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(54) **Heat exchanger for an internal combustion engine**

(57) A heat exchanger, namely a charge air cooler or a exhaust gas cooler comprises a pipe block (14) formed by a plurality of pipes (16), the pipes opening at both ends in a respective tank (12, 12') for a first fluid. The pipes (16) are maintained at both ends by a respective header plate (18) having through openings (20) therein for the pipes (16). A cover (22, 22', 22") extends between the tanks (12, 12') and laterally surrounds the pipe block (14). Mechanical locking means are integrated in the cover about both pipe block ends to maintain the respective tanks (12, 12') in place on the pipe block (14).

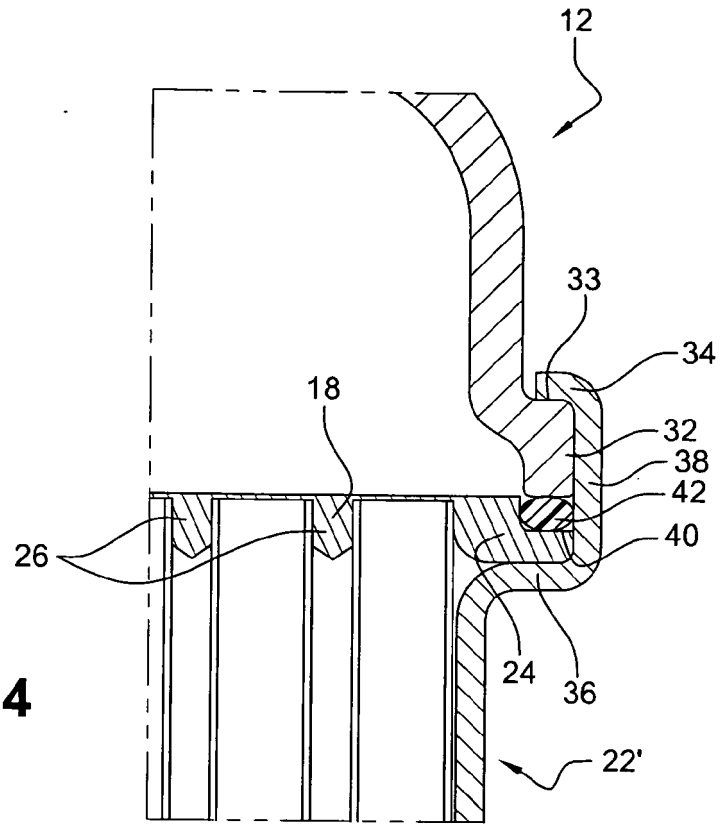

Fig. 4

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Description

FIELD OF THE INVENTION

[0001] The present invention generally relates to a heat exchanger, in particular for use as a charge air cooler or exhaust gas cooler in an internal combustion engine.

BACKGROUND OF THE INVENTION

[0002] Such heat exchangers for use as charge air or exhaust gas coolers conventionally have two tanks, which are spaced apart and are fluidically connected by means of a plurality of pipes (e.g. flat pipes) forming a pipe block. The charge air to be cooled then flows from one tank, through the pipes, to the other tank. The pipe block is surrounded by a separate piece of sheet metal, which is closed circumferentially around the pipe block and forms a cover (or casing) so that a chamber is formed between the two tanks, through which chamber the pipes run. This casing is provided with an inflow and outflow for a coolant.

[0003] In such configurations, it is known that the pipes are held in place at both ends by means of a header plate (or pipe plate) with through-openings for the pipes. The tanks then form a type of hood, which is closed on its broad side by the header plate. During assembly, the pipes are inserted in the header plates and the cover is next arranged around the pipes. The tanks are then mounted on the pipe block.

[0004] Such heat exchanger is e.g. known from US 2008/0289833.

[0005] The header plates conventionally have two functions: they maintain the pipes; and they serve for the fastening of the tanks and cover. Indeed, the pipes, cover and header plates are typically made from aluminium. This thus allows for soldering or brazing parts together. In such case, the header plates may have peripheral edges projecting in such a way as to run in or over the tank, respectively the cover; and the soldering may be carried out along such projecting edges. Although conventional, joints based on fitting and brazing are not easy to achieve. If the tank is not made from aluminium but plastic, the header plate can be provided with clinching tabs to be clamped on the tank.

OBJECT OF THE INVENTION

[0006] The object of the present invention is to provide a heat exchanger that can be assembled in a simple and reliable way.

