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(54) **A MANIFOLD FOR A HEAT EXCHANGER, IN PARTICULAR FOR AN AUTOMOTIVE RADIATOR**

(57) The manifold (1) for a heat exchanger (22), in particular for an automotive radiator, comprises a housing (4), which is a unitary element of a closed profile and has at least one longitudinal channel (5) defined therein, a plurality of slots (7) on one of the surfaces (8) of said housing (4), and two side surfaces (11), wherein said slots (7) are in fluid communication with said at least one longitudinal channel (5). The manifold comprises also a cover (2) applied at least on said slotted surface (8) and said side surfaces (11) of the housing (4) and having a plurality of slots (3) located at positions corresponding to the positions of said slots (7) of said housing (4) for introducing flat tubes (20) of the heat exchanger (22) into them. The cover (2) is connected to the housing (4) by brazing. Said housing (4) further has undercuts (14, 15), on its outer surface covered by said cover (2), extending in the longitudinal direction of said housing (4) and forming channels for correct clad flow management between said housing (4) and said cover (2).

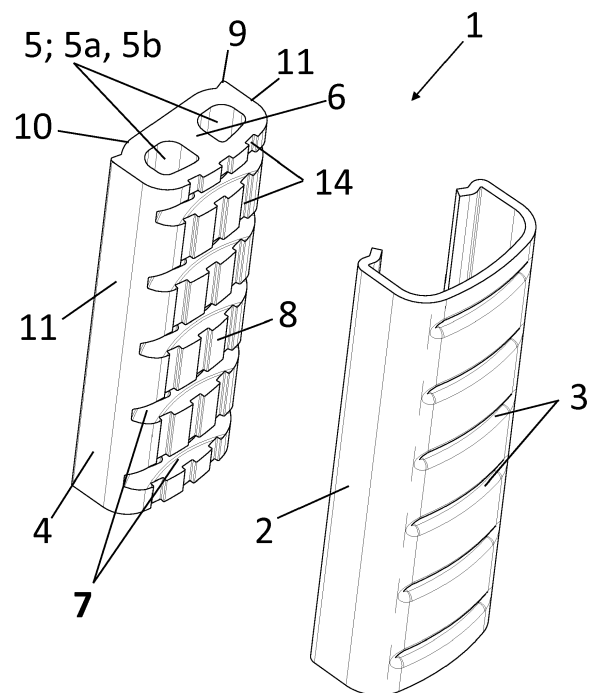


Fig. 1

Description

Technical Field

[0001] The present invention relates to a manifold for a heat exchanger, in particular for an automotive radiator.

Background Art

[0002] From the patent application publication EP 2960609 a manifold for a heat exchanger, in particular for use in a cooler of a cooling system, comprising two parts, namely a housing and a cover applied and bent over the housing is known. Both these elements are provided with plurality of corresponding slots into which tubes of the cooling assembly are introduced. The housing is provided with at least one channel defined therein for the flow of a cooling medium, and the tubes, which pass through the slots of the cover and the slots in the housing, are in fluid communication with that at least one channel for the flow of a cooling medium.

[0003] During manufacturing of the manifold the cover is connected to the housing by brazing in a brazing furnace on the surfaces of the cover and housing adhering to each other. Brazing of two relatively large surfaces, which are surfaces of the cover and housing adhering to each other, can lead to occurring brazing defects, which causes the leakage of the cooling medium flowing through the manifold and prevents the operation and deteriorates stability of the heat exchanger.

[0004] The aim of the present invention is to develop a manifold in which the drawbacks presently occurring during brazing of the housing with the cover are overcome.

[0005] The aim of the invention is a manifold, which allows obtaining an improved connection by brazing between the housing and the cover.

[0006] The aim of the invention is to provide a manifold which assures correct clad flow management between the housing and the cover and degassing during debonding process during Nockolock CAB brazing, which is easier and less expensive in the production and has improved durability.

Disclosure of the Invention

[0007] The above object is achieved by a manifold for a heat exchanger, in particular for an automotive radiator, according to Claim 1 and the following dependent claims.

[0008] The manifold according to the invention having the housing provided, on its outer surface covered by the cover, with undercuts extending in the longitudinal direction of the housing which form channels for correct clad flow management between the housing and the cover, allows obtaining an improved connection by brazing between the housing and the cover. The undercuts also helps with degassing during debonding process during Nockolock CAB brazing.

[0009] The longitudinal undercuts are arranged on the slotted surface of the housing or on two side surfaces of the housing, or may be formed in both the slotted surface of the housing as well as in two side surfaces of the housing.

