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(54) **Manifold, in particular for use in a cooler of a cooling system**

(57) A manifold (1), in particular for use in a cooler (19) of a cooling system, comprises a housing (4), which is a unitary element having a closed profile and has at least one longitudinal channel (5) defined therein and also a plurality of slots (10) on one of surfaces of the housing (4), which slots (10) are in fluid communication with the longitudinal channel (5). The manifold (1) further comprises a covering profile (2) applied on the housing (4), having a plurality of slots (3) at positions corresponding to the positions of the slots (10) of the housing (4) and fixedly connected to the housing (4). The slots (3, 10) of both components of the manifold (1) are adapted for receiving tubes (17) of the cooler (19), while the longitudinal channel (5) has on its surface (6) a stopping means (8) against which the tubes (17) of the cooler (19) may abut.

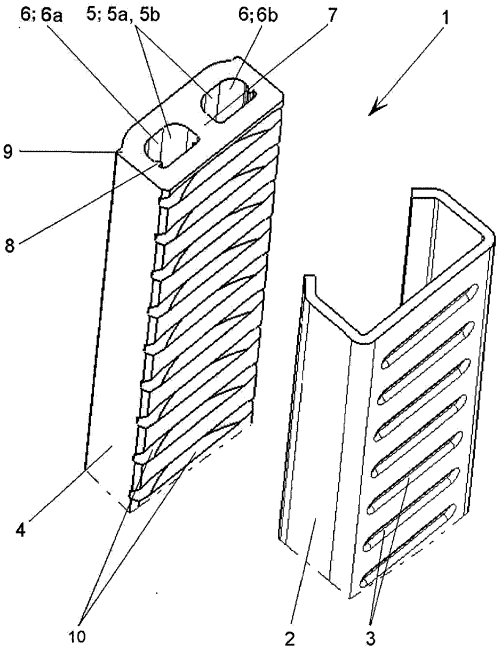

Fig. 1

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Description

Technical Field

[0001] The present invention relates to a manifold, in particular for use in a cooler of a cooling system.

Background Art

[0002] There are known, for example from US2003/0155109 A1, manifolds consisting of two components, namely an inner housing and a covering profile, which is applied and bent on the inner housing. Both those elements are provided with plurality of corresponding slots for introduction of tubes of the cooling assembly/supplying a cooling medium, which tubes are introduced only into the covering profile. The inner housing is provided with a channel defined therein for the flow of the cooling medium. Such a solution, however, results in that it is required to use so-called "end-forming" process, for example by thinning the end of the inserted tube so that only the thinned part of the tube is inserted into the slot of the covering profile, while its non-thinned portion abuts against that covering profile to maintain permeability of the tubes. Manufacturing of the tubes is thus more complicated and additionally during the end-forming process an uncontrolled process of clogging or deforming of the tube channels (especially the extreme ones) may occur what is disadvantageous to the thermal efficiency of the cooler.

[0003] The aim of the present invention is to provide a manifold that is simpler and less expensive to manufacture, by means of which the need for any additional processing of the pipes of the cooling assembly is avoided, and which at the same time ensures in any case permeability of the tubes of the cooling assembly, despite its deep insertion into the manifold.

Disclosure of the Invention

[0004] The above object is achieved by a manifold according to claim 1 and the following dependent claims. The manifold comprises a housing which is a unitary element having a closed profile and which is provided with at least one longitudinal channel defined therein and also a plurality of slots on one of surfaces of the housing. The slots are in fluid communication with at least one longitudinal channel. The manifold further includes a covering profile superimposed on the housing and provided with a plurality of slots at positions corresponding to the positions of the slots of the housing. The covering profile is firmly connected to and sealed against the housing while the slots of the covering profile are adapted for receiving cooler tubes. The manifold according to the invention is characterized in that at least one longitudinal channel of the housing has on its surface a stopping means against which the cooler tubes may abut while the slots of the housing are also adapted for receiving the cooler tubes.

