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(54) A HEAT EXCHANGER ASSEMBLY

(57) An embodiment of the invention herein provides a heat exchanger assembly comprising a heat exchanger and a protection grid. The heat exchanger comprises a plurality of tubes with open ends, a pair of manifolds comprising tanks and headers configured to receive the open ends of the tubes and headers configured to receive the open ends of the tubes. The protection grid mounted on the heat exchanger comprises a first pair of sides parallel to headers and a second pair of sides parallel to the tubes. The protection grid is fixed to the heat exchanger along second sides. The protection grid comprises at least one spacing element on at least one of the first side of the protection grid, which interacts with the heat exchanger to deform the protection grid to a curved profile so that at least a portion of the first edge is spaced away from the heat exchanger.

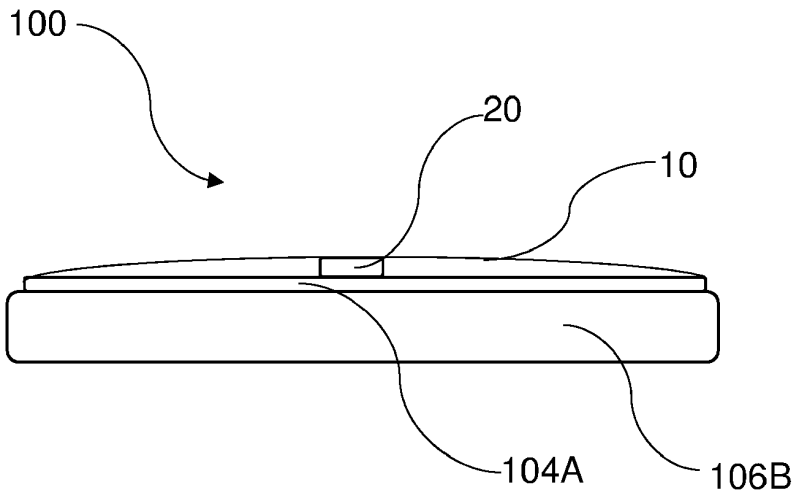

FIG. 6

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Description

[0001] The present invention relates to a heat exchanger assembly. In particular, the present invention relates to a heat exchanger assembly equipped with a protection grid.

[0002] A heat exchanger such as radiator is a part of an engine cooling system adapted to cool fluids such as coolants used for cooling vehicle engine. The radiator typically includes a radiator core formed of spaced parallel tubes, wherein each tube comprises a first end and a second end. The first end of the tubes are individually received in corresponding openings of a first header plate and the second end of the tubes are individually received in corresponding openings of a second header plate. The first header plate and the second header plate receive the respective first and second ends of the tubes. The first header plate in conjunction with a first tank define a first manifold for receiving and distributing a coolant to the tubes. Similarly, the second header plate in conjunction with the second tank define a second manifold. The coolant is passed through the engine to extract heat therefrom and in the process, the coolant is heated.

[0003] More specifically, the heated coolant is fed into the first manifold of the radiator where the first header plate distributes the heated coolant to the radiator tubes connecting the first header plate to the second header plate on an opposite end of the radiator. As the hot coolant passes through the radiator tubes to the opposite tank, the heated coolant transfers heat to tubes of the radiator core which transfers the heat to fins that are lodged between the radiator tubes. The fins release the heat to the ambient air that flows across the radiator core. As known, natural draft of air across the radiator core is utilized to save the power consumption in the vehicle and provide unhindered supply of ambient air. For achieving natural draft of air across the radiator core, the radiator core is disposed behind a front grill of the vehicle. The front grill may be located between a front hood and a front bumper of the vehicle such that the ram air impinges on the front grille of the vehicle as the vehicle moves in forward direction. Such strategic placement of the radiator core enables the ram air to impinge on and pass through the radiator core disposed behind the front grille, thereby creating natural draft of air across the radiator core as the vehicle moves ahead in the forward direction.

[0004] However, such high-speed ram air often carries articles such as stones which may reach and impact the front face of the radiator core causing abrasion, leakage, and ultimate failure of the critical elements such as tubes and fins of the engine cooling system of the vehicle. Generally, a protection grid is located on an air inlet side of the radiator core to prevent articles or the like from reaching the radiator core as the vehicle travels. The protection grid is mounted to the radiator core between the opposite first and second tanks of the radiator using side clips formed on lateral sides of the protection grid that engage with side-plates of the radiator. With such configuration, the protection grid is positioned at the air inlet side of the radiator core, with a relatively small gap between the grid and the radiator. Hence, when any article strikes the protection grid the impact of the article on the grid causes the grid to deflect. Since the gap between the grid and core is relatively small, even a slight deflection of the grid is sufficient to cause the grid to strike the radiator core. Particularly, the gap between the radiator core and the protection grid at the centre is less, as such, the protection grid fails to protect the radiator core against damage from articles striking the protection grid.

[0005] Accordingly, there is a need for an arrangement for tensioning the protection grid and pushing the protection grid away from the radiator core along the airflow direction to prevent any damage to the radiator core due to any article striking the protection grid resulting in protection grid striking the heat exchanger core.

[0006] Further, the invention allows to reduce the vibrations of the protection grid. Consequently, the undesired noise coming from vibrating grid is not heard in passenger cabin anymore.

[0007] 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.

[0008] In view of the foregoing, an embodiment of the invention herein provides a heat exchanger assembly for a vehicle. The heat exchanger assembly comprises at least one heat exchanger and a protection grid. The heat exchanger comprises a plurality of tubes with open ends stacked parallelly with respect to each other, a pair of manifolds comprising tanks and headers configured to receive the open ends of the tubes. The protection grid mounted on the heat exchanger comprises a first pair of sides and a second pair of sides. The first pair of sides is substantially parallel to the headers and the second pair of sides is substantially parallel to the tubes. The protection grid is fixed to the heat exchanger along the second sides. The protection grid comprises at least one spacing element formed on at least one of the first side of the protection grid. The spacing element is adapted to interact with the heat exchanger to deform the protection grid to a curved profile so that at least a portion of the first side is spaced away from the heat exchanger.

[0009] Advantageously, The protection grid further comprises one or more clip members adapted to fix the protection grid to corresponding sides of the heat exchanger.

[0010] Advantageously, the spacing element is arranged on a median portion of the first side of the protection grid so that the protection grid is distanced from the tubes along the direction parallel to the tubes.