[0010] Such undercuts are easy to make since they are formed during the extrusion process of the housing, wherein the undercuts in the housing extend in the extrusion direction. In addition, making the undercuts in the housing reduces its weight, which is an additional beneficial effect by saving material.

[0011] The object of the present invention is also a heat exchanger, in particular an automotive radiator, having such manifold according to Claim 14.

Brief description of the drawings

[0012] The present invention is illustrated by its embodiments in the accompanying drawings, in which:

Fig. 1 is an exploded perspective view of the manifold according to the first embodiment of the invention, Fig. 2 is a perspective view of a fragment of the housing of the manifold according to the first embodiment of the invention with undercuts made on the slotted surface of the housing, Fig. 3 is a perspective view of the assembled manifold according to the first embodiment of the invention with undercuts made on the slotted surface of the housing and with the end plugged by a plug, Fig. 4 is a perspective view of a fragment of the housing of the manifold according to the second embodiment of the invention with undercuts made on the side surfaces of the housing, Fig. 5 is a perspective view of the assembled manifold according to the second embodiment of the invention with undercuts made on the side surfaces of the housing and with the end plugged by a plug, Fig. 6 is a perspective view of a heat exchanger with the manifolds according to the invention, wherein the left-side manifold is in exploded state.

Embodiment of the invention

[0013] Fig. 1 shows the manifold 1 according to the first embodiment of the invention, which is adapted to attach flat tubes 20 thereto for conducting a cooling medium to form the heat exchanger 22, in particular an automotive radiator, such as shown in Fig. 6 and discussed hereinafter.

[0014] Each manifold 1 comprises a housing 4 and a cover 2, as shown in particular in Fig. 1.

[0015] The cover 2 is manufactured as one part of a sheet metal plate, preferably of aluminium and/or its alloys, of a thickness of 0.8 mm to 2 mm, more preferably 1 mm, by means of the stamping process in such manner that it substantially replicates an external shape of the housing 4. The cover 2 has a plurality of slots 3 arranged

in one row and parallel to each other, into which, during use of the manifold 1, flat tubes 20 of the heat exchanger 22 having internal channels are introduced. The slots 3 are precisely matched to the dimensions of the flat tubes 20 in such a manner that the flat tubes 20 are tightly introduced into these slots 3.

[0016] The housing 4 has a closed hollow profile, it is an uniform element manufactured using an extrusion process, it has thick and solid walls resulting in its resistance to high operational pressure and, in the shown embodiment, it contains in its interior two separate longitudinal channels 5a and 5b for the flow of a cooling medium. The channels 5a and 5b are separated from each other by a reinforcing arch 6 in order to strengthen the structure of the housing 4 and the entire manifold 1. However, the housing may also contain in its interior only one longitudinal channel 5. Furthermore, the housing 4 has a plurality of slots 7 at positions corresponding to positions of the slots 3 in the cover 2, wherein the slots 7 need not be made with such accurate dimensions as the slots 3 of the cover 2, that is, their dimensions did not have to be exactly matched to the dimensions of the flat tubes 20, but it is sufficient if the slots 7 will have the size at least the same or larger than the size of the flat tubes 20, and hence also the slots 3. This results in that the flat tubes 20 are received loosely into slots 7 and tightly into slots 3. Like the cover 2, the housing 4 is also preferably made of aluminium and/or its alloys.

[0017] The housing 4 has a surface 8 with slots 7, hereafter called the slotted surface 8, substantially exposed surface 10 opposite the slotted surface 8, which are connected to each other by side surfaces 11.

[0018] Referring particularly to Figs. 3 and 5, it can be noted that the cover 2 is applied on said slotted surface 8 and on said side surfaces 11 of the housing 4 and bent over the housing 4, in particular over its corners 9, so that, preferably, a larger portion of the surface 10, opposite to the slotted surface 8, remains uncovered by the cover 2.

[0019] The cover 2 can protrude longitudinally beyond the ends 12 of the housing 4, so as to form a seat for the baffle/plug 13 preferably of aluminium and/or its alloys, for sealing the ends of the channels 5, 5a, 5b and the entire manifold 1. However, the plug can abut against both elements.

[0020] The cover 2 and the housing 4 are joined together and sealed against each other by brazing in a brazing furnace. Such brazing joint should seal all contact surfaces between the cover 2 and the housing 4, while it is necessary to ensure the tightness of the joint of the cover 2 to the housing 4 against the environment and to ensure the mechanical strength of the structure made as a result of brazing against working conditions of the assembly (a high pressure in particular having pulsating nature).

