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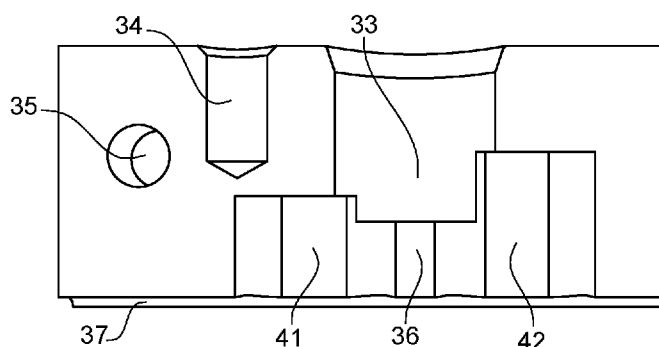


Fig. 2B

(57) Abstract: A bstract A heat exchanger An air condenser comprising: a first connection block adapted to supply or receive refrigerant, comprising at least two distribution openings connected fluidically with a first opening, wherein the distribution openings open directly into the collection chamber and are configured to distribute refrigerant across the collection chamber evenly; at least two distribution openings separated by a wall portion; at least two distribution openings in various spatial configurations.



A heat exchanger

5 FIELD OF THE INVENTION

The invention relates to a heat exchanger, in particular to an air condenser for a motor vehicle.

10 BACKGROUND OF THE INVENTION

The automotive industry is pursuing more and more efficient systems in order to minimize impact on the environment and increase the comfort in the passenger bay. A tendency to improve packaging of system raises a problem of component configuration, weight and efficiency.

15 A heat exchanger for the air conditioning system, for example an air condenser, is usually constructed as a series of tubes interlaced with fins. The heat absorbed by the refrigerant while it is flowing through the evaporator is released to the ambient, very much the same way the radiator releases the heat from engine coolant that the coolant absorbed while it was flowing through the engine. The inlet of the condenser receives
20 the refrigerant in the form of a high pressure and high temperature vapor. As the refrigerant cools down while traveling across the condenser, it turns from gaseous refrigerant into a liquid at high pressure.

Standard air condensers may be connected with the rest of the air conditioning system by use of connecting blocks. Traditional block usually comprises one inlet
25 opening and one outlet opening which enable refrigerant communication between the condenser and other elements of the air conditioning system. However, traditional blocks may be unsatisfactory in terms of pressure drop and even refrigerant distribution. Refrigerant entering the air condenser through the traditional block meets

a big volume of collection chamber to be filled. Moreover, the refrigerant fluid may not be distributed into the collection chamber in an optimal way. This is one of the factors that leads to undesired phenomena called pressure drop.

It would be desirable to provide a heat exchanger connection block, which would provide a lower pressure drop and improved refrigerant distribution in the collection chamber.

SUMMARY OF THE INVENTION

The object of the invention is, among others, a connection block for an air condenser connected fluidically to the first collection chamber, comprising an inlet/outlet opening for heat exchange fluid, characterized in that the connection block comprises at least two distribution openings connected fluidically with a first opening, wherein the distribution openings open directly into the first collection chamber.

Preferably, at least one distribution opening is roundly shaped. Roundly shape refers to a cross section of an opening in a form of a circle, an oval or an oblong.

Preferably, the connection block comprises at least one distribution opening, wherein its central axis is parallel to central axis of the first opening.

Preferably, the connection block comprises at least one distribution opening, wherein its central axis is perpendicular to central axis of the first opening.

Preferably, the connection block comprises at least one distribution opening, wherein its central axis is slanted to central axis of the first opening.

Preferably, a wall portion between at least two distribution openings, has rounded edges at the side facing the first opening.

Preferably, a wall portion between at least two distribution openings has sharp edges at the side facing the first opening.

Preferably, at least one of distribution openings is at least partially reamed.

Preferably, at least one of distribution openings has at least two different cross-sections along its central axis. A first cross-section has a bigger area than a second cross-section, wherein the first cross-section faces the first opening, or a first cross-section has a bigger area than a second cross-section, wherein the first cross-section faces the collection chamber.

Preferably, at least two distribution openings have different depth.

Preferably, at least three distribution openings, the central axes of which are parallel and aligned in series.

Preferably, at least two distribution openings are aligned abreast.

BRIEF DESCRIPTION OF DRAWINGS

Examples of the invention will be apparent from and described in detail with reference to the accompanying drawings, in which:

Fig. 1 shows an overview of a heat exchanger with a extracted cross section of basic embodiment of the invention.

Fig. 2A shows a transverse side cross section area of the basic embodiment of the invention.

Fig. 2B shows a longitudinal side cross section area of the basic embodiment of the invention.

Fig. 3A shows an upper view of the basic embodiment of the invention.

Fig. 3A shows a lower view of the basic embodiment of the invention.

Fig. 4A shows the first possible deployment of connection blocks in accordance with the subject of the invention.

Fig. 4B shows the second possible deployment of connection blocks in accordance
5 with the subject of the invention.

Fig. 4C shows the third possible deployment of connection blocks in accordance with the subject of the invention.

Fig. 4D shows the fourth possible deployment of connection blocks in accordance with the subject of the invention.

10 Fig. 5A shows an exemplary embodiment of the invention with multiple distribution openings configuration.

Fig. 5B shows a cross section of an exemplary embodiment of the invention with the parallel distribution openings configuration.

