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(54) Title: A HEAT EXCHANGER

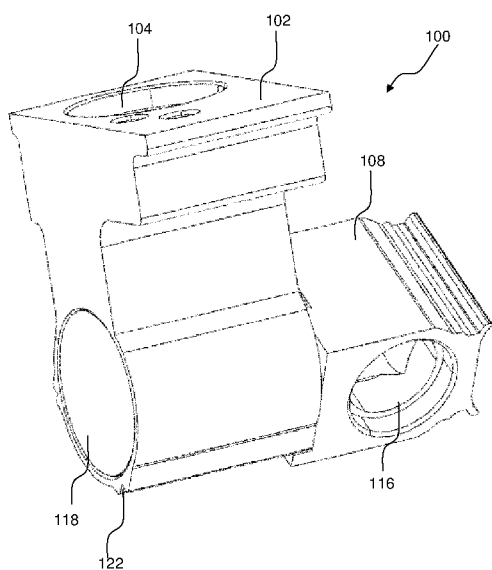


FIG. 4

(57) Abstract: A heat exchanger having a connector for introducing heat exchange fluid to or receive heat exchanger fluid from the heat exchanger is described. The connector includes a first block and a second block. The first block further includes a first fluid channel and a second fluid channel that is in a fluid communication with each other. The second block further includes a solid portion having a protruded portion protruded from the solid portion. The protruded portion further includes a secondary fluid channel. Further, at least a portion of the protruded portion protrudes into the second fluid channel of the first block to secure the second block with the first block in a desired orientation, and the secondary fluid channel of the second block is being in fluid communication with the second fluid channel of the first block.

Published:

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A HEAT EXCHANGER

The present subject matter relates, in general to heat exchangers, and in particular, to heat exchangers with a connector for connecting the heat exchangers with conduits at different orientations in a Heating, Ventilation, and Air Conditioning (HVAC) system.

Generally, HVAC systems are implemented in vehicles to provide comfort driving to the driver and occupants. The HVAC system generally includes heat exchangers (i.e., evaporators, condensers), an expansion valve and a compressor. The heat exchangers are connected to the expansion valve and the compressor through conduits for circulation of refrigerant. Ideally, the heat exchangers are connected to inlet/outlet conduits through a connector, which is a single piece of a metal alloy. The HVAC system has to be configured in such a way so as to achieve efficient space utilization or address packaging issues. As the designs of vehicles change, configuration of components of the HVAC system also varies accordingly. When the heat exchanger is repositioned or routing of the conduits are changed for optimum space utilization or to address packaging issues, the connectors design may become problematic. As the conventional connectors are of single piece metal alloy or metal, their adaptability is low. For example, if the inlet/outlet conduits are repositioned to a different position or orientation from their original position or orientation, the conventional connectors become increasingly complicated to manufacture, which is related to increased costs.

Further, the conventional connectors are manufactured by extruding the optimized shape and then milling the connectors to get desired geometry of the connectors. Further, the connectors may be machined to provide connection interfaces, such as threads. However, such techniques to manufacture the connectors are cumbersome and time-consuming as it involves multiple processing steps, especially for complicated routing of inner channels for heat exchange fluid.

Accordingly, there is a need for a connector allowing simplified adaptation to different configurations of connecting the heat exchangers with the conduits provided in various orientations.

5 An object of the present invention is to provide a heat exchanger with a connector that can be implemented in a HVAC system where the heat exchangers and conduits are positioned at various angles.

10 Another object of the present invention is to reduce mass of the connector to achieve lighter heat exchangers and reduce cost.

15 In the present description, some elements or parameters may be indexed, such as a first element and a second element. In this case, unless stated otherwise, this indexation is only meant to differentiate and name elements which are similar but not identical. No idea of priority should be inferred from such indexation, as these terms may be switched without betraying the invention. Additionally, this indexation does not imply any order in mounting or use of the elements of the invention.

20 In view of the foregoing, an embodiment of this invention herein provides a heat exchanger with a connector for introducing heat exchange fluid to or receive heat exchanger fluid from the heat exchanger. The connector includes a first block and a second block. The first block further includes a first fluid channel and a second fluid channel that is in a fluid communication with each other. The second block further includes a solid portion having a protruded portion protruded from the solid portion. The protruded portion further includes a primary fluid channel. Further, at least a portion of the protruded portion protrudes into the second fluid channel of the first block to secure the second block with the first block in a desired orientation, and the secondary fluid channel of the second block is being in fluid communication with the second fluid channel of the first block.

30

Generally, the first fluid channel is perpendicularly connected with the second fluid channel. Alternatively, the first fluid channel can be connected with the second fluid channel in such a way that the first fluid channel is oblique with respect to the second fluid channel.

5

In one embodiment, the second block further includes a secondary fluid channel that is in fluid communication with the primary fluid channel.

Further, the primary fluid channel is perpendicularly connected with the secondary fluid channel. Alternatively, the primary fluid channel can be connected with the secondary fluid channel in such a way that the primary fluid channel is oblique with respect to the second fluid channel.

In accordance with an embodiment, the second fluid channel is a hollow through-hole having a first end and a second end, and the first fluid channel is connected fluidically to the second fluid channel between the first end and the second end. The connector further includes a closing cap adapted to engage with the second end of the second fluid channel provided in the first block, at the same time, the second block is secured with the first end of the second fluid channel provided in the first block.

