(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 872 434 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
01.09.2021 Bulletin 2021/35

(51) Int Cl.:
F28D 9/00 *(2006.01)* ***F28F 3/04*** *(2006.01)*

(21) Application number: **20461515.7**

(22) Date of filing: **28.02.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Valeo Autosystemy SP. Z.O.O.**
32-050 Skawina (PL)

(72) Inventors:
- **SZOSTEK, Dawid**
  32 050 SKAWINA (PL)
- **BELZOWSKI, Michal**
  32 050 SKAWINA (PL)

(74) Representative: **Bialkowski, Adam**
Valeo Systèmes Thermiques
Industrial Property Department
ZA L'Agiot
8 rue Louis Lormand
CS 80517 LA VERRIERE
78322 Le Mesnil Saint Denis Cedex (FR)

(54) A PLATE ASSEMBLY

(57) A plate assembly for a heat exchanger, comprising a first plate connected by brazing to an end plate on one side and to a second plate on the other side, thereby providing a conduit between the first plate and the second plate for a heat exchange fluid, wherein the second plate comprises an opening, wherein the first plate comprises a reinforcement element comprising a raised portion in contact with a part of edge area of the opening, wherein the reinforcement element is configured to enable flow of a heat exchange fluid through the opening and between the first plate and the second plate.

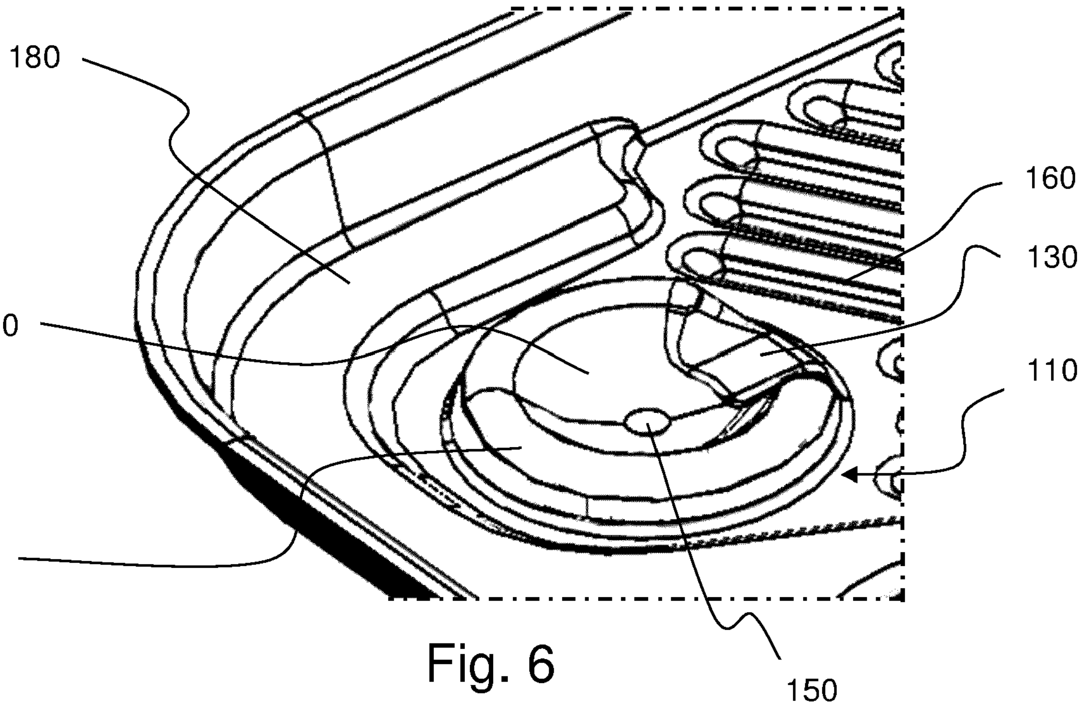

Fig. 6

EP 3 872 434 A1

Description

FIELD OF THE INVENTION

[0001] The invention relates to a plate assembly for a plate heat exchanger. In particular, it relates to plate assembly for a plate heat exchanger for motor vehicle air-conditioning or heat source cooling circuits.

BACKGROUND OF THE INVENTION

[0002] The present invention concerns a stacked-plate heat exchanger, in particular a condenser allowing heat to be exchanged between a refrigerant and a coolant in the liquid phase.

[0003] In this field, heat exchangers comprising a heat exchange bundle comprising a series of plates stacked parallel to each other are known. The stack of plates forms heat exchange surfaces, between which a first heat exchange fluid, for example refrigerant, and a second heat exchange fluid, for example coolant, flow in alternate layers through fluid passage circuits. The stack of plates is therefore configured in such a way as to define two different circuits.