[0007] This object is achieved by a heat exchanger as claimed in claim 1.

SUMMARY OF THE INVENTION

[0008] A heat exchanger in accordance with the present invention comprises a pipe block with a plurality of pipes, the pipes opening at both ends in a respective tank for a first fluid. The pipes are maintained at both ends by a respective header plate having a number of through-openings therein for the pipes. A cover extends between the tanks and laterally essentially surrounds the pipe block. Fastening means are provided about at least one pipe block end, preferably at both ends, that are adapted to maintain the respective tank in place on said pipe block.

[0009] According to an important aspect of the invention, the fastening means take the form of mechanical locking means that are integrated in the cover.

[0010] Hence, whereas in the conventional design the header plate achieves a double joint, the present heat exchanger has mechanical locking means for the tanks that are incorporated in the cover. There is thus a direct joint between the external elements constituted by the tanks and cover that provides a simple and reliable mounting. This actually allows, with an appropriate design, a mounting with a single joint at the extremities of the pipe block, where the header plates have no fastening function for the mounting of the tank onto the pipe block and cover.

[0011] The mechanical locking means are preferably integrally formed in one piece with the cover. However, one could assemble the mechanical locking means to the cover before assembling the heat exchanger, but the mechanical locking means for the tanks are not provided by the header plate.

[0012] In one embodiment, the mechanical locking means comprise by a bent edge region of said cover that is adapted to receive therein a foot region of the respective tank. The bent edge region may comprise clinching tabs that are clamped onto the foot region of the respective tank. The cover may namely be outwardly bent to form a circumferential border surrounded by a projecting edge terminating with the tabs. This allows using conventionally designed plastic tanks that have in their foot region a peripheral shoulder on which the tabs can be clamped.

[0013] The header plate is preferably seated on the circumferential border of the locking means. For fastening the header plate, the latter may comprise locking tabs outwardly protruding from the rim of the header plate and engaging into holes in the cover at the level of the mechanical locking means, e.g. in the projecting edge.

[0014] As it will be understood, what matters here is that the mechanical locking means are incorporated in the cover so as to be able to directly fasten the cover, not through the header plates. Various embodiments of such mechanical locking means may be devised by those skilled in the art. For example, the foot region of the tanks may be provided with interlocking means cooperating with the mechanical locking means of the cover. Also, the tank/cover joint may be designed so that the tank fits around the cover with its locking means, although for sealing purposes it is preferable that the cover locking means surround the tank's connecting region.

[0015] The cover may be comprised of two parts, or more parts, in order to facilitate the assembly. The cover is preferably provided with at least one inlet orifice and one outlet orifice for the second fluid that flows around the pipes.

[0016] In case the present heat-exchanger is used as cooling device, the fluid to be cooled, say exhaust gas or charge air, is the first fluid circulating through the tanks and pipes, while a liquid coolant is the second fluid circulated in the chamber defined by the cover.

[0017] These and other embodiments are recited in the appended dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1: is a perspective view of a preferred embodiment of the present heat exchanger;

FIG. 2: is a perspective view of a first cover-half;

FIG. 3: is a perspective, exploded view of the heat exchanger of Fig.1;

FIG. 4: is a cross sectional view of a portion of the heat exchanger of Fig.1
about the joint between tank and cover;

FIG 5: is a perspective cross sectional illustration of a portion of the heat exchanger of Fig.1 about another joint region between tank and cover;

FIG. 6: is a perspective view of a header plate; and

FIG. 7: is a perspective view of a turbulator plate.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0019] Fig.1 shows a heat exchanger 10 in accordance with an embodiment of the present invention. It comprises a pair of tanks 12, 12' that are mounted at opposite ends of a pipe block 14. As it will be understood from Fig. 3, the pipe block 14 comprises a plurality of flat pipes 16. The flat pipes 16 are maintained in a parallelly spaced relationship by means of header plates 18 arranged about both ends of the pipes 16. The header plates 18 have a shape matching the cross-sectional shape of the pipe block 16 (here rectangular) and are provided with a set of elongate through-openings 20 that receive the pipe ends, the number of through-openings 20 corresponding to the number of pipes 16 to be maintained. Reference sign 24 indicates the rim of the header plate 18 while webs separating two through openings are indicated 26. A first fluid may thus flow from one tank 12, 12' to the other through the flat pipes 16. The tanks 12, 12' here have a conventional hood-shape.