20

In one embodiment, the protruded portion has a circular cross-section corresponding to the cross-section of the second fluid channel.

In accordance with an embodiment of the present subject matter, the second block further includes at least two locking projection provided, in parallel to the protruded portion, on the solid portion of the second block for retaining the angular position between the first block and the second block. The first block further a plurality of rabbets provided on the circumference of the second fluid channel of the first block to receive the locking projections for restricting movement of the second block with respect to the first block.

30

In an example, the connector includes a brazing ring provided on the circumference of the protruded portion of the second block to facilitate connection between the first block and the second block.

5 In one embodiment, the first block and the second block are manufactured by extrusion process.

In an aspect of the present invention, the second block is connected to the manifold of the heat exchanger to introduce the heat exchange fluid to or receive the
10 heat exchange fluid from the heat exchanger.

In another aspect, a connector for introducing heat exchange fluid to or receive heat exchanger fluid from a heat exchanger is provided. The connector includes a first block and a second block. The first block further includes a first fluid channel and a
15 second fluid channel that is in a fluid communication with each other. The second block further includes a solid portion having a protruded portion protruded from the solid portion. The protruded portion further includes a primary fluid channel. Further, at least a portion of the protruded portion protrudes into the second fluid channel of the first
20 block to secure the second block with the first block in a desired orientation, and the secondary fluid channel of the second block is being in fluid communication with the second fluid channel of the first block.

Other characteristics, details and advantages of the invention can be inferred from the description of the invention hereunder. A more complete appreciation of the
25 invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying figures, wherein:

Fig. 1 illustrates a schematic view of a heat exchanger manifold of a heat
30 exchanger that is connected with a conduit through a connector, in accordance with an embodiment of the present subject matter;

Fig. 2A illustrates an exploded view of the connector in accordance with an embodiment of the present subject matter having a second block;

5 Fig. 2B illustrates an exploded view of the connector in accordance with an embodiment of the present subject matter having two second blocks;

Fig. 3A illustrates a cross-sectional view of a first block of the connector of Fig. 2A, in accordance with an embodiment of the present subject matter;

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Fig. 3B illustrates a cross-sectional view of a second block of the connector of Fig. 2A, in accordance with an embodiment of the present subject matter; and

15 Fig. 4 illustrates a perspective view of the connector after assembling the first block and the second block together at a desired orientation, in accordance with an embodiment of the present subject matter.

It must be noted that the figures disclose the invention in a detailed enough way to be implemented, the figures helping to better define the invention if needs be. The invention should however not be limited to the embodiment disclosed in the description.

20 The present subject matter relates to concepts relating to a connector having at least two blocks, where the at least two blocks are interconnected at a desired angle to connect the heat exchangers and the conduits provided in different orientations in a HVAC system. According to an aspect, the connector includes a first block and a second block that is in a fluid communication with the first block. The first block is connected to the second block in a desired orientation to enable the fluid communication between the first block and the second block. The first block may be connected to conduits which carry the heat exchange fluid. The second block may be connected to a manifold of the heat exchanger. The first block may configure a fluid path to communicate the heat exchange fluid between first block and the second block.

The second block may configure another fluid path to communicate the heat exchange fluid received from the first block to the heat exchanger. As the connector is of two blocks and the blocks are to be interconnected in the desired orientation, the connector can be used in any HVAC system having the heat exchanger and the conduits positioned in different orientations and different positions.

These and other advantages of the present subject matter would be described in greater detail in conjunction with the following figures. While aspects relating to connecting heat exchangers to the conduits, provided in a different orientation with respect to the heat exchanger, through a connector in the HVAC system as described above and henceforth can be implemented in any number of different configurations, the embodiments are described in the context of the following system(s).

Fig. 1 illustrates a schematic view of a heat exchanger manifold 16 of a heat exchanger that is connected with a conduit through a connector 100, in accordance with an embodiment of the present subject matter. The connector 100 is provided between the conduit and a manifold 16 of the heat exchanger to connect fluidically the conduit to the heat exchanger. Further, the connector 100 is configured to couple the heat exchanger with the conduit positioned at an angle with respect to the heat exchanger. The connector 100 comprises a first block 102 and a second block 108 that is in a fluid communication with the first block 102. The first block 102 is connected with the second block 108 in such a way that the connector 100 enables to connect the heat exchanger with the conduit obliquely positioned with respect to the heat exchanger. In one example, the first block 102 may be connected to the conduit of the HVAC system, and the second block 108 may be connected to the manifold 16 of the heat exchanger. In one example, the conduit may be an inlet conduit or an outlet conduit. Further, construction of the connector 100 is explained in the forthcoming figures.

