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(54) HEAT EXCHANGER ASSEMBLY

(57) A heat exchanger assembly (1) comprises a first fluid circuit. The first fluid circuit comprising a heat exchanger core (2) including two manifolds (20, 21), a plurality of flow ducts (22) connecting two manifolds (20, 21) and at least one connection block (24) connected to at least one of two manifolds (20, 21). The heat exchanger assembly (1) also comprises a second fluid circuit. The second fluid circuit includes a housing (3) that encapsulates the heat exchanger core (2). The housing (3) comprising at least one opening (35) to receive the at least one connection block (24) of the heat exchanger core (2) so that the at least one connection block (24) extends outside the housing (3). The heat exchanger assembly (1) further comprises a sealing means (27, 28) arranged between the at least one connection block (24) and the housing (3).

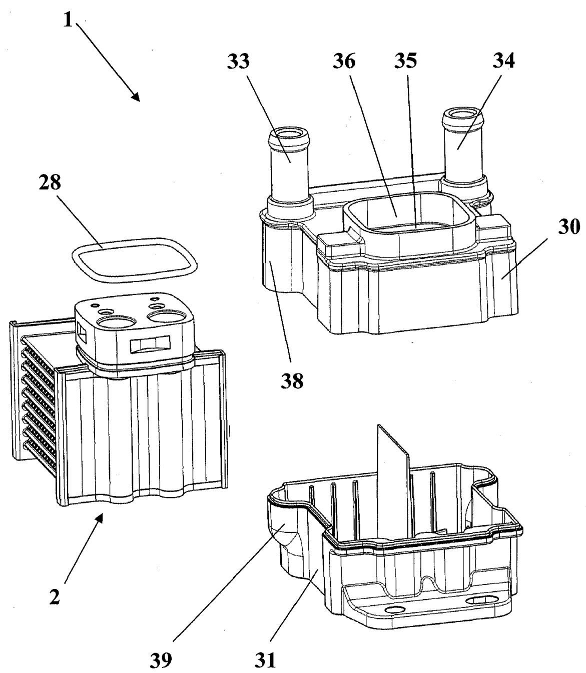

Fig. 1

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Description

Technical Field

[0001] The present invention relates to a heat exchanger assembly, especially to an automotive heat exchanger assembly, in particular a water chiller or a water-gas cooler with indirect cooling.

Prior Art

[0002] One prior art heat exchanger assembly includes two separate fluid circuits. One circuit comprises a plurality of hollow flow plates, which extend parallel to each other. The flow plates, in particular their internal spaces, are fluidly connected to surrounding flow plates at their ends alternately so that this fluid circuit takes the undulate form. Second fluid circuit consists of two manifolds and a plurality of flow ducts. Ends of flow ducts are received in the manifolds. The flow ducts are inserted between the flow plates so that one flow ducts is situated between and is in contact with two adjacent flow plates. Heat exchange takes place on the interface between the flow ducts and the flow plates.

[0003] Generally, prior art solutions suffer from a series of disadvantages. First of all, heat exchanger components, which are responsible for exchanging heat between two fluids, are very often subjected to harsh environmental factors, which leads to corrosion. Second of all, not all exchanger components, which are traversed by a coolant or a fluid to be cooled down, take part in the heat exchange process and, therefore, the heat exchange area is greatly limited.

[0004] One object of the present invention is to provide a heat exchanger assembly provided with improved protection against corrosion.

[0005] Another object of the present invention is to provide a heat exchanger assembly, in which all its components forming respective fluid conduits participate in the heat exchange process, whereby the heat transfer area of the heat exchanger assembly is increased, which in turn increases the heat exchange efficiency.

[0006] The above objects are achieved by a heat exchanger assembly as defined in the annexed claims.