[0020] The pipe block 14 is laterally surrounded by a cover 22, which in this embodiment is subdivided into two cover halves 22' and 22". The cover 22 further extends essentially over the whole height (in axial direction of the pipes) of the pipe block 14. Upon assembly, the cover 22 thus defines a chamber for a second fluid, through which the flat pipes 16 run, that is closed in the axial direction of the pipes 16 by the rim 24 and webs 26 of the header plates 18. The dimensions and shape of the cover are thus designed so as to provide such closed chamber for the flat pipes 16.

[0021] Reference sign 30 indicates a connector 30 is fitted in an orifice in cover half 22' for introducing the second fluid into the chamber around the pipes 16. The other cover half 22" has a similar orifice though which another connector 30' is fitted for the exit of the second fluid.

[0022] It may be noted that cover halves 22 and 22' are provided with lateral cutouts 23 that allow compressing the pipes 16 during assembly.

[0023] When the present heat exchanger is used as exhaust gas cooler or charge air cooler, the gas to be cooled (exhaust gas / charge air) is the first fluid that flows from the tank 12 with two inlet orifices 13 to the second tank 12' with one outlet orifice 13', through the flat pipes 16. A liquid coolant is thus used as second fluid and circulated inside the chamber (defined by the cover 22) around the flat pipes 16.

[0024] Proper operation of the heat exchanger 10 requires that the tanks 12, 12' are firmly fastened to the pipe block 14. For this purpose, the cover 22 comprises at both ends integrated mechanical locking means that are adapted to maintain the respective tanks 12, 12' in place on the pipe block 14. Hence, whereas in the prior art solutions the header plate provides a first joint to the cover and a second joint to the tank, in the present heat exchanger mechanical locking means are advantageously integrally made in one piece with the cover 22 and designed to cooperate directly with the tanks 12, 12' to fix them firmly on the pipe block 14.

[0025] A preferred variant of such mechanical locking means is illustrated in detail in Figs. 4 and 5. As can be seen, the mechanical locking means is formed at the upper end of the cover 22 by a bent end region that is adapted to receive therein a foot region 32 of the tank 12, 12'. As can be seen, the bent end region actually comprises a multiplicity of peripherally distributed clinching tabs 34 that are folded to rest on the foot region 32 of the tank 12.

[0026] The bent end region preferably takes the following shape. The cover 22 describes, first, an outward bend to form a circumferential border 36 and describes a second bend to form a projecting edge 38 extending in direction of the tank 12 and terminating with the clinching tabs 34. The first circumferential border 36 forms a lateral surface 37, transversal to the axial direction of the pipes and cover (preferably substantially perpendicular there-

to), while the projecting edge 38 preferably projects parallel to the axial direction of the pipes 16.

[0027] Preferably, the rim 24 of each header plate 18 rests on the lateral surface 37 of the locking means. The rim 24 comprises a peripheral shoulder 40 that supports an annular gasket 42. In the assembled state, the foot region 32 of each cooling tank compresses the annular gasket 42 onto the shoulder 40 of the rim 24.

[0028] The header plate 18 preferably comprises a number of locking tabs 46 laterally protruding from the rim 24 and engaging into corresponding slots 48 provided in the cover 22, e.g. holes arranged in the raised edge portion 38. The tabs 46 may be bent upon insertion in the respective slots 48. This provides a mechanical locking of the header plates 18 in the cover 22, which cannot move in transversal nor axial directions. In practice the tabs 46 are preferably "expanded", which means that they are subjected to plastic deformation to increase their width; this can be done by flattening or stamping the tabs 46, as it is known to those skilled in the art. The tabs 46 will further be bound to the cover 22 during the brazing process.

[0029] Hence, there is only one joint between cover and tank that allows firm fastening of the tank and header plate, and allows a sealed closure thanks to the gasket 42.

[0030] In the present embodiment, the pipes 16, header plates 18 and cover 22 are made from aluminium or aluminium alloy while the tanks are made from plastic. However, the tanks may alternatively be made from aluminium or aluminum alloy.

[0031] It may be noted that upon assembly of the pipes 16 with the header plates 18 and with the cover 22, this obtained assembly is placed in a furnace for brazing in order to provide a sealed connection between those pieces. This will also permit brazing the lateral cutouts 23 in the cover 22 to the outer-most pipes 16, thus ensuring a sealed closure of the chamber for the second fluid. To facilitate the brazing process, the metal parts may advantageously be provided, as it is known in the art, with a brazing cladding, i.e. a thin layer of a metal having a lower melting point than the parts themselves.