[0011] Advantageously, the spacing element is ar-

ranged on the first side of the protection grid so that the protection grid is distanced from the tubes along the direction parallel to the tubes.

[0012] Advantageously, the spacing element is arranged on the first side of the protection grid, so the spacing element splits the first side into two uneven portions, both distanced from the tubes along the direction parallel to the tubes.

[0013] Advantageously, the spacing element is supported on the corresponding header of the heat exchanger, so that the first side pushes the spacing element towards the header.

[0014] Advantageously, the spacing element is supported on the corresponding tank of the heat exchanger, so that the first side pushes the spacing element towards the tank.

[0015] Advantageously, the protection grid comprises at least one spacing element on each of the first pair of sides. The at least one spacing element is arranged on the first pair of sides, which splits the first pair of sides into two uneven portion and distances the protection grid from the tubes along the direction parallel to the tubes. Advantageously, the spacing element is arranged on a median portion of each of the first pair of sides of the protection grid so that the protection grid is distanced from the tubes along the direction parallel to the tubes.

[0016] Advantageously, the spacing element is supported on the corresponding header of the heat exchanger, so that the respective first side pushes the spacing element towards the header.

[0017] Advantageously, the spacing element is supported on the corresponding tank of the heat exchanger, so that the respective first side pushes the spacing element towards the tank.

[0018] Advantageously, the protection grid comprises multiple spacing element uniformly spaced with respect to each other.

[0019] Advantageously, the protection grid comprises multiple spacing element irregularly spaced with respect to each other.

[0020] Advantageously, the protection grid is made of synthetic material.

[0021] Advantageously, the heat exchanger can be, for example, a radiator, a heater, a condenser, an intercooler, or an oil cooler.

[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 exemplarily illustrates a heat exchanger assembly, according to an embodiment of the present invention, also an enlarged view of one side of the heat exchanger is illustrated;

Fig. 2 exemplarily illustrates an exploded view of the heat exchanger assembly, according to an embodiment of the present invention;

Fig. 3 and Fig. 4 exemplarily illustrates a front and rear perspective view of a protection grid of Fig. 1, respectively;

Fig. 5 and Fig. 6 exemplarily illustrates a schematic representation depicting mid-cross sectional view and top view of the heat exchanger assembly of Fig. 1, respectively;

Fig. 7 and Fig. 8 exemplarily illustrates a schematic representation depicting mid-cross sectional view and top view of a heat exchanger assembly, according to another embodiment of the present invention, respectively;

Fig. 9 and Fig. 10 exemplarily illustrates a schematic representation depicting mid-cross sectional view and top view of the heat exchanger assembly, according to yet another embodiment of the present invention; and

Fig. 11 and Fig. 12 exemplarily illustrates a schematic representation depicting mid-cross sectional view and top view of the heat exchanger assembly, according to yet another embodiment of the present invention;

[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 assembly having a protection grid. The heat exchanger such as for example, radiator generally includes a protection grid for protecting radiator core against impact from stones or any article. The protection grid is generally mounted on a radiator using side clips formed on lateral sides of the protection grid that engage with side-plates of the radiator. With such configuration, the protection grid is disposed close to the radiator core, so that the stones striking the protection grid may cause the protection grid to deform and strike the radiator core and damage the radiator core. In particular, the gap between the radiator core and the protection grid at the center of the protection grid is small, so the protection grid fails to protect the radiator core against damage from articles striking the protection grid and causing the protection grid to strike the radiator core. Therefore, the present invention provides an arrangement for tensioning the protection grid and pushing the protection grid or urging the protection grid away from the radiator core along the airflow direction to prevent any damage to the radiator core due to any article striking the protection grid.

[0025] Referring to Fig. 1 and Fig. 2, the heat exchanger assembly 100 includes at least one heat exchanger 102 and a protection grid 10 mounted to the heat exchanger 102. The heat exchanger 102 includes a core 108, a first tank 106A and a second tank 106B. In accordance with one embodiment, the first tank 106A is an inlet tank and the second tank 106B is an outlet tank. The heat exchanger 102, can be a radiator, a condenser or any other heat exchanger. In the present embodiment, the heat exchanger 102 is a radiator. The heat exchanger core 108 may be formed as an assembly of closely spaced apart, parallel tubes (not shown in Figs). Each tube having a first end and a second end. The first ends are fluidly connected to a first header plate 104A and the second ends are fluidly connected to a second header plate 104B. Each of the header plates (104A, 104B) has openings there-through that allow fluid-tight connection with the ends of the tubes.

[0026] The header plates (104A, 104B) are supported in spaced apart and parallel to each other. The first tank 106A is connected to the first header plate 104A to configure first manifold which may be the inlet manifold. Similarly, the second tank 106B is connected to the second header plate 104B to configure outlet manifold. The first tank 106A is connected to the first header 104A so that the first ends of the tubes are in fluid communication with the interior of the first tank 106A. Similarly, the second tank 106B is connected to the second header plate 104B so that the second ends of the tubes are in fluid communication with the interior of the second tank 106B. A radiator side frame assembly is configured to support the periphery of the radiator core 108. Particularly, the radiator side frame assembly comprises a first side frame 110A and a second side frame 110B, which extend along the length of the first and second sides of the heat exchanger 102.

[0027] Still referring to Fig. 1 and Fig. 2, the protection grid 10, may be made of synthetic material or any other material that renders the protection grid flexible to be able to deform to a certain extent and at the same time renders the protection grid rigid to be able to withstand impact of the articles such as stones. The maximum deformation the protection grid can undergo is 5 to 15 mm. The grid 10 may comprise a substantial grid portion 12, a first pair of sides 14A and a second pair of sides 14B. The first pair of sides 14A and the second pair of sides 14B defines a continuous outer frame of the protection grid 10. The protection grid 10 may be mounted to the heat exchanger 102 such that the first pair of sides 14A are substantially parallel to the headers (104A, 104B) of the heat exchanger 102. The second pair of sides 14B are substantially parallel to the tubes of the heat exchanger core 108. The grid portion 12 may overlap the heat exchanger core 108 and shields the heat exchanger core 108. At least one of the first pair of side 14A may comprise at least one spacing element 20 and the second pair of side 14B may comprise one or more clip members 16. The protection grid 10 may be fixed to the heat exchanger 102 along second sides 14B via one or more clip members 16. Each of the clip members 16 may be adapted to lock with the respective side frame (110A, 110B) of the heat exchanger 102. The clip members 16 may either directly engage with the respective side frames 110A and 110B or engage with corresponding engagement elements formed on the respective side frame 110A and 110B. The spacing element 20 may be formed on at least one the first edge may interact with the heat exchanger 102 to deform the protection grid 10 to a curved profile, as shown in Fig. 6, so that at least a portion of the first side 14A is spaced away from the heat exchanger 102. In particular the heat exchanger core 108.