Disclosure of Invention

[0007] A heat exchanger assembly comprises a first fluid circuit. The first fluid circuit comprises a heat exchanger core including two manifolds, a plurality of flow ducts connecting two manifolds and at least one connection block connected to at least one of two manifolds. The heat exchanger assembly also comprises a second fluid circuit. The second fluid circuit includes a housing that encapsulates the heat exchanger core. The housing comprises at least one opening to receive the at least one connection block of the heat exchanger core so that the at least one connection block extends outside the housing. Additionally, the heat exchanger assembly comprises a sealing means arranged between the at least one connection block and the housing.

[0008] Further advantageous embodiments of the invention are defined in the dependent claims.

[0009] All components of the heat exchanger core that are involved in heat exchange between the coolant and the fluid to be cooled down are closed in the housing and protected by it. It also means that the coolant supplied to the housing flows over/is in contact with all those components, which maximizes heat exchange between the coolant and the fluid to be cooled down.

[0010] As the housing is made of plastic materials the housing itself and all the components contained therein are protected effectively against corrosion. It also means that the housing can easily be manufactured in any shape required by a customer and adapted to various needs. Moreover, the housing can be provided with additional mounting features/elements like brackets or hooks to mount the heat exchanger assembly in a vehicle.

[0011] Moreover, many components of the heat exchanger assembly can be formed in a single part, which reduces the number of separate components used and makes the production process easier.

Brief Description of Drawings

[0012] The present invention is described in more detail below, with reference to the accompanying drawings, which show non-limiting embodiments of the invention, wherein:

Fig. 1 shows an exploded perspective view of a heat exchanger assembly according to the invention,
Fig. 2 shows a perspective view of a heat exchanger core of the heat exchanger assembly according to the invention,
Fig. 3 shows a perspective view of the heat exchanger assembly according to the invention, once assembled, and
Fig. 4 shows a cross-section view of the heat exchanger assembly according to the invention.

Embodiments of Invention

[0013] A heat exchanger assembly 1 comprises a heat exchanger core 2, which in turn includes first and second manifolds 20, 21. The heat exchanger core 2 further comprises a plurality of flat hollow flow ducts 22 arranged in two rows. Ends of the flow ducts 22 are inserted in a plurality of corresponding slots provided in the manifolds 20, 21, namely one end of each flow duct 22 is received in one slot. In other words, the flow ducts 22 are connected to the manifolds 20, 21. In the embodiments shown in the figures the manifold 20 has two flow channels and the manifold 21 has one flow channel defined therein. The flow channels of the manifolds 20, 21 are in fluid communication with both the slots provided in the manifolds 20, 21 and inner passages of the flow ducts 22. The heat exchanger core 2 may further comprise a plurality of coolant turbulators 23 in such a way that one coolant turbulator 23 is situated between two adjacent flow ducts 22. The function of the coolant turbulators 32 is to transform a laminar flow of a coolant into a turbulent one, what, in turn, increases the heat exchange efficiency.

[0014] The heat exchanger core 2 further comprises a connection block 24 for a fluid to be cooled down, especially CO_2. The connection block 24 is situated on and connected to one of the manifolds, namely the first manifold 20. The connection block 24 comprises two ports 25, 26 through which the fluid to be cooled down flows into and out of the heat exchanger core 2. For this purpose the ports 25, 26 are in fluid communication with the flow channels defined in the first manifold 20, the inner passages of the flow ducts 22 and the flow channel defined in the second manifold 21. All components of the heat exchanger core 2 are connected to each other by brazing to ensure the fluid-tightness of the heat exchanger core 2.

[0015] When the heat exchanger core 2 is assembled the following flow path is formed: the fluid to be cooled down enters the port 25 in the connection block 24, then flows successively through one of two flow channels defined in the first manifold 20, one row of the flow ducts 22, the channel defined in the second manifold 21, the other row of the flow ducts 22, the other flow channel defined in the first manifold 20 and finally leaves the heat exchanger core 2 through the port 26. In other words, the heat exchanger core 2, in particular the connection block 24, the manifolds 20, 21 and the flow ducts 22, defines a first fluid circuit, especially for the fluid to be cooled down.