In Fig. 2A, an exploded view of the connector 100 in accordance with an embodiment of the present subject matter having a second block 108 is illustrated. In one embodiment, the connector 100 is adapted to introduce heat exchange fluid to or

receive heat exchange fluid from the heat exchanger. In one example, the heat exchange fluid can be a refrigerant. The connector 100 may include the first block 102 and the second block 108 which is in a fluid communication with the first block 102. In an example, the first block 102 includes a first fluid channel 104, and a second fluid channel 106 which are in a fluid communication with each other. In another example, the first block 102 may include more than one first fluid channel 104 being fluidically connected with the second fluid channel 106. In yet another example, the first fluid channel 104 may be formed in a transverse axis with respect to the first block 102, and the second fluid channel 106 may be formed in an axial direction with respect to the first block 102. The first fluid channel 104 and the second fluid channel 106 are formed in the first block 102 to enable the heat exchange fluid to flow therein. In one embodiment, the second fluid channel 106 is a hollow through-hole having a first end 126 and a second end 128. The first fluid channel 104 may be fluidically connected in between the first end 126 and the second end 128 of the second fluid channel 106.

The second block 108 further includes a solid portion 110, and a protruded portion 114 protruded from the solid portion 110. The protruded portion 114 comprises a primary fluid channel 112. The solid portion 110 may further include a secondary fluid channel 116 adapted to introduce the heat exchange fluid to or receive the heat exchange fluid from the primary channel 112. In an example, the primary fluid channel 112 and the secondary fluid channel 116 are oblique to each other. In another example, the primary fluid channel 112 and the secondary fluid channel 116 are perpendicular to each other. In yet another example, the primary fluid channel 112 is fluidically connected to the secondary fluid channel 116 at an angle. In one embodiment, the solid portion 110 may include more than one secondary fluid channel 116 fluidically connected to the primary fluid channel 112. It is also envisaged that the primary fluid channel 112 is directly connected with the manifold 16 in a straight line, thereby omitting the necessity of implementing the secondary fluid channel 116.

During assembly, the first block 102 and the second block 108 are immobilized in a desired angular orientation to each other during brazing. The second block 108 may

be arranged with the first block 102 in a desired orientation through the protruded portion 114. In an example, at least a portion of the protruded portion 114 is adapted to protrude at least partially into the second fluid channel 106 of the first block 102 to secure the second block 108 with the first block 102 in the desired orientation. In another example, the protruded portion 114 is entirely protruded into the second fluid channel 106 of the first block 102 to secure the second block 108 with the first block 102 in the desired orientation. In yet another example, the protruded portion 114 may be received into any one of the first end 126 or a second end 128 of the second fluid channel 106 of the first block 102. In one embodiment, the desired orientation of the second block 108 with respect to the first block 102 may be changed according to requirement, particularly relative position and orientation of the conduit with respect to the heat exchanger of the HVAC system. The second block 108 is secured with the first block 102 in such a way that the primary fluid channel 112 is in a fluid communication with the second fluid channel 106 of the first block 102 to facilitate fluid flow therein. Preferably, the protruded portion 114 has a circular cross-section corresponding to the cross-section of the second fluid channel 106, thereby enabling easy insertion and adjustable angular relationship. In other examples, different shapes of protrusion are also possible to implement as the protruded portion 114, as long as the protruded portion 114 enable selecting various angular arrangements between the first block 102 and the second block 108. Optionally, the second block 108 may be connected with the first block 102 and at the same time enforcing angular position between the first block 102 and the second block 108, through various means, e.g. by locking mechanisms.

The connector 100 further may include a closing cap 118 adapted to engage with at least one end of the second fluid channel 106 of the first block 102 based on securing end of the second block 108. For example, when the second block 108 is secured with the first end 126 of the second fluid channel 106 of the first block 102, the closing cap 118 is adapted to engage with the second end 128 of the second fluid channel 106 of the first block 102 and vice versa. In one example, the closing cap 118 is a baffle.

Further, the first block 102 and the second block 108 may be brazed to retain the second block 108 with the first block 102. To facilitate the brazing process between the first block 102 and the second block 108, a brazing ring 120 is provided on the circumference of the protruded portion 114 of the second block 108.

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In another aspect of the invention, the connector 100 may include two second blocks 108 adapted to be secured with the first end 126 and the second end 128 of the first block 102 respectively, in case the connector 100 is implemented to connect two heat exchangers with the two different conduits. In such scenario, the closing cap 118 is replaced with another second block as shown in Fig. 2B. The configuration illustrated in Fig.2B may be especially useful when there is multiple heat exchanger cores, neighboring each other with their corresponding manifolds, so that the connector 100 can be placed between the heat exchanger cores and connect them fluidically.

Alternatively, if there are more inlets or outlets cooperating with a single manifold section, the design of the connector 100 may be slightly altered to accommodate collecting the heat exchange fluid or introducing the heat exchange fluid to their openings at the same time. The protruded portions 114 then might be rearranged to be longer (i.e. to form so called jumperlines), with adaptation of openings and connecting arrangements on the second blocks 108 to connect fluidically to manifold at desired places. In such case, the angular flexibility is still provided by the connector 100.

The connector 100 may further include a locking mechanism for restricting movement of the second block 108 with respect to the first block 102. In one example, the locking mechanism may be a locking projection-rabbets setup. In one embodiment, one or more locking projections 124 are provided, in parallel to the protruded portion 114, on the solid portion of the second block 108 for retaining angular position between the first block 102 and the second block 108. Further, the rabbets 122 are provided on the circumference of the second fluid channel 106 of the first block 102 in such a way that the rabbets 122 are adapted to receive the one or more locking projections when the second block 108 is secured with the first block 102. In one example, the one or

more locking projections 124 being a rectangular projection adapted to retain angular position between the first block 102 and the second block 108 by protruding into the rabbets 122 provided in the first block 122. In another embodiment, the one or more locking projections 124 may be provided in the second block 108, and the rabbets may be provided in the first block 102. In any case, provision of locking means as described above enables simplified adaptation of the angular orientation by modifying parameters of the shape to require minimum, if any, involvement of machining.