[0004] To this end, the invention proposes a heat exchanger of the type defined hereinabove, which comprises at least one pass of a heat exchange fluid. The term "pass" is to be understood to mean a group or sub-group of plates between which the fluid follows one and the same direction in one and the same sense. In plates of one and the same pass, the inlet and outlet orifices are situated, in particular, at two opposite edges of said plates. On moving on from one pass to another, the sense in which the fluid circulates is reversed. It is thus possible to lengthen the path of the fluid through the exchanger. By virtue of these features, the heat exchanger may exhibit improved performance.

[0005] The plates comprise communication passages to allow the first heat exchange fluid and the second heat exchange fluid to pass from one flow channel to the other. They form so called distribution channels. The openings may be provided alternately facing the communication passages so as to prevent fluids from mixing.

[0006] At least on one side, the plate heat exchanger may comprise a connection block mounted directly to the last plate (end plate) so as to enable connection to heat exchange fluid lines constituting a further part of the heat exchange circuit within the heat exchange system.

[0007] The plates may be equipped with turned-up peripheral edges, which are joined together in a sealed manner so as to delimit the first flow channels and the second flow channels.

[0008] One end plate is arranged at each of the ends of the stack of the plates forming the heat exchange core. As the plates of the stack have shapes which allow for forming channels for heat exchange fluid flow, and sometimes inducing turbulences as well, they are not flat. Consequently, the end plates, which are usually of thicker material and are generally flat, are connected to said plates only in selected connection points, with free space in-between. It is worth noting that it may be commercially viable to produce as low amount of plate types as possible. Consequently, the last plate of stack forming plates may still have an opening, even though it will not convey fluid through it - i.e. it will be sealed by an end plate.

[0009] In case of some plate heat exchanger cores, a typical failure is connected with area of a distribution channel, especially on the side without connection blocks. Pressure in distribution channel pushes the end plate to external side, where pressure is much lower, e. g. is equal to atmospheric pressure. The unsupported area of the end plate, i.e. an area, which is not connected to the next plate but which is facing the last opening of the distribution channel, is substantial and due to that, it starts to move up and down during changes to heat exchange fluid pressure. Consequently, fractures on last stack plate in area near to distribution channel may occur, as can be seen in Fig. 2 showing a prior art configuration with black line indicating a fracture location. The first plate 100 is connected to the end plate 300 on one side and to the second plate 200 on the other side, thereby providing a conduit between the first plate 100 and the second plate 200 for a heat exchange fluid. The fractures may occur on the raised portions, e.g. those serving as turbulators 160, which also serve as connection points between plates. Said fractures may lead to leaks between circuits, for example they may lead to movement of the oil from refrigerant circuit into coolant circuit.

SUMMARY OF THE INVENTION

[0010] The object of the invention is a plate assembly for a heat exchanger, comprising a first plate connected by brazing to an end plate on one side and to a second plate on the other side, thereby providing a conduit between the first plate and the second plate for a heat exchange fluid, wherein the second plate comprises an opening, wherein the first plate comprises a reinforcement element comprising a raised portion in contact with a part of edge area of the opening, wherein the reinforcement element is configured to enable flow of a heat exchange fluid through the opening and between the first plate and the second plate.

[0011] Preferably, the reinforcement element comprises at least one flow channel delimited by the raised portion.

[0012] Preferably, the raised portion is comprised of plurality of sections in contact with the second plate with a plurality of flow channels between them.

[0013] Preferably, the reinforcement element comprises a wall located within the outline of the opening.

[0014] Preferably, the wall is integral with the raised portion.

[0015] Preferably, the wall is rounded.

[0016] Preferably, the wall comprises a contact portion being in contact with the end plate 300.

[0017] Preferably, the contact portion is located centrally within the outline of the opening.

[0018] Preferably, the wall is rounded towards the second plate.

[0019] Preferably, the wall is rounded towards the end plate.

[0020] Preferably, the first plate comprises shaped turbulators configured to connect the first plate with the second plate by brazing.

[0021] Preferably, the end plate has bigger thickness than the first plate.

[0022] Preferably, the end plate has thickness equal to the first plate.

[0023] Preferably, the first plate comprises a raised corner contact area in the vicinity of the reinforcement element, which has a corner brazed connection with the second plate.

[0024] Preferably, the first plate further comprises a raised brazed connection with the second plate resulting from connecting the raised portion with the second plate, wherein the flow channel is located between the raised brazed connection and the corner brazed connection.

[0025] The object of the inventions is also a heat exchanger comprising a plate assembly as described above.