[0016] The heat exchanger assembly 1 further comprises a housing 3. In the embodiment shown in the figures, the housing 3 comprises a first half-shell 30 and a second half-shell 31. The housing 3 further comprises two coolant ports 33, 34 situated on the first half-shell 30. The housing 3 may comprise brackets 37, which allow the housing 3 to be secured to components of a vehicle.

[0017] The housing 3, in particular the half-shells 30, 31, is made of plastic materials or other corrosion-resistant materials, which makes the housing 3 immune to corrosion caused by destructive environmental factors.

[0018] When both half-shells 30, 31 are brought and connected together they define an internal space and the heat exchanger core 2 fits into the internal space. To ensure that the housing 3 is fluid-tight a sealing means 32 is provided between the half-shells 30, 31. Alternatively, the half-shells 30, 31 are joined directly, after insertion of the core 2, for example by means of plastic welding. The housing 3, once assembled, encapsulates the heat exchanger core 2, namely the heat exchanger core 2 is closed and contained inside the housing 3. The housing 3 further comprises a flange 36, which defines and surrounds an opening 35. The opening 35 receives the connection block 24 of the heat exchanger core 2 so that a section of the connection block 24 protrudes beyond the edge of the opening 35, whereby the ports 25, 26 are easily accessible from the outside of the heat exchanger assembly 1. In other words, the connection block 24 extends outside the housing 3. To ensure that the heat exchanger assembly 1 is fluid-tight the heat exchanger core 2 comprises a sealing means, that seals the connection block 24 against an inner surface of the opening 35/flange 36 of the housing 3, wherein the sealing means is in contact with both the connection block 24 and the inner surface of the housing 3. This way the coolant is prevented from flowing out of the housing 3 through the opening 35. In the embodiment shown in the figures the sealing means includes a groove 27 formed in an outer surface of the connection block 24 and a seal 28, in particular an O-ring, arranged in the groove 27. When the connection block 24 is inserted in the opening 35 the seal 28 presses tightly against the inner surface of the opening 35/flange 36 so that the fluid-tightness of the heat exchanger assembly 1 is ensured. Advantageously, the half-shells 30, 31 are joined together along a line which is remote from the opening 35. This simplifies and improves sealing between the connection block 35 and the housing 3.

[0019] The connection block 24 can comprise a series of recesses 29 on its outer surface for high pressure test tools. When the heat exchanger assembly 1 is assembled the recesses 29 are situated outside the housing 3. Preferably, the connection block 24 has the general form of a cuboid. In such a case, the connection block 24 has four side walls. Each of the recesses 29 is located in the centre of each side wall. Preferably, the recesses 29 each have an arched bottom. However, depending on the needs and final application of the connection block 24, the recesses 25 can be made in different positions on the side walls of the connection block 24 and may have different shapes depending on the tools to be used. This ensures that a wide variety of high pressure tools can be used while other advantages of the invention are maintained.

[0020] The housing 3 can comprise two open channels defined in walls of the half-shells 30, 31, what means that the open channels are integral to the half-shells 30, 31. Each of the open channels in fact includes two separate aligned open channels 38, 39, one for each half-shell 30, 31, respectively. The open channels 38, 39 are formed at the extension of the coolant ports 33, 34. The open channel 38 in the first half-shell 30 is straight and has a constant cross-section. The open channel 39 in the second half-shell 31 is in turn at least partially bended/arc-shaped over its length and at its end facing a bottom of the second half-shell 31. It means that the cross-section of the open channel 39 at least partially decreases towards the bottom of the second half-shell 31 over the length of the channel 39. In particular, one section of the channel 39 can be straight while the other section can be arc-shaped and end in a distance to the bottom of the second half-shell 31, as shown in figure 3. The open channels 38, 39 allow the coolant to flow evenly over all flow ducts 22 in a given row. Moreover, the open channels 38, 39 are configured to decrease pressure drops and ensure smooth coolant flow within the housing 3 by creating efficient flow regime.