[0032] It may further be noted that the foot region 32 of the tank 12, 12' has a conventional S-shape, forming a peripheral shoulder 33 on which the tabs 34 can be easily clamped. Hence, the locking means integrated in the cover 22 allow an easy fastening of conventionally-designed plastic or aluminium tanks. Those skilled in the art may of course provide for other types of design for the tank and/or for the mechanical locking means. For example, the tank connection region may be provided with locking means cooperating with the locking means of the cover 22. Also, the tanks could be provided with tabs or other projections that would lock into holes or recesses in the cover. In designing such interlocking means, it is of advantage to provide for a blocking of the header plates by axial compression, as in the shown embodiment.

[0033] Finally, conventional measures or configurations may be implemented. A turbulator plate 31, as shown in Fig.7, may e.g. be placed between every adjacent pair of flat pipes 16. As it known in the art, such plates 31 may take the form of an aluminium sheet with staggered corrugations stamped into each side to enhance the heat exchange efficiency. Other kinds of measures to control the flow of coolant in the chamber may be implemented. Turbulator devices may also be inserted in the flat pipes.

[0034] As it will further appear to those skilled in the art, the pipe block may consist of two or more rows of superposed flat pipes. In such case the header plates would be adapted to have corresponding rows of through-orifices.

Claims

1. A heat exchanger for exchanging heat between two fluids comprising:

   a pipe block (14) comprising a plurality of pipes (16), said pipes opening at both ends in a respective tank (12, 12') for a first fluid, said pipes (16) being maintained at both ends by a respective header plate (18) having through openings (20) therein for said pipes (16);
   a cover (22, 22', 22") extending between said tanks (12, 12') and laterally essentially surrounding said pipe block (14);
   fastening means at at least one pipe block end, preferably both, that are adapted to maintain the respective tank (12, 12') in place on said pipe block (14);
   characterized in that said fastening means are mechanical locking means that are integrated into said cover (22, 22', 22").

2. The heat exchanger according to claim 1, **characterized in that** the mechanical locking means are integrally formed in one piece with said cover (22).

3. The heat exchanger according to claim 1 or 2, **characterized in that** said mechanical locking means comprise by a bent edge region of said cover (22, 22', 22") that is adapted to receive therein a foot region (32) of the respective tank (12).

4. The heat exchanger according to claim 3, **characterized in that** said bent edge region comprises clinching tabs (34) that are clamped onto the foot region (32) of the respective tank (12).

5. The heat exchanger according to claim 3 or 4, **characterized in that** in said bent edge region, the cover is outwardly bent to form a circumferential border (36) surrounded by a projecting edge (38) terminat-

ing with said tabs (34).

6. The heat exchanger according to claim 5, **characterized in that** said projecting edge (38) extends substantially parallel to the axial direction of said pipes (16).

7. The heat exchanger according to claim 5 or 6, **characterized in that** said header plate has a rim (24) that rests on said circumferential border (36).

8. The heat exchanger according to claim 7, **characterized by** an annular gasket (42) compressed between said header plate rim (24) and said foot (32) of said tank (12).

9. The heat exchanger according to claim 7 or 8, **characterized in that** said header plate (18) has locking tabs (46) outwardly protruding from said rim (24) and engaging into slots (48) in said cover (22).

10. The heat exchanger according to claim 9, **characterized in that** said locking tabs (46) are expanded upon insertion into said slots (48).

11. The heat exchanger according to claim 1, **characterized in that** each tank comprises locking means cooperating with said mechanical locking means of said cover.

12. The heat exchanger according to any one of the preceding claims, **characterized in that** said cover (22) and/or header plate (18) and/or tubes (14) and/or tank (12, 12') is/are made from metal, preferably from the same metal, more preferably from aluminium or aluminium alloy.

13. The heat exchanger according to any one of the preceding claims, **characterized in that** said cover (22) is comprised of two halves (22', 22").

14. The heat exchanger according to any one of the preceding claims, **characterized by** a turbulator plate (31) in-between each pair of adjacent pipes (16).

