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(54) **HEAT EXCHANGER ASSEMBLY**

(57) The present invention relates to the heat exchanger assembly comprising at least two manifolds (1), each of which includes the cover (4) closed at both ends having defined therein at least one longitudinal channel (5), as well as many slots (10) on one of the surfaces of said cover (4), and the header (2) applied on said cover (4) and extending beyond the ends of said cover (4), wherein the header (2) has a plurality of slots (3) at positions corresponding to the positions of said slots (10) of said cover (4). The flat tubes (17) extend between the manifolds (1) for conducting a cooling medium, wherein the ends of each flat tube (17) are tightly attached in

corresponding slots (3) of the headers (2) of the manifolds, while the fins (18) extend between adjacent flat tubes (17). In the parts of the header (2) extending beyond the ends of the cover (4) additional extreme slots (3a) are formed and the heat exchanger assembly comprises additional extreme flat tubes (17a) extending parallel to the flat tubes (17) between the extreme openings (3a) of the opposed manifolds (1). The ends of said extreme flat tubes (17a) pass through the extreme slots (3a) of the header (2) and are at least in part bent towards the ends of the covers (4) of the manifolds (1).

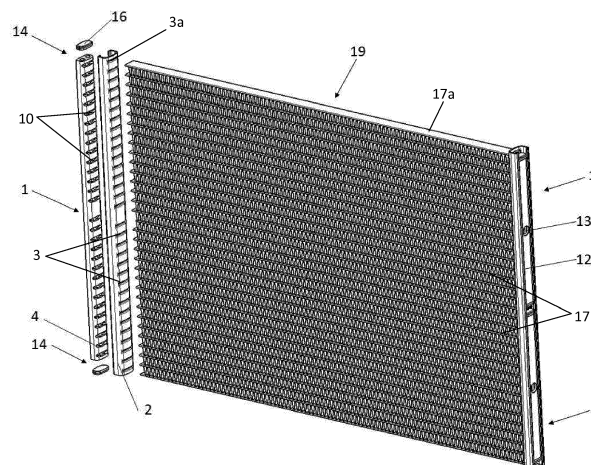


Fig. 1

Description

Technical Field

[0001] The present invention relates to a heat exchanger assembly.

Background Art

[0002] From prior art disclosed in EP14461546, a heat exchanger comprising flat tubes arranged in parallel one above the other, between which heat-dissipating fins are extended, is known. The ends of the flat tubes are tightly joined to manifolds extending perpendicular to the flat tubes.

[0003] The manifolds consist of two components: a cover and a header applied to and bent over the cover. Both those elements are provided with a plurality of corresponding slots into which ends of said flat tubes of the heat exchanger assembly are inserted. The cover is provided with at least one longitudinal channel defined therein, which, in combination with channels inside the flat tubes, forms a closed circuit for a flow of a cooling medium.

[0004] During assembling the heat exchanger, the flat tubes between which the fins extend are introduced into the slots of both manifolds.

[0005] In order to close the channels of the cover of the manifold the plugs are placed at each end of the cover. The header extends beyond the ends of the cover and the plugs are arranged inside of the header and immobilized by a total or point deformation of the walls of the header. Then, the brazing of the elements is carried out for permanent and tight connection of all elements.

[0006] In a such design of the heat exchanger assembly there is no elements for locking mutual position of the flat tubes and manifolds which results in occurring a risk of spontaneous rotation of the manifold about its longitudinal axis, whereby the position of the ends of the flat tubes with respect to the slots of the cover and the header is improper. This usually leads to improper connection of these elements during brazing and to the formation of leaks of the system or lack of orthogonality between the cover and tubes.

[0007] The present invention aims to ensure stabilization of the position of the whole assembly before and during soldering, thereby eliminating the above-mentioned possibility of changing the position of the manifold in relation to the flat tubes and preventing the risk of leakage occurring between the flat tubes and the manifolds during joining these elements in the brazing process.

Disclosure of the Invention

[0008] The above object is achieved by a heat exchanger assembly according to Claim 1 and the following dependent Claims.