[0021] When the entire heat exchanger assembly 1 is assembled the heat exchanger core 2 is closed in and/or encapsulated by the housing 3. The coolant ports 25, 26 of the connection block 24 can be easily accessed from the outside of the heat exchanger assembly 1. The coolant flows into the housing 3 through the port 33, next flows between the flow ducts 22, cooling down the fluid flowing therein, and flows out of the housing 3 through the port 34. In other words, the housing 3 defines a second fluid circuit, in particular for the coolant.

[0022] Above, only one preferred embodiment of the heat exchanger assembly 1 has been described. In another embodiment of the invention the heat exchanger core 2 can comprise only one row of the flow ducts 22. In such a case the manifolds 20, 21 each comprise only one flow channel defined therein. Moreover, each of the manifolds 20, 21 is associated with its own connection block 24. One connection block 24 is an inlet one, whereas the other is an outlet one, and the fluid to be cooled down flows through the flow ducts 22 only in one direction. The housing 3 comprises one opening 35 for each of the connection blocks 24, namely two openings 35 in total. It means that the number of the openings 35 is equal to the number of the connection blocks 24. In still another embodiment of the invention only one manifold 20 is provided with the connection block 24 and the heat exchanger core 2 comprises one row of flow ducts 22. In this embodiment the fluid to be cooled down flows to the second manifold 21 through one set of the flow ducts 22 and flows back to the first manifold 20 through a second set of the flow ducts 22 of the same row. In such a case the fluid to be cooled down flows into and out of the heat exchanger core 2 through one connection block 24 placed on the first manifold 20. In more general terms, the heat exchanger assembly 1 comprises at least one connection block 24 connected to at least one manifold 20, 21 and the housing 3 has at least one opening 35 to receive at least one connection block 24.

[0023] In yet another embodiment of the invention the housing 3 can consist of any appropriate number of shells, for example three, four, etc. Moreover, as shown in figure 4, the channel 39 can be arc-shaped over its entire length, namely from an edge of the second half-shell 31 to the bottom of the second half-shell 31 and can end at the bottom itself. It means that the cross-section of the channel 39 decreases over the entire length of the open channel 39 from the edge of the second half-shell 31 to the bottom of the second half-shell 31.

[0024] In further embodiment of the invention the sealing means between the heat exchanger core 2 and the housing 3 need not be provided between the connection block 24 and the inner surface of the opening 35/flange 36 of the housing 3. In this embodiment, the sealing means can be situated between and be in contact with the connection block 24 and an inner surface of the housing 3 around the opening 35, namely the surface of the housing 3 that faces the heat exchanger core 2. The sealing means can include a circumferential flange on a side surface of the connection block 24 and a seal, such as a O-ring, placed on a surface of the circumferential flange that faces the inner surface of the housing 3. The circumferential flange presses the seal tightly against the inner surface of the housing 3.

[0025] In another embodiment of the invention the coolant ports 33, 34 and the corresponding open channels 38, 39 can be provided on different shells of the housing 3.

Claims

1. A heat exchanger assembly (1) comprising:

    a first fluid circuit, said first fluid circuit comprising a heat exchanger core (2) including two manifolds (20, 21), a plurality of flow ducts (22) connecting said two manifolds (20, 21) and at least one connection block (24) connected to at least one of said two manifolds (20, 21);
    a second fluid circuit;
    characterized in that
    said second fluid circuit includes a housing (3) that encapsulates said heat exchanger core (2), said housing (3) comprising at least one opening (35) to receive said at least one connection block (24) of said heat exchanger core (2) so that said at least one connection block (24) extends outside said housing (3), and
    said heat exchanger assembly (1) further comprises a sealing means (27, 28) arranged between said at least one connection block (24) and said housing (3).

2. The heat exchanger assembly (1) according to claim 1, **characterized in that** said sealing means (27, 28) includes a groove (27) on an outer surface of said at least one connection block (24) and a seal (28) received in said groove (27) and being in contact with an inner surface of the housing (3).

3. The heat exchanger assembly (1) according to any of the preceding claims, **characterized in that** it includes two connection blocks (24), said two connection blocks (24) each connecting to one of said manifolds (20, 21), said housing (3) comprising two openings (35) for said two connection blocks (24).