Fig. 3A illustrates a cross-sectional view of the first block 102 of the connector 100, in accordance with an embodiment of the present subject matter. The cross-sectional view of the first block 102 clearly depicts position of the first fluid channel 104 and the second fluid channel 106. In the present embodiment, the first fluid channel 104 is fluidically connected in-between the first end 126 and the second end 128 of the second fluid channel 106 to provide fluid communication between the first fluid channel 104 and the second fluid channel 106. In one example, the first fluid channel 104 is connected to the second fluid channel 106 in such a way that the first fluid channel 104 is perpendicular to the second fluid channel 106. In another example, the first fluid channel 104 is connected to the second fluid channel 106 at angle ranging from 45° to 135° .

Fig. 3B illustrates a cross-sectional view of the second block 108 of the connector 100, in accordance with an embodiment of the present subject matter. The cross-sectional view of the second block 108 clearly depicts position of the primary fluid channel 112 and the secondary fluid channel 116. In the present embodiment, the primary fluid channel 112 is fluidically connected to the secondary fluid channel 116 to provide fluid communication between the primary fluid channel 112 and the secondary fluid channel 116. In one example, the primary fluid channel 112 is connected to the secondary fluid channel 116 in such a way that the primary fluid channel 112 is perpendicular to the secondary fluid channel 116. In another example, the primary fluid channel 112 is connected to the secondary fluid channel 116 at angle ranging from 45° to 135° .

Fig. 4 presents a perspective view of the connector 100 after assembling the first block 102 and the second block 108 together at a desired orientation, in accordance with an embodiment of the present subject matter. The first block 102 is angularly enforced with the second block 108 at angle to form the connector 100. The first fluid channel 104 and the secondary fluid channel 116 are in a fluid communication through the second fluid channel 106 along with the primary fluid channel 112. The connector 100 enables the heat exchange fluid flow to the heat exchanger through the first fluid channel 104, the second fluid channel 106, the primary fluid channel 112 and the secondary fluid channel 116. In one example, the heat exchange fluid is a refrigerant that includes, but not limited to, R11, R12, R113, R114, R115, R22, R123, R134a, R404a, R407C, and R410a. In one example, the connector 100 is manufactured by an extrusion process as two blocks. In another example, the connector 100 can be manufactured as more than two blocks by the extrusion process. As the connector 100 manufactured as two blocks, i.e., the first block 102 and the second block 108, the blocks can be secured in different angles thereby achieving different orientation of the connector 100. In one example, the first block 102 is connected to the inlet/outlet conduits to communicate the heat exchange fluid between the first block 102 and the second block 108. Further, the second block 108 is connected to the manifold 16 of the heat exchanger to communicate the heat exchange fluid between the second block 108 and the heat exchanger. The first block 102 and the second block 108 may be secured together by a brazing process or by gluing. As the connector 100 manufactured as two blocks, no machining process required to achieve the desired orientation thereby reducing weight of the connector 100 by ~24-28% as compared to the conventional connectors. The reduction of mass of the connector 100 leads to reduction mass of the heat exchanger which is better in terms of mechanical behavior (i.e., vibration resistance). The conventional blocks are difficult to be properly brazed due to weight and need additional processes to make brazing process feasible (e.g. sand blasting of parts to improve heat transfer in brazing furnace). Reduction of weight and the material which has to be used allows to mitigate those problems. In one embodiment, the

connector 100 is manufactured from a group including, but not limited to, a metal or metal alloy.

5 In any case, the invention cannot and should not be limited to the embodiments specifically described in this document, as other embodiments might exist. The invention shall spread to any equivalent means and any technically operating combination of means.

CLAIMS

1. A heat exchanger comprising a connector (100) for introducing heat exchange fluid to or receiving heat exchange fluid from the heat exchanger, wherein the connector
5 (100) comprises:

a first block (102) comprising a first fluid channel (104) and a second fluid channel (106) in a fluid communication with each other;

a second block (108) comprising a solid portion (110) comprising a protruded portion (114), wherein the protruded portion (114) comprises a primary fluid channel
10 (112), and wherein at least a portion of the protruded portion (114) protrudes into the second fluid channel (106) of the first block (102) to secure the second block (108) with the first block (102) in a desired orientation, the primary fluid channel (116) of the second block (108) being in fluid communication with the second fluid channel (106) of the first block (102).

15 2. The heat exchanger according to claim 1, wherein the first fluid channel (104) is perpendicularly connected with the second fluid channel (106).

3. The heat exchanger according to claim 1, wherein the first fluid channel (104) is
20 connected with the second fluid channel (106) in such a way that the first fluid channel (104) is oblique with respect to the second fluid channel (106).

4. The heat exchanger according to any preceding claim, wherein the second block (108) further comprises a secondary fluid channel (116) which is in fluid communication
25 with the primary fluid channel (112).