[0009] According to the invention there is provided a

heat exchanger assembly comprising at least two manifolds, each of which comprises a cover being a single element having a closed contour and having defined therein at least one longitudinal channel, and also many slots on one of the surfaces of said cover, wherein said slots are in fluid communication to said at least one longitudinal channel and the cover is closed at both ends; and a header applied on said cover and extending beyond the ends of said cover, wherein the header has a plurality of slots at positions corresponding to the positions of said slots of said cover and further said header is fixedly connected to and sealed against said cover. Between the manifolds extend flat tubes for conducting a cooling medium, and the ends of each flat tube are tightly attached in corresponding slots of the headers of the manifolds. Between adjacent flat tubes extend fins. In the parts of the header extending beyond the ends of the cover are formed additional extreme slots, while the heat exchanger assembly comprises additional extreme flat tubes extending parallel to the flat tubes between the extreme openings of the opposed manifolds, wherein the ends of said extreme flat tubes pass through the extreme slots of the cover and are at least in part bent towards the ends of the housings of the manifolds.

[0010] The ends of extreme flat tubes can be cut parallel to the longitudinal axes of the extreme flat tubes forming two side portions and at least one central portion wherein said at least one central portion and the side portions are bent toward the end of the corresponding cover.

[0011] The fins can extend between the extreme flat tubes and their adjacent flat tubes.

[0012] Both said header, said cover, as well as the flat tubes and the fins are made of aluminium and/or its alloys and are connected together by means of brazing.

[0013] The extreme flat tubes may be connected to the header by means of brazing.

[0014] At least one manifold can be closed at both its ends by a plug, wherein the bent end of the extreme flat tube presses the plug against the cover of the manifold.

[0015] Said plug may be made of aluminium and/or its alloys and may be connected to said header and said cover by means of brazing.

[0016] The size of said slots of said cover is at least equal or greater than the size of said slots of said header.

[0017] Said header can be applied on said cover in a such manner that one surface of said cover is exposed, wherein said surface comprises at least one port which is in fluid communication to said at least one longitudinal channel, for connection to an external circuit of the cooling medium.

[0018] An advantage of the invention is that it eliminates in a simple way the previously described problems of the prior art by using the existing components used in the construction of the heat exchanger assembly, and thus avoiding the additional costs related to the development and production of new elements.

Brief description of the drawings

[0019] An embodiment of the present invention is shown in the accompanying drawings, in which:

Fig. 1 is an exploded perspective view of the heat exchanger assembly according to the invention,

Fig. 2 is a perspective view of the manifold connected to the flat tubes and the extreme flat tube, according to the invention,

Fig. 3 shows a cross-sectional perspective view of the flat tube which is placed in the slots of the manifold,

Fig. 4 is a cross-sectional perspective view of the extreme flat tube which is placed in the extreme slot of the header of the manifold according to the invention before the bending operation of the end of the extreme flat tube,

Fig. 5 shows a view as in fig. 6, wherein the end of the extreme flat tube is bent,

Fig. 6 shows another example of the bending of the end of the extreme flat tube.

Embodiments of the invention

[0020] The heat exchanger assembly 19, shown in exploded view in fig. 1, comprises three manifolds 1, two of which are aligned with each other and are, respectively, an inlet manifold for introducing a cooling medium through a corresponding opening 13 and an outlet manifold for discharging the cooling medium from the system through the respective opening 13, while the intermediate manifold is located opposite of said inlet and outlet manifold for returning the cooling medium from the input manifold to the output manifold.

[0021] In other preferred embodiments of the heat exchanger assembly 19, one manifold 1 on each side of the assembly is used, each of which has an opening/port 13, wherein one of the manifolds is an inlet manifold and the other is an outlet manifold. Similarly, it is possible to apply one manifold 1 on each side of the assembly, wherein one manifold does not have openings/ports 13 and the other has two openings/ports 13 for supplying and discharging a cooling medium.

[0022] It is also possible butt connection of some manifolds 1 in one longer manifold.