4. The heat exchanger assembly (1) according to any of the preceding claims, **characterized in that** said housing (3) includes a first half-shell (30) and a sec-

ond half-shell (31).

5. The heat exchanger assembly (1) according to any of the preceding claims, **characterized in that** said housing (3) is made of plastic materials.

6. The heat exchanger assembly (1) according to any of the preceding claims, **characterized in that** said housing (3) comprises two coolant ports (33, 34) and two open channels, said open channels being formed in a wall of said housing (3) and extending at the extension of said two coolant ports (33, 34).

7. The heat exchanger assembly (1) according to any of the preceding claims, **characterized in that** said connection block (24) comprises a series of recesses (29) on its outer surface for high pressure tools.

8. The heat exchanger assembly (1) according to any of claims 6-7, **characterized in that** said open channels each include two open channels (38, 39), a first open channel (38) in said first half-shell (30) being straight and having a constant cross-section, a second open channel (39) in said second half-shell (31) being at least partially arc-shaped over its length and having a cross-section at least partially decreasing towards a bottom of said second half-shell (31).

9. The heat exchanger assembly (1) according to claim 8, **characterized in that** said second open channel (39) is arc-shaped over its entire length so that said cross-section of said second open channel (39) decreases over said entire length of said second open channel (39) towards said bottom of said second half-shell (31).

10. The heat exchanger assembly (1) according to any of claims 8-9, **characterized in that** said second open channel (39) ends in a distance to said bottom of said second half-shell (31).

11. The heat exchanger assembly (1) according to any of claims 8-9, **characterized in that** said second open channel (39) ends at said bottom of said second half-shell (31).

