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(54) A heat exchanger

(57) The invention relates to a heat exchanger comprising a cooling core consisting of a plurality of parallel tubes and cooling fins, two header tanks (3) fluidly connected with opposite ends of each tube and end caps brazed to and tightly closing upper and lower ends of each header tank (3). The invention relates also to an integrated module comprising two heat exchangers of this type and coupled with common end caps (4a), in particular a vehicle CRFM (Condenser, Radiator, cooling Fan Module). To enable a one-shot brazing operation of the heat exchanger or the integrated module, each end cap (4a) has a flat surface (5) closing and recessed inside the header tank (3) profile and provided with a bead (7) on the periphery thereof, and at least two protrusions (8) adjoining to the side walls of the header tank (3) and provided with C-shaped latches (9), the ends of which engage on the corresponding projections (10) on external side walls of the header tank (3).

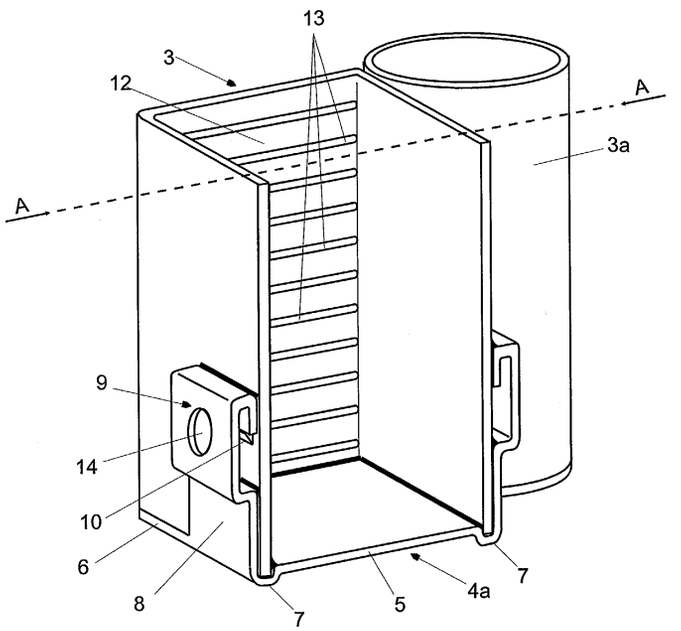

Fig 2

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Description

[0001] The invention relates to a heat exchanger comprising a cooling core consisting of a plurality of parallel tubes and cooling fins, two header tanks fluidly connected with opposite ends of each tube and end caps brazed to and tightly closing upper and lower ends of each header tank. The invention relates also to an integrated module comprising two heat exchangers of this type and coupled with common end caps, in particular a vehicle CRFM (Condenser, Radiator, cooling Fan Module).

[0002] Generally heat exchangers of this type are provided with brackets used to secure the heat exchanger to a vehicle chassis or as supporting points or bases for fixing other elements, in particular a fan and a fan shroud. The brackets should have the suitable rigidity, reliability of the attachment and resistance to mechanical vibrations generated during operation of the heat exchanger. It is also a desirable feature if the heat exchanger or an integrated CRFM module enables a one-shot brazing operation, which improves the process of manufacturing the heat exchanger and decreases its costs.

[0003] U.S. Pat 5,441,100 discloses a heat exchanger having headers closed with end caps having a pin protruded upward or downward and integral with a cap, which is used to mount the heat exchanger on a structural base, such as vehicle chassis.

[0004] An integral type heat exchanger is disclosed e. g. in U.S. Pat 6,364,005. According to these teachings the radiator and the condenser are connected with each other with end plates closing the openings of the headers and provided with separate pins attached to the appropriate mounting holes of end plates. The end plates are provided with rectangularly and circularly recessed lock members and temporarily fitted to the openings of the headers via a brazing material piece.

[0005] The object of the present invention is to provide a heat exchanger or a CRFM module of the type mentioned above, having end caps brazed to and tightly closing upper and lower ends of each header tank, that have a simple one-part and economic construction, ensure a leakproofness of connection and enables a one-shot brazing operation of the heat exchanger or the integrated module.

[0006] Another object of the present invention is to provide the heat exchanger having end caps that may be used to mount the heat exchanger e.g. to a vehicle chassis and/or as an assembly feature or bracket for fixing additional elements, such as puller and pusher shroud, wires, cables, etc.