Fig. 6A shows a schematic perspective view of an exemplary embodiment of the
15 invention with the perpendicular distribution openings configuration.

Fig. 6B shows a cross section of an exemplary embodiment of the invention with the slanted distribution openings configuration.

Fig. 7A shows an example of possible distribution openings configuration aligned in series.

20 Fig.7B. shows an example of possible distribution openings configuration aligned abreast.

DETAILED DESCRIPTION OF EMBODIMENTS

Embodiments of the invention disclose a heat exchanger 1 for a motor vehicle,
25 comprising a connection element between the heat exchanger 1 and refrigerant loop further, called a first connection block 30. The heat exchanger is an air condenser for

the air conditioning system. It may be a heat exchanger adapted to work in two modes of operation: in a cooling mode as a condenser and in heating mode as an evaporator.

The first connection block 30 and a second connection block 50 are explicitly distinguished, as they differ in terms of design. The first connection block 30 is the subject of the invention and is described extensively throughout the specification. The second connection block 50 is of different design, for example of a design known in the art, for example with a straightforward communication between an inlet and an outlet of the block.

A first collection chamber 20 and a second collection chamber 21 have also been distinguished for the sake of clarity and to enable description of possible deployment of the connection blocks 30, 50 on the collection chambers 20, 21, yet one shall consider both of collection chambers 20, 21 as interchangeable. For example, this may be the case if direction of the flow is envisaged to be reversed.

In a known heat exchanger, during operation, the refrigerant enters the heat exchanger 1 through the inlet side of the first connection block 30 and it is directed into a first collection chamber 20 to supply the refrigerant to the heat exchanger 1. The refrigerant circulates between the first collection chamber 20 and the second collection chamber 21 through tubes 22. The tubes 22 are connected in a fluidic manner with the collection chambers 20, 21. The tubes 22 are interlaced in parallel to one another, optionally with fins 23 for increasing overall heat exchanger 1 efficiency. This mode of operation and placement of components apply also to the following invention.

Fig. 1 and Fig. 4A present an exemplary overview of the heat exchanger 1 comprising two connection blocks 30, 50, both assembled on the first collection chamber 20. The first connection block 30 is configured to distribute the refrigerant to the first collection chamber 20. The second connection block 50 is configured to collect refrigerant after it completes desired circulation path. In the embodiment presented in the Fig. 1 and Fig. 4A, the first connection block 30 is assembled on the same first collection chamber 20 as the second connection block 50, which is adapted as an outlet of refrigerant from the heat exchanger 1. Other possible embodiments concerning deployment of the connection blocks 30, 50 on the collection chambers 20, 21 include, among others: an embodiment wherein the first connection block 30 is deployed on the first collection chamber 20 and the second connection block 50 is

deployed on the second collection chamber 21, wherein the first connection block 30 performs a function of the inlet to the heat exchanger 1 and the second connection block 50 performs a function of the outlet from the heat exchanger 1 (see Fig 4B); an embodiment wherein the first connection block 30 is deployed on one first collection chamber 20 and another first connection block 30 is deployed on the second collection chamber 21, wherein the first connection blocks 30 of the same kind perform a function of both inlet and outlet of the heat exchanger 1 (see Fig. 4C); an embodiment wherein two first connection blocks 30 are deployed on one first collection chamber 20, wherein at least one of the first connection blocks 30 performs a function of the inlet to the heat exchanger 1 and the first connection block 30 of the same kind performs a function of the outlet from the heat exchanger 1 (see Fig 4D).

Figures 2A to 3B present detailed views of the first connection block 30. In its basic embodiment, the first connection block 30 has two distribution openings 41, 42 which are connected in a fluidic manner with the first opening 33. Distribution openings 41, 42 are also configured to be connected fluidically with the collection chambers 20, 21.

The distribution openings 41, 42, 43 are primarily in a rounded shape, yet according to the embodiment presented in the Fig. 3B a form of an oblong is also envisaged. As a result of creating at least two adjacent distribution openings, a wall portion 36 is formed between them. Each wall portion 36 separates the stream of the refrigerant between at least two distribution openings 41, 42, 43. At least two distribution openings 41, 42, 43 in a form of an oblong are more preferable and favorable in terms of refrigerant distribution and lower pressure drop in collection chambers 20, 21, due to bigger cross-section area than a block with a single communication passage between openings in a form of a straight channel. As shown in Fig. 1, Fig. 2B and Fig. 3A, a wall portion 36 between at least two distribution openings may have sharp edges at the side facing the first opening 33. Alternatively, as presented in the Fig. 5B, a wall portion 36 between at least two distribution openings 41, 42 may have rounded edges at the side facing the first opening 33. Thanks to rounded edges of wall portion 36 at the side facing the first opening 33, the refrigerant may be directed into distribution openings 41, 42 in a more orderly manner.

A multiplication of distribution openings 41, 42, 43 within the first connection block 30 is also envisaged. Fig. 5A presents one example, where more than two distribution openings 41, 42, 43 are present.

5 In general, a central axis of any opening is designated by a line formed by center points of all its cross-sections in its longitudinal direction. Some possible embodiments of the distribution openings 41, 42, 43 are described in further paragraphs.

10 In one example, in a first connection block 30 comprising at least two distribution openings 41, 42, 43, central axis of at least one distribution opening 41c, 42c, 43c is parallel to central axis of the first opening 33c. For example, Fig. 2B and Fig. 5B disclose one first opening 33 connected fluidically with two distribution openings 41, 42. The central axis of the first opening 33c is parallel to central axis of at least one distribution opening, in this case to all of them.