[0021] The brazing is a process of joining materials by means of a molten clad having characteristics close to the materials to be joined (base materials) at a temper-

ature lower but close to their melting temperature. Herein, it means that the clad (usually it is AlSi family alloy) is applied on at least one of the components, the housing 4 or the cover 2, and the clad, while melting during brazing in a controlled atmosphere (oxygen-free atmosphere, thus preventing oxidation of the clean metal surface from which the oxides presented there have been removed directly earlier by the flux), will produce a joint between the two contacting surfaces of the components.

[0022] Preferably, the clad is applied on one or both sides of the cover 2 by plating method, wherein the clad is an alloy (e.g. AlSi alloys) having melting point lower than the melting point of the material of the cover 2. Most preferably, the clad is applied on both sides of the cover 2 in order to connect both cover 2 with the housing 4 on the one side as well as the cover 2 with the flat tubes 20 of the heat exchanger 22 on the other side.

[0023] However, brazing of two relatively large surfaces, such as surfaces of the cover 2 and the housing 4, can lead to brazing defects in the form of gaps, which will result in leakage of the cooling medium out of the housing 2 through the regions around the tubes 20 mounted loosely in the slots 7 and through said gaps in the brazing joint.

[0024] According to the invention, the housing 4 has undercuts 14, 15, on its outer surface covered by the cover 2, extending in the longitudinal direction of the housing 4 and forming the channels for correct clad flow management between the housing 4 and the cover 2.

[0025] The undercuts 14, 15 reduce the contact surface region between the housing 4 and the cover 2, which is advantageous for reasons of brazing these surfaces, support the distribution of the clad to critical regions due to the formation of the adequate system of capillary forces, and simultaneously the internal spaces in the manifold acts as containers for collecting products of a thermal decomposition of the binder (i.e. gases and ash of the organic matter) used to maintain on the cover 2 or the housing 4 (or possibly on both) the flux necessary to remove the oxide layer on the brazed surfaces (it is applied respectively earlier, immediately prior to assembly of the housing 4 and the cover 2 together). This is a quite important feature, as the presence of the above mentioned products of the so-called debonding in the brazing joint leads to deterioration of its quality (increase porosity until to lack of the formation of the brazing joint inclusively).

[0026] In the first embodiment of the manifold 1 according to the invention said longitudinal undercuts 14 are arranged on the slotted surface 8 of the housing 4, as shown in figs. 1, 2 and 3.

[0027] A manifold 1 in the second embodiment of the invention comprises the housing 4 and the cover 2 which are the same as described above in the first embodiment of the invention. However, in the second embodiment of the invention, longitudinal undercuts 15 are arranged on the side surfaces 11 of the housing 4, as shown in figs. 4 and 5, and not in the slotted surface 8.

[0028] It is also possible that the undercuts 14, 15 can

be arranged both on the slotted surface 8 and on the side surfaces 11 of the housing 4.

[0029] The size of the undercuts, their number and distribution should be such that the manifold has adequate mechanical strength. Generally, the design of such undercuts will be clear to designers developing brazing products with the requirements imposed on strength and/or requirements related to the tightness.

[0030] In the case of the undercuts 14 on the slotted surface 8, the side wall of the undercut should be inclined to its bottom at the preferred angle 90-150 degrees and the depth of the undercut should be greater than 0.4 mm in order to ensure formation of capillary forces at the place of the contact of the edge of the undercut at the housing 4 to the cover 2, that is, the forces causing the flow of the clad during the brazing process from the places. Other dimensional restrictions have to result from said mechanical strength of the structure in this region, i.e. unbrazed places may not be too large as they will negate the very idea of the invention (i.e. ensuring proper brazing on a minimal, defined experimentally or by simulation, surface of the joint of the two components subjected to pressure).

[0031] Such undercuts are easy to make, since they are formed during the extrusion process of the housing, wherein the undercuts 14, 15 extend in the extrusion direction. In addition, making the undercuts in the housing reduces its weight, which is an additional beneficial effect by saving material.

[0032] In addition, the undercuts 15 on the side surfaces 11 of the housing, extending in the longitudinal direction of the housing 4, separate critical regions of the brazing, i.e. regions of the bent of the cover 2 on the housing 4 at the corners 9. As seen in Fig. 4 and 5 the undercut 15 has an asymmetrical shape: the side wall of the undercut 15 closer to the corner 9 is perpendicular to the bottom, while the wall located further from the corner 9 is obliquely tapered to the side 11. This shape results from the principle of forming the capillary force in such joint that is significantly greater when the gap disappears gradually than abruptly. Thanks to that we prioritize formation of the brazing joint in the critical region in terms of the functionality of the manifold, i.e. in region distal from the corner 9 at the expense of the region proximal to the corner 9.

[0033] In addition, the undercuts 15 help in detection of soldering defects, since, if the cover 2 is not tightly joined to the housing 4, then leaks will occur.