5. The heat exchanger according to claim 4, wherein the primary fluid channel (112) is perpendicularly connected with the secondary fluid channel (116).

6. The heat exchanger according to claim 4, wherein the primary fluid channel (112) is connected with the secondary fluid channel (116) in such a way that the primary fluid channel (112) is oblique with respect to the second fluid channel (116).

5 7. The heat exchanger according to any preceding claim, wherein the second fluid channel (106) is a hollow through-hole having a first end (126) and a second end (128), wherein the first fluid channel (104) is connected fluidically to the second fluid channel (106) between the first end (126) and the second end (128).

10 8. The heat exchanger according to claim 7, further comprising a closing cap (118) adapted to engage with the second end (128) of the second fluid channel (106) provided in the first block (102), whereas the second block (108) is secured with the first end (126) of the second fluid channel (106) provided in the first block (102).

15 9. The heat exchanger according to any of the preceding claims, wherein the protruded portion (114) has a circular cross-section corresponding to the cross-section of the second fluid channel (106).

10. The heat exchanger according to any of the preceding claims, wherein the second block (108) includes at least two locking projections (124) provided, in parallel to the protruded portion (114), on the solid portion (110) of the second block (108) for retaining the angular position between the first block (102) and the second block (108).

25 11. The heat exchanger according to claim 10, the first block (102) comprising a plurality of rabbets (122) provided on the circumference of the second fluid channel 106 of the first block (102) adapted to receive the locking projections (124) for restricting movement of the second block (108) with respect to the first block (102).

30 12. The heat exchanger according to any preceding claim, further comprising a brazing ring (120) provided on the circumference of the protruded portion (114) of the

second block (108) to facilitate connection between the first block (102) and the second block (108).

13. The heat exchanger according to any of the preceding claims, wherein the first
5 block (102) and the second block (108) are manufactured by extrusion process.

14. The heat exchanger comprising the connector (100) as described in any of the
preceding claims, wherein the second block (108) is connected to a manifold of the heat
exchanger to introduce the heat exchange fluid to or receive the heat exchange fluid
10 from the heat exchanger.

15. A connector (100) for introducing heat exchange fluid to or receiving heat exchange
fluid from a heat exchanger, wherein the connector (100) comprises:

15 a first block (102) comprising a first fluid channel (104) and a second fluid
channel (106) in a fluid communication with each other;

a second block (108) comprising a solid portion (110) comprising a protruded
portion (114), wherein the protruded portion (114) comprises a primary fluid channel
(112), and wherein at least a portion of the protruded portion (114) protrudes into the
second fluid channel (106) of the first block (102) to secure the second block (108) with
20 the first block (102) in a desired orientation, the primary fluid channel (116) of the
second block (108) being in fluid communication with the second fluid channel (106) of
the first block (102).