15 In an another example, in a block comprising at least two distribution openings 41, 42, the central axis of at least one distribution opening 41c, 42c is perpendicular to central axis of the first opening 33c. For example, Fig. 6A discloses one first opening 33 connected fluidically with two distribution openings 41, 42. The central axis of the first opening 33c is perpendicular to central axis of the distribution opening 41c. Moreover, central axis of the first opening 33c is also perpendicular to the central axis of the distribution opening 42c and the central axis distribution opening 41c is parallel
20 to the central axis of the distribution opening 42c.

25 In an another example, in a block comprising at least two distribution openings 41, 42, central axis of at least one distribution opening 41c, 42c is slanted with respect to central axis of the first opening 33c. Slanted means that the angle between central axis of the first opening 33c and central axis of the distribution opening 42c is different than 90 degrees, 180 degrees or 270 degrees. For example, Fig. 6B discloses the first opening 33 connected fluidically with two distribution openings 41, 42. The central axis of the first opening 33c is slanted to central axis of the distribution opening 42c. Moreover, central axis of the first opening 33c is parallel to the central axis of the distribution opening 41c and the central axis of the distribution opening 41c is slanted
30 to the central axis of the distribution opening 42c.

In the basic embodiment of an invention comprising at least two distribution openings 41, 42, central axis of at least one distribution opening 41c is parallel to central axis of the other distribution opening 42c. This embodiment is presented in the Fig. 2B.

5 In the other embodiment of an invention comprising at least two distribution openings 41, 42, central axis of at least one distribution opening 41c is perpendicular to central axis of the other distribution opening 43c. This embodiment is presented in the Fig 6A.

10 In the other embodiment of an invention comprising at least two distribution openings 41, 42, the central axis of at least one distribution opening 41c is slanted with respect to the central axis of the other distribution opening 42c. This embodiment is presented in the Fig. 6B.

As mentioned before, the distribution openings 41, 42 are adapted to distribute the refrigerant to the first collection chamber 20. Fig. 2A and Fig. 2B distinguish the most basic form of distribution openings 41, 42, wherein a wall portion 36 has sharp edges at the side facing one of the collection chambers 20, 21, depending on the first connection block 30 location.

Reaming at least one of the distribution openings 41, 42 at the side facing the first collection chamber 20 is possible and it may be useful in terms of distribution of refrigerant to the first collection chamber 20. Consequently, at least one of the distribution openings 41, 42 has at least two different cross-sections along its central axis 41c, 42c. In one of the embodiments, a first cross-section has a bigger area than a second cross-section, wherein the first cross-section faces the first opening 33. In the other embodiment, a first cross-section has a bigger area than a second cross-section, wherein the first cross-section faces the collection chamber. The exemplary embodiment is presented on the peripheral side of the distribution opening 41 in the Fig. 5B.

30 The distribution openings 41, 42 are of the certain, initially desired depth, where depth of the opening can be defined as the distance penetrated by the opening along its channel axial direction inside the connection block. However, it may be necessary to deploy the mounting points 34, 35 on the path of distribution channels. Depth of

mounting points 34, 35 can be defined analogically to the opening depth. In one of
embodiments of the invention, it is possible to reduce the initial depth of at least one
of the distribution openings 41 in regard to the other, such that at least two distribution
openings have different depth. The reduced depth of distribution opening 41 in
5 comparison with the other distribution opening 42 is presented in the Fig. 2B and Fig.
5B. The depth of the mounting point 34 presented in Fig. 2B represents an example,
where the depth of the distribution opening 42 had to be reduced because it was not
possible to replicate the depth of the other distribution opening 42..

Regarding the embodiments, wherein the first connection block 30 comprises
10 at least three distribution openings 41, 42, 43, there are at least two possible
configurations of the distribution openings 41, 42, 43. In one of the embodiments,
central axes 41c, 42c, 43c of the distribution openings 41, 42, 43 are parallel and the
distribution openings 41, 42, 43 are aligned in series, i.e. one can draw the straight line
connecting the central points defined by the central axes 41c, 42c, 43c of each
15 distribution opening 41, 42, 43 analogically as presented by the dashed line in the Fig.
7A. Dashed circular line in the Fig. 7A indicates the location of the first opening 33. In
another embodiment, central axes 41c, 42c, 43c, 44c, of the distribution openings 41,
42, 43, 44 are parallel and the distribution openings 41, 42, 43, 44 are aligned abreast,
i.e. one can draw at least two parallel lines connecting the central points defined by the
20 central axes 41c, 42c, 43c, 44c of each distribution opening 41, 42, 43, 44 analogically
as presented in the cross sectional view in the Fig. 7B by the dashed lines. Dashed
circular line in the Fig. 7A indicates location of the first opening 33.

The connection first connection block 30 is preferably made from a solid
aluminum block, due to its lightweight properties, processing capabilities and
25 performance. The first opening 33 can be drilled to desired depth in one of the
transverse walls of the aluminum block. The distribution openings 41, 42, 43 may then
be drilled in the direction of the first opening 33, so that the openings are connected
fluidically. The mounting rails 39 can also be created by cutting out the material of solid
aluminum block. The mounting rails 39 enable the assembly of the first connection
30 block 30 to the collection chamber 20, 21 by tight connection and brazing. Additionally,
the mounting points 34, 35 can also be created where needed. Other methods of
carrying out the first connection block 30 e.g. laser cutting, computer numerical control
machining or casting should also be considered executable. The first connection block

30 can be assembled with one of the collection chambers 20, 21 using mounting rails 39 and two elements are brazed together.

Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of drawings, the disclosure, and the appended claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to the advantage.

Claims

1. A heat exchanger (1) comprising a first collection chamber (20) and a first connection block (30) connected to the first collection chamber (20), the connection block comprising an inlet/outlet opening for heat exchange fluid, characterized in that
5 the first connection block (30) comprises at least two distribution openings (41, 42, 43), connected fluidically with a first opening (33), wherein the distribution openings open directly into the first collection chamber (20).
2. The first connection block (30) according to claim 2 or 3, wherein central axis
10 (41c, 42c 43c) of at least one distribution opening (41, 42, 43) is parallel to central axis (33c) of the first opening (33).
3. The first connection block (30) according to claim 2 or 3, wherein central axis
15 (41c, 42c 43c) of at least one distribution opening (41, 42, 43) is perpendicular to central axis (33c) of the first opening (33).
4. The first connection block (30) according to claim 2 or 3, wherein central axis
20 (41c, 42c 43c) of at least one distribution opening (41, 42, 43) is slanted to central axis (33c) of the first opening (33).
5. The first connection block (30) of all preceding claims, wherein
a wall portion (36) between at least two distribution openings (41, 42, 43, 44), has rounded edges at the side facing the first opening (33).
- 25 6. The first connection block (30) according to any of claim 1-5, wherein
a wall portion (36) between at least two distribution openings (41, 42), has sharp edges at the side facing the first opening (33).

7. The first connection block (30) of all preceding claims, wherein at least one of distribution openings (41, 42) is at least partially reamed.
- 5 8. The first connection block (30) of all preceding claims, wherein at least one of distribution openings (41, 42, 43) has at least two different cross-sections along its central axis (41c, 42c, 43c).
9. The first connection block (30) according to claim 10, wherein a first cross-
10 section has a bigger area than a second cross-section, wherein the first cross-section faces the first opening (33).
10. The first connection block (30) according to claim 11, wherein a first cross-
15 section has a bigger area than a second cross-section, wherein the first cross-section faces the collection chamber (20, 21).
11. The first connection block (30) of all preceding claims, wherein at least two distribution openings (41, 42) have different depth.
- 20 12. The first connection block (30) of all preceding claims, comprising at least three distribution openings (41, 42, 43), the central axes (41c, 42c, 43c) of which are parallel and aligned in series.
13. The first connection block (30) of all preceding claims, comprising at least two
25 distribution openings (41, 42) aligned abreast.

14. The first connection block (30) according to claim 1, wherein at least one distribution opening (41, 42, 43) is roundly shaped.

15. The first connection block (30) according to claim 1, wherein at least one
5 distribution opening (41, 42, 43) is in the shape of an oblong.

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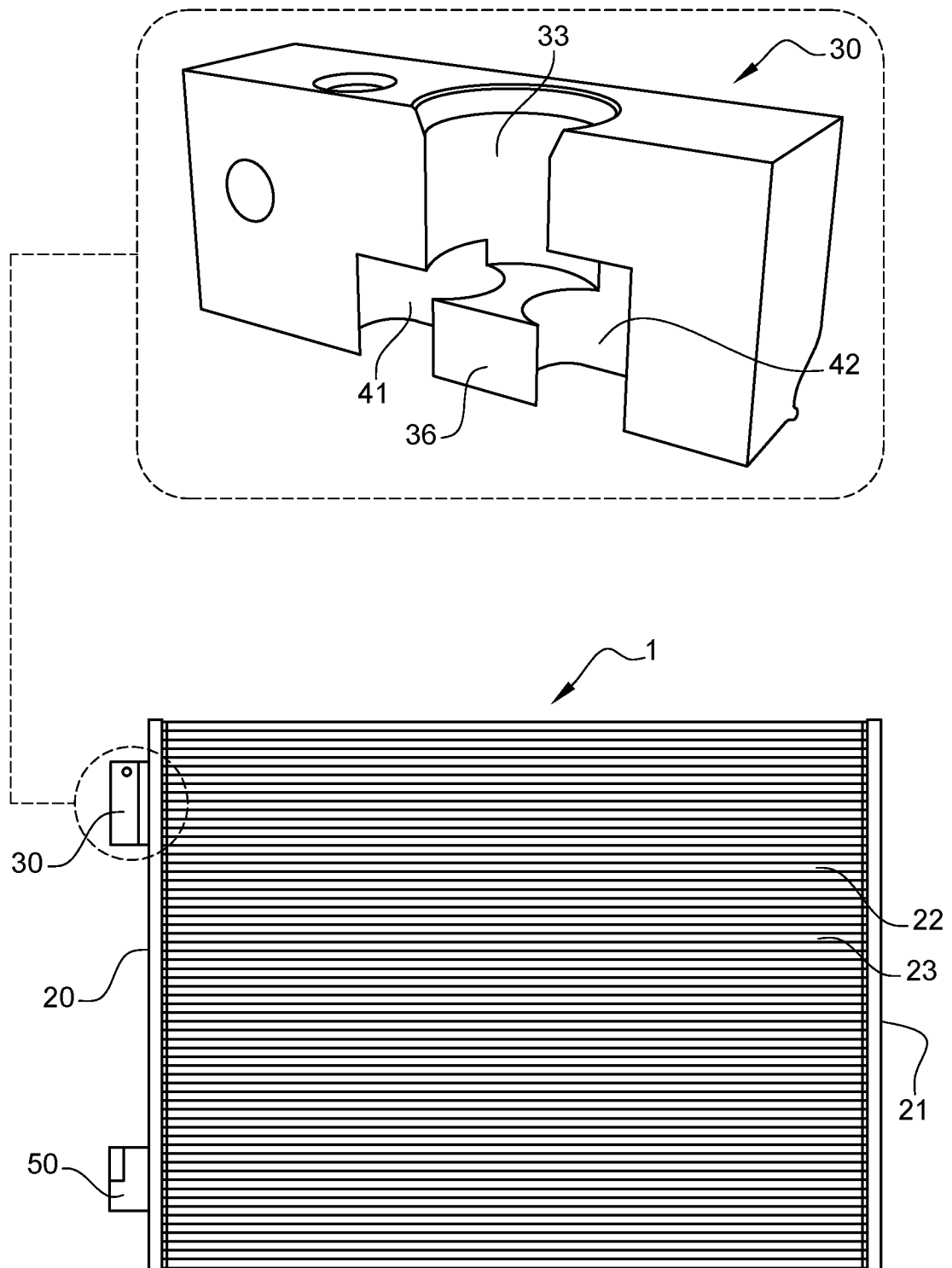