[0034] As shown in Fig. 6, in use of the manifold 1 according to the invention in the heat exchanger 22, the flat tubes 20 are inserted into the slots 3, 7 of both components of the manifold 1 that is into the cover 2 and the housing 4. The flat tubes 20 are secured to and sealed against the manifold 1 by brazing between the flat tube 20 and the cover 2, i.e. around the slots 3.

[0035] Fig. 6 shows the heat exchanger 22, in which manifolds 1 according to the invention are used. Two separate manifolds 1 are arranged on the right side of

the heat exchanger 22, wherein one of them is used for supplying the cooling medium into the heat exchanger, while the other is for discharging that medium. These manifolds 1 are provided with openings/ports 21 on their exposed surfaces 10, i.e. uncovered by the cover 2, for connection to an external circuit of a cooling medium. These openings are in fluid communication with the channels 5, 5a, 5b of the housing 4. The manifold 1 shown on the left side of the heat exchanger 22 is not provided with such openings/ports, therefore it is only an intermediate element in the heat exchanger 22 assembly, i.e. the cooling medium enters through one of the manifolds 1 on the right side of the heat exchanger, flows through a part of the flat tubes, flows into the manifold 1 on the left side of the assembly, re-enters later into the second part of the flat tubes 20 and exits through the other of the manifolds 1 on the right side of the heat exchanger 22. In the heat exchanger one manifold 1 can be used on its each side, each of which has an opening/port 21, wherein one of the tubes is an inlet tube and the other is an outlet tube.

[0036] Note that it is possible to exchange technical features between the above-described embodiments of the invention. It is possible to connect some manifolds in one longer manifold, in such a case the manifolds without plugs are used which are firmly butt joined, and only then the extreme ends of the manifolds are closed with plugs.

Claims

1. A manifold (1) for a heat exchanger (22), in particular for an automotive radiator, comprising:

a housing (4), which is a unitary element of a closed profile and has at least one longitudinal channel (5) defined therein, a plurality of slots (7) on one of the surfaces (8) of said housing (4), and two side surfaces (11), wherein said slots (7) are in fluid communication with said at least one longitudinal channel (5); and
a cover (2) applied at least on said slotted surface (8) and said side surfaces (11) of the housing (4) and having a plurality of slots (3) located at positions corresponding to the positions of said slots (7) of said housing (4) for introducing flat tubes (20) of the heat exchanger (22) into them, wherein said cover (2) is connected to said housing (4) by brazing;

characterized in that

said housing (4) further has undercuts (14, 15), on its outer surface covered by said cover (2), extending in the longitudinal direction of said housing (4) and forming channels for correct clad flow management between said housing (4) and said cover (2).

2. The manifold according to Claim 1, **characterized in that** said longitudinal undercuts (14) are provided on said slotted surface (8) of said housing (4).
3. The manifold according to Claim 1, **characterized in that** said longitudinal undercuts (15) are provided on said two side surfaces (11) of the housing (4).
4. The manifold according to Claim 1, **characterized in that** said longitudinal undercuts (14, 15) are provided both on said slotted surface (8) of the housing (4) and on said two side surfaces (11) of the housing (4).
5. The manifold according to Claim 1 or 2 or 4, **characterized in that** a side wall of the undercut (14) is inclined to its bottom at an angle of 90-150 degrees, and the depth of said undercut is greater than 0.4 mm.
6. The manifold according to Claim 1 or 3 or 4, **characterized in that** each undercut (15) has an asymmetrical shape, in which a side wall of said undercut (15) proximal to the corner (9) is perpendicular to the bottom of said undercut, while a wall located distal from the corner (9) is obliquely tapered to said side (11).
7. The manifold according to any one of the preceding Claims, **characterized in that** said housing (4) is made of aluminium and/or its alloys by extrusion, and said cover (2) is made of aluminium and/or its alloys by means of a stamping process.
8. The manifold according to any one of the preceding Claims, **characterized in that** said undercuts (14, 15) on said surfaces (8, 11) of said housing (4) extend in the extrusion direction.
9. The manifold according to any one of the preceding Claims, **characterized in that** a clad is applied at least on a surface of said housing (4) or said cover (2) to allow brazing.
10. The manifold according to Claim 9, **characterized in that** said clad is applied at least on one side of said cover (2) by plating method.
11. The manifold according to Claim 10, **characterized in that** said clad is applied on both side of said cover (2) by plating method.
12. The manifold (1) according to any one of the preceding Claims, **characterized in that** said cover (2) has thickness in a range from 0.8 mm to 2 mm.
13. The manifold according to any one of the preceding Claims, **characterized in that** the size of said slots (7) of said housing (4) is at least equal to or greater than the size of said slots (3) of said cover (2).
14. A heat exchanger (22), in particular an automotive radiator, comprising the manifold (1) according to any one of Claims 1-13.

