration, there is pressure drop and the first fluid and the second fluid undergo heat exchange substantially later from the instance these fluids are introduced into the plate type heat exchanger, accordingly, the plate type heat exchanger exhibits limited thermal efficiency and performance. Further, the conventional plate type heat exchanger requires a comparatively larger flow areas for a given flow rate and at the given inlet and outlet temperatures. Furthermore, the conventional plate type heat exchangers are bulky and face packaging issues.

[0004] Accordingly, there is a need for a plate type heat exchanger that exhibits thermal efficiency and performance. Further, there is a need for a plate type heat exchanger that is compact and prevents packaging issues. Further, there is a need for a plate type heat exchanger that requires comparatively smaller flow areas for a given flow rate and at the given inlet and outlet temperatures compared to the conventional plate type heat exchangers.

SUMMARY

[0005] A plate type heat exchanger for heat exchange between a first fluid and a second fluid is disclosed in accordance with an embodiment of the present invention. The plate type heat exchanger may comprise a plurality of first plates and second plates, a first closing plate, a second closing plate, a first inlet, a first outlet, a second inlet and a second outlet. The first plates and the second plates are stacked alternately with respect to each other in overlapping manner between first and second closing plates respectively to configure first fluid flow passages and second fluid flow passages for first and second fluid on opposite sides of the individual first plate and the second plate. The first plates include a pair of first openings and the second plates include a pair of second openings. The first openings define a first distribution column and a first collection column. Similarly, the second openings define a second distribution column and a second collection column. The first inlet and the first outlet are in fluid communication with the first fluid flow passages through the respective first distribution and collection columns for ingress and egress of the first fluid with respect to the first fluid flow passages. The second inlet and the second outlet are in fluid communication with the second fluid flow passages through the respective second distribution and collection columns for ingress and egress of the second fluid with respect to the second fluid flow passages. The first inlet, the first outlet, the second inlet and the second outlet are arranged with respect to each other to configure cross flow between first fluid and the second fluid.

[0006] Generally, the first inlet and first outlet are disposed diagonally opposite to each other at first and third corners C1 and C3 of the plate type heat exchanger respectively, whereas the second inlet and the second outlet are disposed diagonally opposite to each other at second and fourth corners C2 and C4 of the plate type heat exchanger respectively.

[0007] Particularly, the first inlet and the second inlet are disposed on opposite sides with respect to longitudinal side of the plate type heat exchanger to configure counter cross flow between first fluid and second fluid

such that first fluid and second fluid while flowing through respective separate first and second flow passages approach each other from opposite directions and cross each other.

[0008] Alternatively, the first inlet and the second inlet are disposed on opposite sides with respect to lateral side of the plate type heat exchanger to configure concurrent cross flow between first fluid and second fluid.

[0009] Generally, the first inlet and the first outlet are arranged along a first plane "A" passing through centers of the first inlet and first outlet.

[0010] Further, the second inlet and the second inlet and second outlet are arranged along a second plane "B" that is angularly disposed with respect to the first plane "A" and passing through centers the second inlet and the second outlet.

[0011] In accordance with an embodiment, the first inlet and the first outlet are formed on at least one of the first closing plate and the second closing plate.

[0012] Alternatively, the first inlet and the first outlet are formed on opposite closing plates respectively.

[0013] Similarly, the second inlet and the second outlet are formed on either one of the first closing plate and the second closing plate.

[0014] More specifically, the second inlet and the second outlet are formed on opposite closing plates respectively.

[0015] Generally, the longitudinal side of the plate type heat exchanger is forming an angle with at least one of the first plane "A" and the second plane "B".

[0016] Particularly, at least one opening of at least one of the plates is blocked and the plates includes at least one additional hole to configure at least two first fluid passes through the heat exchanger.

[0017] Particularly, at least one of aligned and connected openings, aligned to the first inlet is blocked.

[0018] Further, at least one of aligned and connected openings, proximal to the first outlet is blocked.

[0019] Generally, the plate type heat exchanger includes two plates with blocked openings defining a first pass between the first closing plate and one of the plates with blocked opening, the second pass between the two plates with blocked openings and a third pass between the other of the plates with blocked opening and the second closing plate.

BRIEF DESCRIPTION

[0020] 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 an isometric view of a conventional plate type heat exchanger;

FIG. 2 illustrates an isometric view of a plate type heat exchanger in accordance with an embodiment of the present invention configuring counter cross flow between first and second fluid;

FIG. 3 illustrates an isometric view of a plate type heat exchanger in accordance with another embodiment of the present invention configuring concurrent cross flow between first and second fluid;

FIG. 4 illustrates a top view of the plate type heat exchanger of FIG. 2 or FIG. 3;

FIG. 5 illustrates a sectional view of the plate type heat exchanger along sectional plane X-X' of FIG. 4;

FIG. 6 illustrates a sectional view of the plate type heat exchanger along sectional plane Y-Y' of FIG. 4;

FIG. 7 illustrates an isometric view of the plate of the plate type heat exchanger of FIG. 2 or FIG. 3;

FIG. 8 illustrates an exploded view of the plate of the plate type heat exchanger of FIG. 2 or FIG. 3 depicting only two plates with at least one of the corresponding openings being blocked to configure three fluid flow passes;

FIG. 9 illustrates an isometric view of one of the two plates with blocked opening of FIG. 8; and

FIG. 10 illustrates an isometric view of another of the two plates with blocked opening of FIG. 8.