BRIEF DESCRITPTION OF DRAWINGS

[0026] Examples of the invention will be apparent from and described in detail with reference to the accompanying drawings, in which:

Fig. 1 shows a heat exchanger comprising an assembly according to the invention;

Fig. 2 shows a prior art plate assembly;

Fig. 3 shows a plate assembly according to the invention;

Fig. 4 shows an exploded assembly of Fig. 3 in closer view;

Fig. 5a shows a cross-sectional view A of Fig. 3 in a first example;

Fig. 5b shows a cross-sectional view B of Fig. 3 in the first example;

Fig. 6 shows the first plate of the assembly in the first example in closer view;

Fig. 7a shows a cross-sectional view A of Fig. 3 in a second example;

Fig. 7b shows a cross-sectional view B of Fig. 3 in the second example;

Fig. 8 shows an example of connection outlines between the first plate and the second plate;

Fig. 9 shows another example of connection outlines between the first plate and the second plate.

DETAILED DESCRIPTION OF EMBODIMENTS

[0027] Fig. 1 shows a heat exchanger 1 comprising an assembly according to the invention. It comprises a heat exchanger core comprising a plurality of shaped plates, connected at the edges to form separated conduits for heat exchange fluids. In order to enhance the pressure resistance of the heat exchanger, the plates are sandwiched between a lower plate and an upper end plate. The assembly according to the invention is preferably located on the bottom section of the core. It may also be located on the top section or on both simultaneously.

[0028] Fig. 2 shows a prior art plate assembly of prior art, with fracture between the plates indicated on the right-hand side. Said fracture occurs after repeated pressure changes in case of a first plate 100 plate having opening and a direct connection with an end plate 300 and a second plate 200 through shaped portions of the plates.

[0029] Fig. 3 shows a plate assembly according to the invention in an overview. A plurality of channels 4 is created so that conduits for the heat exchange fluids can be connected vertically with subsequent horizontally stacked plates to enable travel of the fluids in parallel or in counterflow, depending on heat exchanger configuration. In other words, they can form distribution channels.

[0030] Fig. 4 shows an exploded assembly 2 of Fig. 3 in closer view. The plate assembly 2 comprises a first plate 100, a second plate 200 and an end plate 300. Said plates are obtained, for example, by chasing, punching and/or molding a rolled metal sheet, for example aluminum and/or an aluminum alloy.

[0031] The first plate 100 is connected to the end plate 300 on one side and to the second plate 200 on the other side, thereby providing a conduit 3 between the first plate 100 and the second plate 200 for a heat exchange fluid. The connection is realized by brazing side walls 105, 205, 305 of the plates to each other after stacking the plates, thereby limiting the conduits for the fluid. The plates 100, 200 are further connected to each other through shaped portions, e.g. turbulators 160.

[0032] The plates 100, 200 comprise openings 4 for heat exchange fluid flow, with or without collars, so that after connecting the plates channels for heat exchange fluids will be created at selected places. In particular, the second plate comprises an opening 210.

[0033] The first plate 100 comprises a reinforcement element 110. The reinforcement element 110 is configured to enable flow of a heat exchange fluid through the opening 210 and between the second plate 200 and the first plate 100. At the same time, the reinforcement element 110 comprises a raised portion 120 in contact with a part of edge area 220 of the opening 210 of the second plate 200. For example, the contact is realized by brazing, therefore the first plate 100 and the second plate 200 are fixedly connected in this place.

[0034] Fig. 5a shows a cross-sectional view A of Fig. 3 in a first example, while Fig. 5b shows a cross-sectional view B. The reinforcement element 110 comprises at least one flow channel 130 delimited by the raised portion 120. This channel 130 communicates fluidly the conduit 3 and the opening 210. Turbulators 160, i.e. shaped deformations on the first plate 100, are used as further connection points between the first 100 and second 200 plates.

[0035] Fig. 6 shows the first plate 100 of the assembly in a first example in closer view. The reinforcement element 110 comprises a wall 140 with a contact portion 150 being in contact with the end plate 300, the wall 140 being located within the outline of the opening 210. In other words, the wall 140 is visible when viewed through the opening 210 along its central axis. Preferably, the wall 140 is integral to the raised portions 120, i.e. it is formed from the same sheet of material. Preferably, the wall 140 is rounded. This may improve flow of the fluid and/or simplify manufacturing process. It may be rounded towards the end plate 300 as shown. It may also be rounded towards the second plate 200, in which case there would be no contact point 150 between the wall 140 and the end plate 200.

[0036] Fig. 7a shows a cross-sectional view A of Fig. 3 in a second example, while Fig. 7b shows a cross-sectional view B of Fig. 3 thereof. In this example, the wall 140 is distanced from the end plate 300 so that there is no contact between them. In other words, within the outline of the opening 210, the first plate 100 is not in contact with the end plate 300. Although this example is inferior with respect to the example of Fig. 5a, 5b, it nevertheless still helps with delaying and/or preventing occurrence of the fractures on plate 100. The end plate 300 may have bigger thickness than the first plate 100.