[0007] According to the present invention there is provided a heat exchanger having end caps brazed to and tightly closing upper and lower ends of each header tank, characterised in that each end cap has a flat surface closing and recessed inside the header tank profile and provided with a bead on the periphery thereof, and at least two protrusions adjoining to the side walls of the header tank and provided with C-shaped latches, the ends of which engage on the corresponding projections provided on external side walls of header tank.

[0008] The end caps serve as a separator, providing leakproofness of connection and as an assembly feature (bracket) for additional elements. The end cap is assembled to the heat exchanger through a snap connection, which assures its position and protect from self movement during the brazing operation. The flat recessed surfaces of the end caps block the header tank and the end cap from displacements in relation to each other. Such displacements might occur due to thermal expansion during the furnace brazing operation. Furthermore the recessed surfaces ensure increased surface of joint between the end cap and the header tank. The end cap may be used in various types of heat exchangers, providing the shape and dimensions of the header tanks profiles are the same and their walls are provided with projections. The projections can easily be made by chiselling, the Tog lock method or any other suitable way, known to a person skilled in the art.

[0009] The end cap can also serve as a connector coupling two heat exchangers of the integrated CRFM module.

[0010] Preferably the circumferential bead extends into a circumferential wall.

[0011] It is advantageous if the C-shaped portion of the end cap has at least one, preferably circular aperture.

[0012] The heat exchanger according to the present invention is presented below by way of example embodiments in connection with the drawings on which:

Fig. 1 is a perspective view of an integrated vehicle CRFM module according to the present invention comprising four end caps;

Fig. 2 is an enlarged perspective view of a portion of a heat exchanger with the end cap according to the present invention in cross-section;

Fig. 3 is a front cross-section of a portion of a heat exchanger shown in Fig. 2 along the vertical plane going through the line A-A of Fig. 2;

Fig. 4 is a cross-section of another embodiment of the end cap;

Fig. 5 is a cross-section of yet another embodiment of the end cap;

Fig. 6 is a perspective view of one more embodiment of the end cap; and

Fig. 7 is a plan view of the end cap shown in Fig.6.

[0013] Fig. 1 shows an integrated vehicle CRFM module comprising two heat exchangers: vehicle's cooling

system radiator 1, and the condenser of a vehicle air condition system 1 a. The main component of each heat exchanger 1 (1 a) is a cooling core 2 (2a) comprising of a plurality of parallel tubes and cooling fins disposed between the tubes, which are fluidly connected with two header tanks 3 (3a). For simplicity of the drawing the inlet and outlet pipes, as well as other CRFM components are omitted in the drawing.

[0014] As shown the heat exchangers 1 and 1 a are coupled with each other by means of four end caps 4 tightly closing upper and lower ends of the headers 3 and 3a of the heat exchangers 1 and 1 a respectively, so as to form an integrated CRFM.

[0015] Each embodiment 4, 4a, 4b and 4c of the end cap shown in Fig. 1 to Fig. 6, has a form of a single-element shape, manufactured by die-stamping of the metal sheet, preferably brazing-material-clad-aluminium sheet.

[0016] Fig. 2 and Fig 3 show the end cap 4a in cross-sectional perspective view and in front view respectively, along with portions of the header tanks 3 and 3a of the heat exchangers 1 and 1a. The end cap 4a has two similar flat surfaces, of which only one, the surface 5 closing the header tank 3 is shown. Surface 5 is perpendicular to the header tank 3 longitudinal axis and depressed inside the header tank 3. The flat surface 5 on the periphery thereof is provided with a circumferential bead 7 that improves the leakproofness and strength of connection between the header tank 3 and the end cap 4 after brazing. Furthermore the end cap 4 has two protrusions 8 adjoining the side walls of the header tank 3 and two protrusions 8a (only one shown on the drawing) adjoining the side walls of the second header tank 3a.