DETAILED DESCRIPTION

[0021] The present invention envisages a plate type heat exchanger that includes first plates, second plates, a first inlet, a first outlet, a second inlet and a second outlet. The first plates and the second plates are stacked alternately with respect to each other in overlapping manner between first and second closing plates respectively. The first and the second plates in conjunction with each other configure first fluid flow passages and second fluid flow passages on opposite sides of the individual first plate and the second plate for heat exchange between first fluid flowing through first fluid flow passages and second fluid flowing through the second fluid flow passages. The first plates and the second plates are configured with a pair of first openings and a pair of second openings respectively. The first openings define first distribution and collection columns. Similarly, the second openings define second distribution and collection columns. The first inlet and the first outlet are in fluid communication with the first fluid flow passages through the respective first distribution and collection columns for in-

gress and egress of the first fluid with respect to the first fluid flow passages. The second inlet and the second outlet are in fluid communication with the second fluid flow passages through the respective second distribution and collection columns for ingress and egress of the second fluid with respect to the second fluid flow passages. One of the openings formed on at least one of the plates is blocked and the plates includes at least one additional hole to configure at least two first fluid passes. The first inlet, the first outlet, the second inlet and the second outlet are arranged with respect to each other to configure cross flow, particularly, either one of counter cross flow and concurrent cross flow between first fluid and the second fluid. Although, the present invention is explained with example a water condenser used in vehicular environment, however, the present invention is applicable to any plate type heat exchanger, such as for example, water chiller used in vehicular and non-vehicular environment, where it is required to utilize advantages of counter cross flow or concurrent cross flow between first and second fluids undergoing heat exchange to render the plate type heat exchanger compact and energy efficient.

[0022] A plate type heat exchanger 100 is disclosed in accordance with an embodiment of the present invention. The plate type heat exchanger includes first plates 10, second plates 20, a first inlet 12, a first outlet 14, a second inlet 22 and a second outlet 24. The first inlet 12, the first outlet 14, the second inlet 22 and the second outlet 24 are so arranged with respect to each other to configure cross low, particularly, either one of counter cross flow and concurrent cross flow between first fluid and the second fluid flowing through the first fluid passages and the second fluid flow passages. The first inlet 12 and first outlet 14 are disposed diagonally opposite to each other at first and third corners C1 and C3 of the plate type heat exchanger 100 respectively. Similarly, the second inlet 22 and the second outlet 24 are disposed diagonally opposite to each other at second and fourth corners C2 and C4 of the plate type heat exchanger 100 respectively to configure counter cross flow between the first fluid and the second fluid.

[0023] The first plates 10 and the second plates 20 are stacked alternately with respect to each other in overlapping manner between first and second closing plates 30a and 30b respectively. Such arrangement of the first and second plates 10 and 20 configures first fluid flow passages and second fluid flow passages on opposite sides of the individual first plate 10 and the second plate 20 for heat exchange between first fluid flowing through first fluid flow passages and second fluid flowing through the second fluid flow passages. The first plates 10 and the second plates 20 are configured with a pair of first openings 10a and a pair of second openings 20a respectively. The first openings 10a define first distribution and collection columns 40a and 40b. Similarly, the second openings 20a define second distribution and collection columns 50a and 50b.

[0024] Referring to FIG. 5 and FIG. 6, the first inlet 12 and the first outlet 14 are in fluid communication with the first fluid flow passages through the respective first distribution and collection columns 40a and 40b for ingress and egress of the first fluid with respect to the first fluid flow passages. More specifically, the first pair of openings 10a on the first heat exchange plates 10 are aligned with respect to each other to define the distribution and collection columns 40a and 40b. At least one of the first pair of openings 10a are further aligned to or offset from the first inlet 12 and first outlet 14. The first plate 10 further includes an additional pair of openings 10c that are aligned with the second pair of openings 20a formed on the second plates 20 to configure the second distribution and collection columns 50a and 50b. Particularly, the additional pair of openings 10c formed on the first heat exchange plates 10a are aligned with the second pair of openings 20a formed on the second plates 20 and configuring the second distribution and collection columns 50a and 50b. The second inlet 22 and a second outlet 24 are in fluid communication with the second fluid flow passages through the respective second distribution and collection columns 50a and 50b for ingress and egress of the second fluid with respect to the second fluid flow passages. More specifically, the second pair of openings 20a on the second heat exchange plates 20 are aligned with respect to each other to define the distribution and collection columns 50a and 50b. At least one of the second pair of openings 20a are either aligned with or offset from the second inlet 22 and second outlet 24. The second heat exchange plate 20 further includes an additional pair of openings 20c that are aligned with the first pair of openings 10a formed on the first plates 10 to configure the first distribution and collection columns 40a and 40b. Particularly, the additional pair of openings 20c formed on the second heat exchange plates 20a are aligned to the first pair of openings 10a formed on the first plates 10 and configuring the first distribution and collection columns 40a and 40b.

[0025] Generally, one opening 10a, 20a of at least one of the plates 10, 20 is blocked and the plates 10, 20 includes at least one additional hole 10d, 20d to configure at least two first fluid passes between the lateral sides of the plate type heat exchanger 100. The one blocked opening 10a, 20a of the at least one of the plates 10, 20 facilitates in distribution of the fluid throughout the area of the plates 10, 20. By increasing the number of the fluid flow passes, thermal interaction between the first fluid flowing through the first flow passages and the second fluid flowing through the second fluid passages is prolonged, resulting in improved heat exchange between the first fluid and the second fluid. At least one of aligned and connected openings 10a, 20a aligned to the first inlet 12 is blocked. At least one of aligned and connected openings 10a, 20a proximal to the first outlet 14 is blocked. Generally, as referred to FIG. 5 and FIG.6, the plate type heat exchanger 100 includes two plates 10, 20 with blocked openings 10b, 20b defining a first pass between the first closing plate 30a and one of the plates

10, 20 with blocked opening 10b, 20b, the second pass between the two plates 10, 20 with blocked openings 10b, 20b and a third pass between the other of the plates 10, 20 with blocked opening 10b, 20b and the second closing plate 30b.

[0026] Further, the first inlet 12, the first outlet 14, the second inlet 22 and the second outlet 24 are arranged with respect to each other to configure cross flow, particularly, either one of counter cross flow and concurrent cross flow between first fluid and the second fluid.

[0027] In counter cross flow, the first and second heat exchange fluid flowing through separate fluid flow passages approach each other from opposite directions and cross each other. Particularly, the first and second heat exchange fluids ingress the plate type heat exchanger 100 through oppositely disposed first and second inlets 12 and 22, flow through the respective first and second fluid flow passages and egress through oppositely disposed first and second outlets 14 and 24 as illustrated in FIG. 2, accordingly, the first and second heat exchange fluids approach each other from opposite directions and diagonally cross each other while flowing through the separate fluid flow passages.