[0037] Fig. 8 shows an example of connection outlines between the first plate 100 and the second plate 200. In particular, this figure presents schematically the brazed connections between the first plate 100 and the second plate 200 being a result of brazing their raised portions. A raised brazed connection 121 is an effect of brazing of the raised portions 120 to the second plate 200 in the vicinity of the opening 210. Contact portion 150 is the result of brazing of the wall 140 of the reinforcement element 110 to the end plate 300. The area free of connecting portions in the vicinity of the raised portion 120 is the flow channel 130. Opposite the flow channel 130 is the corner brazed connection 181, resulting of brazing the raised portion 180 of the first plate 100 in the corner area of the first plate 100. In other words, wherein the flow channel 130 is located between the raised brazed connection 121 and the corner brazed connection 181. In this manner, the brazing in the area of the raised portion 120 mitigates negative pressure influence in the area remote from the solid corner connection, while the advantageous placement of the flow channel 130 still enables flow of the fluid between the opening 210 and the conduit 3.

[0038] Fig. 9 shows another example of connection outlines between the first plate 100 and the second plate 200. The raised portion 120 is comprised of plurality of sections in contact with the second plate 200 with a plurality of flow channels 130 between them. The raise portions 120 enable brazing contacts 121 as shown in Fig. 9. In this manner, the flow of fluid is less restricted, while still maintaining good connection between the reinforcement element 110 and the second plate 200.

[0039] Assembly of the end plate with two last internal plates as described above creates a robust and rigid structure.

[0040] The invention allows to at least delay occurrence of fracture within the first plate.

[0041] The plate assembly according to the invention may be applied in water cooled condensers. Similar structure can be also used for any other plate type exchanger including plate type evaporators.

[0042] Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of drawings, the disclosure, and the appended claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to the advantage.

Claims

1. A plate assembly 2 for a heat exchanger 1, comprising a first plate 100 connected by brazing to an end plate 300 on one side and to a second plate 200 on the other side, thereby providing a conduit 3 between the first plate 100 and the second plate 200 for a heat exchange fluid, wherein the second plate 200 comprises an opening 210, wherein the first plate 100 comprises a reinforcement element 11 comprising a raised portion 120 in contact with a part of edge area 220 of the opening 210, wherein the reinforcement element 110 is configured to enable flow of a heat exchange fluid through the opening 210 and between the first plate 100 and the second plate 200.

2. A plate assembly 2 according to claim 1, wherein the reinforcement element 110 comprises at least one flow channel 130 delimited by the raised portion 120.

3. A plate assembly 2 according to any preceding claim, wherein the raised portion 120 is comprised of plurality of sections in contact with the second plate 200 with a plurality of flow channels 130 between them.

4. A plate assembly 2 according to any preceding claim,

wherein the reinforcement element 110 comprises a wall 140 located within the outline of the opening 210.

5. A plate assembly 2 according to claim 4, wherein the wall 140 is integral with the raised portion 120.

6. A plate assembly 2 according to any of claims 4 to 5, wherein the wall 140 is rounded.

7. A plate assembly 2 according to any of claims 4 to 6, wherein the wall 140 comprises a contact portion 150 being in contact with the end plate 300.

8. A plate assembly 2 according to claim 7, wherein the contact portion 150 is located centrally within the outline of the opening 210.

9. A plate assembly 2 according to claim 6, wherein the wall 140 is rounded towards the second plate 200.

10. A plate assembly 2 according to any of claims 6 to 8, wherein the wall 140 is rounded towards the end plate 300.

11. A plate assembly 2 according to any preceding claim, wherein the first plate 100 comprises shaped turbulators 160 configured to connect the first plate 100 with the second plate 200 by brazing.

12. A plate assembly 2 according to any preceding claim, wherein the end plate 300 has bigger thickness than the first plate 100.

13. A plate assembly 2 according to any of preceding claims, wherein the first plate 100 comprises a raised corner contact area 180 in the vicinity of the reinforcement element 110, which has a corner brazed connection 181 with the second plate 200.

14. A plate assembly 2 according to claim 13, wherein the first plate 100 further comprises a raised brazed connection 121 with the second plate 200 resulting from connecting the raised portion 120 with the second plate 200, wherein the flow channel 130 is located between the raised brazed connection 121 and the corner brazed connection 181.