[0005] The manifold developed in this way is simple and easy to manufacture. Through the use of the stopping means it is not necessary to machine the ends of the cooler tubes and it is ensured that the inlets/outlets of the tubes themselves are always exposed, thus providing the maximum permeability of the gas cooler assembly. Furthermore, the ends of the tubes are not in contact with the optionally plated parts, i.e. the covering profile. Thanks to that the risk of clogging of the channels with the plating material in its liquid phase associated with the capillary effect (rising of the molten solder into the slots) is less critical. Furthermore, the fact that the tubes are received in the interior of the housing causes that the gas cooler assembly comprising manifolds according to the invention is already quite stiff before the permanent connection of components, while its individual elements are fixed relative to each other, what considerably facilitates the permanent connection of all components of the assembly to each other, for example by brazing.

Brief description of the drawings

[0006] The present invention is illustrated in its embodiments in the accompanying drawings, in which:

Fig. 1 shows an exploded perspective view of the manifold according to a first embodiment of the invention.

Fig. 2 shows a perspective view of the assembled manifold according to the first embodiment of the invention.

Fig. 3 shows a cross sectional view of the manifold according to the first embodiment of the invention with the flat tubes introduced.

Fig. 4 shows detail A of fig. 3.

Fig. 5 shows a cross sectional view of the manifold according to a second embodiment of the invention with the flat tubes introduced.

Fig. 6 shows detail B of Fig. 5.

Fig. 7 shows the gas cooler assembly with the manifolds according to the invention.

Embodiments of the Invention

[0007] The manifold 1 according to the invention comprises a cap or covering profile 2 and an inner housing 4. The covering profile 2 is manufactured from a plate, preferably of aluminium and/or its alloys, having a thickness of 0.8 mm to 2 mm, preferably 1 mm, by means of pressing process and bent in such manner that it substantially replicates the external shape of the inner housing 4. By such a structure of the covering profile 2 it is

easy to manufacture. The covering profile 2 made of aluminium and/or its alloys may be plated on its one or both sides and has a plurality of slots 3 arranged in a single row, into which flat tubes 17 of a gas cooler 19 are introduced during the use of the manifold 1. The slots 3 are precisely made slots, so that the flat tubes 17, having internal passages, are tightly received in these slots 3.

[0008] The inner housing 4 has a closed hollow profile, it is an unitary element, it is manufactured using an extrusion process, it has thick and solid walls, whereby it is resistant to high operational pressure, and 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 7 in order to strengthen the structure of the inner housing 4 and the entire manifold 1. The inner housing 4 is also provided in its interior, i.e. on surfaces 6a, 6b of the channels 5a, 5b, with stopping elements 8, against which the inserted flat tubes 17 abut. In this embodiment, the stopping elements 8 are in the form of projections 8a extending along the channels 5a, 5b and from their surfaces 6a, 6b towards the interior of the channels 5a, 5b. Furthermore, also the inner housing 4 has a plurality of slots 10 at positions corresponding to the positions of the slots 3 in the covering profile 2, which the slots 10 need not be made with such accurate dimensions as the slots 3 of the covering profile 2, that is, their dimensions do not have to be exactly matched to the dimensions of the flat tubes 17, it is sufficient for the slots 10 to have a size larger than, or at least the same as, the size of flat tubes 17, and hence also the slots 3. This results in that the flat tubes 17 are received loosely in the slots 10 and tightly in the slots 3. The slots 10 can be made by a process using a milling saw, which process does not have to be precise, with the result that the inner housing 4 made in that way is simple and cheaper to manufacture. Furthermore, the slots 10 are in fluid communication with the channels 5a, 5b of the inner housing 4. Just like the covering profile 2, the inner housing 4 is also preferably made of aluminium and/or its alloys.