[0023] Each manifold 1 includes a header 2 and a cover 4. The header 2 is manufactured from the plate, preferably of aluminium and/or its alloys, of a thickness of 0.8 mm to 2 mm, preferably 1 mm, by means of the stamping process and bent in such manner that it substantially replicates the external shape of the cover 4. By such structure of the header 2 it is easy to manufacture. The cover 2 made of aluminium and/or its alloys may be plated on its one or both sides and has a plurality slots 3 arranged in a single row, in which the aluminium flat tubes 17 are introduced during assembling of the heat exchanger 19. The slots 3 are precisely made slots, so that the ends of

the flat tubes 17 are tightly received in the slots 3.

[0024] The cover 4 is the uniform element having a closed hollow profile made by means of an extrusion process having thick and massive walls ensuring resistance to high working pressure. In the illustrated embodiment, said cover comprises in its interior two separate longitudinal channels 5 for a flow of a cooling medium, but it should be noted that the cover may comprise one or more than two longitudinal channels, depending on the intended use of the heat exchanger 19. The channels 5 are separated from each other by a reinforcing arch 7 in order to strengthen the structure of the cover 4 and the entire manifold 1. The cover 4 has also a plurality of slots 10 at positions corresponding to the positions of the slots 3 in the header 2, wherein the slots 10 need not be made with such precise dimensions as the slots 3 of the header 2 that is their dimensions did not have to be exactly matched to the dimensions of the flat tubes 17. It is sufficient if the slots 10 will have a size larger than or at least the same size as the flat tubes 17 have and thus also the size of the slots 3. This results in that the flat tubes 17 are received loosely into slots 10 and tightly into slots 3. The slots 10 can be made by a process using a saw milling, which process does not have to be precise, which causes that the cover 4 made in that way is simple and cheaper to manufacture. The slots 10 are further in fluid communication to the channels 5 of the cover 4. Like the header 2, the cover 4 is also preferably made of aluminium and/or its alloys.

[0025] As illustrated in fig. 2, in the process called crimping the header 2 is applied and bent over the cover 4, in particular over its corners, so that a larger portion of one of the outer surfaces of the cover 4, preferably the exposed surface 12 opposite to the surface on which the slots 10 are made, remains preferably uncovered by the header 2. Of course, the header 2 does not have to protect the almost entire or entire surface of the cover 4. It is sufficient if the header 2 will cover at least a surface of the cover 4 in which the slots 10 are arranged.

[0026] The header 2 projects longitudinally beyond the cover 4, namely beyond the ends 14 of the cover 4, so as to form a seat 15 for the baffle/plug 16, preferably of aluminium and/or its alloys, for sealing the ends 14 of the cover 4 and the whole manifold 1.

[0027] The header 2 and the cover 4 are joined together and sealed to each other, as well as with respect to the plug 16, by brazing in a brazing furnace. This causes sealing all contact edges between these elements. The manifold 1 assembled in this way has a substantially rectangular cross-section.

[0028] During assembling of the heat exchanger assembly 19 a process called collecting is performed, in which the flat tubes 17 equipped with internal channels, between which fins 18 extend, are introduced into the slots 3, 10 of the components of the manifolds 1. The tubes are firstly received tightly into the slots 3 and next loosely into the slots 10, wherein edges of the tubes abut against an internal surface of the slots 10 with the result

that its further movement deeper into the cover 4 is stopped. The flat tubes 17 are secured to and sealed against the manifolds 1 by brazing between the flat tube 17 and the header 2, i.e. around the slots 3.

[0029] It was noted that in the assembled heat exchanger assembly 19, which is prepared for the brazing process, an attachment of the flat tubes 17 in slots 3 of the manifolds 1 does not provide a sufficiently stable maintaining of the mutual position of these elements. There is a risk that the manifolds 1 can rotate around their longitudinal axes causing that the ends of the flat tubes 17 are not correctly positioned in the slots 3, 10 of the manifolds 1. It causes improper attachment and sealing of these components during brazing.

[0030] Therefore, additional extreme slots 3 are formed on the extreme lengths of the headers 2, which are arranged at borders of the heat exchanger assembly 19 and which extend beyond the ends of the covers 4 and plugs 16 provided thereon, as shown in figures 1 and 2. Furthermore, the additional two stiffening extreme flat tubes 17a are provided, the ends of which are inserted into respective said extreme slots 3a of the manifolds 1 and then bent towards the cover 4 of the respective manifold 1 by applying a bending force F over the entire width of the tube, as shown in figures 4 and 5.