[0028] Referring to Fig. 3 and Fig. 4, the spacing element 20, herein after referred as spacer 20, may be located on a median portion of at one of the pair of first sides 14A. In one embodiment, the plurality of spacers 20 may be uniformly located on one of the first pair of sides 14A with respect to each other. In another embodiment, the plurality of spacers 20 may be irregularly disposed on at least one of the first pair of sides 14A with respect to each other. In yet another embodiment, the plurality of spacers 20 may be uniformly disposed with respect to one another on the frame of the protection grid 10. In yet another embodiment, the plurality of spacer 20 may be irregularly disposed with respect to each other on the frame of the protection grid 10.

[0029] In the illustrated example, the spacer 20 may comprise a base member 20A and a support member 20B extending vertically from the base member 20A. The base member 20A may comprise a first end 20C and a second end 20D. The first end 20C of the spacer 20 may be integrally formed to said first side 14A of the protection grid 10 and the second end 20D of the spacer 20 interacts the corresponding header (104A, 104B) of the heat exchanger 102. Particularly, the second end 20D of the spacer 20 may be configured to interact with the corresponding header (104A, 104B) of the heat exchanger 102 so that the protection grid 10 deforms to the curved profile and increase the gap between the protection grid 10 and the heat exchanger core 108. Instead of the spacer 20 integrally formed with the protection grid, the spacer 20 can be separately formed with respect to the protection grid.

[0030] Still referring to Fig. 3 and 4, the clip members 16 protrudes from the second pair of sides 14B of the protection grid 10, and are adapted to fix the protection grid 10 to the corresponding sides of the heat exchanger 102. Particularly, the clip members 16 are adapted to fix the protection grid 10 to the corresponding side frames (110A, 110B) of the heat exchanger 102. The clip member 16 may be integrally formed on and extends from the second pair of sides 14B of the protection grid 10. Instead of clip members integrally formed with the protection grid, the clip members can be separately formed with respect to the protection grid. In the illustrated example, the clip member 16 constitutes a first section 16A including a groove 16C that receives and secures to the side frame

(110A, 110B) and a second section 16B extending from the first section 16A. The second section 16B is a tab-like structure 16D extends outward at an angle from the first section 16B.

[0031] The clip members 16 disposed at the second pair of sides 14B firmly engages with the side frames (110A, 110B) of the heat exchanger 102 in such a way to firmly mount the protection grid 10 thereto. The spacer 20 formed on the first pair of sides 14A of the protection grid 10 may be adapted to interact with the heat exchanger 102 to deform the protection grid 10 to a curved profile so that at least a portion of the first side 14A is spaced away from the heat exchanger 102. With reference to Fig. 1 to Fig. 6, in the illustrated example, the spacer 20 may be arranged on a median portion of the first pair of sides 14A of the protection grid 10, so that the protection grid 10 is distanced from the tubes and the fins along the direction parallel to the tubes. The spacer 20 extends from the respective first side 14A of the protection grid 10 and interacts with the corresponding header (104A, 104B) of the heat exchanger 102, so that the spacer 10 pushes the first side 14A of the protection grid away from the header (104A, 104B). The spacer 20 is arranged on the first side 14A of the protection grid 10, so that the spacer 20 splits the first side 14A into two uneven portions. The both uneven portions are distanced from the tubes along the direction parallel to the tubes. Referring to Fig. 6, the spacer 20 being supported on the header (104A, 104B) pushes the first side 14A of the protection grid and as such the protection grid away from the header (104A, 104B) which tensions the grid 10 and serves to cause an outward bend or c -shaped profile to the protection grid 10.

[0032] Fig. 7 and Fig. 8 exemplarily illustrates heat exchanger assembly 200, according to another embodiment of the present invention, where the spacer 20 is adapted to extend from the respective first side 14A of the protection grid 10 and interacts with the corresponding tank (106A, 106B) of the heat exchanger 102, so that the spacer 20 pushes the first side 14A away from the tank (106A, 106B). The spacer 20 may be arranged on the first side 14A of the protection grid 10, so that the spacer 20 splits the first side 14A into two uneven portions, as shown in Fig. 8. The both uneven portions are distanced from the tubes and the fins along the direction parallel to the tubes. Fig. 9 and Fig. 10 exemplarily illustrate heat exchanger assembly 300, according to yet another embodiment of the invention, wherein the spacer 20 may extend in a plane perpendicular to the plane of the protection grid 10 and interact with the header (104A, 104B) of the heat exchanger 102. Fig. 11 and Fig. 12 exemplarily illustrate heat exchanger assembly 400, according to yet another embodiment of the present invention, where the spacer 20 extends in a plane perpendicular to the plane of the protection grid 10 and interacts with the tank (106A, 106B) of the heat exchanger 102. Regardless the configuration or plane of extension of the spacer 20 with respect to the protection grid 10, the spacer 20 may still be adapted to tension the grid 10 and cause an outward bend or c -shaped profile to the protection grid 10, so that protection grid 10 is moved away from the heat exchanger core 108 and deflects any projected articles at the heat exchanger core 108.

[0033] All the above-described embodiments are just to explain the present invention while more embodiments and combinations thereof might exist. Hence, the present invention should not be limited to the above-described embodiments alone.

Claims

1. A heat exchanger assembly (100) comprising:

- at least one heat exchanger (102) comprising a plurality of tubes with open ends stacked parallelly with respect to each other, a pair of manifolds comprising headers (104A, 104B) and tanks (106A, 106B) configured to receive the open ends of the tubes; and
- a protection grid (10) mounted on the heat exchanger (102), the protection grid (10) comprising a first pair of sides (14A), and a second pair of sides (14B), wherein the first pair of sides (14A) is substantially parallel to headers (104A, 104B) and the second pair of sides (14B) is substantially parallel to the tubes,

characterized in that,

the protection grid (10) is fixed to the heat exchanger (102) along second sides (14B), and the protection grid (10) comprises at least one spacing element (20) formed on at least one of the first side (14A) of the protection grid (10) and adapted to interact with the heat exchanger (102) to deform the protection grid (10) to a curved profile so that at least a portion of the first side (14A) is spaced away from the heat exchanger (102).