[0017] Each protrusion 8 and 8a extends vertically and is provided with C-shaped latches 9 and 9a, respectively, which engage on the corresponding projections 10 and 10a provided on side walls of header tanks 3, 3a. In particular, each C-shaped latch 9 and 9a has four bend portions indicated successively as 11a, 11b, 11c and 11d. The first 11a and the third 11c portion are perpendicular to the side walls of the header tank 3, while the second 11b and the fourth 11d portions are parallel to the wall of the header tank 3. Additionally the endmost fourth portion 11d adjoins the side walls of the header tank 3 pointing back to the end of the header tank 3 and its edge engages on the top surface of the projection 10. The projections 10 are placed on both side walls of the rectangular header tank 3 that are perpendicular to its flat face 12 with apertures 13 for tubes of the cooling core 2. Furthermore the second bend portion 11b is provided with circular apertures 14, enabling mounting a CRFM to a vehicle chassis. The construction of protrusions 8a and latches 9a is similar; however the apertures are not present here.

[0018] During manufacturing the heat exchanger according to the invention, one should provide the header tanks 3 and 3a with projections 10 and 10a. The projections may be preferably made by means of chiselling of the header tanks walls or another method of deforming the walls of the header tanks 3 and 3a that permits to form edges on which the C-shaped latches 9 and 9a may engage, e.g. the Tog lock method. After mounting the cooling core 2 tube of the radiator 1 into appropriate apertures 13 of the header tank 3, and similarly mounting a cooling core 2a tube of the condenser 1 a into appropriate apertures of the header tank 3a, the end caps 4 are snapped on the open ends of the header tanks, coupling two heat exchangers. The latches 9 and 9a of the end cap 4 engage on the corresponding projections 10 and 10a securing the connection. Finally, after preliminary assembling the CRFM, the entire unit is placed in a furnace, where the one-shot brazing process is carried out.

[0019] Further description presents some other embodiments of the end cap. Reference numerals of the elements performing the same functions correspond to those shown in Fig. 1 to Fig.3.

[0020] Fig. 4 shows another embodiment of the end cap 4b for closing only one heat exchanger. The construction of the end cap 4b is simpler, since the flat surface 5 of the end cap corresponds to the virtual end surface of only one header tank 3. Additionally the C-shaped latch 9 of the protrusion 8 has only three bend portions (11a, 11b and 11c) while the endmost bend portion 11c is perpendicular to side wall of the header tank 3 and engages on the projection 10, made by the Tog lock method.

[0021] Another embodiment of the end cap 4c is shown in Fig. 5. The C-shaped latch 9 comprises of only two bend portions 11b and 11c. The first bend portion 11b is inclined to the side wall of the header tank 3 and the second bend portion 11c is perpendicular to the side wall of the header tank 3.

[0022] Yet another form of the end cap 4d is shown in Fig. 6 and Fig. 7. Here the end cap is a closing part or separator of a circular header tank 3. The end cap 4d has a flat surface 5 surrounded by a circumferential wall 6 and is provided with three protrusions 8 comprising latches 9 having a similar construction to that shown in Fig. 4 and placed equidistantly on the perimeter of the header tank 3. The edge of the third bend portion 11c engages with the projection 10 and its surface corresponds to a curvature of the header tank 3.

Claims

1. A heat exchanger comprising a cooling core consisting of a plurality of parallel tubes and cooling fins, two header tanks fluidly connected with opposite ends of each tube and end caps brazed to and tightly closing upper and lower ends of each header tank, **characterised in that** each end cap has a flat surface (5) closing and recessed inside the header tank (3) profile and provided with a bead (7) on the periphery thereof, and at least two protrusions (8)

adjoining to the side walls of the header tank (3) and provided with C-shaped latches (9), the ends of which engage on the corresponding projections (10) on external side walls of the header tank (3).

2. A heat exchanger as claimed in claim 1, **characterised in that** is integrated with the second heat exchanger (1a) by means of the end caps (4a) closing header tanks (3, 3a) of two heat exchangers (1, 1a).

3. A heat exchanger as claimed in claim 1, **characterised in that** the circumferential bead (7) extends into a circumferential wall (6).

4. A heat exchanger as claimed in claim 1 or 2 or 3, **characterised in that** the C-shaped latch (9) of the end cap (4, 4a, 4d) comprises four bend portions (11a, 11b, 11c, 11d).

5. A heat exchanger as claimed in claim 1 or 2 or 3, **characterised in that** the C-shaped latch (9) of the end cap (4b) comprises three bend portions (11a, 11b, 11c).