[0031] In this way, the manifolds 1 are fixed relative to one another and to the set of the flat tubes 17 so that the possibility of their rotation has been eliminated.

[0032] Using the additional extreme flat tubes 17a as stiffening elements do not require development of new elements, as the elements used in the construction of the heat exchanger assembly 19 are used, which is advantageous from the point of view of manufacturing costs.

[0033] It should be noted that extreme flat tubes 17a are not part of the cooling medium circuit, since their ends are above the plugs 16 closing the channels 5 of the manifolds 1. However, due to the fact that the fins 18 extend between the extreme flat tubes 17a and their adjacent flat tubes 17, said extreme flat tubes 17a are involved in the heat exchange process.

[0034] Furthermore, the extreme flat tubes 17a may be bent to such an extent that they press on the plug 16 pressing it against the cover 4, so that the better protection against leakage of the connection between the plug 16 and the cover 4 is ensured, as shown in fig. 5. In addition, pressure of the plugs 16 by means of the ends of the extreme flat tubes 17a eliminates the necessity to deform the walls of the header in order to hold plugs 16 in place. It should be also added that the extreme flat tubes 17a may also be joined to the slots 3a of the headers 2 in the brazing process of the remaining elements of the heat exchanger.

[0035] In the embodiment shown in fig. 6, the end of the additional flat tube 17 has been cut along the tube axis, and next only its extreme parts 21 and central portion 22 has been bent. Such a method of immobilizing an additional flat tube is advantageous because it is pos-

sible to use less bending force applied only to the deformed portions, and additionally a concentration of pressure is increased.

Claims

1. A heat exchanger assembly comprising at least two manifolds (1), each of which comprises

a longitudinal cover (4) having defined therein at least one longitudinal channel (5) and also many slots (10) located on a surface of said cover (4), wherein said slots (10) are in fluid communication to said at least one channel (5) and the cover (4) is closed at both ends; and a header (2) applied on said cover (4) and extending beyond the closed ends of said cover (4), wherein the header (2) has a plurality of slots (3) at positions corresponding to the positions of said slots (10) of said cover (4) and further said header (2) is fixedly connected to and sealed against said cover (4);

flat tubes (17) extending between the manifolds (1) for conducting a cooling medium, wherein the ends of each flat tube (17) are tightly attached in corresponding slots (3) of the headers (2) of the manifolds, fins (18) extending between adjacent flat tubes (17), **characterized in that:**

in the parts of the header (2) extending beyond the closed ends of the cover (4) additional extreme slots (3a) are formed, while the heat exchanger assembly comprises additional extreme flat tubes (17a) extending parallel to the flat tubes (17) between the extreme openings (3a) of the opposed manifolds (1), wherein the ends of said extreme flat tubes (17a) pass through the extreme slots (3a) of the header (2) and are at least in part bent towards the ends of the respective cover (4).

2. The heat exchanger assembly according to Claim 1, **characterized in that** the ends of the extreme flat tubes (17a) are cut parallel to the longitudinal axes of the extreme flat tubes (17a) forming two side portions (21) and at least one central portion (22) wherein said central portion (22) and side portions (21) are bent toward the end of the corresponding cover (4).
3. The heat exchanger assembly according to Claim 1, **characterized in that** the fins (18) extend between the extreme flat tubes (17a) and their adjacent flat tubes (17).
4. The heat exchanger assembly according to Claim 1, **characterized in that** both said header (2), said cov-

er (4), as well as the flat tubes (17) and the fins (18) are made of aluminium and/or its alloys and are connected together by means of brazing.