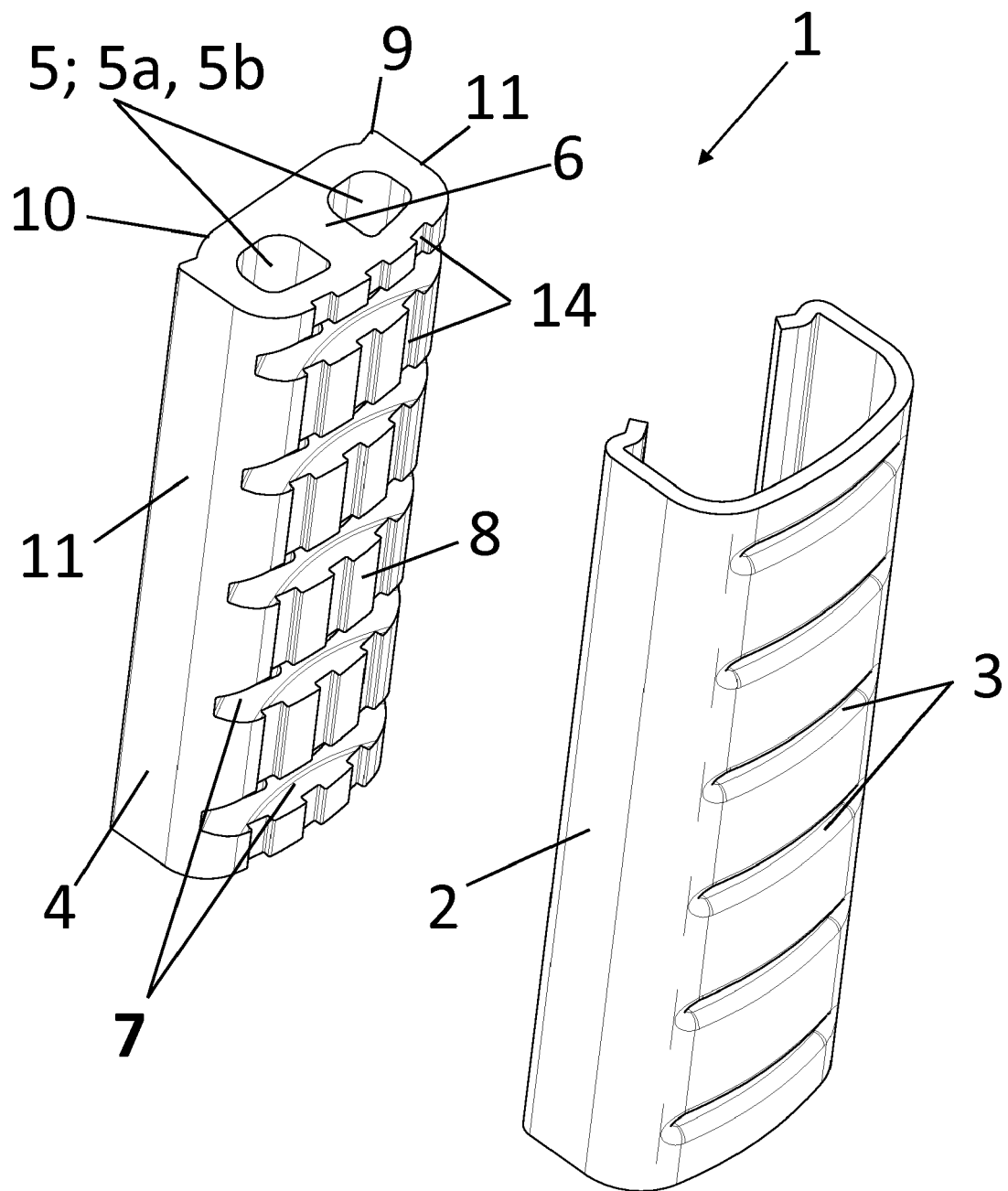


Fig. 1

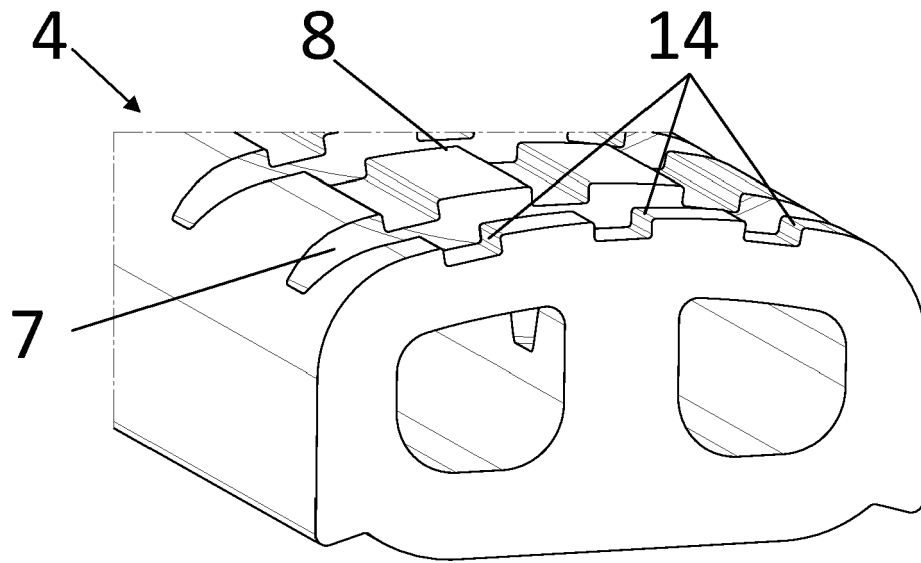


Fig. 2

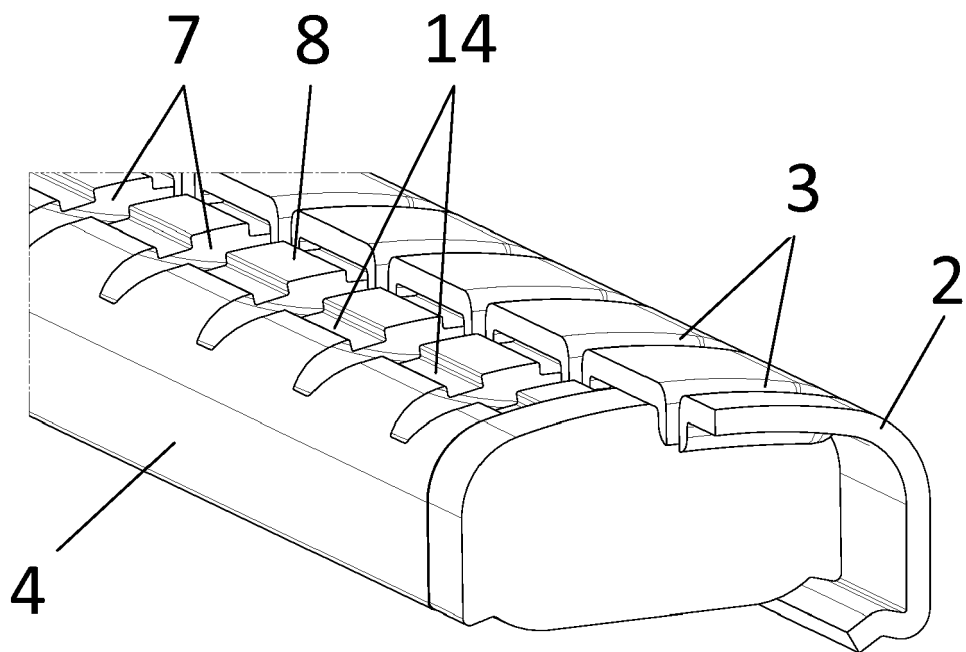


Fig. 3

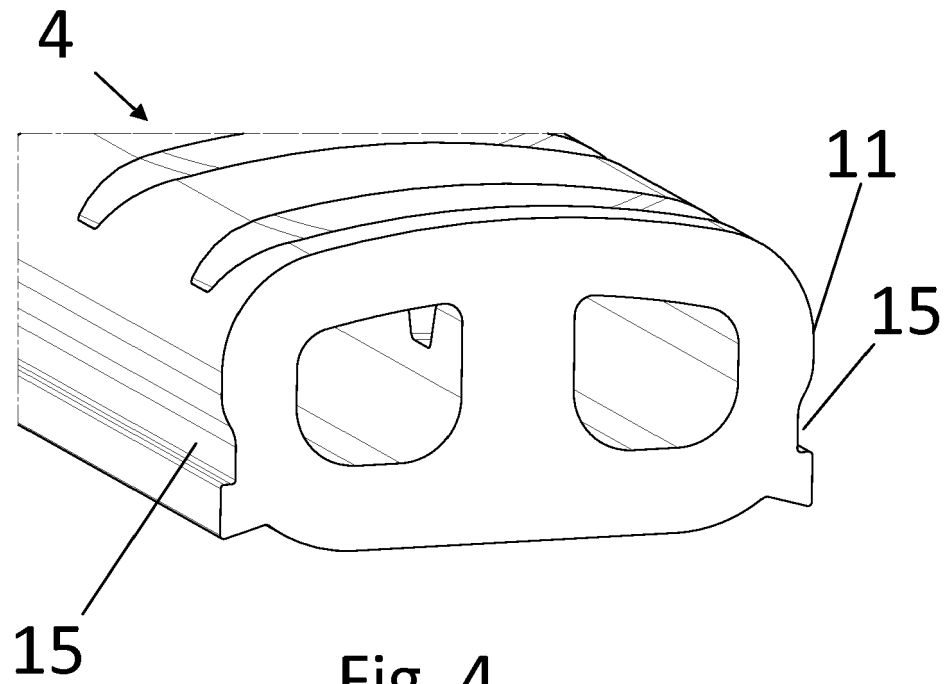


Fig. 4

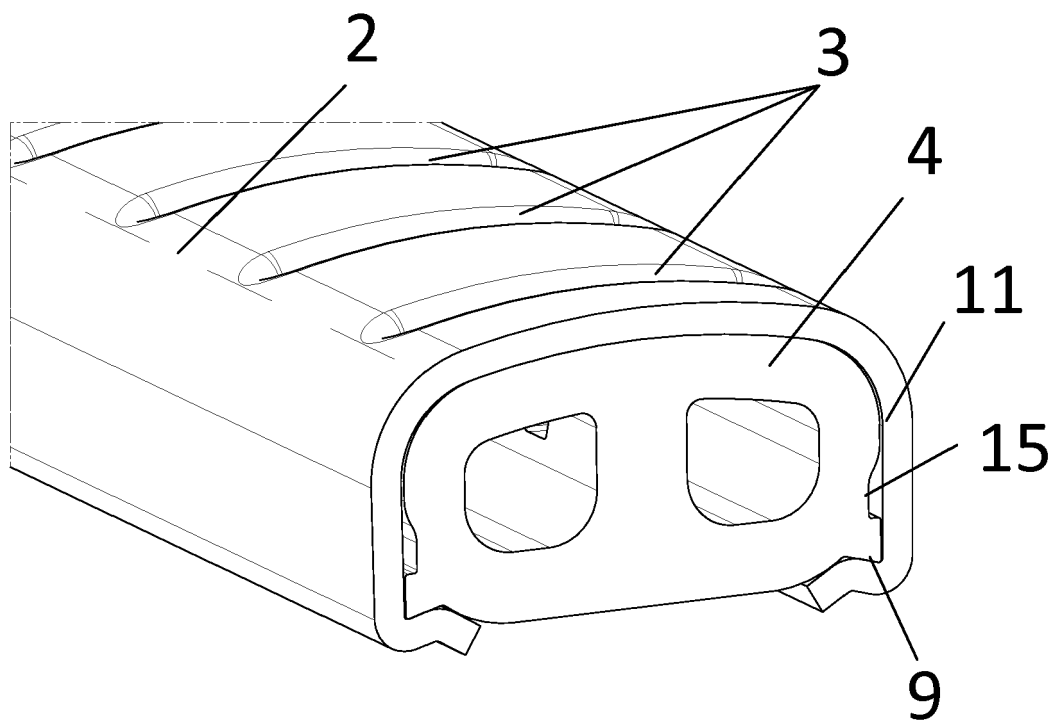


Fig. 5

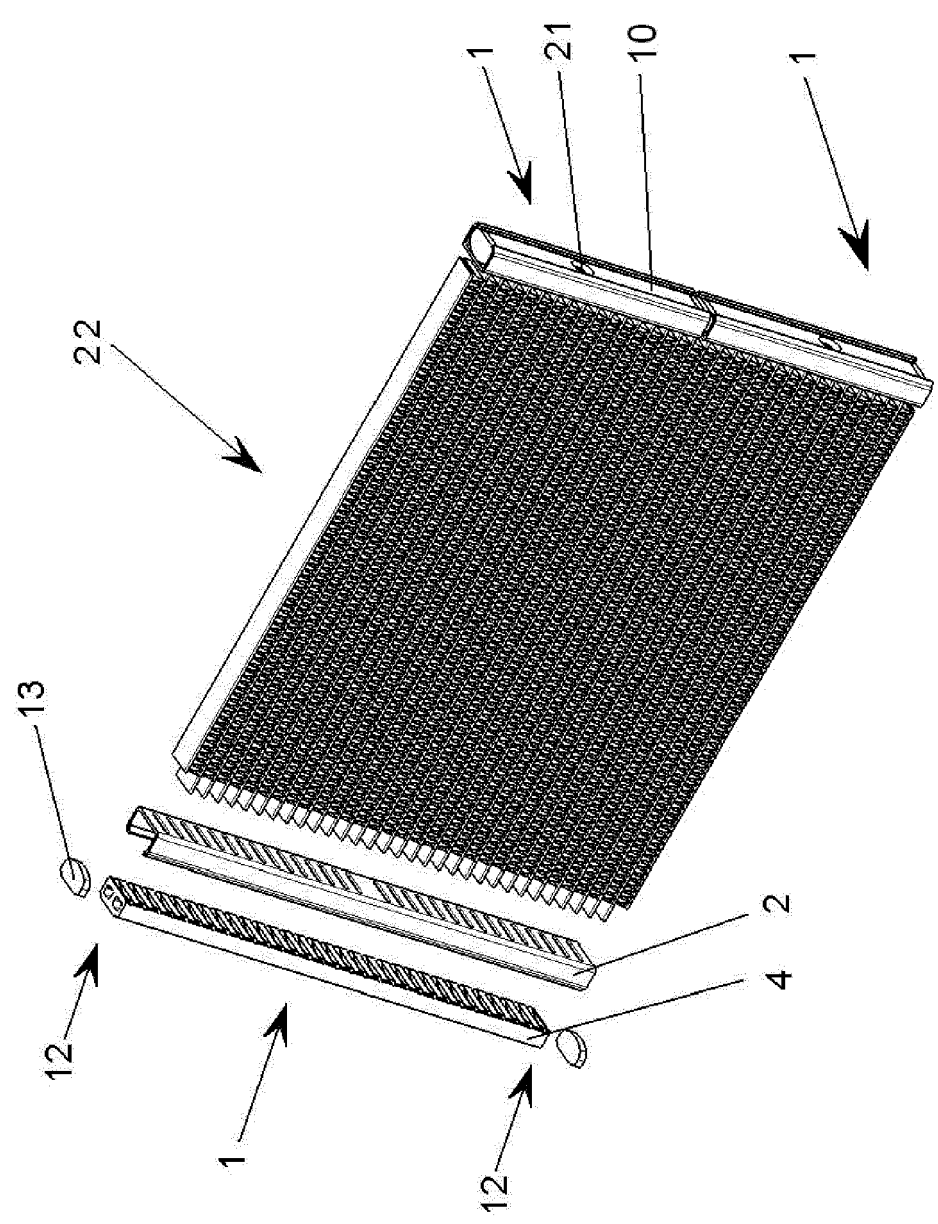


Fig. 6



EUROPEAN SEARCH REPORT

Application Number
EP 16 16 7508

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y,D	EP 2 960 609 A1 (VALEO AUTOSYSTEMY SP Z O 0 [PL]) 30 December 2015 (2015-12-30) * paragraphs [0007] - [0010]; figures 1,2 *	1-14	INV. F28D1/053 F28F9/02