[0028] In case of concurrent cross flow, the first and second heat exchange fluid flowing through separate fluid flow passages flow in the same directions and cross each other. Particularly, the first and second heat exchange fluids ingress the plate type heat exchanger 100 through first and second inlets 12 and 22 on the same side, flow through the respective first and second fluid flow passages and egress through oppositely disposed first and second outlets 14 and 24 also on the same side but opposite to the first and second inlets 12 and 22, accordingly, the first and second heat exchange fluids flow in the same direction and diagonally cross each other while flowing through the separate fluid flow passages.

[0029] FIG. 2 illustrates an isometric view of the plate type heat exchanger 100 in accordance with an embodiment of the present invention configuring counter cross flow between first and second fluid. The first inlet 12 and the second inlet 22 are disposed on opposite sides with respect to one of the longitudinal sides of the plate type heat exchanger 100. The first outlet 14 and the second outlet 24 are disposed on opposite sides with respect to the other longitudinal side of the plate type heat exchanger 100, wherein the first inlet 12 and the first outlet 14 are disposed diagonally opposite to each other to configure counter cross flow between first fluid and second fluid. With such placement of the first inlet 12 and the second inlet 22, the first outlet 14 and the second outlet 24, the first fluid and second fluid approach each other from opposite directions and cross each other while flowing through respective separate first and second flow passages. FIG. 3 illustrates an isometric view of the plate type heat exchanger 100 in accordance with another embodiment of the present invention configuring concurrent cross flow between first and second fluid. The first inlet 12 and the second inlet 22 are disposed on opposite sides with respect to one of the lateral sides of the plate type heat exchanger 100. The first outlet 14 and the second outlet 24 are disposed on opposite sides with respect to the other lateral side of the plate type heat exchanger 100, wherein the first inlet 12 and the first outlet 14 and the second inlet 22 and the second outlet 24 are disposed diagonally opposite to each other to configure concurrent cross flow between first fluid and second fluid. The concurrent cross flow between first fluid and second fluid results in improved heat transfer between the first fluid and the second fluid flowing through the respective first and second fluid flow passages. More specifically, with the concurrent cross flow between first fluid and second fluid, the first fluid and the second fluid start interacting and start undergoing heat exchange just after entering the plate heat exchanger, thereby improving efficiency and performance of the plate type heat exchanger. The plate type heat exchanger 100 of such configuration is compact and prevents packaging issues. The plate type heat exchanger 100 of such configuration requires comparatively smaller flow areas for a given flow rate at the given inlet and outlet temperatures compared to the conventional plate type heat exchanger.

[0030] The first inlet 12 and the first outlet 14 are arranged either on a same plate 30a or different planes 30a and 30b. In accordance with one embodiment, the first inlet 12 and the first outlet 14 are configured on the first closing plate 30a. Alternatively, the first inlet 12 and the first outlet 14 are configured on the second closing plate 30b. In accordance with yet another embodiment, the first inlet 12 is formed on the first closing plate 30a and the first outlet 14 is formed on the second closing plate 30b.

[0031] Similarly, the second inlet 22 and the second outlet 24 are arranged either on a same plane or a different planes. In accordance with an embodiment of the present invention, the second inlet 22 and the second outlet 24 are configured on the first closing plate 30a. Alternatively, the second inlet 22 and the second outlet 24 are configured on the second closing plate 30b. In accordance with yet another embodiment, the second inlet 22 is formed on the first closing plate 30a and the second outlet 24 is formed on the second closing plate 30b.

[0032] Referring to the FIG. 4, a first plane "A" passing through centers of the first inlet 12 and first outlet 14 is angularly disposed with respect to and crosses a second plane B passing through the second inlet 22 and the second outlet 24. Further, the longitudinal side of the plate type heat exchanger 100 is forming an angle with respect to at least one of the first plane "A" and the second plane "B".

[0033] 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) for heat exchange between a first fluid and a second fluid, the heat exchanger (100) comprising:

   • a plurality of first plates (10) and second plates (20) stacked alternately with respect to each other in overlapping manner between first and second closing plates (30a) and (30b) and adapted to configure first fluid flow passages and second fluid flow passages for first and second fluid on opposite sides of the individual first plate (10) and the second plate (20), the first plates (10) comprising a pair of first openings (10a) and the second plates (20) comprising a pair of second openings (20a) wherein the first openings (10a) define a first distribution column (40a) and a first collection column (40b), and wherein the second openings (20a) define a second distribution column (50a) and a second collection column (50b),
   • a first inlet (12) and a first outlet (14) in fluid communication with the first fluid flow passages through the respective first distribution and collection columns (40a) and (40b) for ingress and egress of the first fluid with respect to the first fluid flow passages;
   • a second inlet (22) and a second outlet (24) in fluid communication with the second fluid flow passages through the respective second distribution and collection columns (50a) and (50b) for ingress and egress of the second fluid with respect to the second fluid flow passages;
   characterized in that the first inlet (12), the first outlet (14), the second inlet (22) and the second outlet (24) are arranged with respect to each other to configure cross flow between first fluid and the second fluid.

2. The heat exchanger (100) as claimed in the previous claim, wherein the first inlet (12) and first outlet (14) are disposed diagonally opposite to each other at first and third corners C1 and C3 of the plate type heat exchanger (100) respectively, whereas the second inlet (22) and the second outlet (24) are disposed diagonally opposite to each other at second and fourth corners C2 and C4 of the plate type heat exchanger (100) respectively.

3. The heat exchanger (100) as claimed in any of the preceding claims, wherein the first inlet (12) and the second inlet (22) are disposed on opposite sides with respect to one of the longitudinal sides of the plate type heat exchanger to configure counter cross flow between first fluid and second fluid such that first fluid and second fluid while flowing through respective separate first and second flow passages approach each other from opposite directions and cross each other.