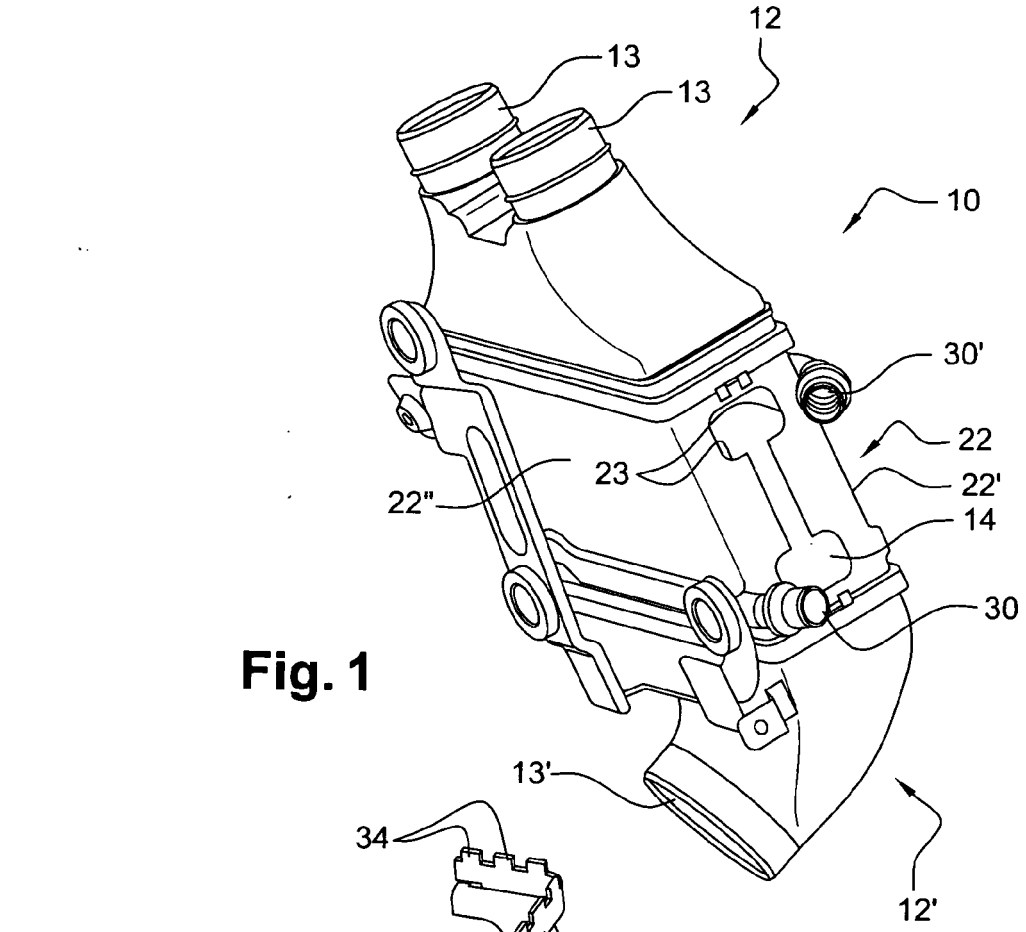

Fig. 1

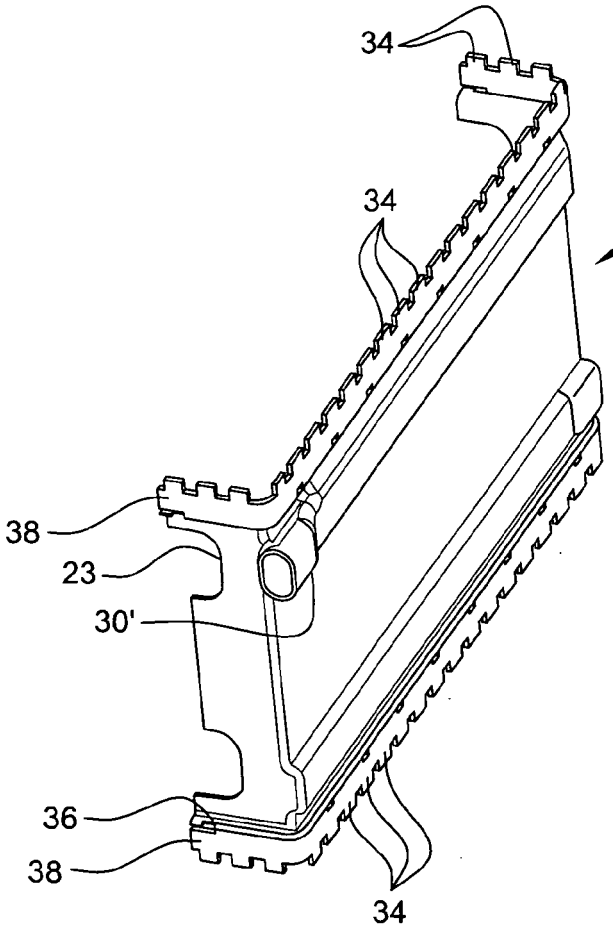

Fig. 2