1/6

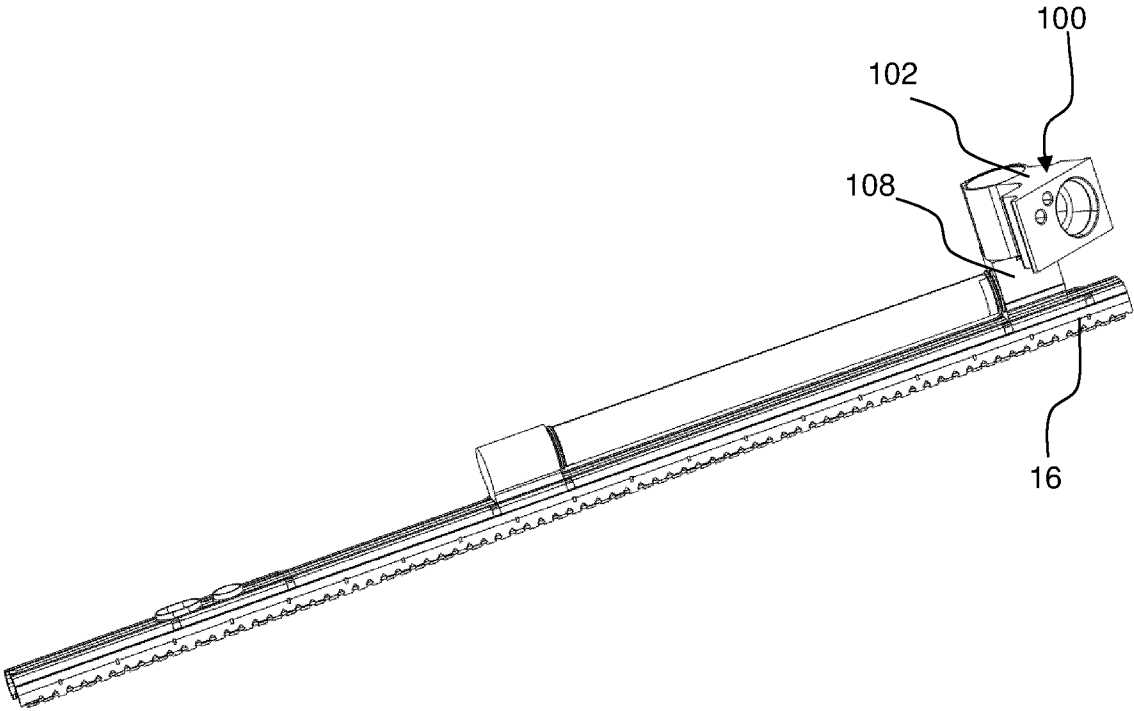


FIG. 1

2/6

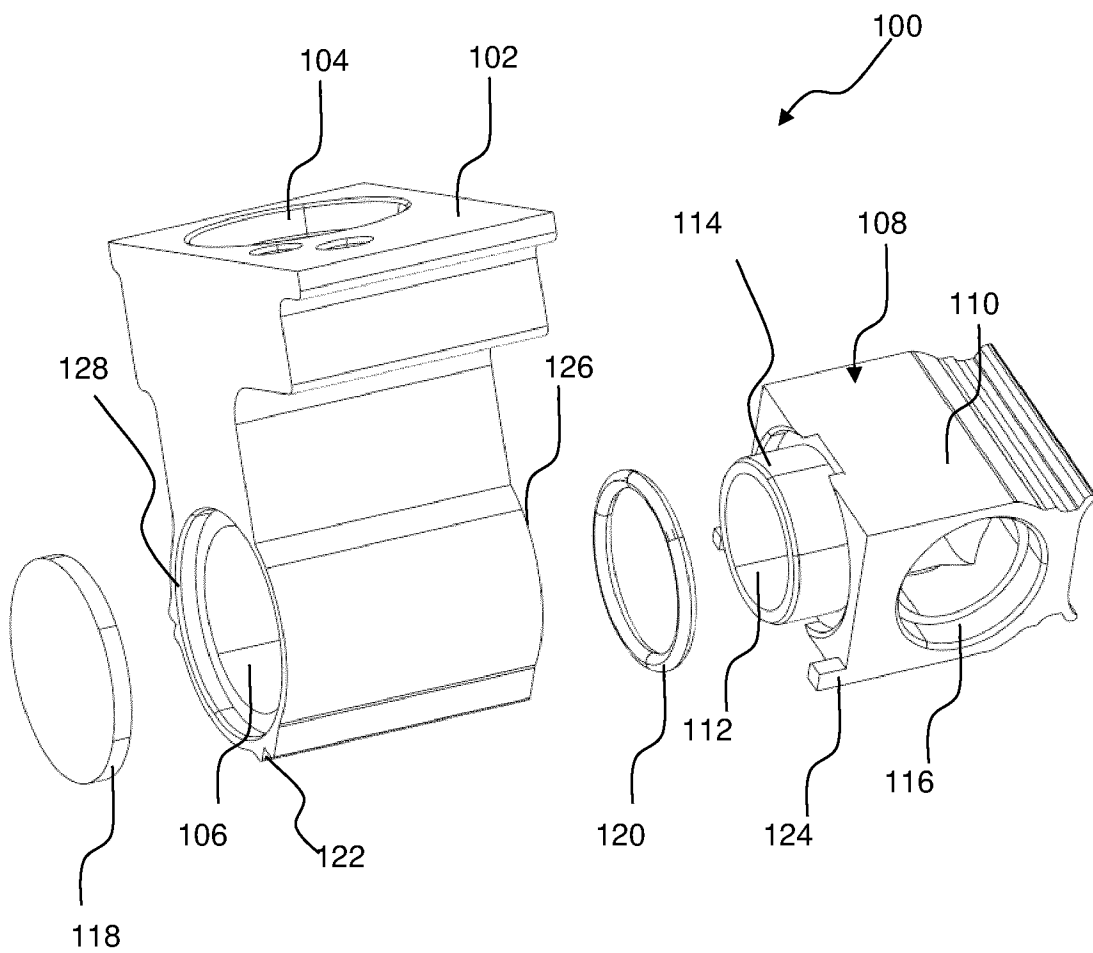


FIG. 2A

3/6

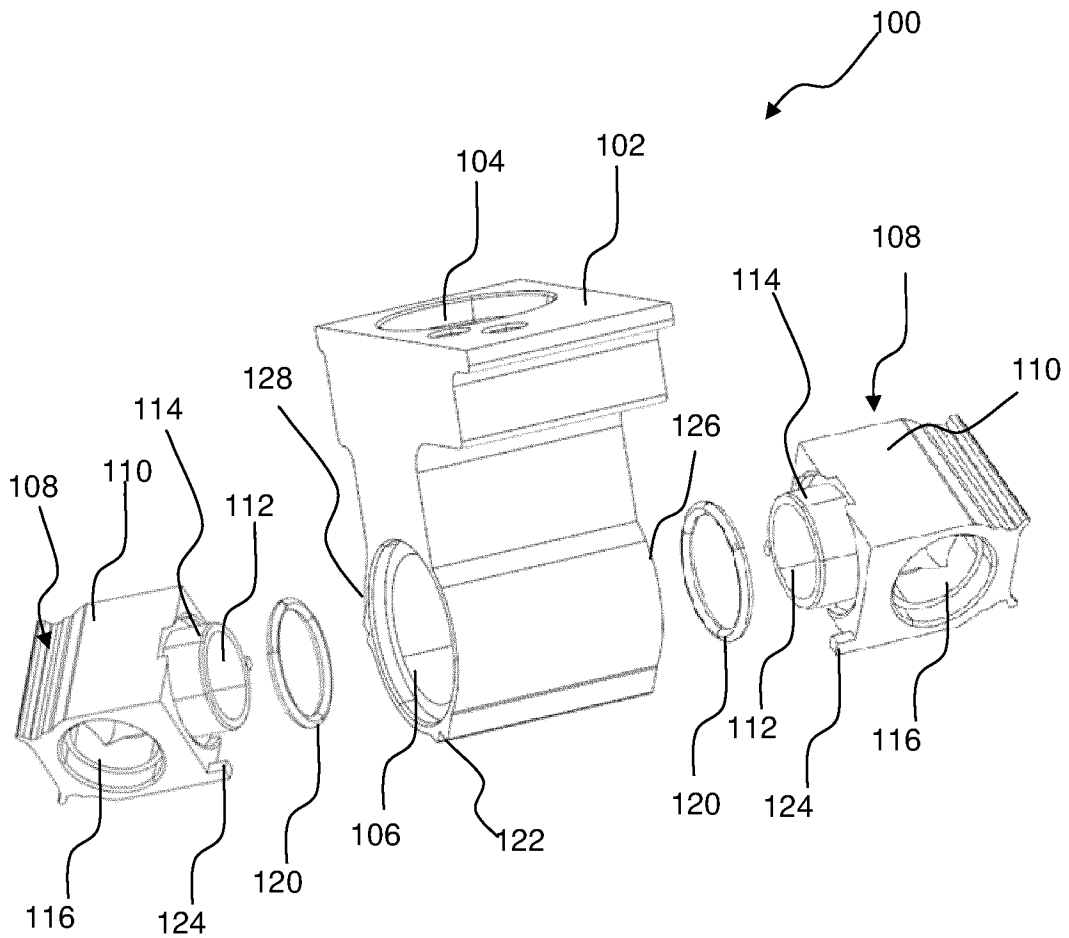


FIG. 2B

4/6

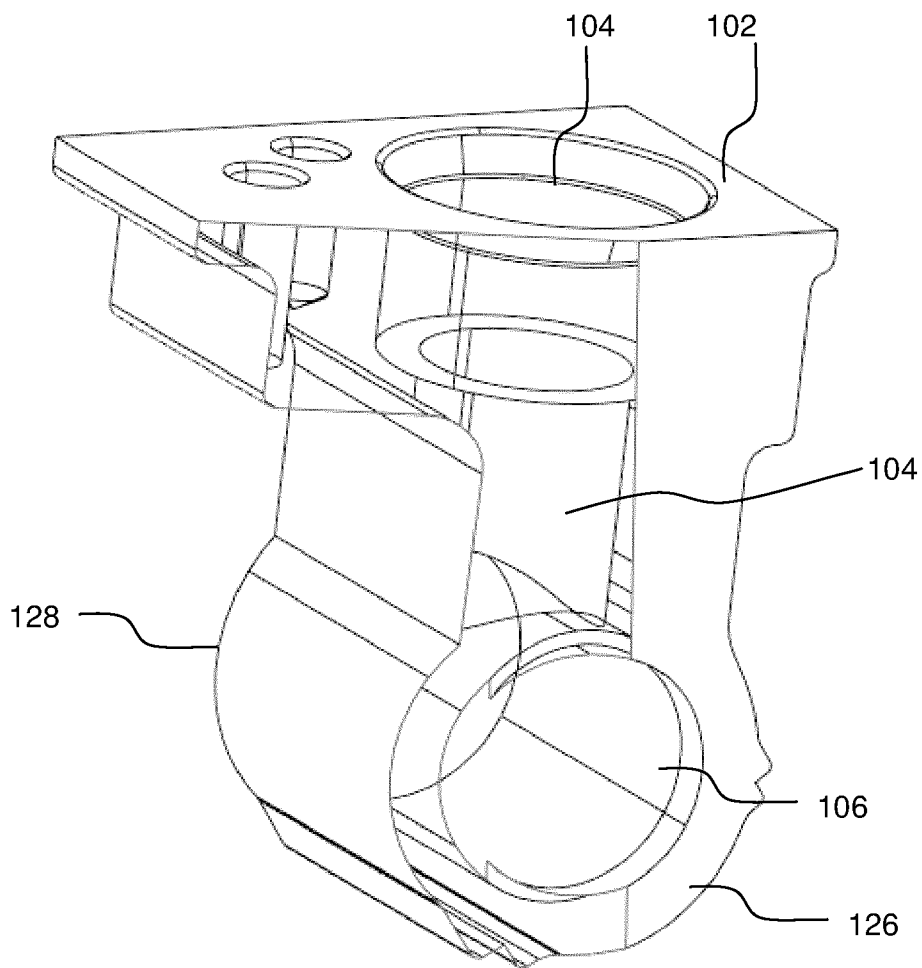


FIG. 3A

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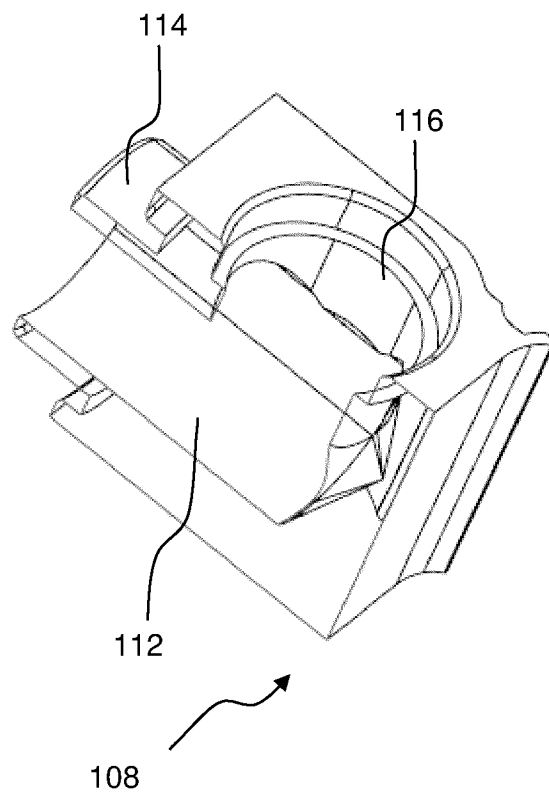


FIG. 3B