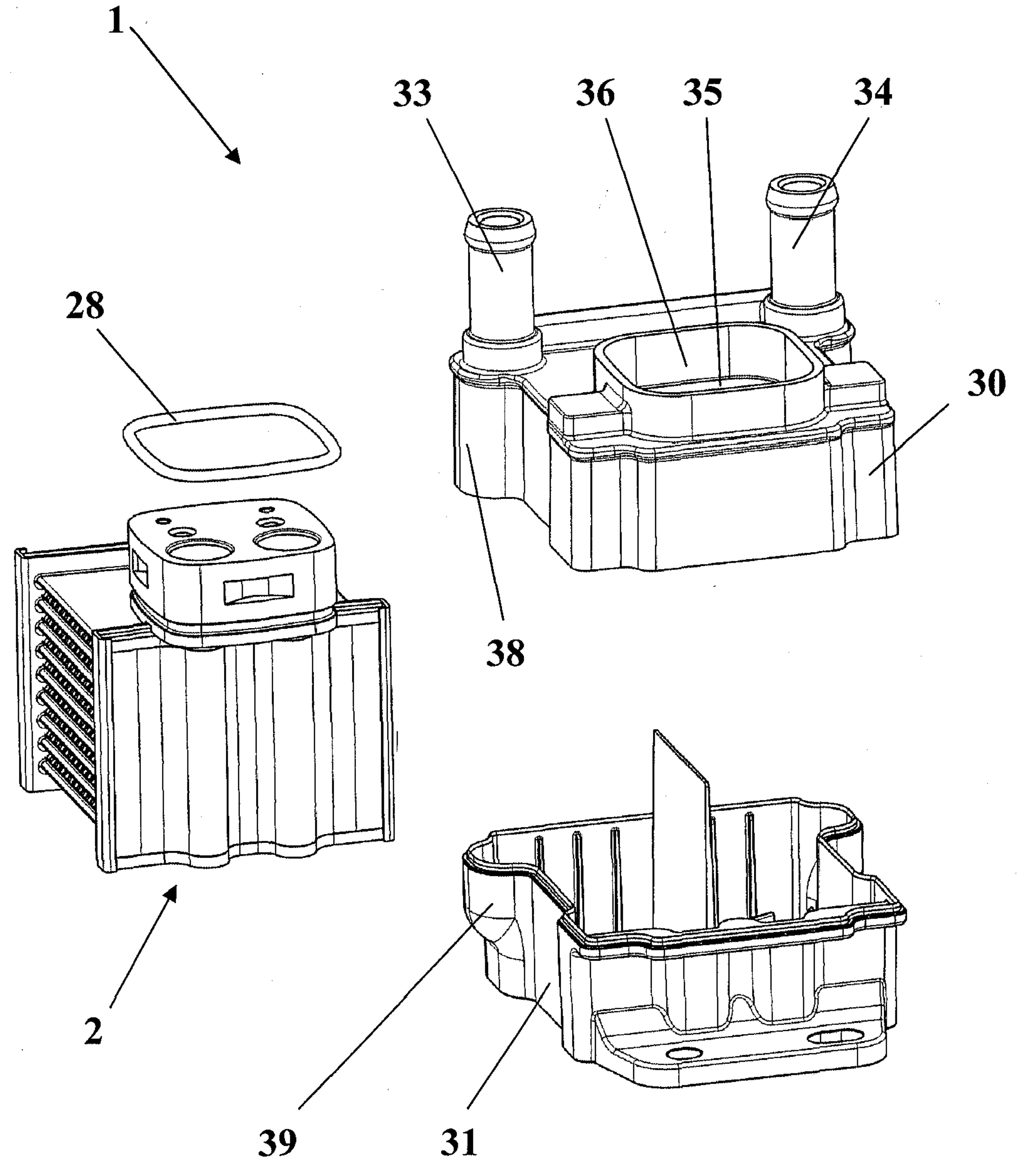

Fig. 1

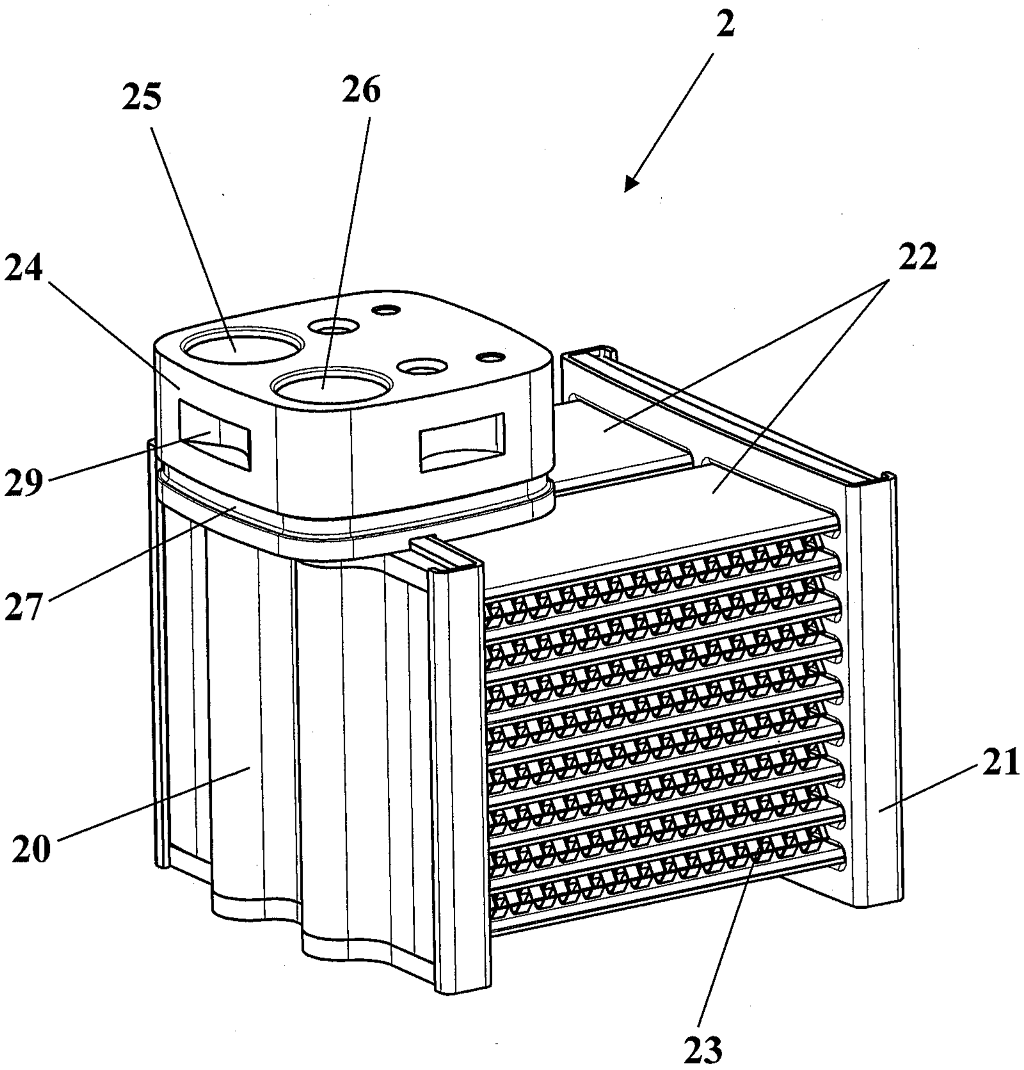

Fig. 2

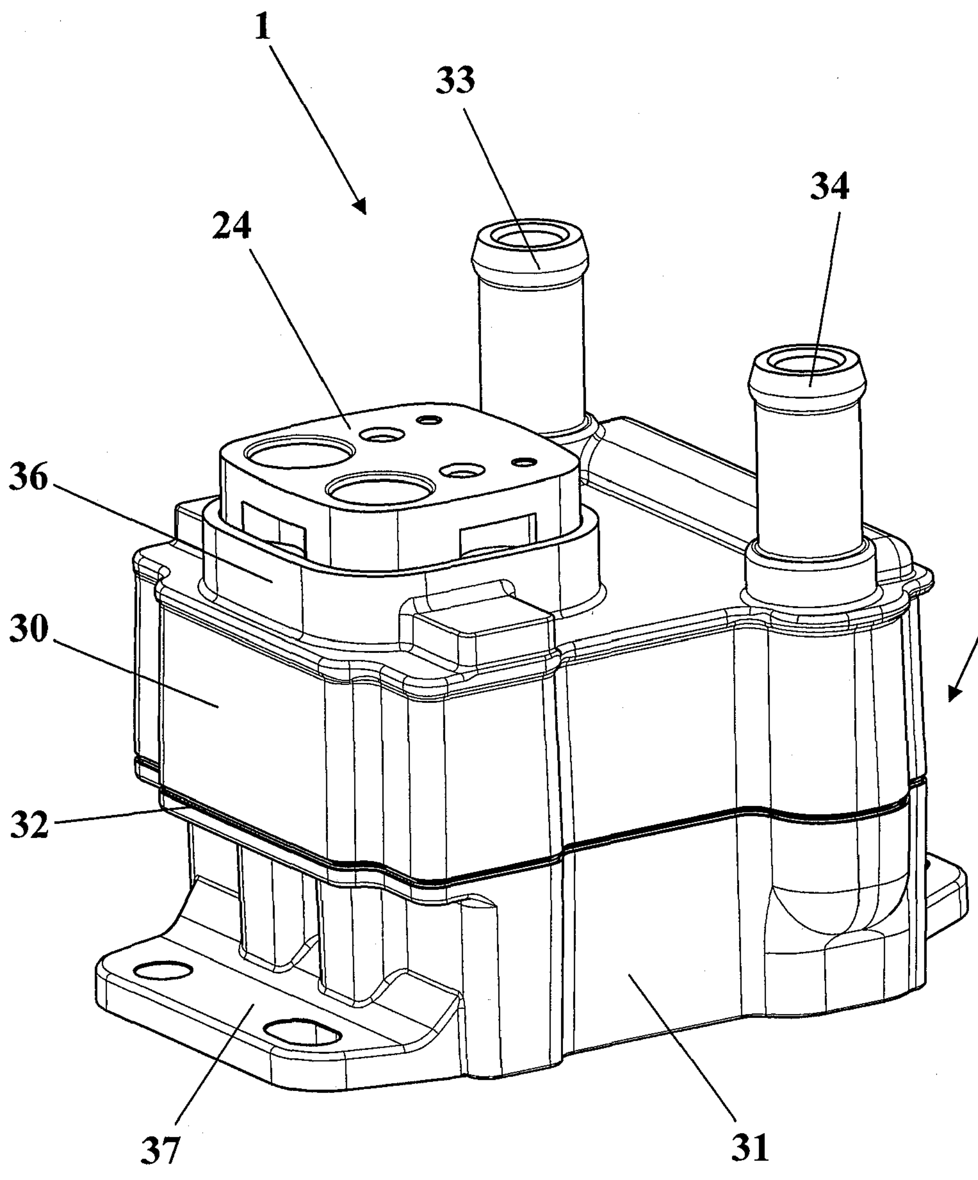

Fig. 3