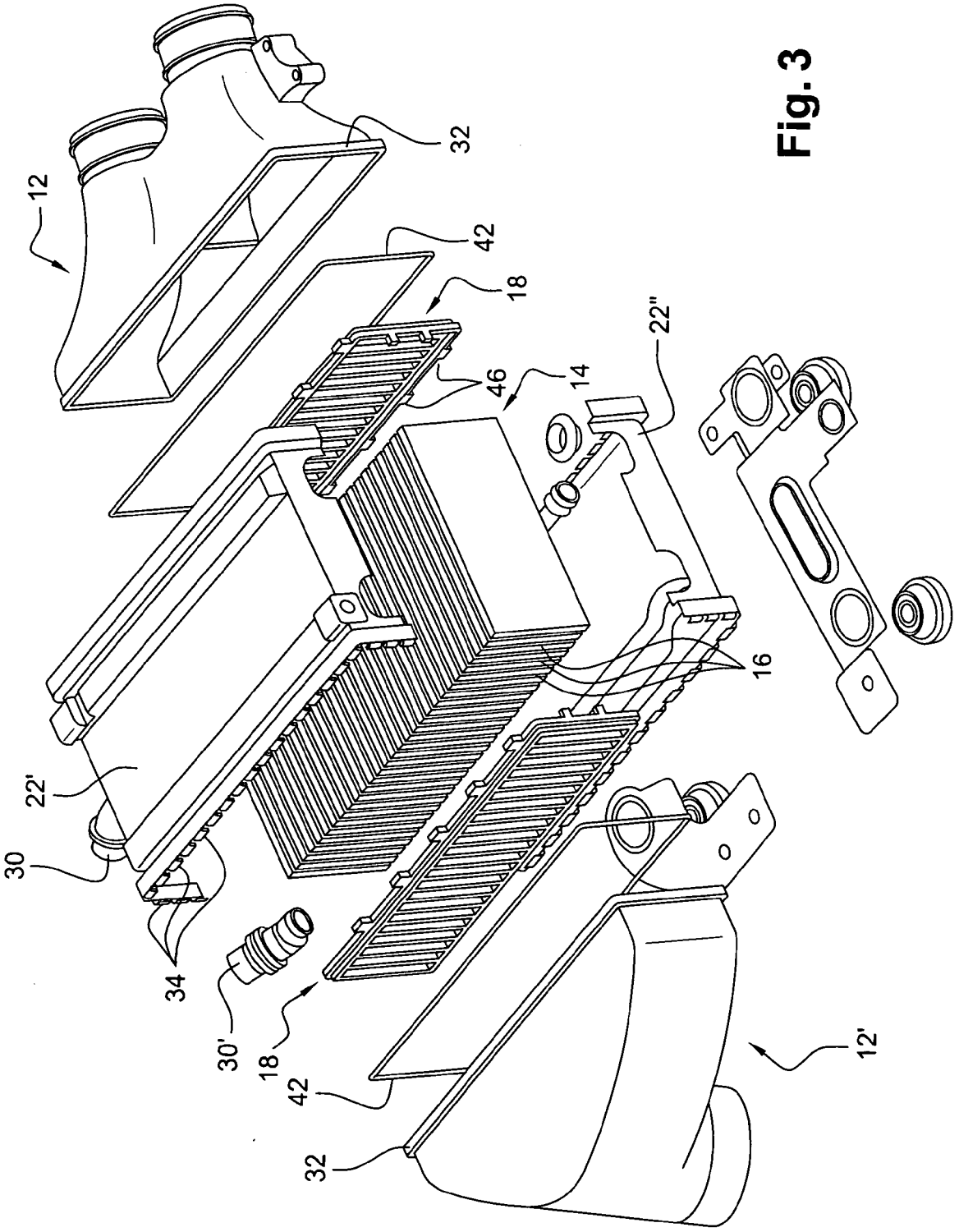

Fig. 3

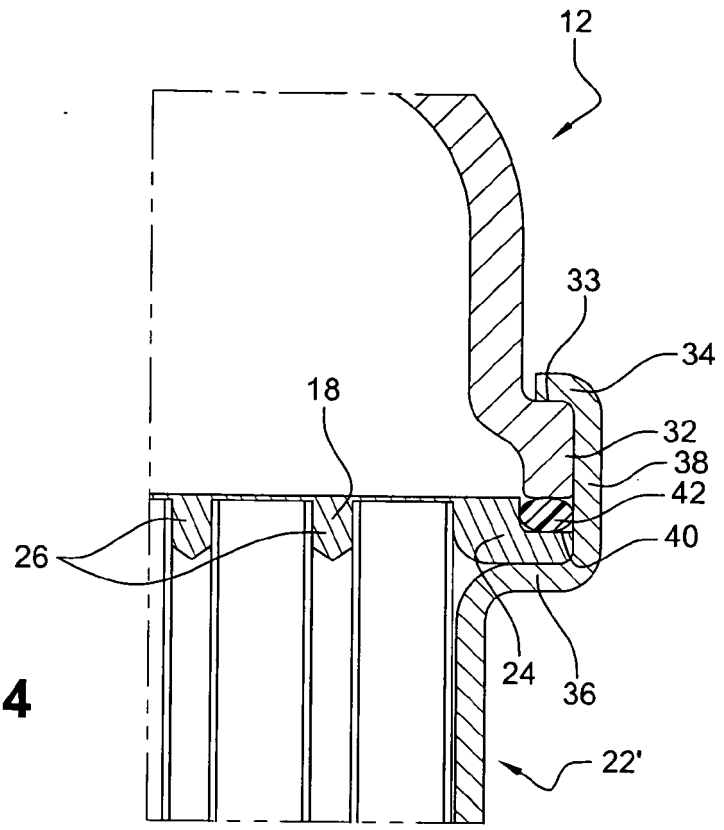
12
33
34
18
32
38
42
40
26
24
36
22'