Y	WO 02/35170 A1 (SHOWA DENKO KK [JP]; SHIMANUKI HIROYASU [JP]; HOSHINO RYOICHI [JP]; OG) 2 May 2002 (2002-05-02) * page 17, lines 16-25; figure 7 *	1-14	
A	US 6 564 863 B1 (MARTINS CARLOS [FR]) 20 May 2003 (2003-05-20) * the whole document *	1-14	
A	US 2008/105419 A1 (OH KWANGHEON [KR] ET AL) 8 May 2008 (2008-05-08)	1-14	
A	DE 195 24 052 A1 (BEHR GMBH & CO [DE]) 2 January 1997 (1997-01-02) * the whole document *	1-14	
A	JP H02 309196 A (NIPPON DENSO CO) 25 December 1990 (1990-12-25) * abstract *	1-14	TECHNICAL FIELDS SEARCHED (IPC) F28D F28F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 5 October 2016	Examiner Axters, Michael
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 16 16 7508

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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05-10-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2960609 A1	30-12-2015	CN 105318770 A EP 2960609 A1 US 2015377560 A1	10-02-2016 30-12-2015 31-12-2015
WO 0235170 A1	02-05-2002	AU 1267702 A WO 0235170 A1	06-05-2002 02-05-2002
US 6564863 B1	20-05-2003	DE 60038534 T2 EP 1131594 A1 ES 2306660 T3 FR 2793014 A1 JP 2002543368 A US 6564863 B1 WO 0066964 A1	10-06-2009 12-09-2001 16-11-2008 03-11-2000 17-12-2002 20-05-2003 09-11-2000
US 2008105419 A1	08-05-2008	NONE	
DE 19524052 A1	02-01-1997	NONE	
JP H02309196 A	25-12-1990	NONE	

EPO FORM P0459

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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Patent documents cited in the description

- EP 2960609 A [0002]