4. The heat exchanger (100) as claimed in any of the preceding claims, wherein the first inlet (12) and the second inlet (22) are disposed on opposite sides with respect to one of the lateral sides of the plate type heat exchanger to configure concurrent cross flow between first fluid and second fluid.

5. The heat exchanger (100) as claimed in claim 3 or claim 4, wherein the first inlet (12) and the first outlet (14) are arranged along a first plane A passing through centers of the first inlet (12) and first outlet (14).

6. The heat exchanger (100) as claimed in any of the previous claim, wherein the second inlet (22) and the second outlet (24) are arranged along a second plane B angularly disposed with respect to the first plane A and passing through centers of the second inlet (22) and the second outlet (24).

7. The heat exchanger (100) as claimed in the previous claim, wherein the first inlet (12) and the first outlet (14) are formed on at least one of the first closing plate (30a) and the second closing plate (30b).

8. The heat exchanger (100) as claimed in the claim 5, wherein the first inlet (12) and the first outlet (14) are formed on opposite closing plates (30a) and (30b) respectively.

9. The heat exchanger (100) as claimed in the claim 6, wherein the second inlet (22) and the second outlet (24) are formed on at least one of the first closing plate (30a) and the second closing plate (30b).

10. The heat exchanger (100) as claimed in in the claim 6, wherein the second inlet (22) and the second outlet (24) are formed on opposite closing plates (30a) and (30b) respectively.

11. The heat exchanger (100) as claimed in claim 5 or 6, wherein the longitudinal side of the plate type heat exchanger (100) is forming an angle with respect to at least one of the first plane A and the second plane B.

12. The heat exchanger (100) as claimed in any of the preceding claims, wherein at least one opening (10a, 20a) formed on at least one of the plates (10, 20) is blocked and the plates (10, 20) comprise at least one additional hole (10d, 20d) to configure at least two first fluid passes through the heat exchanger (100).

13. The heat exchanger (100) as claimed in any of the preceding claims, wherein at least one of aligned

and connected openings (10a, 20a) aligned to the first inlet (12) is blocked.

14. The heat exchanger (100) as claimed in any of the preceding claims, wherein at least one of aligned and connected openings (10a, 20a) proximal to the first outlet (14) is blocked.

15. The heat exchanger (100) as claimed in any of the preceding claims, comprises two plates (10, 20) with blocked openings (10b, 20b) defining a first pass between the first closing plate (30a) and one of the plates (10, 20) with blocked opening (10b, 20b) , the second pass between the two plates (10, 20) with blocked openings (10b, 20b) and a third pass between the other of the plates (10, 20) with blocked opening (10b, 20b) and the second closing plate (30b).