Fig. 4

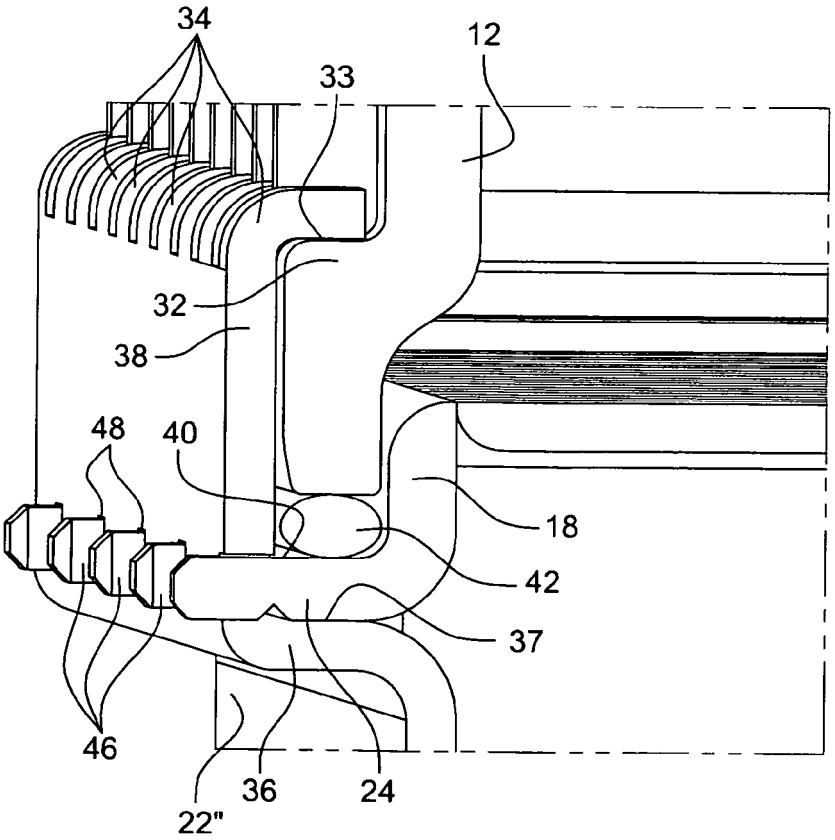
34
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Fig. 5