2. The heat exchanger assembly (100) as claimed in the previous claim, wherein the protection grid (10) further comprises one or more clip members (16) protruding from the second pair of sides (14B) of the protection grid (10), wherein the clip members (16) are adapted to fix the protection grid (10) to corresponding sides of the heat exchanger (102).

3. The heat exchanger assembly (100) as claimed in any of the preceding claims, wherein the spacing element (20) is arranged on a median portion of the first side (14A) of the protection grid (10), so that the protection grid (10) is distanced from the tubes along the direction parallel to the tubes.

4. The heat exchanger assembly (100) as claimed in any of the preceding claims, wherein the spacing

element (20) is arranged on the first side (14A) of the protection grid (10), so that the spacing element(20) splits the first side (14A) into two uneven portions, both distanced from the tubes along the direction parallel to the tubes.

5. The heat exchanger assembly (100) as claimed in any of the preceding claims, wherein the spacing element (20) is supported on the corresponding header (104A, 104B) of the heat exchanger (102), so that the spacing element (20) pushes the first side (14A) away from the header (104A, 104B).

6. The protection grid (10) as claimed in any of the preceding claims, wherein there are multiple spacing elements (20) uniformly spaced with respect to each other.

7. The heat exchanger assembly (100) as claimed in any of the preceding claims, wherein there are multiple spacing elements (20) irregularly spaced with respect to each other.

8. The heat exchanger assembly (100) as claimed in any of the preceding claims, wherein the spacing element (20) is supported on the corresponding tank (106A, 106B) of the heat exchanger (102), so that the spacing element (20) pushes the first side (14A) away from the tank (106A, 106B).

