(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 696 488 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
19.08.2020 Bulletin 2020/34

(51) Int Cl.:
F28F 19/01 *(2006.01)* ***F25B 39/04*** *(2006.01)*
F25B 43/00 *(2006.01)*

(21) Application number: **19461513.4**

(22) Date of filing: **15.02.2019**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Valeo Autosystemy SP. Z.O.O.**
32-050 Skawina (PL)

(72) Inventors:
- **SZOSTEK, Dawid**
  PL 32-050 Skawina (PL)
- **BELZOWSKI, Michal**
  PL 32-050 Skawina (PL)
- **POKRYWINSKI, Karol**
  PL 32-050 Skawina (PL)
- **SUS, Pawel**
  PL 32-050 Skawina (PL)
- **CICHOSZ, Filip**
  PL 32-050 Skawina (PL)

(74) Representative: **Bialkowski, Adam**
Valeo Systèmes Thermiques
ZA l'Agiot
8 rue Louis Lormand
CS 80517 La Verrière
78322 Le Mesnil Saint Denis Cedex (FR)

(54) HEAT EXCHANGER WITH FILTER FOR REFRIGERANT FLUID LOOP

(57) The invention relates to a heat exchanger for a refrigerant fluid loop, the heat exchanger comprising at least one inlet configured to allow a refrigerant fluid (R) to enter into the heat exchanger, at least one outlet configured to allow the refrigerant fluid (R) to exit the heat exchanger, the heat exchanger comprising at least one block (200) in which a filter (300) is arranged, this filter (300) comprising at least one frame (301) which holds a filtering part, the block (200) comprising at least one first part (210) and one second part (220), characterized in that the block (200) is arranged downstream the outlet, in that a portion (212) of the first part (210) extends in the second part (220), and in that the filter (300) extends, at least, in the second part (220) of the block (200)

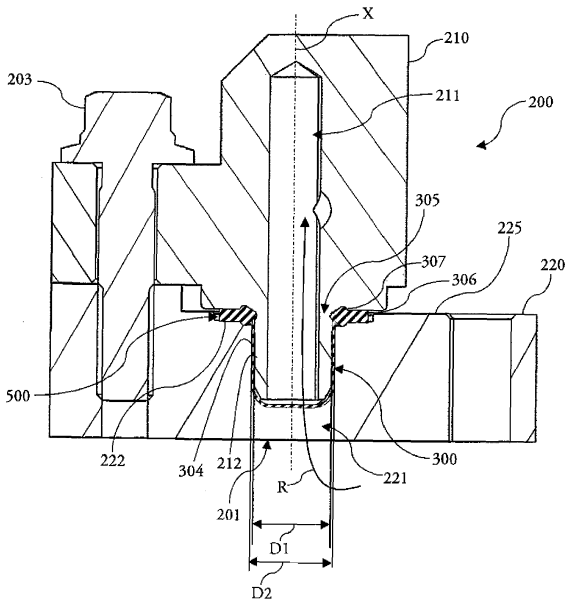

Fig. 7

EP 3 696 488 A1

Description

[0001] The present invention relates to the domain of heat exchangers designed for refrigerant fluid loops. More specifically, the present invention concerns devices for filtering the refrigerant fluid that flows through such heat exchangers.

[0002] A refrigerant fluid loop generally comprises at least two heat exchangers, at least one compressor and at least one expansion device. The compressor and the expansion device are both fragile and comprise movable elements that can easily break. It is therefore important that only the refrigerant fluid enters this compressor or the expansion device. In order to achieve that goal, it is already known to filter the refrigerant fluid before it reaches one of these components.

[0003] However, some particles may be inside heat exchangers, for instance due to manufacturing processes or sometimes default in the cleaning system of such heat exchanger. The cleaning of such particles appears to be really expensive and complex, and usually ineffective. And even with all the care that can be given to this cleaning, some of those particles can remain in those heat exchangers and can then be dragged by the refrigerant fluid to finally damage the compressor, the expansion device or any other element in which this refrigerant fluid could flow.

[0004] As a result, automotive suppliers are more and more concerned with this filtration, and they aim to filter even smaller particles than what is already filtered.