Fig. 1

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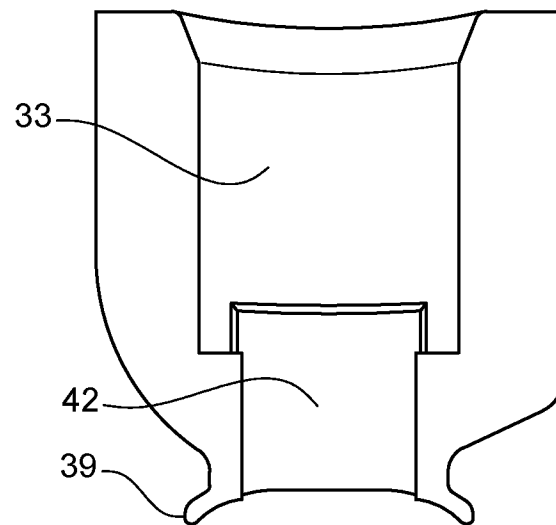


Fig. 2A

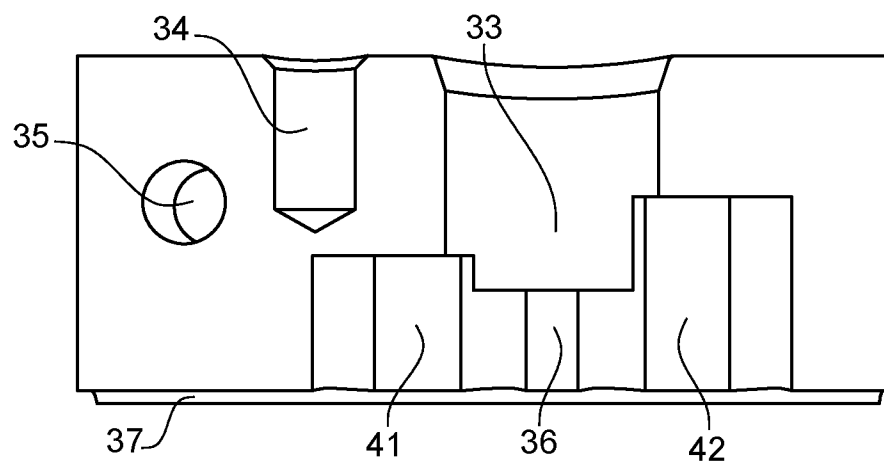


Fig. 2B

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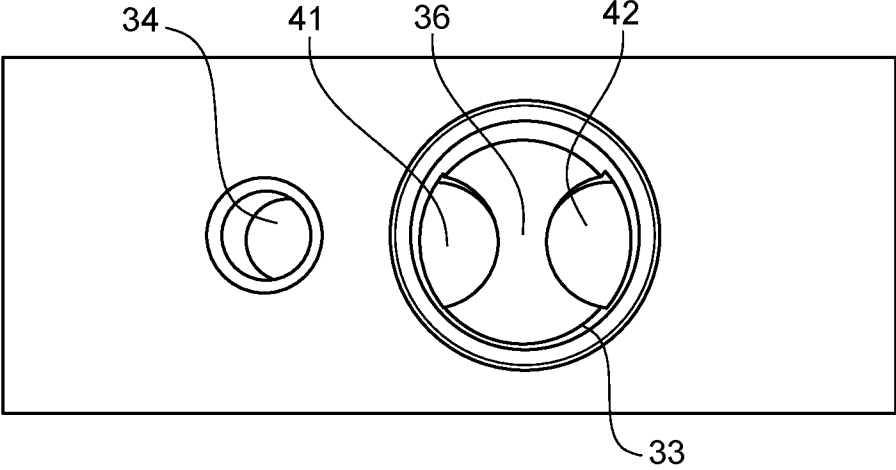