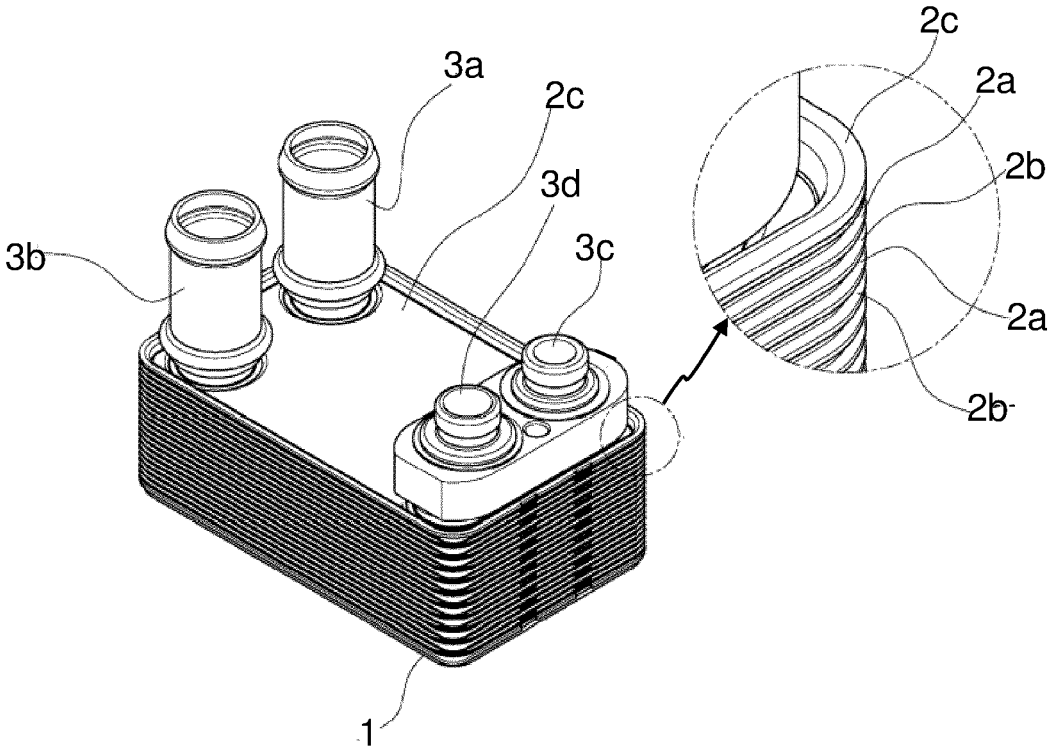

FIG. 1

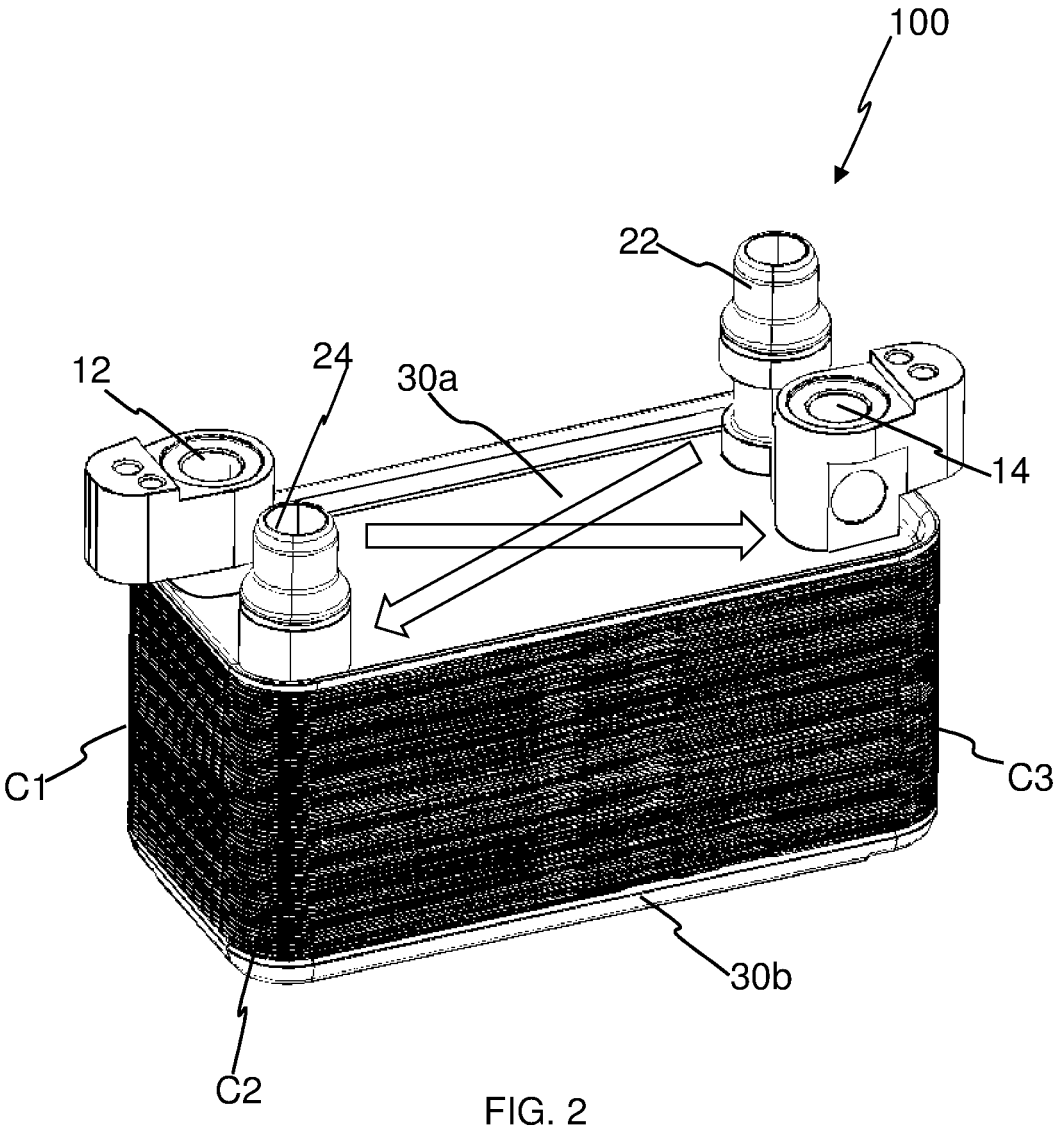

FIG. 2

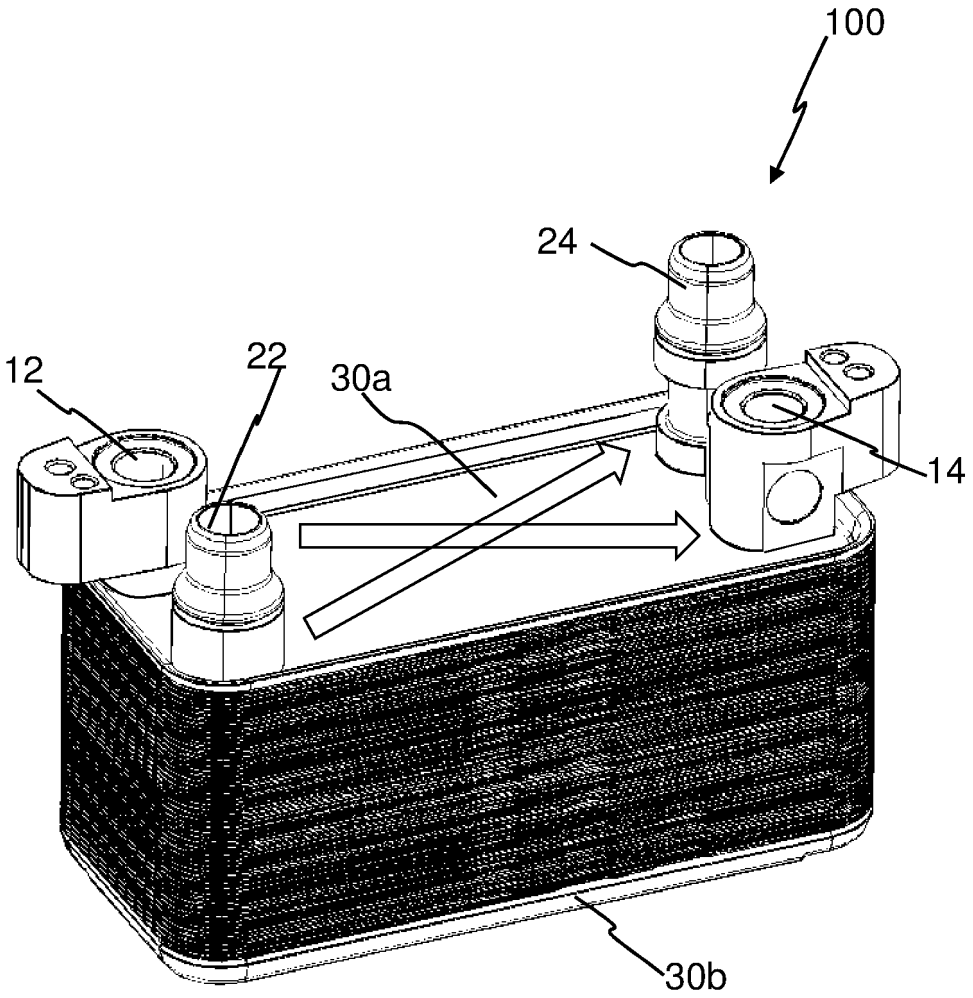

FIG. 3

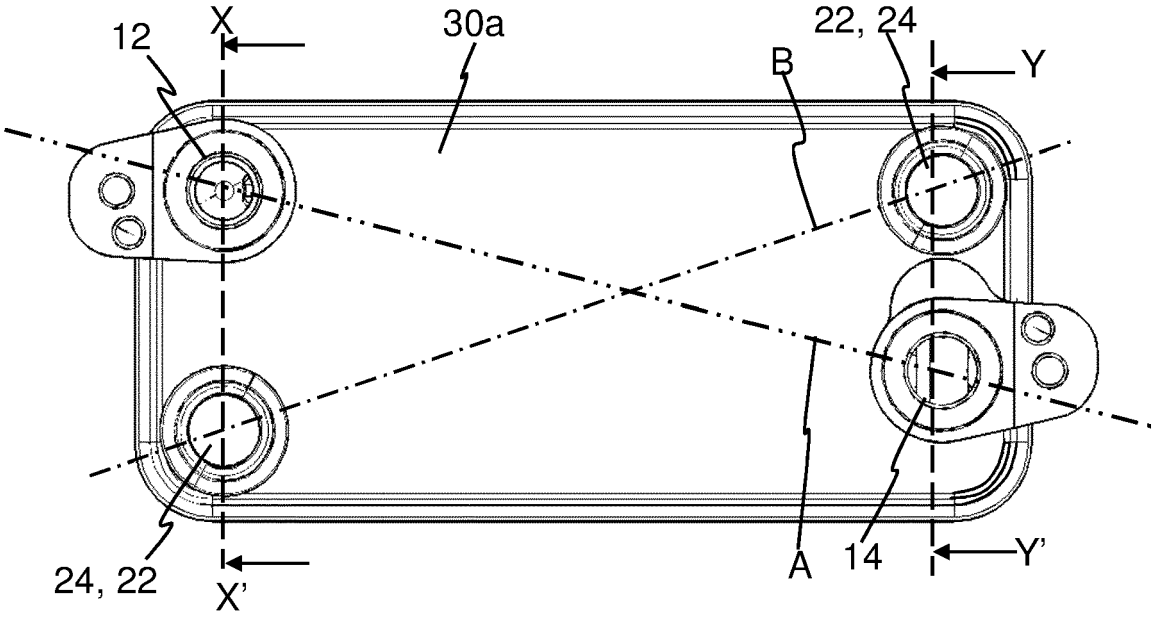

FIG. 4

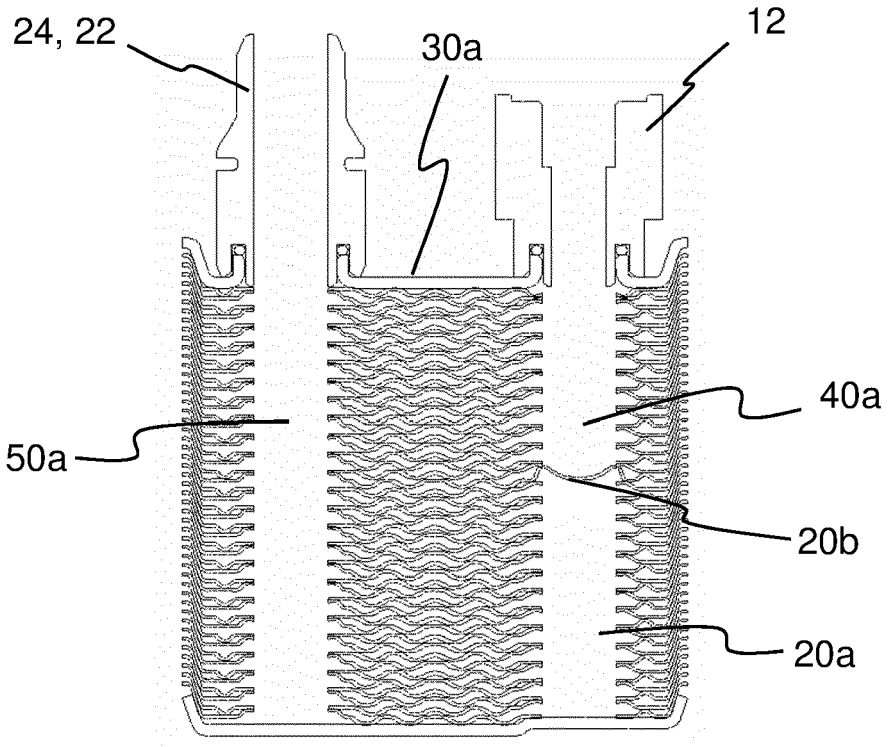

FIG. 5

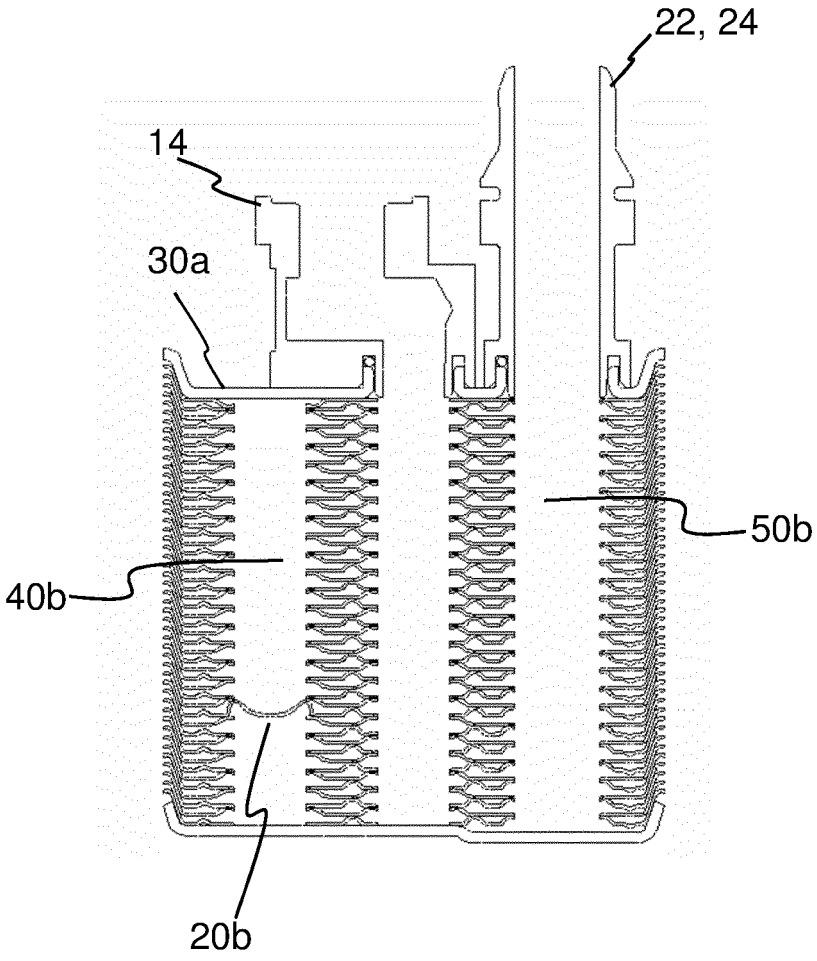

FIG. 6

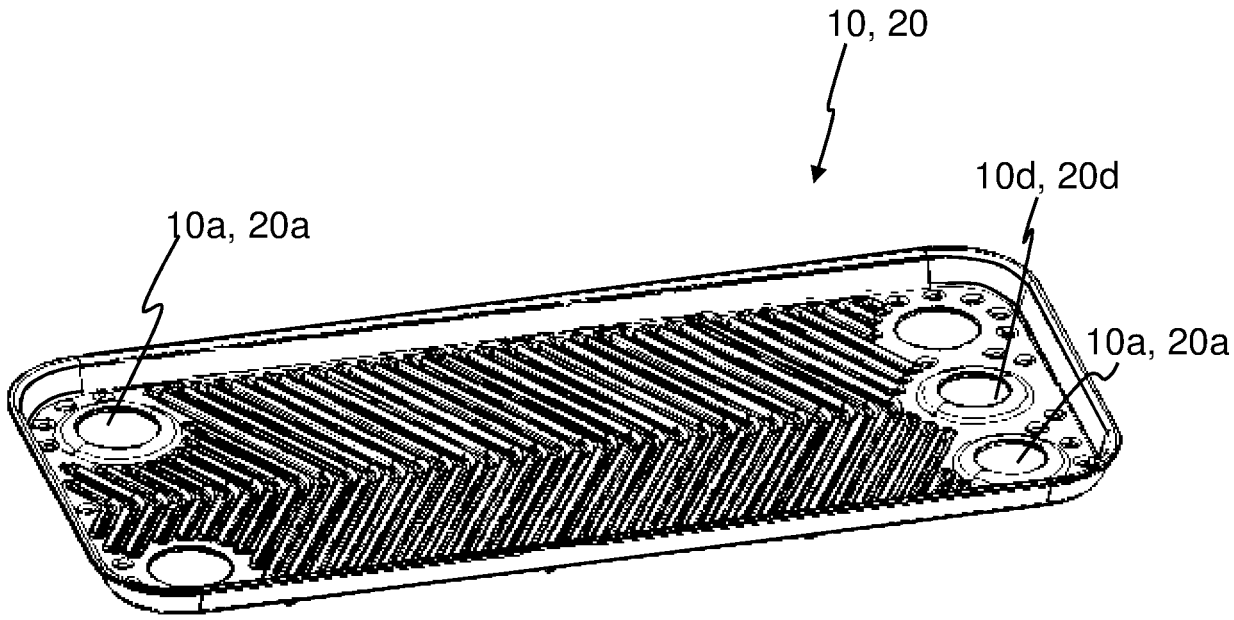