6. A heat exchanger as claimed in claim 1 or 2 or 3, **characterised in that** the C-shaped latch (9) of the end cap (4c) comprises two bend portions (11b, 11c); the first (11b) of which is inclined to the wall of the header tank (3) and the second (11c) is perpendicular to the side wall of the header tank (3).

7. A heat exchanger as claimed in claim 1 or 2 or 3, **characterised in that** the C-shaped latch (9) of the end cap has at least one aperture (14).

8. A heat exchanger as claimed in claim 7, **characterised in that** the aperture (14) is substantially circular.

9. A heat exchanger as claimed in any of preceding claims, **characterised in that** the end cap is made of brazing-material-clad-aluminium sheet.

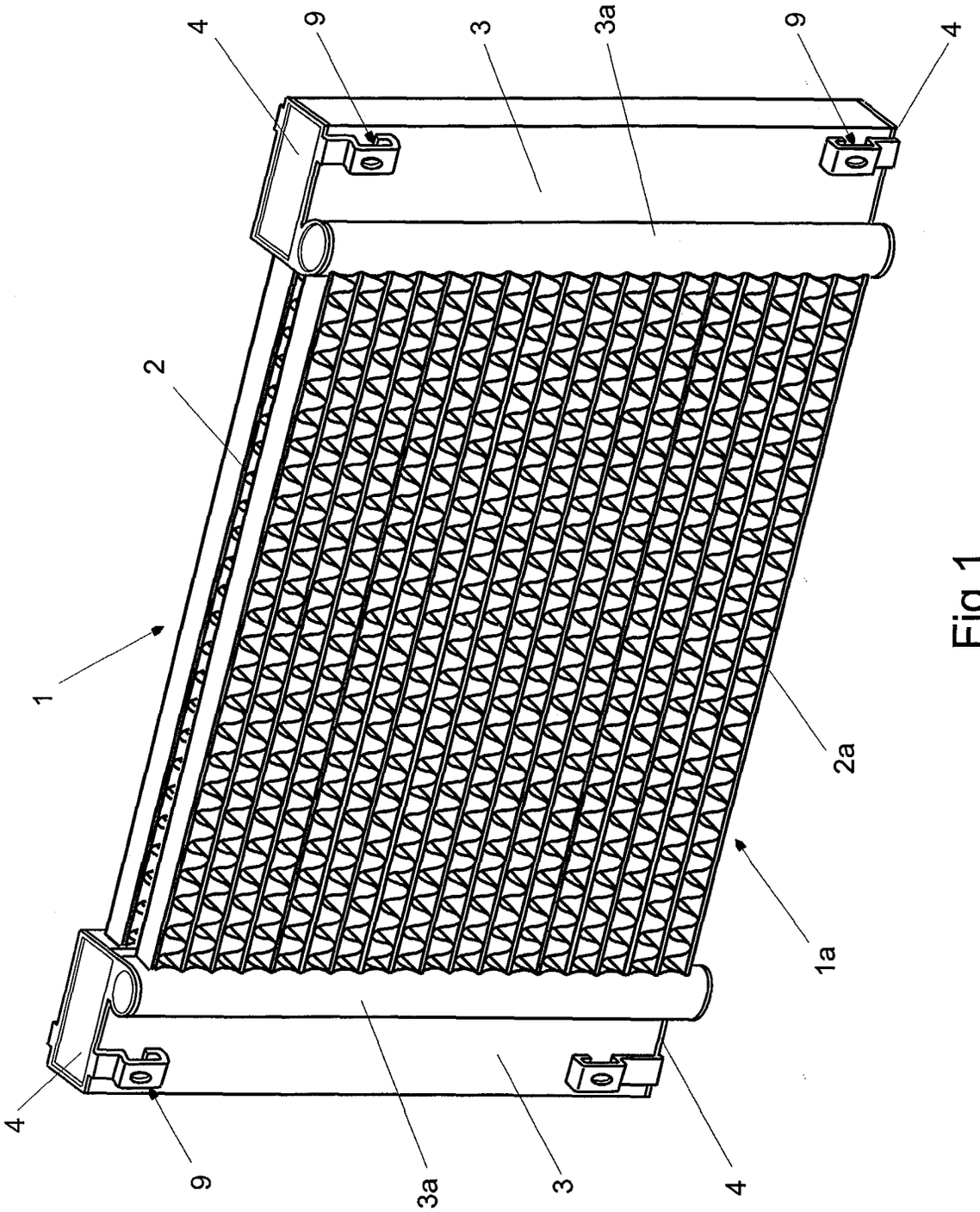

Fig 1

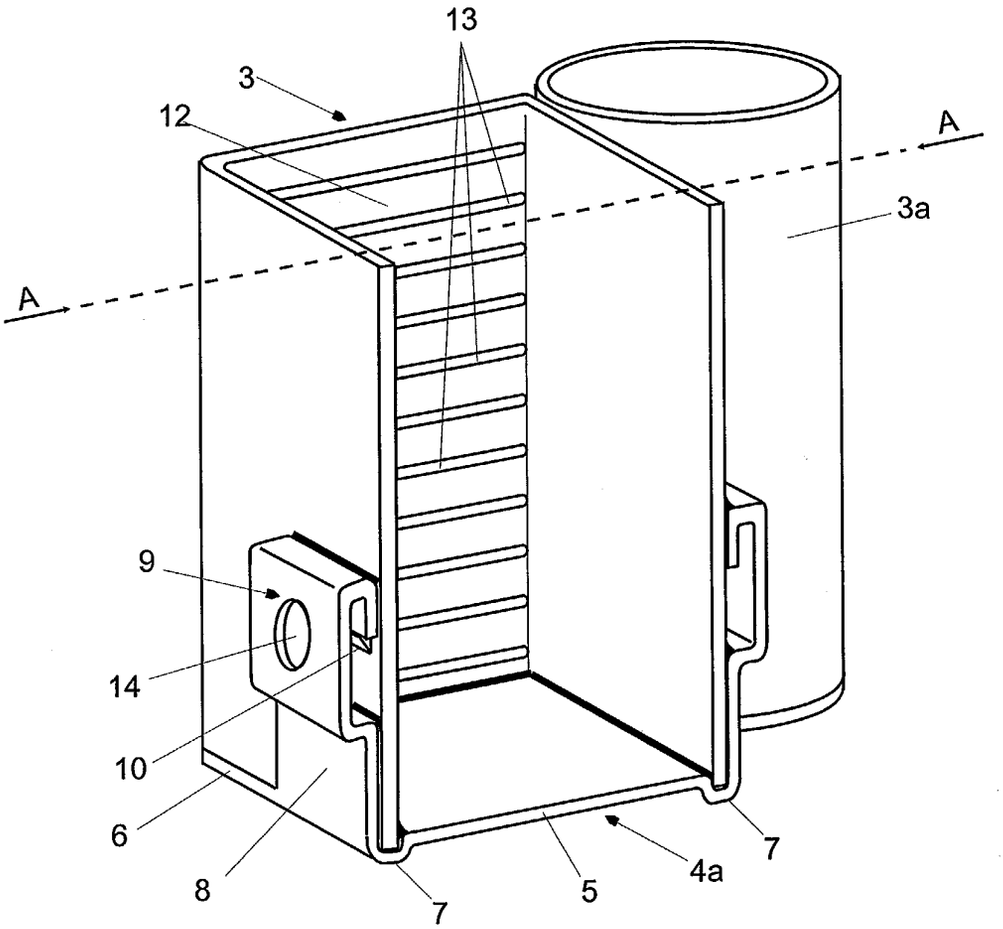
13
3
12
A
A
3a
9
14
10
6
8
7
5
4a
7

Fig 2

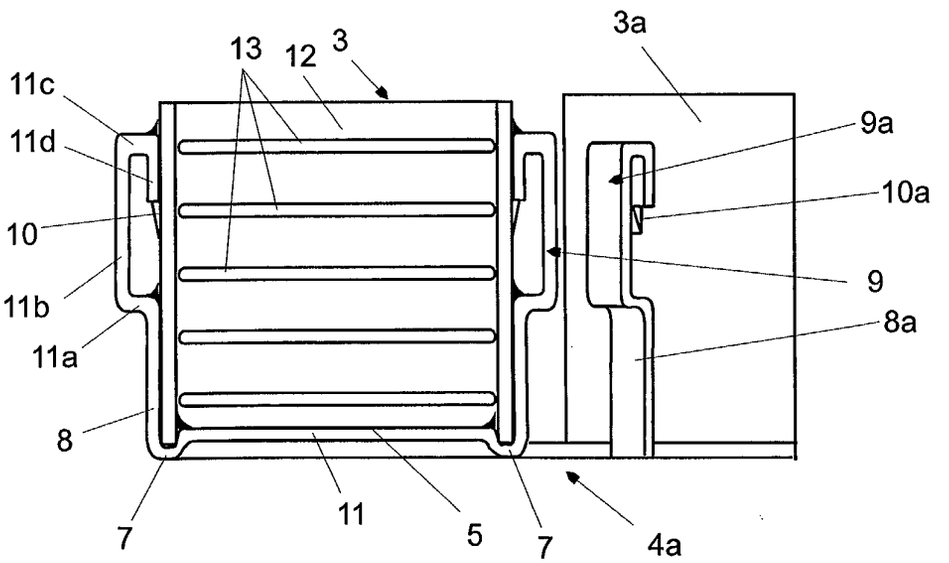
3a
13
12
3
11c
11d
9a
10a
10
9
11b
8a
11a
8
7
11
5
7
4a