Fig. 3A

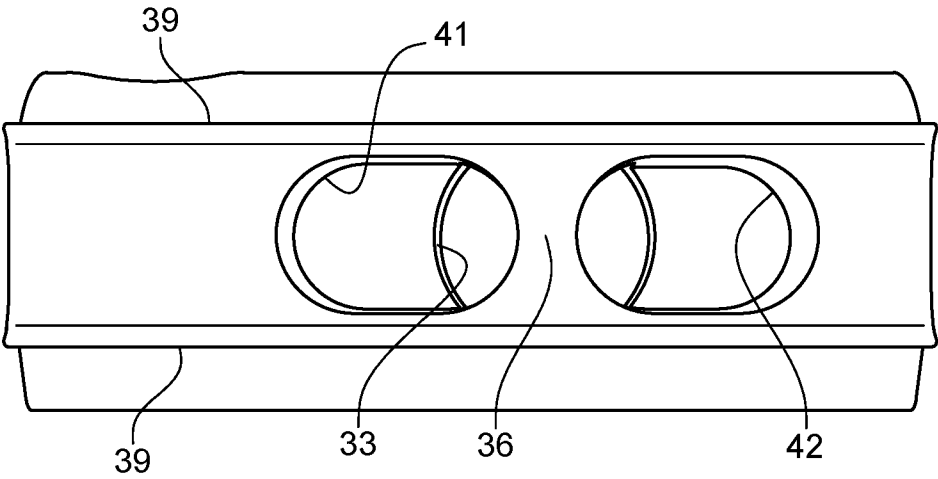


Fig. 3B

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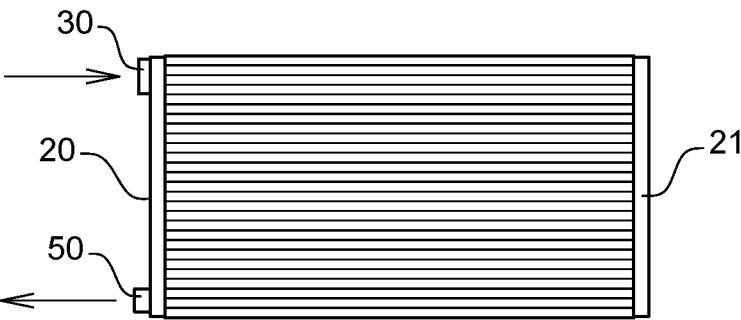