[0009] As illustrated in fig. 2, the covering profile 2 is applied on and bent over the inner housing 4, in particular over its corners 9, so that, preferably, a larger portion of one of the outer surfaces of the inner housing 4, preferably an exposed surface 12 opposite to the surface on which the slots 10 are made remains uncovered by the covering profile 2. Of course, the covering profile 2 does not have to cover almost entire or entire surface of the inner housing 4. It is sufficient that the covering profile 2 covers at least that surface of the inner housing 4, in which the slots 10 are positioned, in such a case the covering profile 2 does not cover most of the housing 4 as it is the case in the currently described preferred embodiment, whereby the housing 4 is no longer positioned inside the bent covering profile 2, but rather these two elements are mutually adjacent. The covering profile 2 extends longitudinally beyond the profile of the inner housing 4, namely beyond ends 14 of the housing so as to form a seat 15 for a baffle/plug 16, preferably of aluminium and/or its alloys, for sealing the ends 14 of the inner housing 4 and the entire manifold 1. However, in another embodiment there is no need to form such a seat, in which case the ends of both the covering profile 2 and the inner housing 4 are aligned with each other, as a result of which the plug 16 rests on both those elements. The covering profile 2 and the inner housing 4 are joined together and sealed against each other, as well as with respect to the plug 16, by brazing in a brazing furnace. This causes sealing of all contact edges between these elements. The manifold 1 assembled in this way has a substantially rectangular cross-section.

[0010] In use of the manifold 1 according to the invention in the gas cooler assembly 19, the flat tubes 17, between which ribs 18 extend, are introduced into the slots 3, 10 in both components of the manifold 1. The tubes are firstly received tightly in the slots 3 and next loosely in the slots 10 and abut against the stopping elements 8 in the inner housing 4 with the result that their further movement into the inner housing 4 is prevented. This also results in that the outlets/inlets of flat tubes 17 will not be blocked/closed by the surfaces 6a, 6b of the channels 5a, 5b. Such configuration also allows precise and easy assembling of the entire gas cooler assembly, and it ensures that elements of the assembly assembled in such a way will not rotate or otherwise move relative to each other before/during brazing, while eliminating the need for using so-called "end-forming" process. The flat tubes 17 are secured to and sealed against the manifold 1 by brazing between the flat tube 17 and the covering profile 2, i.e. around the slots 3.

[0011] Figures 5 and 6 show a second embodiment of the manifold 1 according to the invention. General design of the manifold 1 according to this embodiment is the same as in the first embodiment shown in figures 1-4. However, in this case, the inner housing 4 is provided only with a single longitudinal channel 5 being in fluid communication with the slots 10, and thus only one surface 6 of the longitudinal channel 5, i.e. the interior of the inner housing 4 is not divided by the reinforcing arch 7 into two separate channels 5a, 5b. The assembled manifold 1 has a configuration similar to cylindrical and due to the fact that such a configuration is naturally resistant to high pressure and the diameter of the tube is not large (of the order of several/several tens of millimetres) the use of the reinforcing arch 7 is not necessary. In this embodiment, the stopping element 8 is in the form of a notch 8b on the inner surface of the inner housing 4, i.e. the surface 6 of the longitudinal channel 5, at the slot 10. Moreover, the inner housing 4 has on its outer surface, near the slots 10, two opposite longitudinal projections 11. These projections 11 are main brazing points serving to enhance sealing process of the manifold 1 and also the process of joining its components together. By using the projections 11 an assembly is obtained, in which at least these two projections 11 and, hence, the inner housing 4, contact with the covering profile 2 over the entire

length of the tube, thereby providing a correct and effective brazing. Furthermore, the projections 11 improve the effect of bending the covering profile 2 over the inner housing 4.

[0012] Fig. 7 shows the gas cooler assembly of the cooling system, in which manifolds 1 according to the invention are used. On the right-hand side of the gas cooler 19 there are arranged two separate manifolds 1, wherein one of them is used for supplying the cooling medium into the cooler, while the other is for discharging that medium. These manifolds 1 are provided on their exposed surfaces 12, uncovered by the covering profile 2, with apertures/ports 13 for connection to an external circuit of the cooling medium. These openings are in fluid communication with the channels 5, 5a, 5b of the inner housing 4. The manifold 1 shown on the left-hand side of the gas cooler 19 is not provided with such openings 13, as a result of which it is merely an intermediate element in the gas cooler assembly 19, i.e. the cooling medium flows into one of the manifolds 1 on the right-hand side of the assembly, flows through a portion of the flat tubes, flows into the manifold 1 on the left-hand side of the assembly, then flows again into the flat tubes 17, and flows out the other of the manifolds 1 on the right-hand side of the assembly. In other embodiments of the gas cooler assembly 19, one manifold 1 is used on each side of the assembly, each of which has an aperture/port 13, and one of the manifolds is an inlet manifold while 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 apertures/ports 13, and the other has two apertures/ports 13 for supplying and discharging the cooling medium.