Fig 3

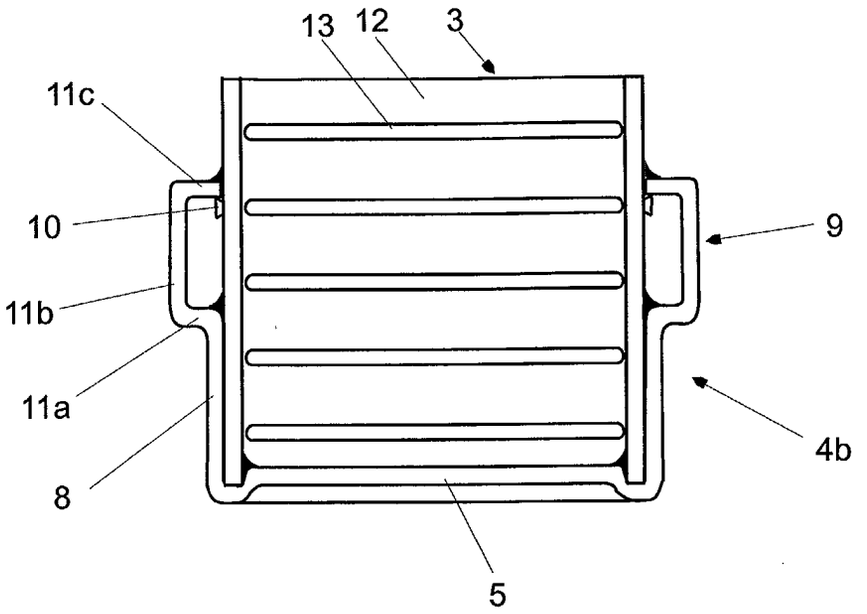

Fig 4

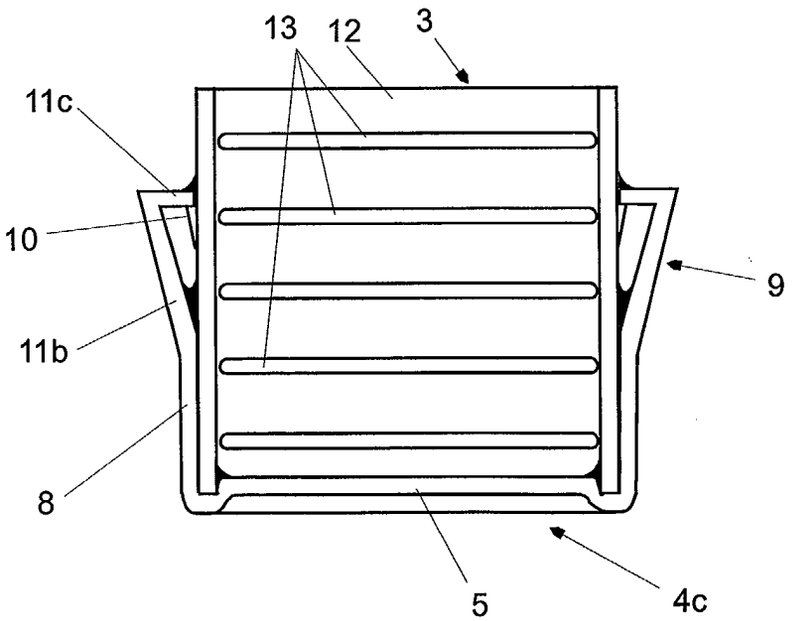