Fig. 4A

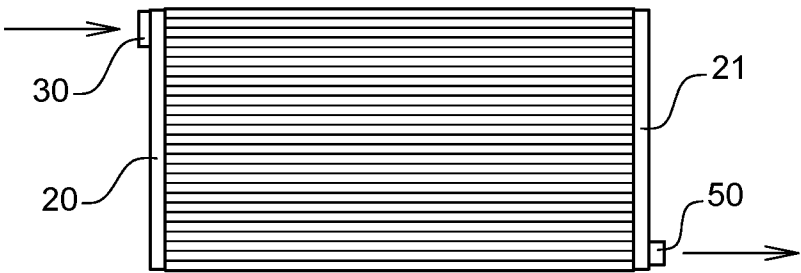


Fig. 4B

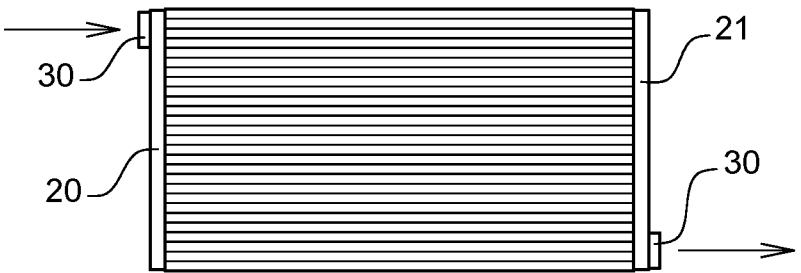


Fig. 4C

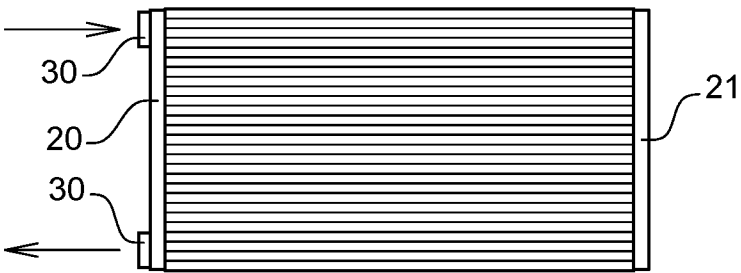


Fig. 4D

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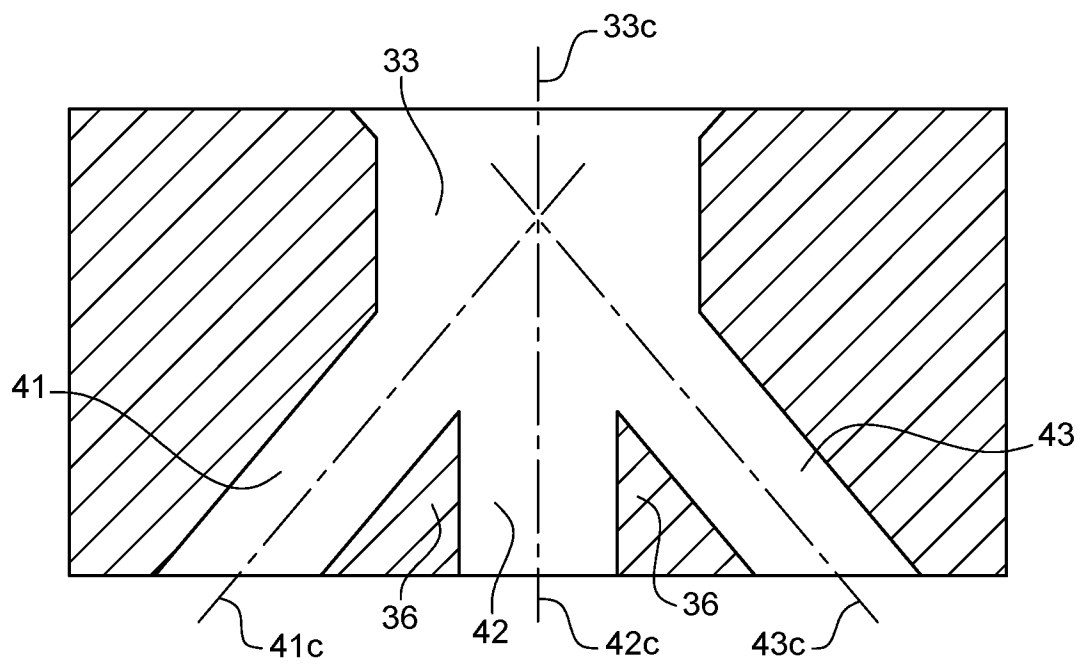


Fig. 5A

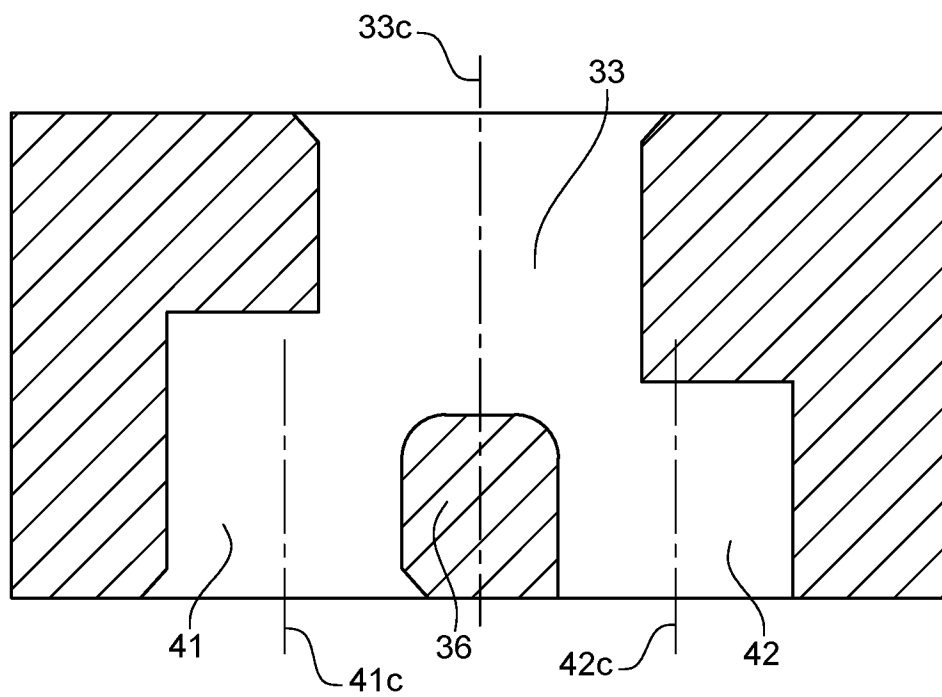


Fig. 5B

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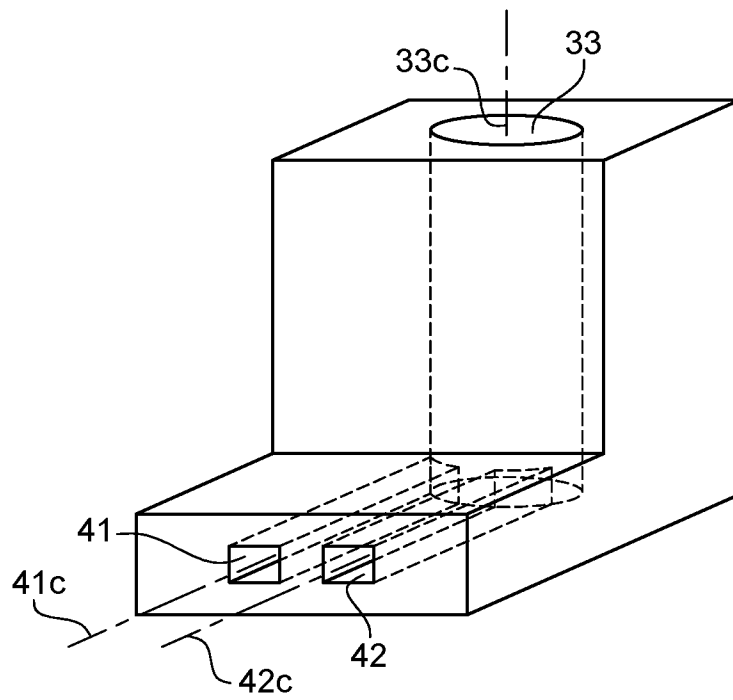