[0013] Note that it is possible to replace the technical features between the above-described embodiments of the invention. For example, in the inner housing 4 having two separate channels 5a, 5b the stopping elements 8 in the form of the notches 8, 8b can be used, while in the inner housing 4 having a single channel 5, the stopping elements 8 in the form of the projections 8a can be used. It is also not necessary to use two stopping elements 8, in many practical applications only one is sufficient, furthermore the position of these elements in relation to the slots 10 can vary, i.e. adjacently to the slots 10 or at some distance from them. It is also possible to connect several manifolds 1 into one longer manifold, in such a case, the manifolds without plugs 16 are used and are firmly butt joined, and only the extreme ends of the manifolds are closed by plugs 16.

Claims

1. A manifold (1), in particular for use in a cooler (19) of a cooling system, comprising:

a housing (4), which is a unitary element having a closed profile and has at least one longitudinal channel (5) defined therein and also a plurality of slots (10) on one of surfaces of said housing (4), said slots (10) being in fluid communication with said at least one longitudinal channel (5); and

a covering profile (2) applied on said housing (4) and having a plurality of slots (3) at positions corresponding to the positions of said slots (10) of said housing (4), said covering profile (2) being fixedly connected to and sealed against said housing (4), said slots (3) of said covering profile (2) being adapted for receiving tubes (17) of said cooler (19) ;

characterized in that

said at least one longitudinal channel (5) has on its surface (6) a stopping means (8) against which said tubes (17) of said cooler (19) may abut; and

said slots (10) of said housing (4) are also adapted for receiving said tubes (17) of said cooler (19).

2. A manifold according to Claim 1, **characterized in that** said stopping means (8) is in the form of opposing projections (8a) on said surface (6) of said at least one longitudinal channel (5), said projections (8a) being directed towards the interior of said at least one longitudinal channel (5) and arranged at said slots (10) of said housing (4).

3. A manifold according to Claim 1, **characterized in that** said stopping means (8) is in the form of notches (8b) on said surface (6) of said at least one longitudinal channel (5), said notches (8b) being arranged at said slots (10) of said housing (4).

4. A manifold according to any one of the preceding Claims, **characterized in that** the size of said slots (10) of said housing (4) is at least equal to or greater than the size of said slots (3) of said covering profile (2).

5. A manifold according to any one of the preceding Claims, **characterized in that** said at least one longitudinal channel (5) includes two channels (5a, 5b) separated by a reinforcing arch (7), each said channel (5a, 5b) having its own stopping means (8) on its surface (6a, 6b).

6. A manifold according to any one of the preceding Claims, **characterized in that** said covering profile (2) is so applied on said housing (4) that one surface (12) of said housing (4) is exposed, said surface (12) having at least one port (13) in fluid communication with said at least one longitudinal channel (5) for connection to an external circuit of a cooling medium.

7. A manifold according to any one of the preceding

Claims, **characterized in that** both said covering profile (2) and said housing (10) are made of aluminium and/or its alloys and are connected to each other by means of brazing.

8. A manifold according to any one of the preceding Claims, **characterized in that** it is closed at both of its ends by a plug (16).

9. A manifold according to claim 8, **characterized in that** said plug (16) is also made of aluminium and/or its alloys and is coupled to said covering profile (2) and said housing (10) also by means of brazing.