FIG. 7

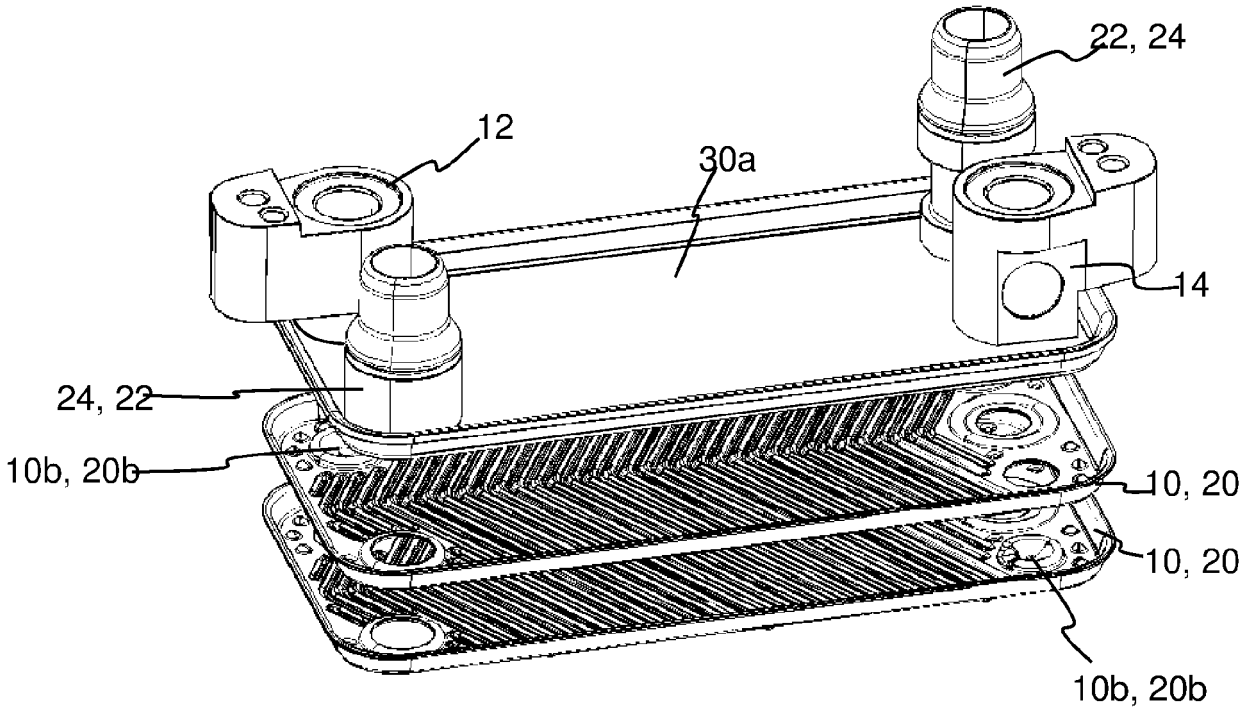

FIG. 8

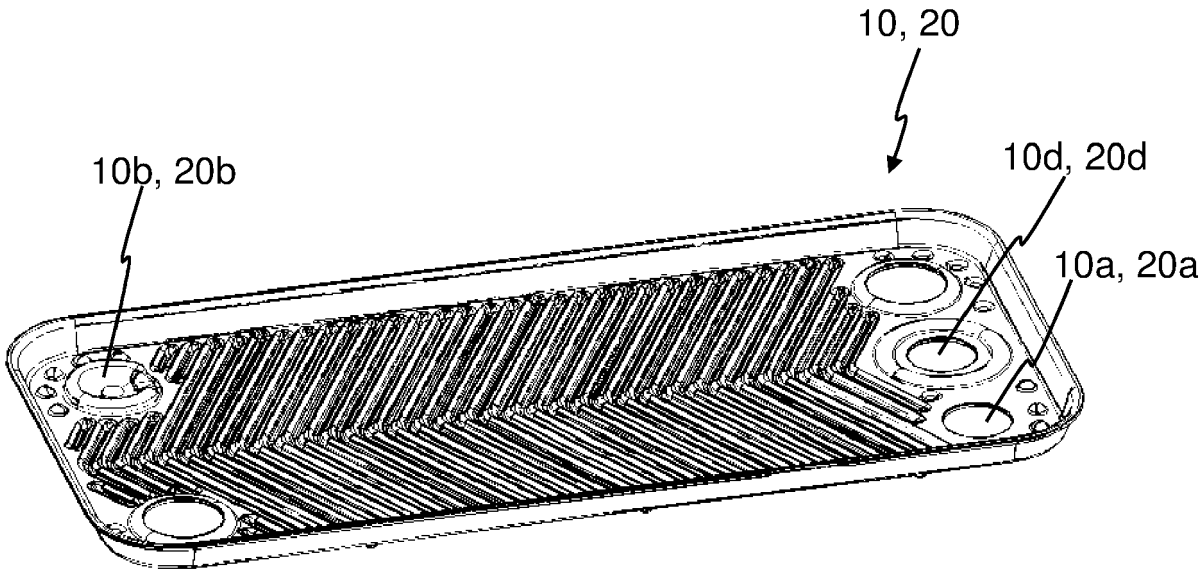

FIG. 9

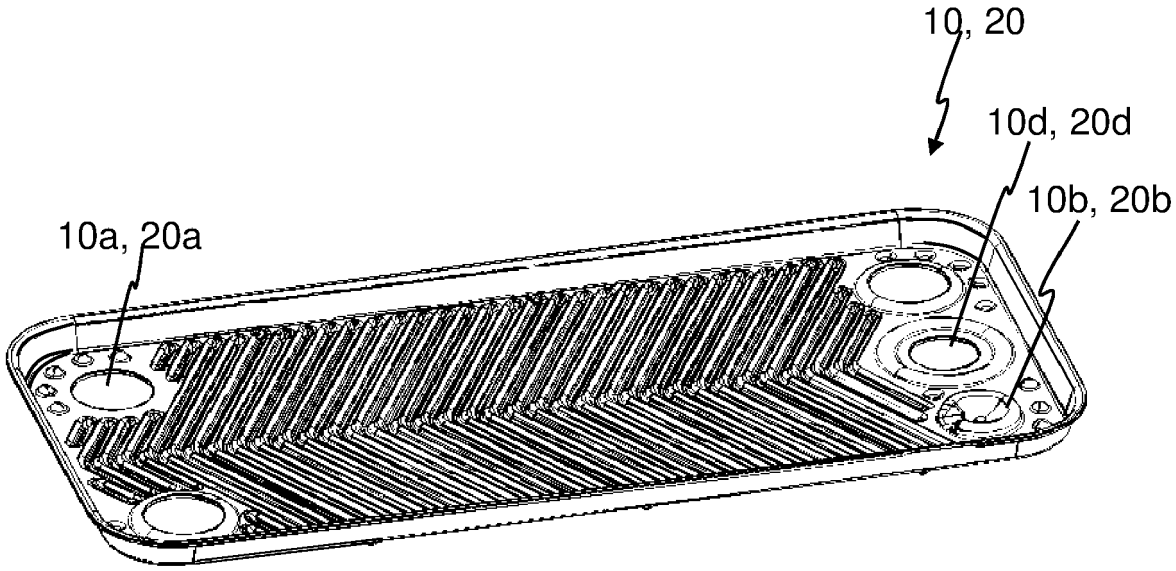

FIG. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 23 16 8168

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 6 918 434 B2 (MODINE MFG CO [US]) 19 July 2005 (2005-07-19) * figure 1 *	1-11	INV. F28D9/005 F28F3/46 F28F9/02
X	FR 3 124 588 A1 (VALEO SYSTEMES THERMIQUES [FR]) 30 December 2022 (2022-12-30) * figures 1,2,5 *	1-15	

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	8 September 2023	Martínez Rico, Celia

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 16 8168

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08-09-2023

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		DE 10243522 A1	01-04-2004
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		US 2004112579 A1	17-06-2004
FR 3124588 A1	30-12-2022	FR 3124588 A1	30-12-2022
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- WO 2020251164 A1 **[0002]**