Fig. 6A

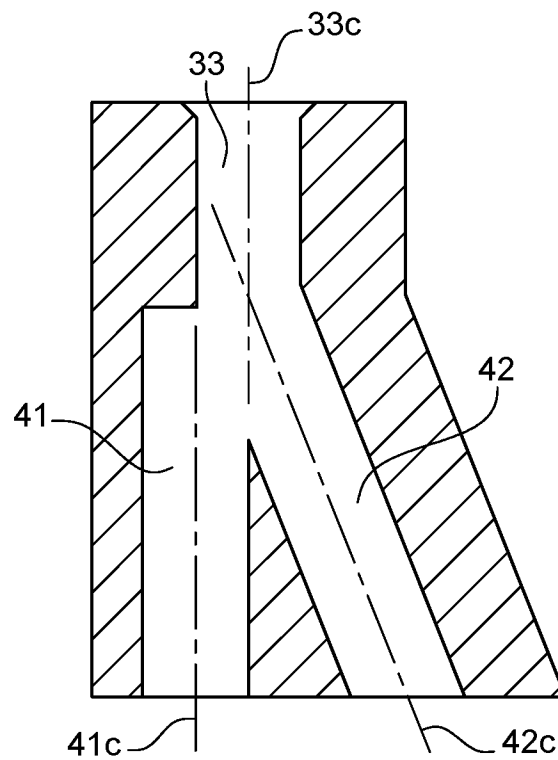


Fig. 6B

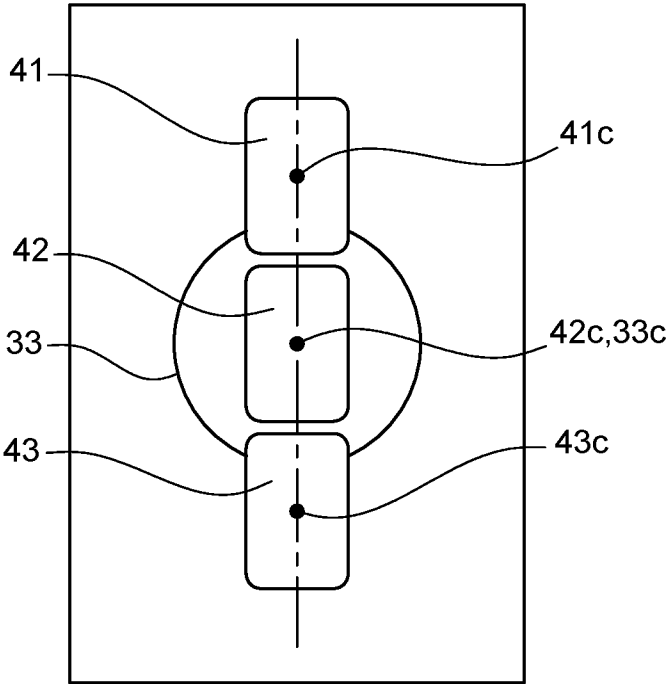


Fig. 7A

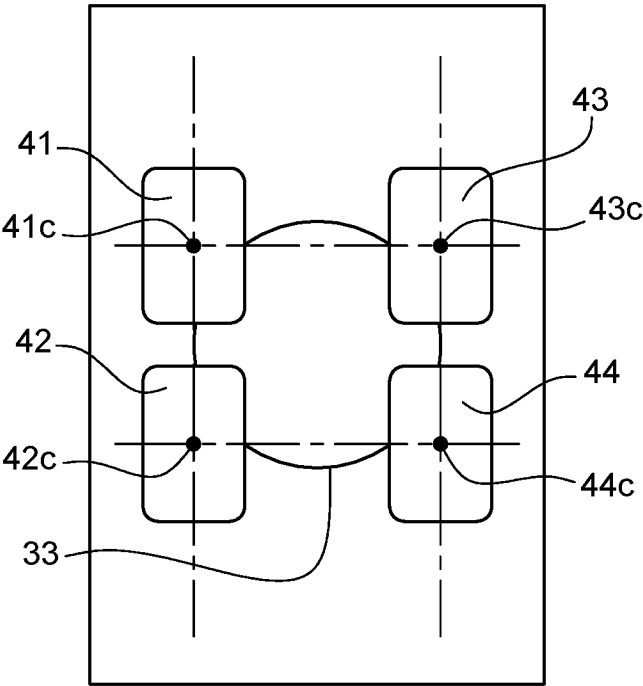


Fig. 7B

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2019/085633

A. CLASSIFICATION OF SUBJECT MATTER
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 ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F28D F25B F28F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2018/017297 A1 (ARINO KOTA [JP]) 18 January 2018 (2018-01-18) paragraph [0049] - paragraph [0056]; figures 8-10,14 -----	1,3,4, 6-11,14, 15
X	EP 2 006 631 A1 (VALEO SYSTEMES THERMIQUES [FR]) 24 December 2008 (2008-12-24) paragraph [0021] - paragraph [0032]; figures 1-4 -----	1,4-7,9, 10,13-15
X	US 2007/131405 A1 (HARADA MASAKI [JP] ET AL) 14 June 2007 (2007-06-14) paragraph [0047]; figures 3,4,6b -----	1,4,5, 12-15
X	JP H11 230693 A (SHOWA ALUMINUM CORP) 27 August 1999 (1999-08-27) abstract; figures 2,3 ----- -/-	1,3,5,7, 11-14



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

5 March 2020

Date of mailing of the international search report

13/03/2020

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PCT/EP2019/085633

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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