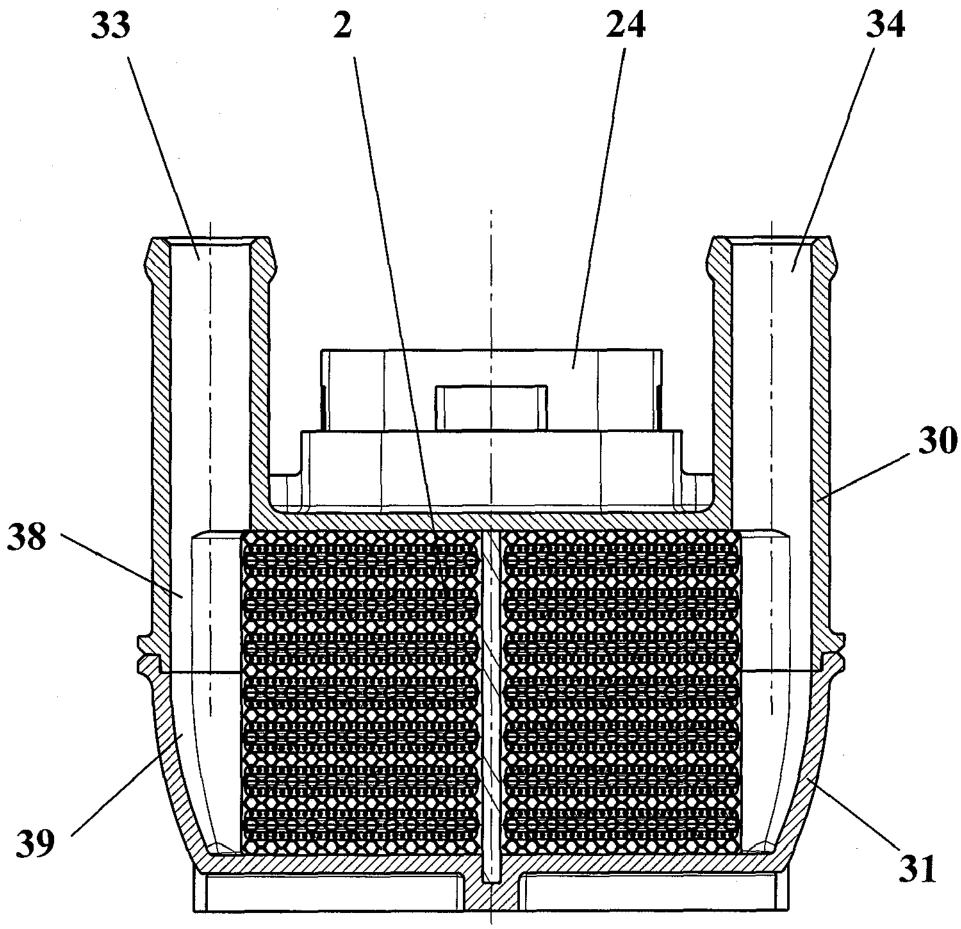

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 17 46 1602

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	23 February 2018	Louchet, Nicolas

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 46 1602

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