9. The protection grid (10) as claimed in any of the preceding claims, is made of synthetic material.

10. The protection grid (10) as claimed in any of the preceding claims, wherein the heat exchanger (102) is a radiator.

11. A heat exchanger (102) to which a protection grid (10) as claimed in any one of the preceding claims is mounted.

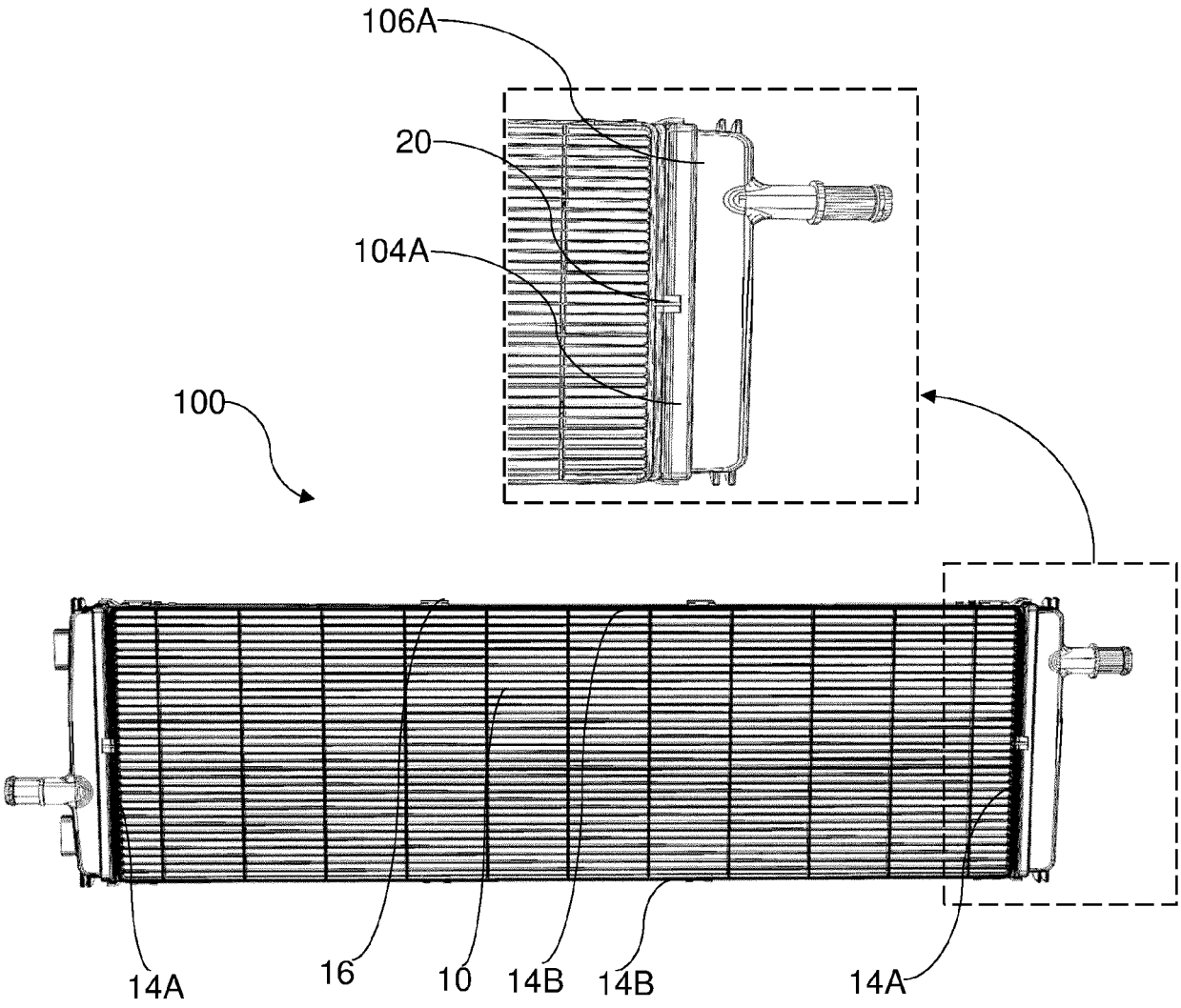

FIG. 1

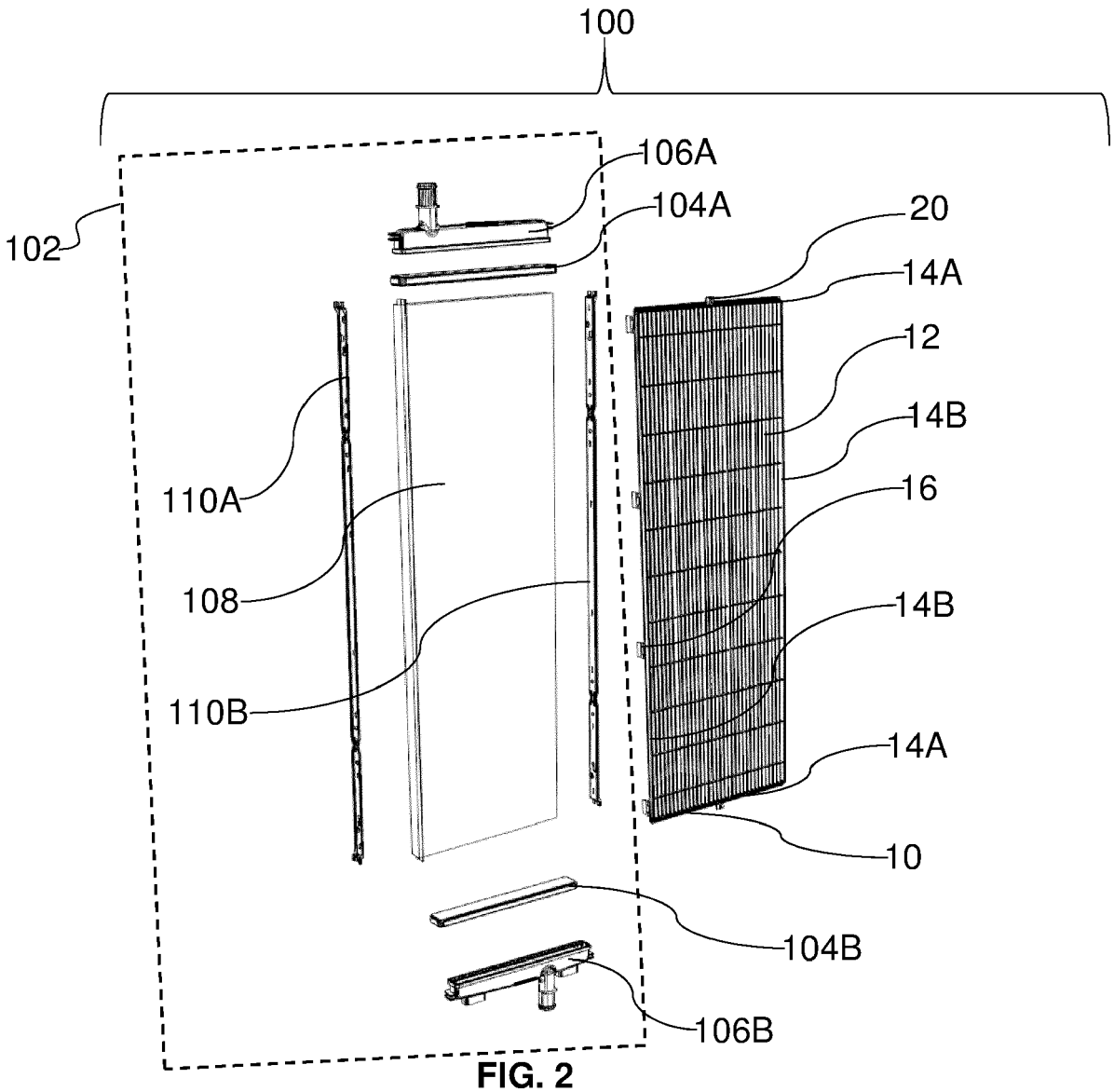
100
102
106A
104A
20
14A
12
14B
16
14B
14A
10
110A
108
110B
104B
106B