6/6

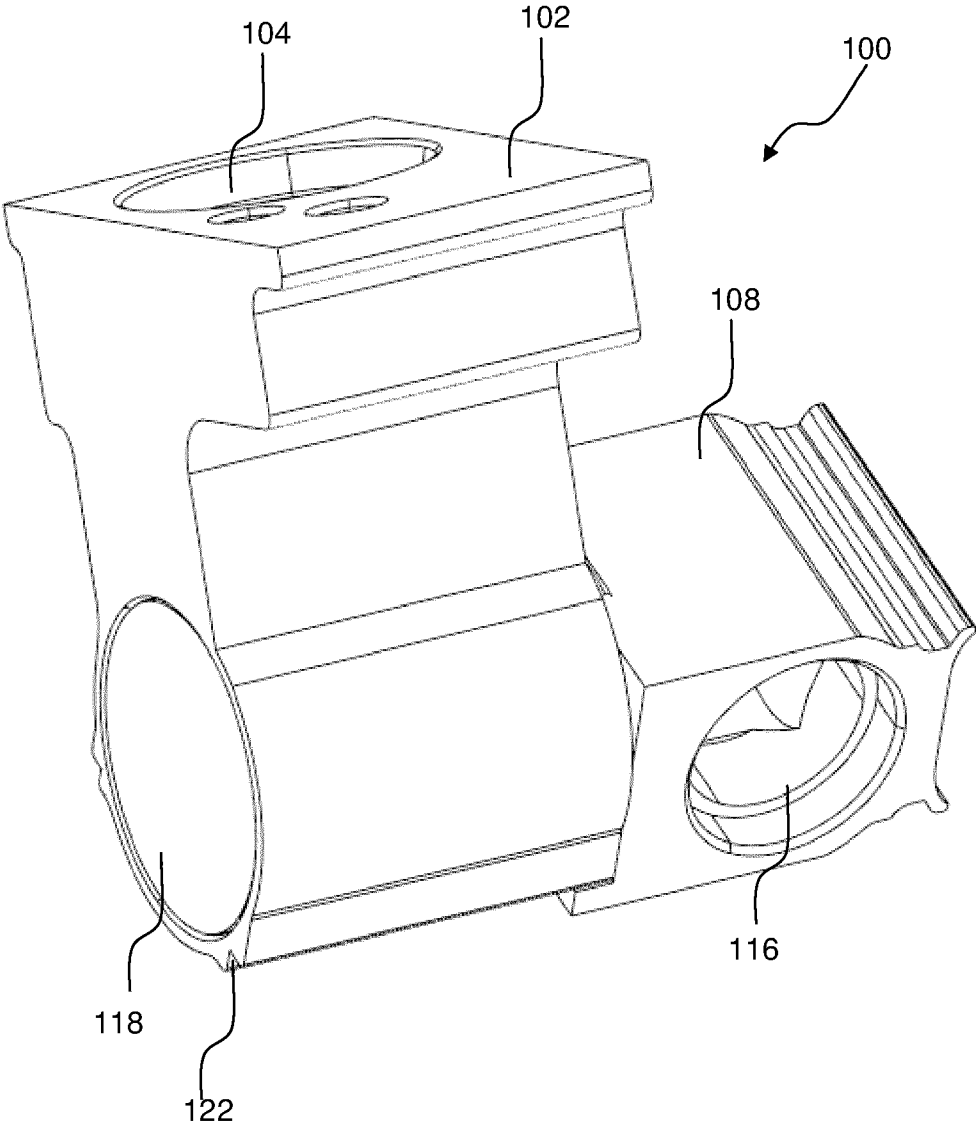


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/085628

A. CLASSIFICATION OF SUBJECT MATTER
INV. F28F9/02
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)
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 5 163 716 A (BOLTON JAMES D [US] ET AL) 17 November 1992 (1992-11-17)	1,2,4
Y	figures	3,5
X	JP H09 196508 A (CALSONIC CORP) 31 July 1997 (1997-07-31) abstract; figures	1,2
Y	WO 2017/032405 A1 (MAHLE INT GMBH [DE]) 2 March 2017 (2017-03-02) figure 3	3,5



Further documents are listed in the continuation of Box C.



See patent family annex.

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