15. A heat exchanger 1 comprising a plate assembly according to any of the preceding claims.

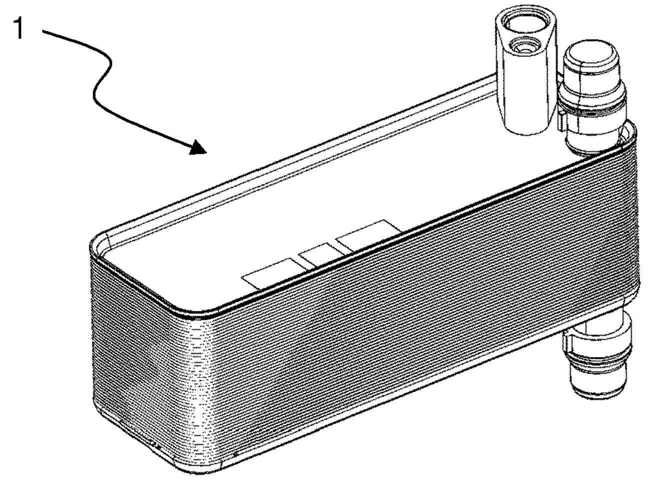

Fig. 1

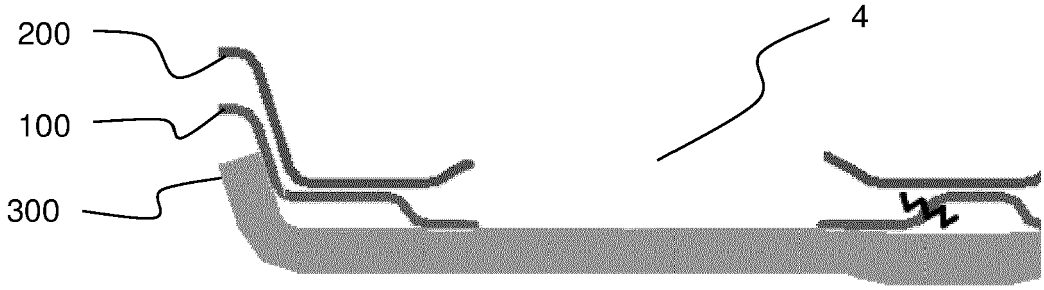

Fig. 2

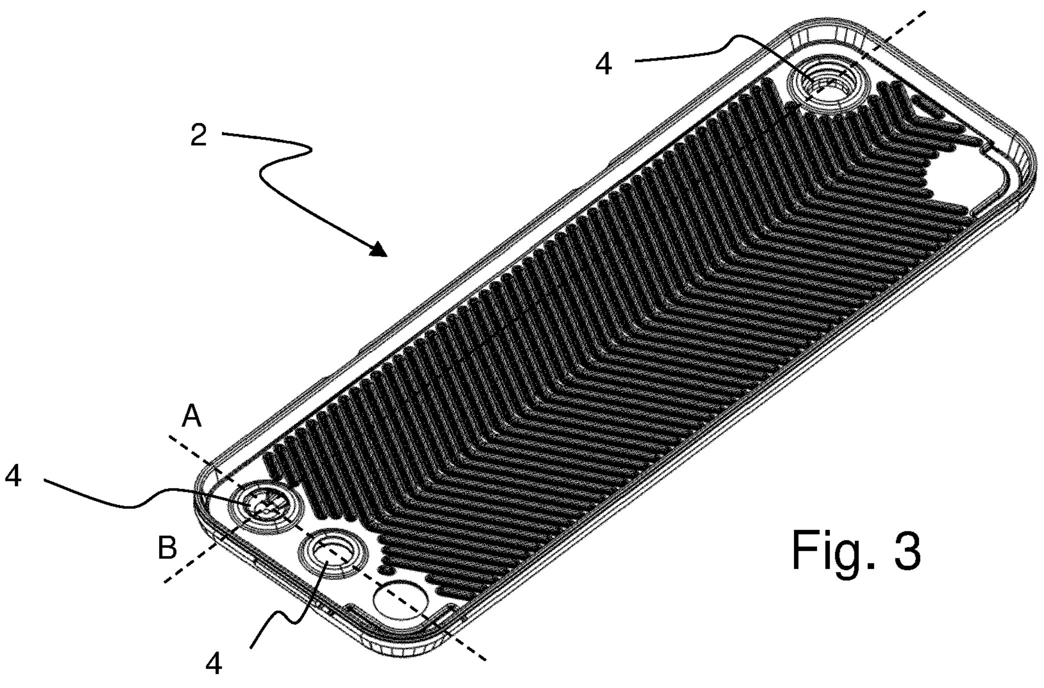

Fig. 3

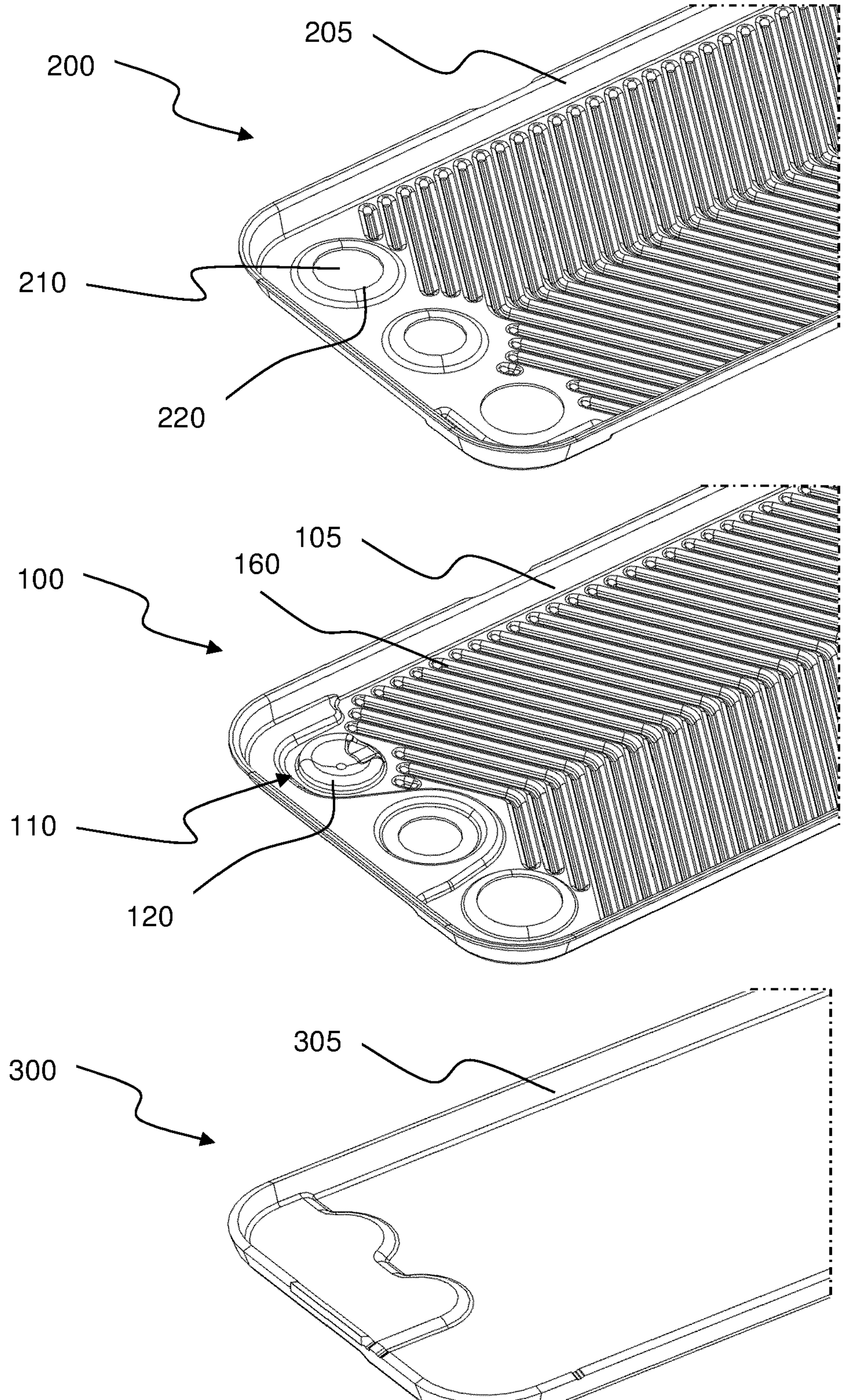

Fig. 4

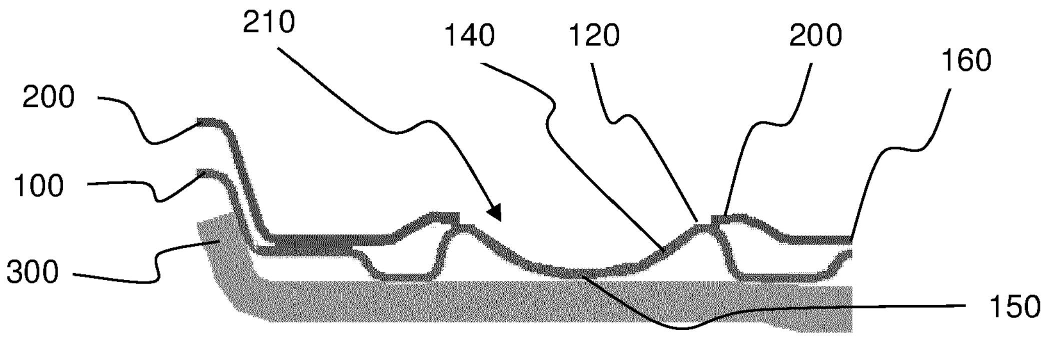

Fig. 5a

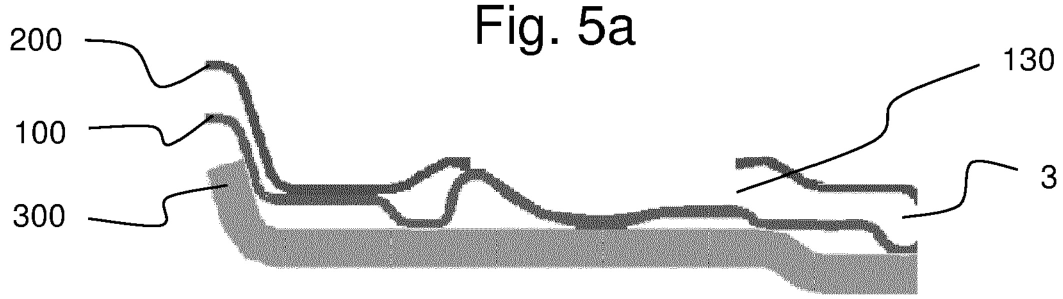

Fig. 5b

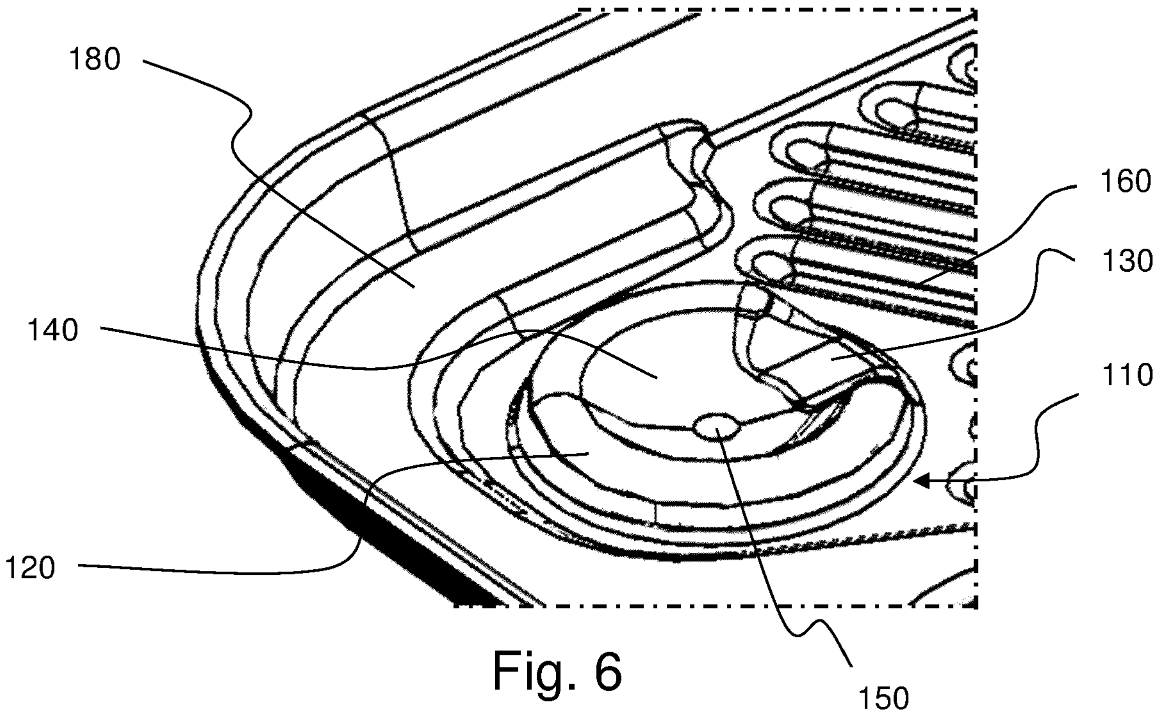

Fig. 6

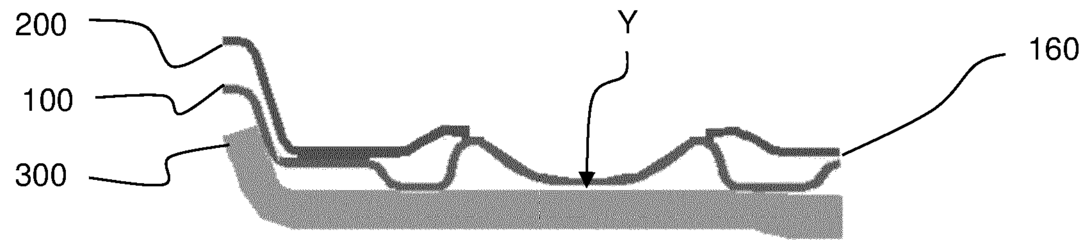

Fig. 7a

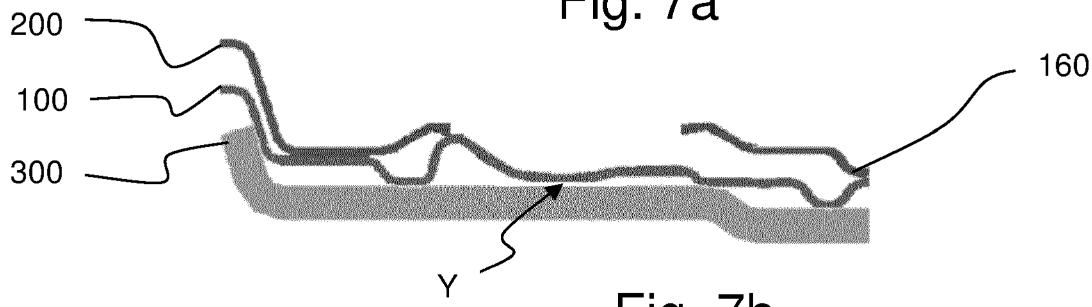