FIG. 2

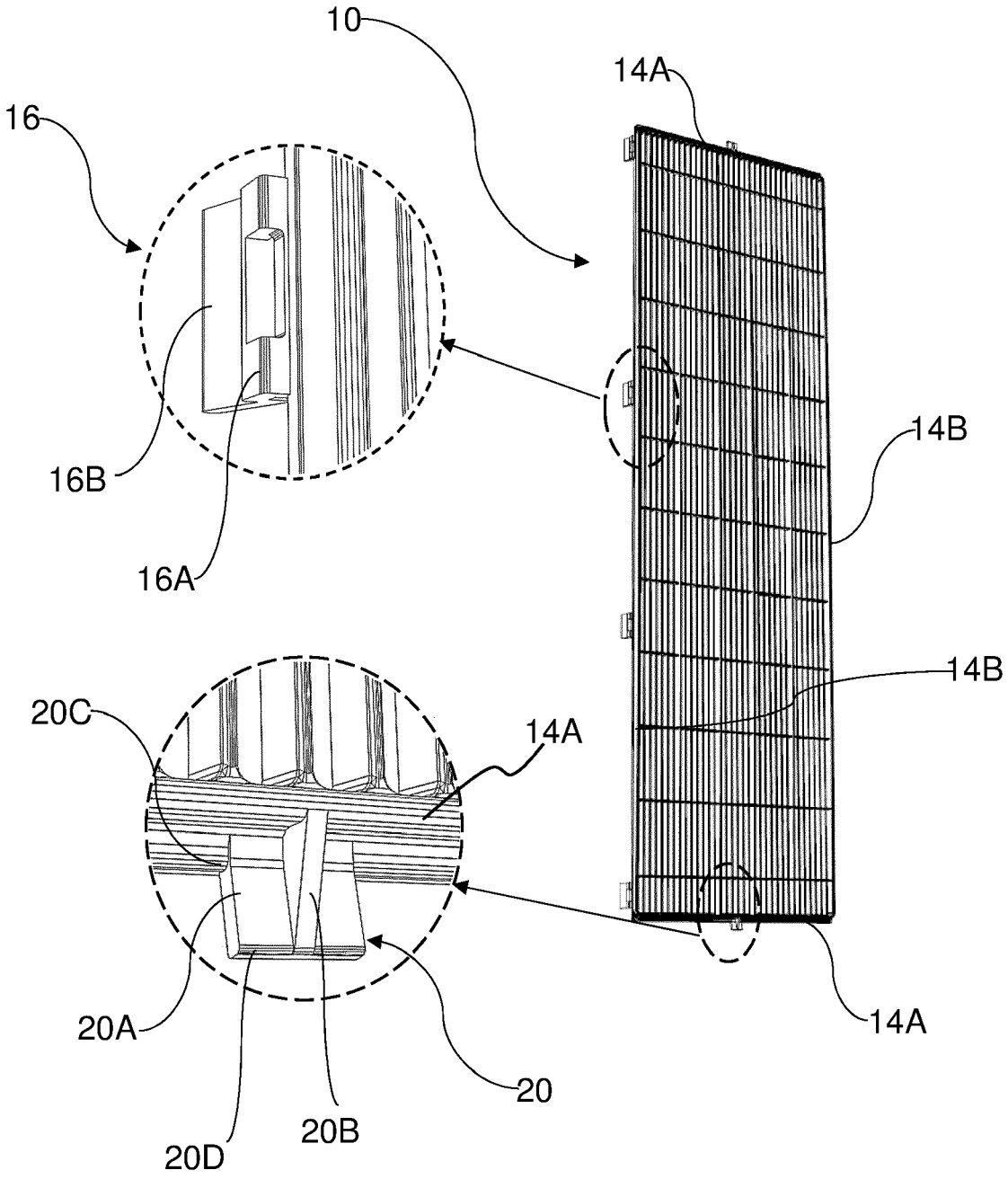

FIG. 3

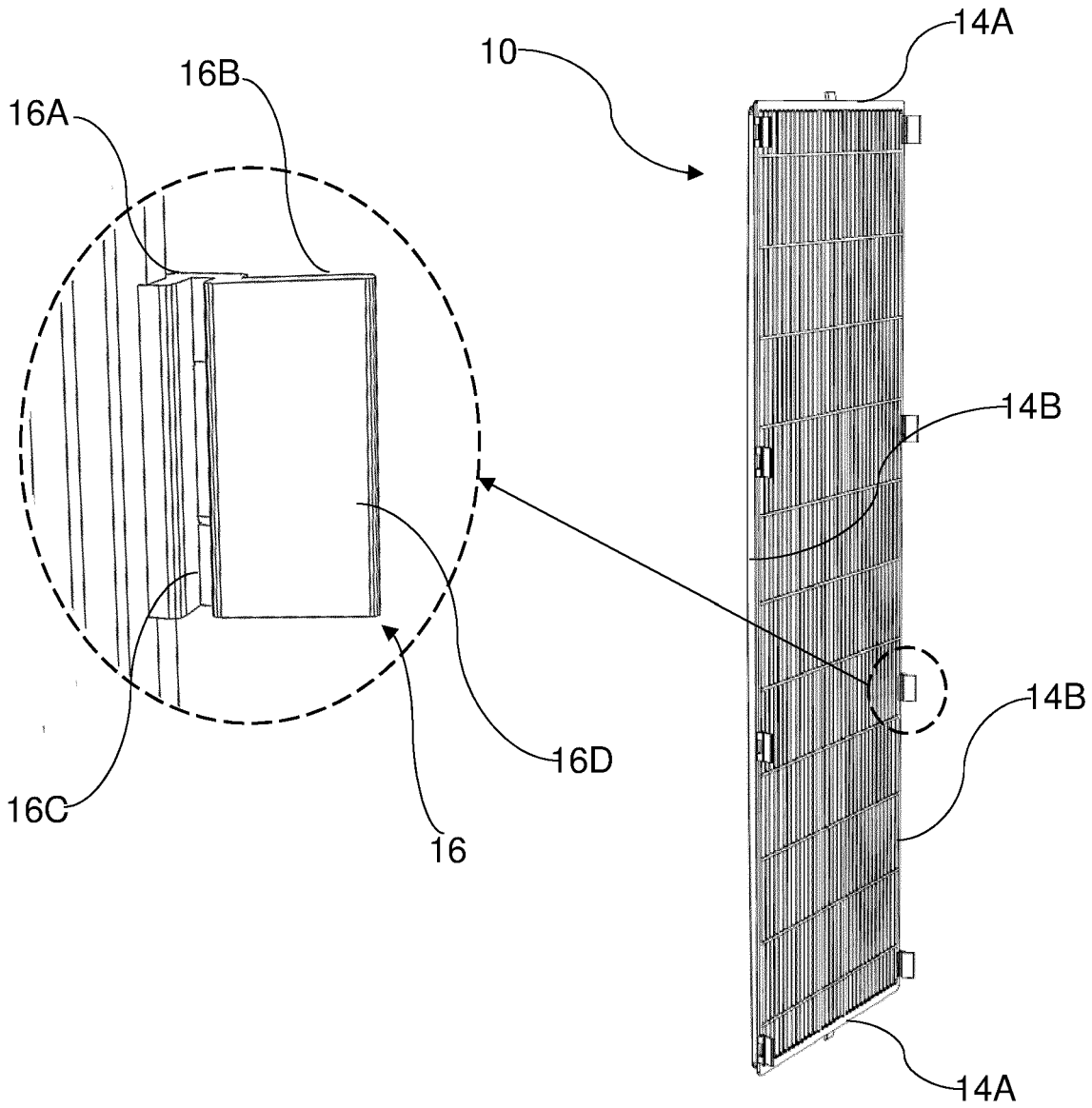

FIG. 4

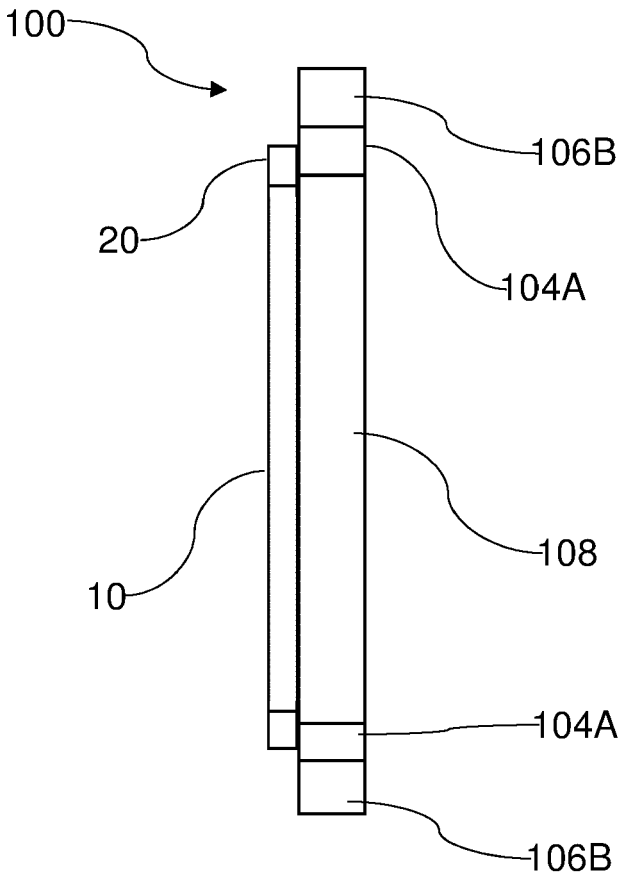

FIG. 5

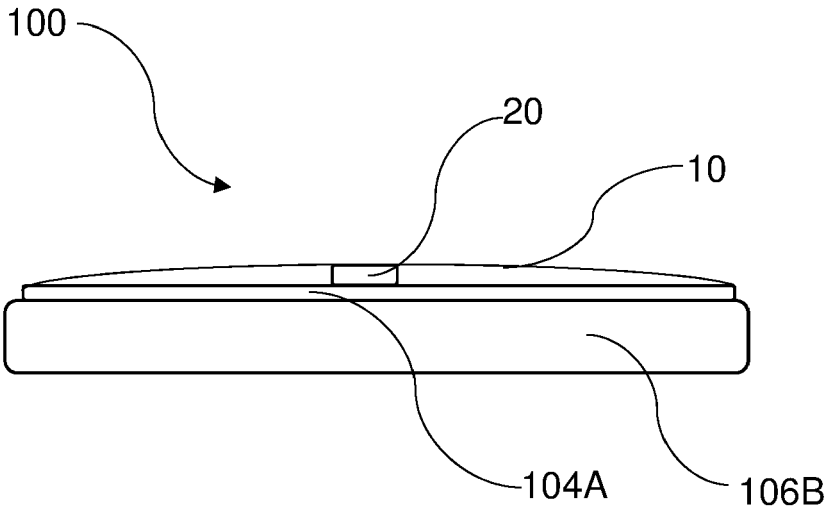

FIG. 6

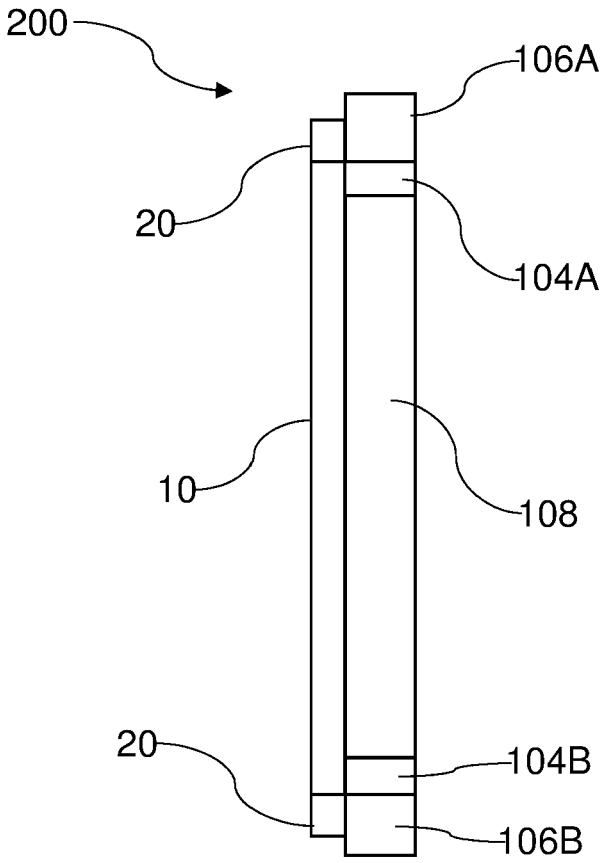

FIG. 7

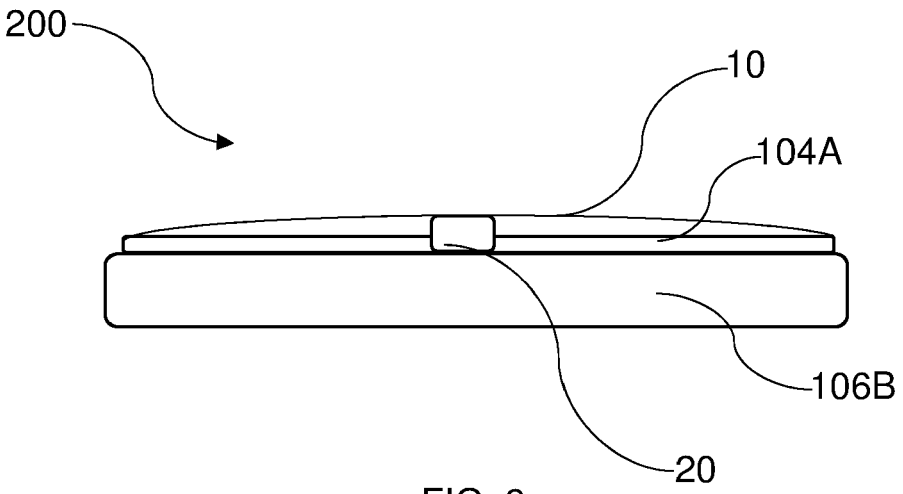

FIG. 8

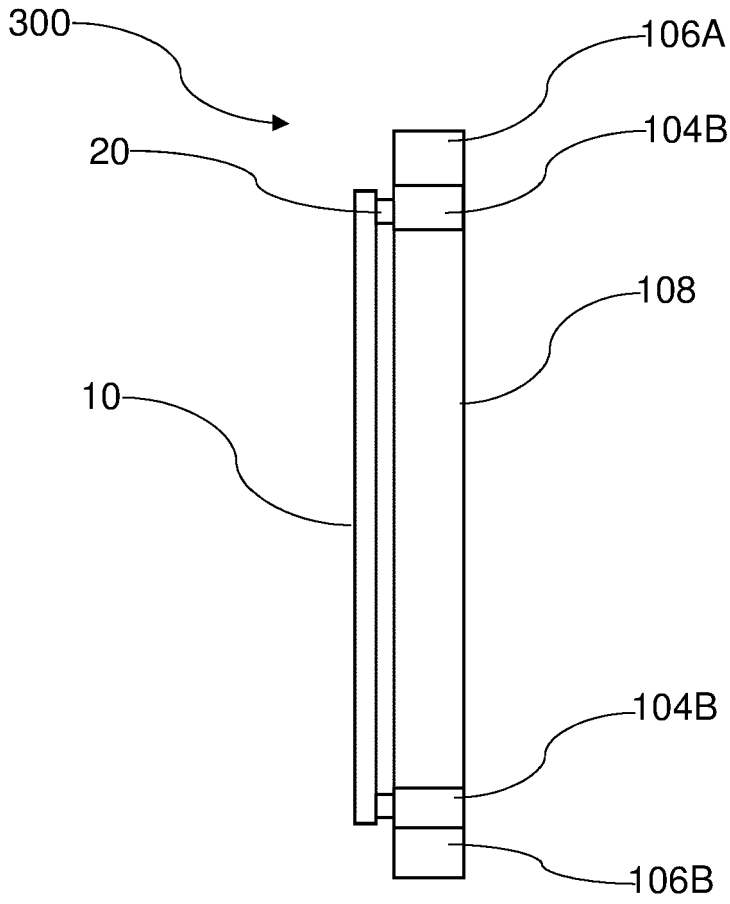

FIG. 9

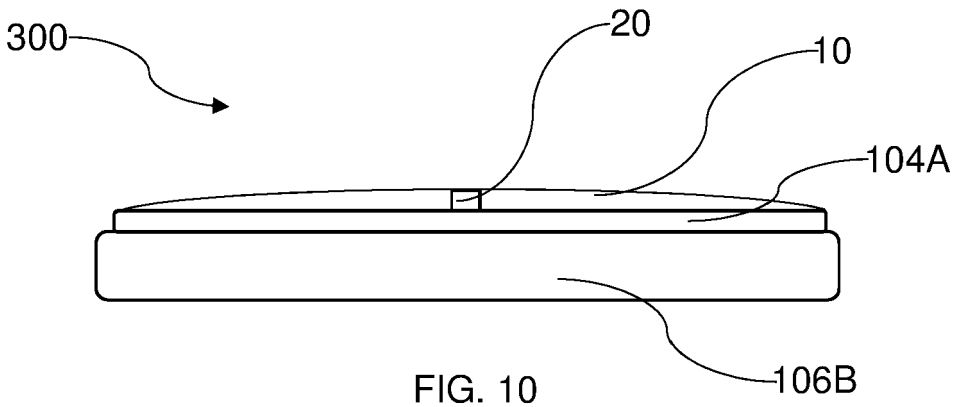

FIG. 10

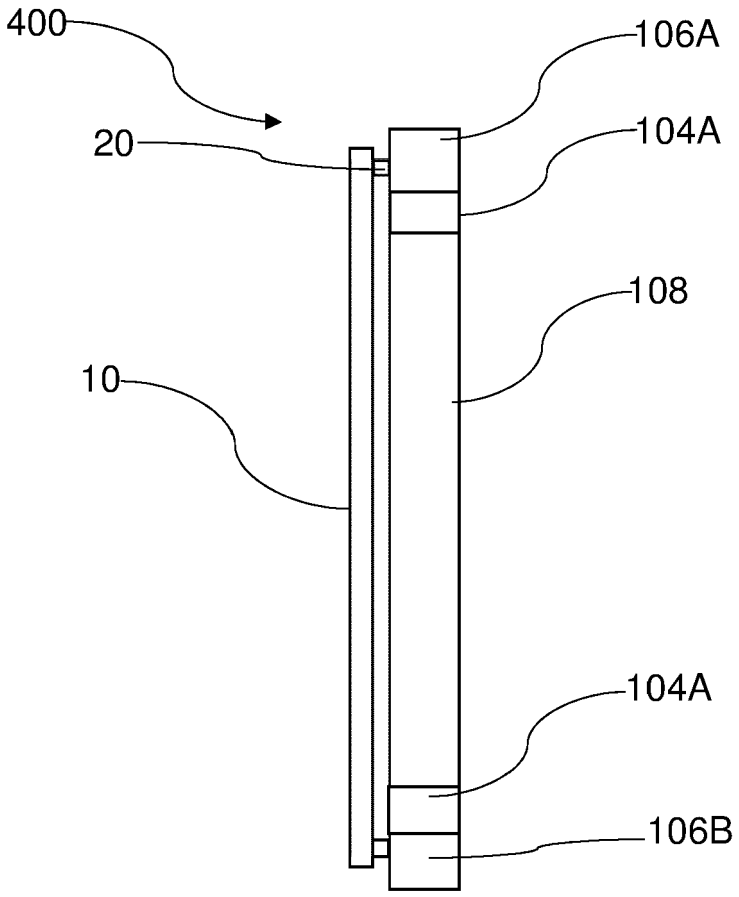

FIG. 11