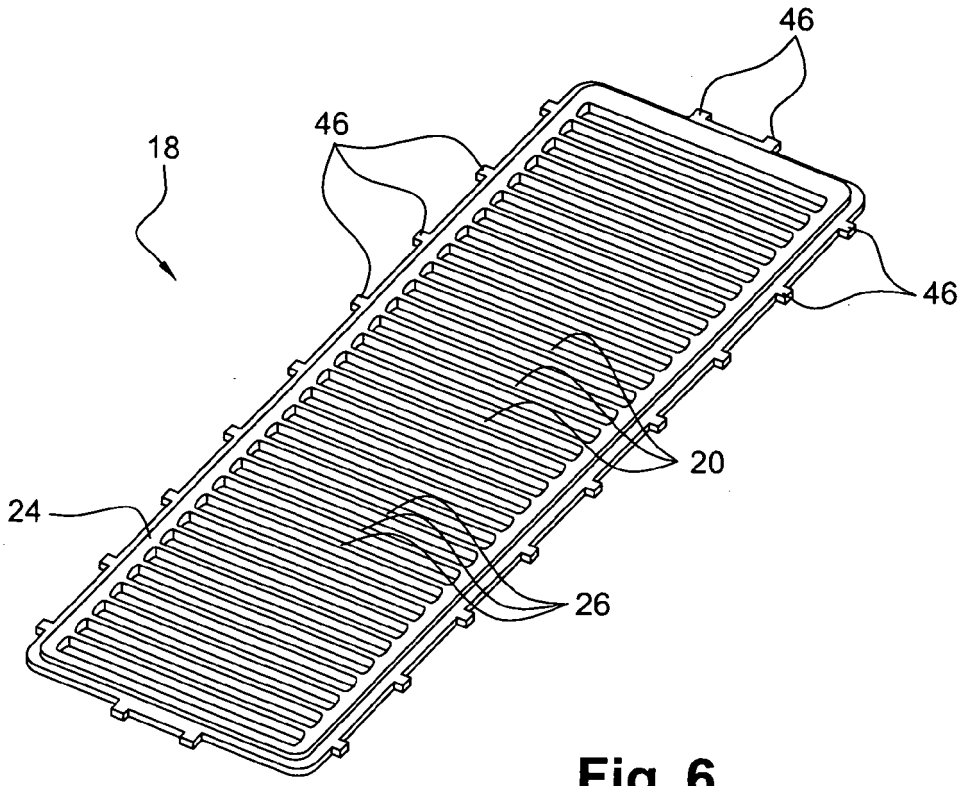

Fig. 6

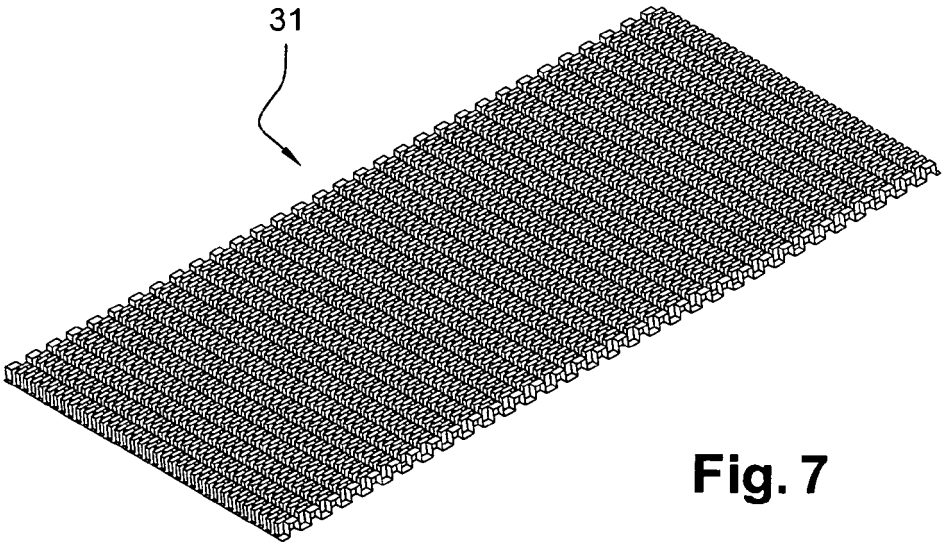

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 10 19 2794

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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	3 May 2011	Vassoille, Bruno

CATEGORY OF CITED DOCUMENTS

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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