5. The heat exchanger assembly according to Claim 1, 5
characterized in that the extreme flat tubes (17a) are connected to the header (2) by means of brazing.
6. The heat exchanger assembly according to Claim 1, 10
characterized in that at least one manifold (1) is closed at both its ends by the plug (16), wherein the bent end of the extreme flat tube (17a) presses the plug against the cover (4) of the manifold (1).
7. The heat exchanger assembly according to Claim 6, 15
characterized in that said plug (16) is made of aluminium or its alloys and is connected to said header (2) and said cover (4) by means of brazing.
8. The heat exchanger assembly according to Claim 1, 20
characterized in that the size of said slots (10) of said cover (4) is at least equal or greater than the size of said slots (3) of said header (2).
9. The heat exchanger assembly according to any one of preceding Claims, 25
characterized in that said header (2) is applied on said cover (4) in such a manner that one surface (12) of said cover (4) is exposed, wherein said surface (12) comprises at least one port (13) which is in fluid communication to said at least one longitudinal channel (5), for connection to the external circuit of the cooling medium. 30

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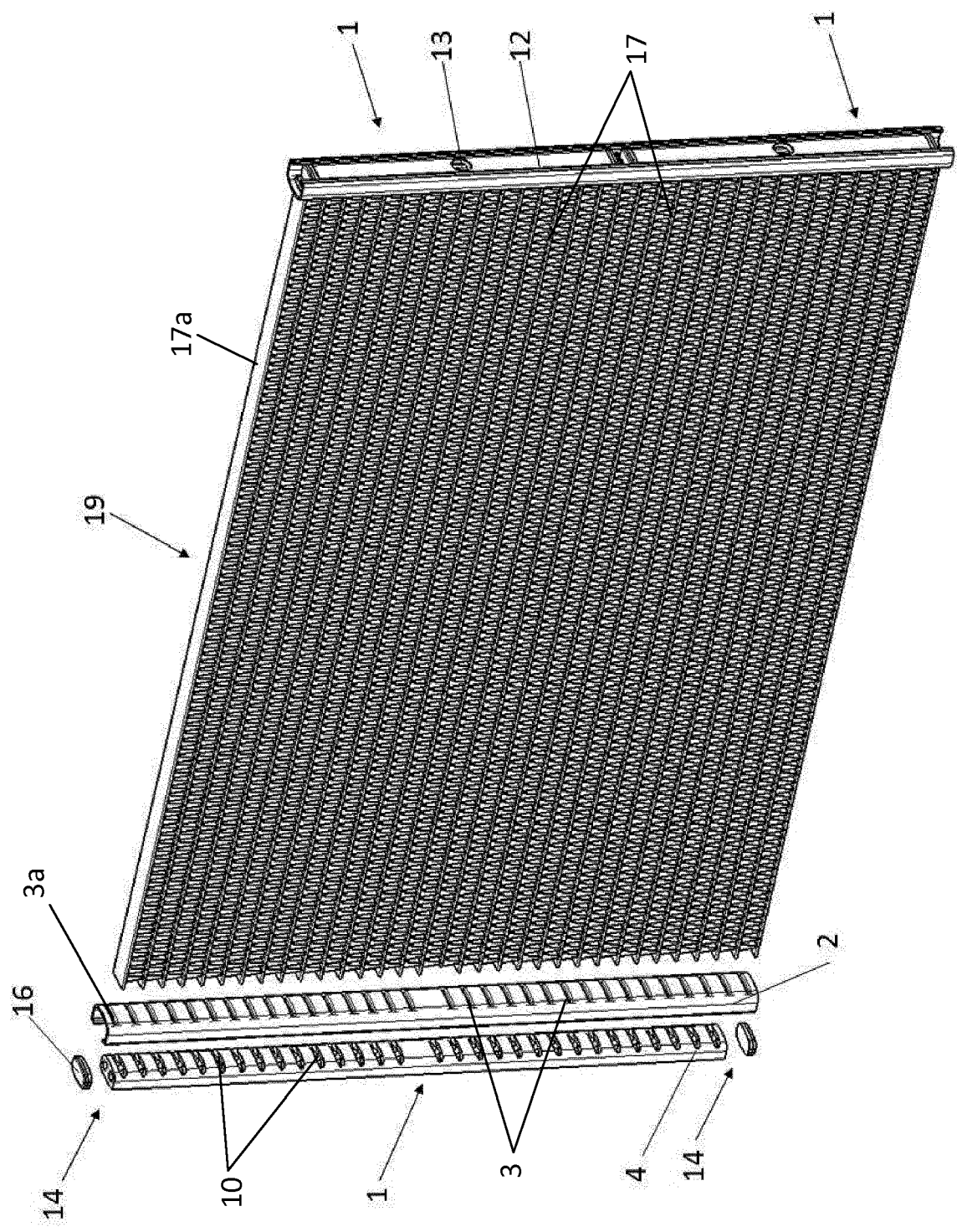
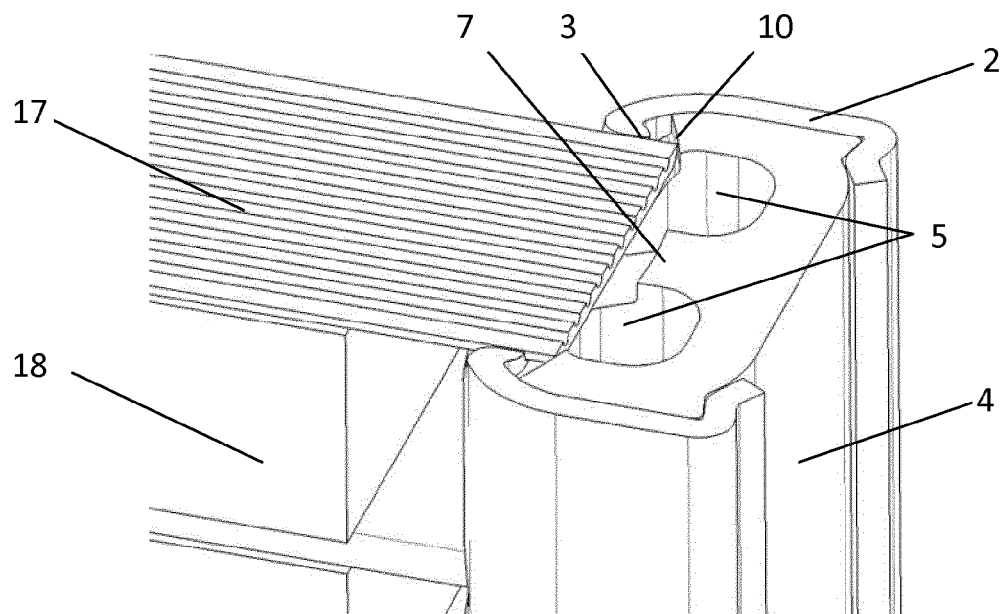
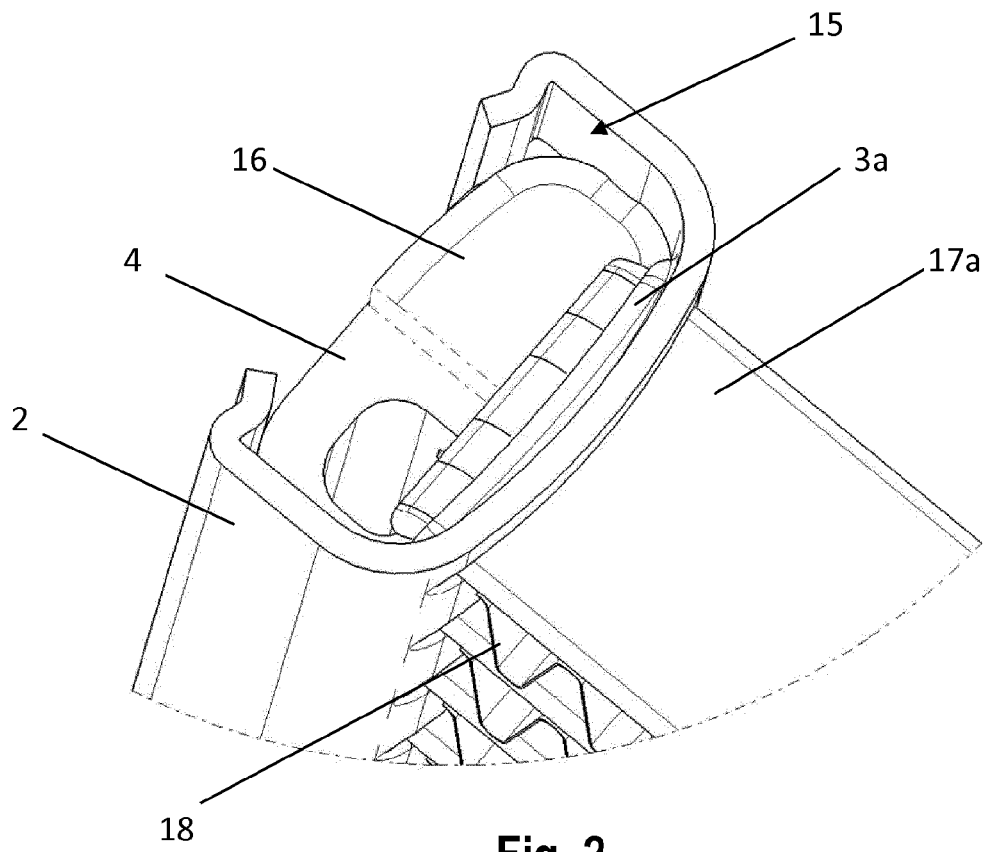