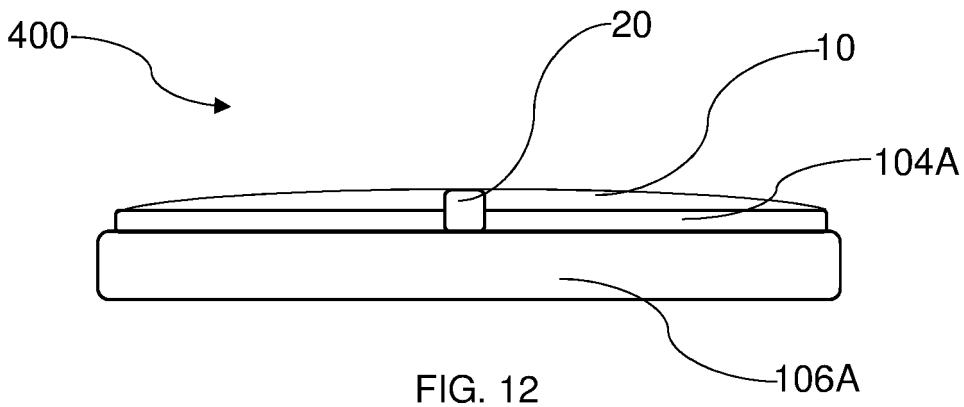

FIG. 12

Europäisches Patentamt
European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 20 46 1592

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 3 457 071 A1 (VALEO AUTOSYSTEMY SP ZOO [PL]) 20 March 2019 (2019-03-20) * the whole document *	1-11	INV. F28D1/053 B60R19/52 F28F9/00
A	US 2019/061662 A1 (WOJDYLA MICHAEL [US] ET AL) 28 February 2019 (2019-02-28) * the whole document *	1-11	F28F19/00
A	EP 3 435 020 A1 (VALEO AUTOSYSTEMY SP ZOO [PL]) 30 January 2019 (2019-01-30) * the whole document *	1-11	
A	EP 2 495 521 A1 (DENSO THERMAL SYSTEMS SPA [IT]) 5 September 2012 (2012-09-05) * the whole document *	1-11	

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	26 April 2021	Axters, Michael

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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P : intermediate document

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