Fig. 7b

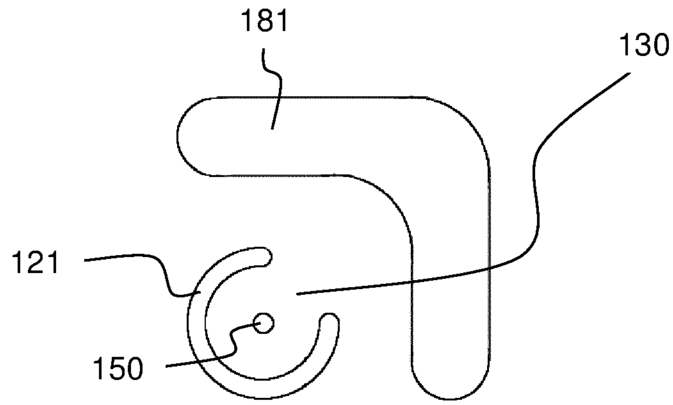

Fig. 8

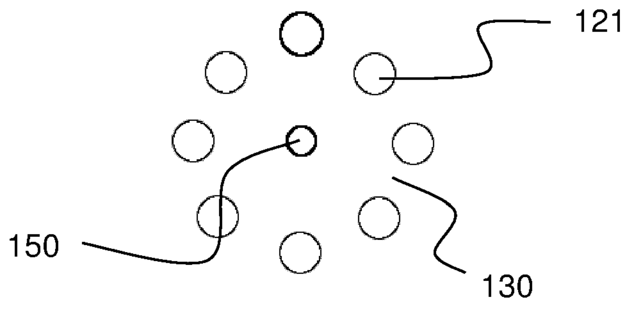

Fig. 9

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 20 46 1515

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	WO 2015/082350 A1 (SWEP INT AB [SE]) 11 June 2015 (2015-06-11) * figures 1-2 * -----	1-15	INV. F28D9/00 F28F3/04
X	EP 2 267 391 A2 (SWEP INT AB [SE]) 29 December 2010 (2010-12-29) * figure 3 * -----	1,15	
X	WO 88/09474 A1 (ALFA LAVAL THERMAL [SE]) 1 December 1988 (1988-12-01) * figures 3,4 * -----	1,15	
X	WO 2018/215425 A1 (SWEP INT AB [SE]) 29 November 2018 (2018-11-29) * figure 1c * -----	1,15	

TECHNICAL FIELDS SEARCHED (IPC)

F28D
F28F

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	17 July 2020	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
O : non-written disclosure
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
& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 46 1515

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

17-07-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2015082350 A1	11-06-2015	EP 3077752 A1	12-10-2016
		WO 2015082350 A1	11-06-2015
EP 2267391 A2	29-12-2010	EP 2267391 A2	29-12-2010
		PT 2267391 T	20-06-2018
		TR 201809058 T4	23-07-2018
WO 8809474 A1	01-12-1988	NONE	
WO 2018215425 A1	29-11-2018	CN 110709653 A	17-01-2020
		EP 3631322 A1	08-04-2020
		KR 20200010357 A	30-01-2020
		SE 1750634 A1	23-11-2018
		US 2020173695 A1	04-06-2020
		WO 2018215425 A1	29-11-2018

EPO FORM P0459

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