Fig. 1



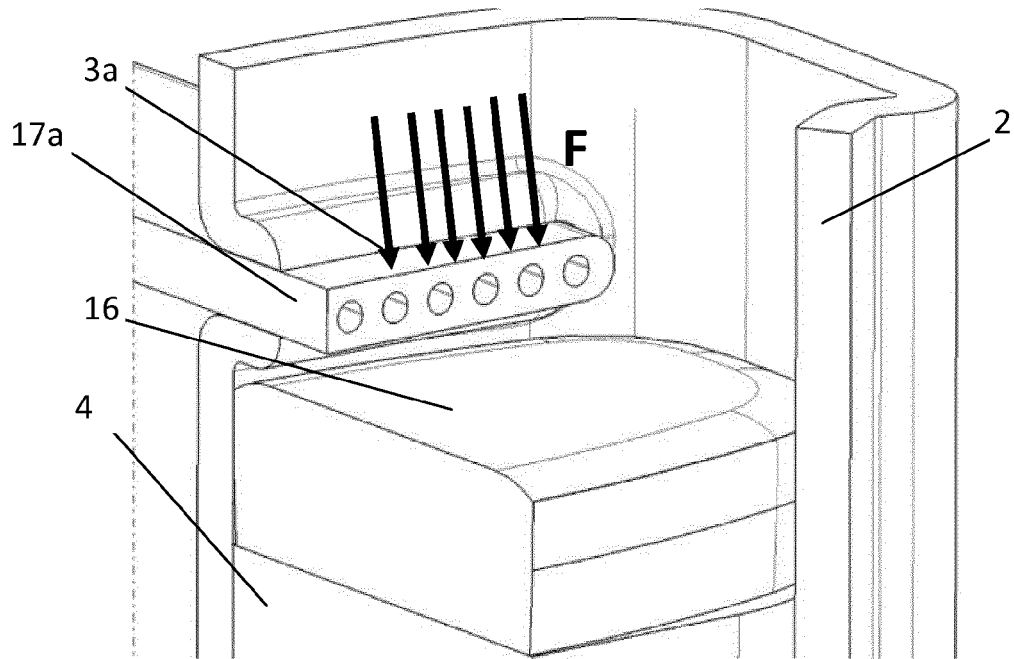


Fig. 4

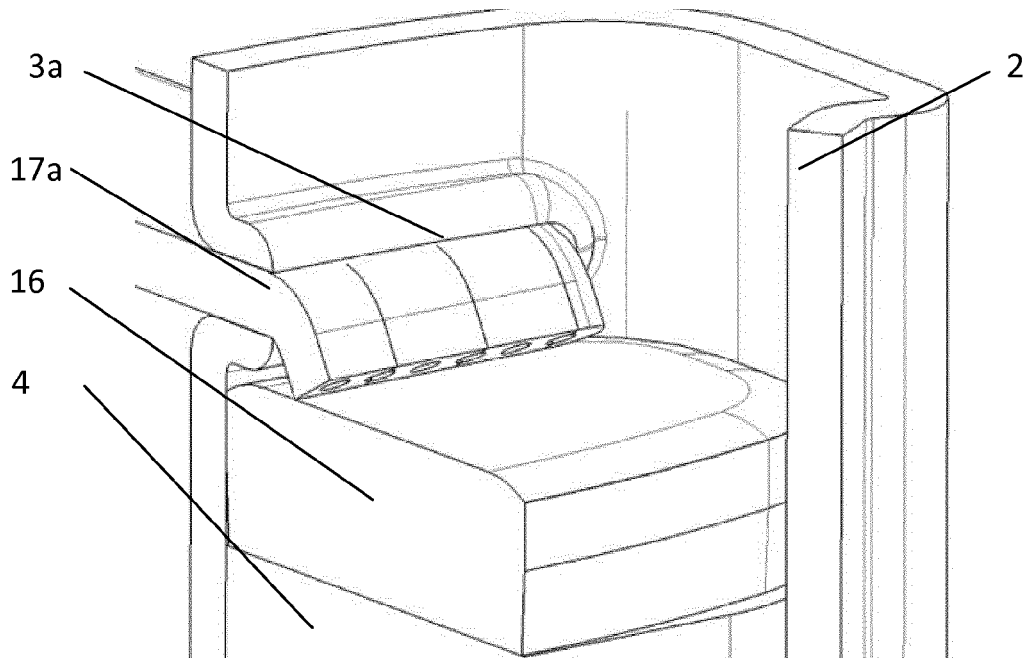


Fig. 5

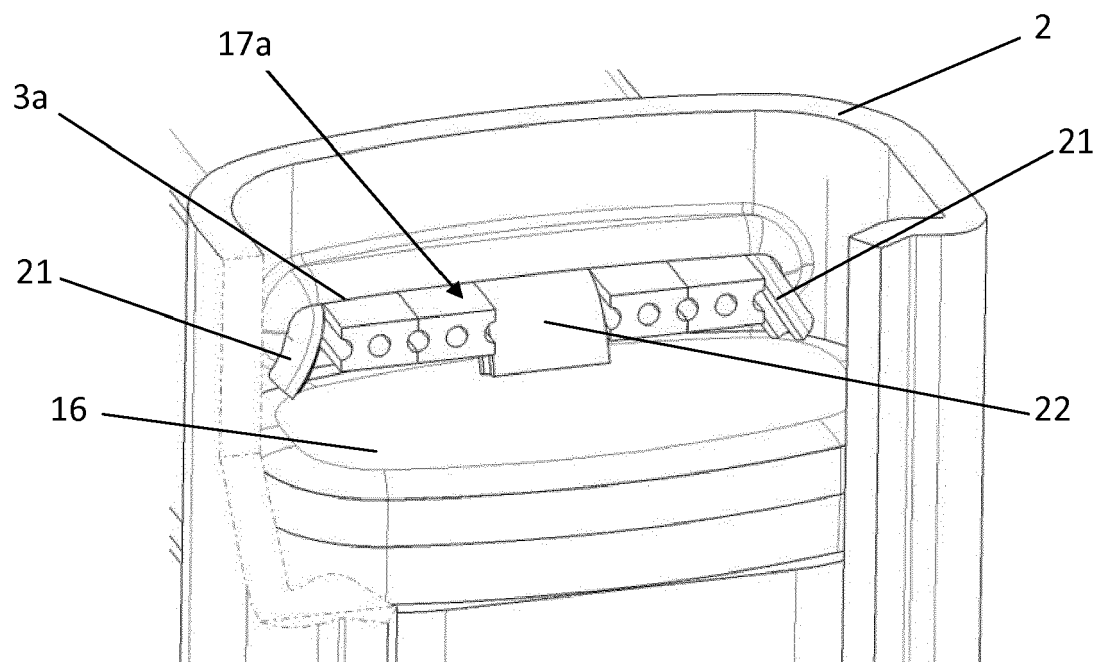


Fig. 6



EUROPEAN SEARCH REPORT

Application Number
EP 16 17 2127

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 10 November 2016	Examiner Martínez Rico, Celia
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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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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