10. A cooler (19) comprising a manifold (1) according to any one of Claims 1-9.

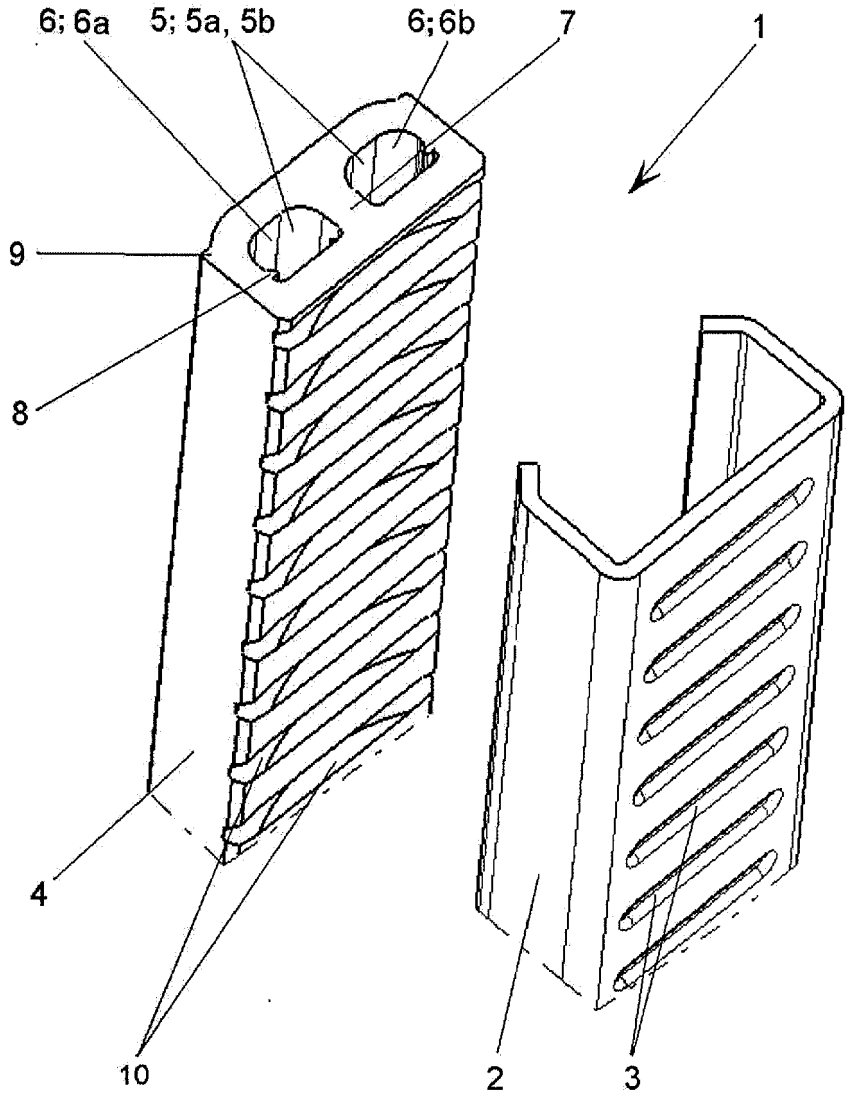

Fig. 1

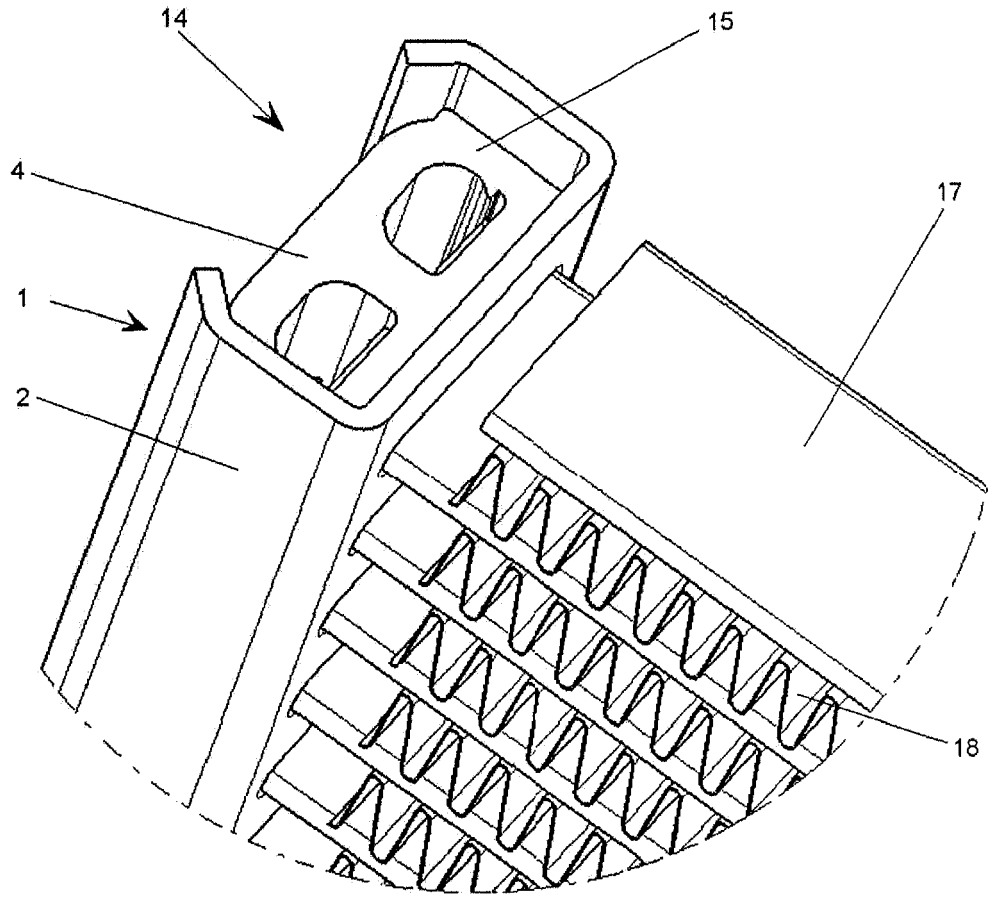

Fig. 2

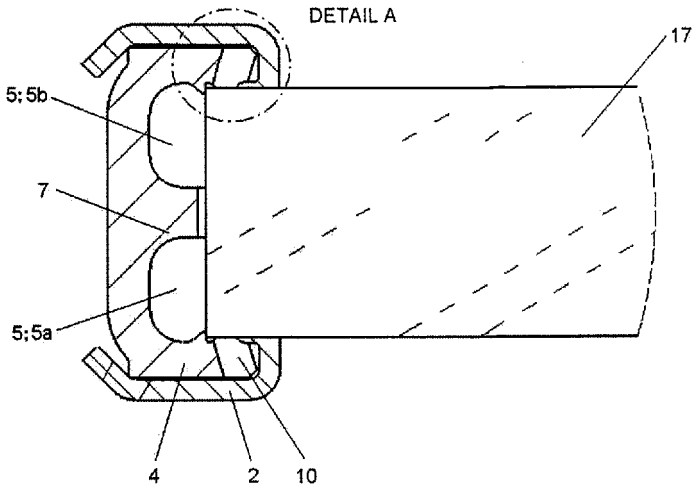