Fig 5

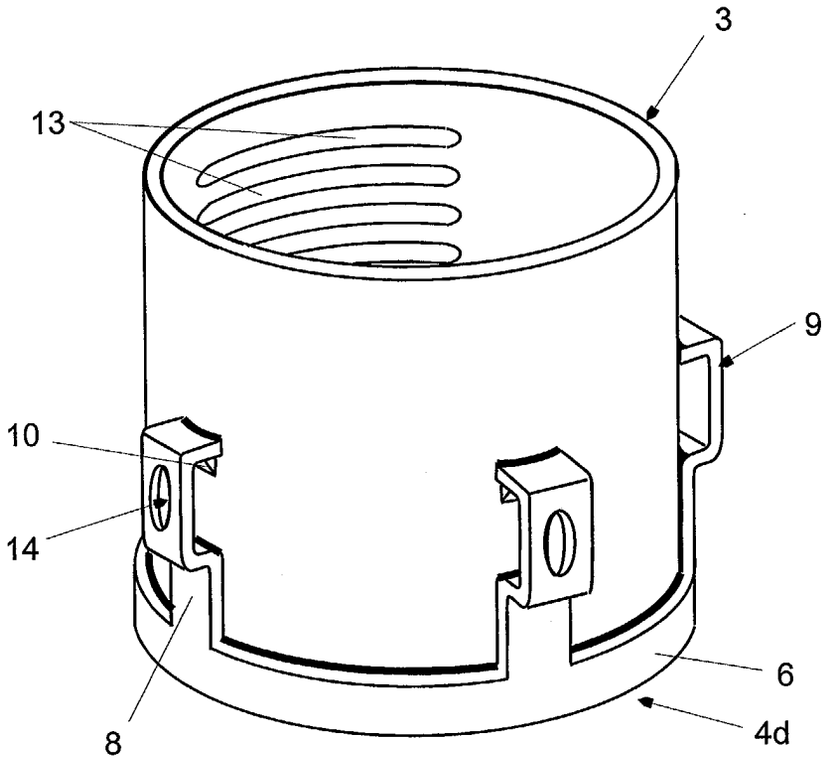

Fig 6

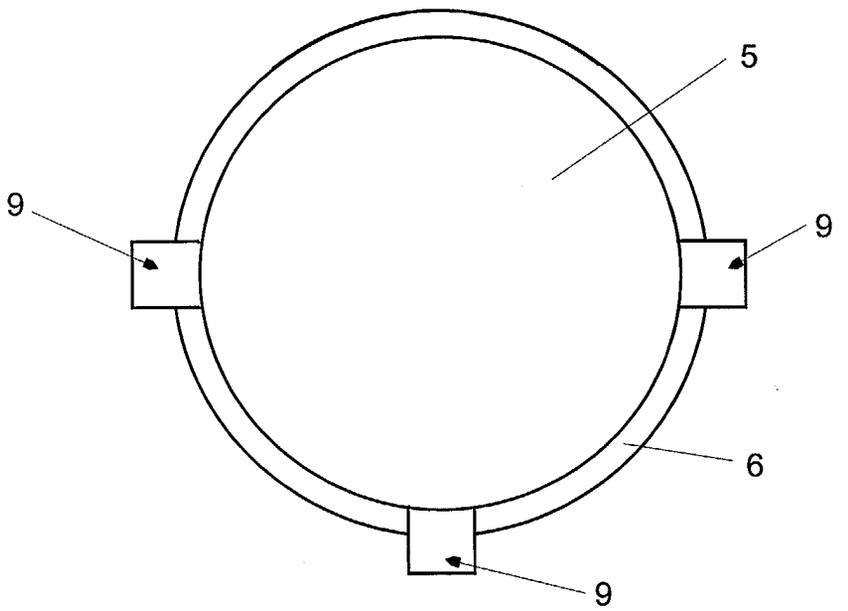

Fig 7