Fig. 3

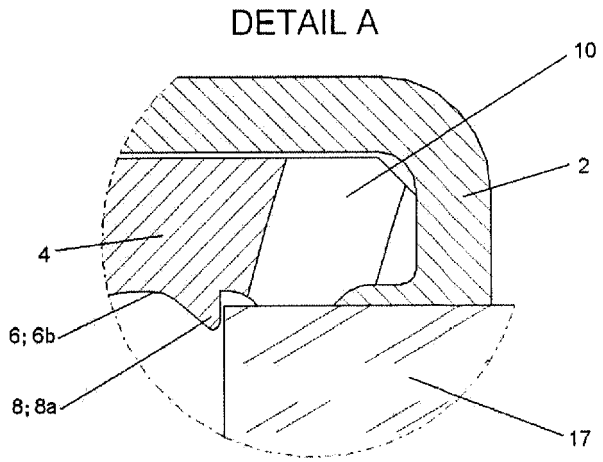

Fig. 4

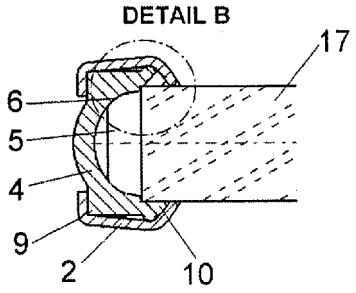

FIG. 5

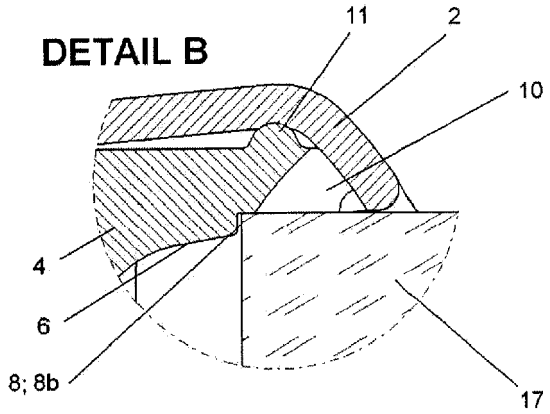

FIG. 6

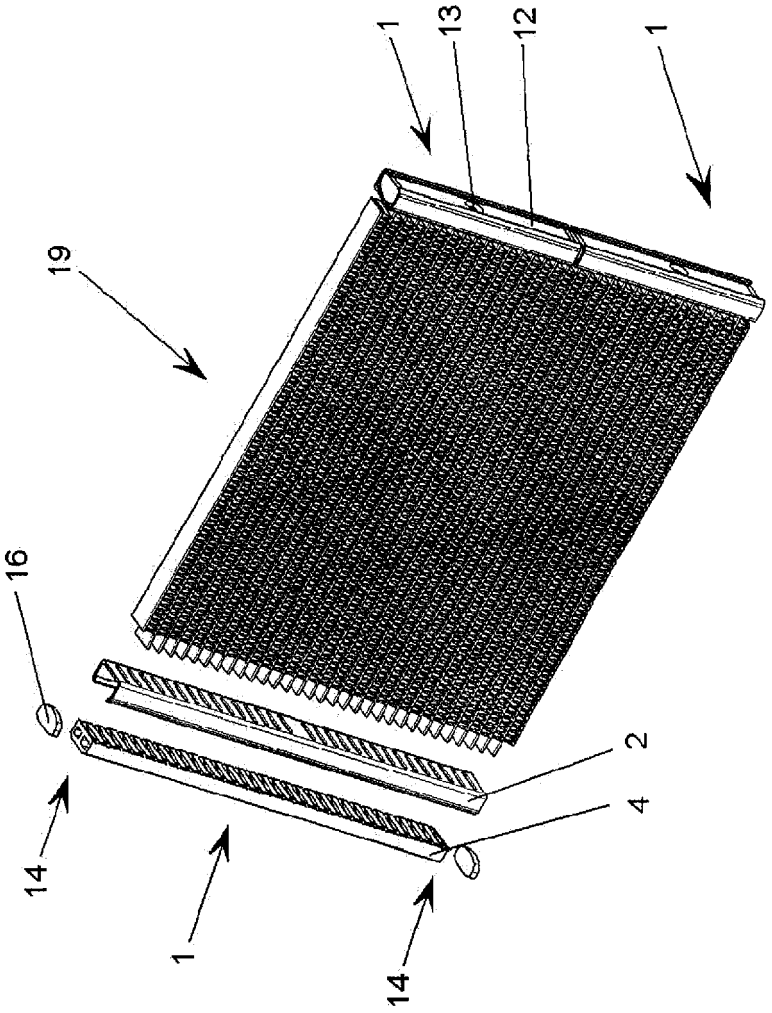

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 14 46 1546

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 September 2014	Axters, Michael

CATEGORY OF CITED DOCUMENTS

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