[0005] The present invention solves at least this issue, by providing a heat exchanger for a refrigerant fluid loop, the heat exchanger comprising at least one inlet configured to allow a refrigerant fluid to enter into the heat exchanger, at least one outlet configured to allow the refrigerant fluid to exit the heat exchanger, the heat exchanger comprising at least one block in which a filter is arranged, this filter comprising at least one frame which holds a filtering part, the block comprising at least one first part and one second part. According to the invention, the block is arranged downstream the outlet, a portion of the first part of the block extends in the second part of said block, and the filter extends, at least, in the second part of the block. In other words, the first part and the second part of the block are connected thanks to a male-female connection. According to the invention, the filtering part of the filter is the part of such filter which actually filters the refrigerant fluid, that is to say which retain the biggest particles that can be dragged by the refrigerant fluid. The frame forms a structural element of the filter, that is to say that this frame gives its shape to the filter, and especially to the filtering part of this filter. In other words, the frame of this filter permits to maintain the shape of the filtering part, ensuring the efficiency of the filtration operated by said filtering part.

[0006] According to an aspect of the invention, a first path is arranged in the first part of the block and a second path is arranged in the second part of the block, the first path and the second path being, at least partially, coaxial and the filter extending, at least, in the second path. In other words, the first path and the second path are at least partially aligned along an axis. It is thus understood that the first path and/or the second path can be partially curved. Advantageously, the alignment, even partial, of the first path and the second path permits to the filter to extend simultaneously in the first path of the first part of the block and in the second path of the second part of said block.

[0007] According to the invention, the portion of the first part which extends in the second part of the block forms a male-part of the male-female connection arranged between the first part and the second part of the block, the second path of the second part forming a female part of said male-female connection. According to the aspect of the invention just cited, the first path of the first part is arranged, at least, in said male-part. As result, it is understood that the second path present a diameter bigger than a diameter of the first path.

[0008] According to a first embodiment of the invention, the filter is interposed between the first part and the second part of the block. The word "interposed" here means that the filter is in contact simultaneously with the first part and with the second part of the block. In other words, the first part, the filter and the second part of the block are, according to the first embodiment, aligned, in this order, along the axis or viewed a plane perpendicular to said axis. Especially, it is the frame of this filter which is interposed between the first part and the second part of the block, the filtering part being thus free to filter the refrigerant fluid.

[0009] According to a first variant of this first embodiment of the invention, the frame of the filter comprises a collar interposed between the first part and the second part of the block, and at least the filtering part of the filter surrounds the portion of the first part of the block which extends in the second part of such block. In other words, according to this example of the invention, the filtering part of the filter surrounds the male part of the male-female connection arranged between the first part and the second part of the block.

[0010] Advantageously, according to this first variant of the first embodiment of the invention, at least the collar of the filter forms a sealing device arranged between the first part and the second part of the block. Optionally, a rib can be arranged on the collar, this rib contributing, together with the collar, to form the sealing device. This sealing device is adapted to prevent any refrigerant fluid leakage between the first part and the second part of the block. A groove adapted to receive such sealing device can be formed in the first part and/or in the second part of the block. More precisely, this groove is formed either in a face of the first part which faces the second part of the block or in a face of the second part which faces the first part of said block.

[0011] Alternately, the sealing device can be added between the first part and the second part of the block.

According to this alternative, the sealing device can for instance be an O-ring or a flat ring.

[0012] Alternately or additionally, the material cooperating with the filtering part (e.g. the frame) can have sealing properties.

[0013] According to the invention, the frame of the filter can comprise at least one retaining means which cooperates with the first part and/or with the second part of the block in order to attach the filter to the block. For instance, the frame and the at least one retaining means can form a single piece, that is to say that the at least one retaining means and the frame cannot be separated without damaging at least the frame or the retaining means. Advantageously, the frame can comprise more than one retaining means. According to an example of application of the invention, the frame comprise three retaining means evenly distributed around the frame.

[0014] According to a second variant of the first embodiment of the invention, the at least one retaining means is interposed, for example wedged, between the first part and the second part of the block.

[0015] According to a second embodiment of the invention, the at least one retaining means cooperates with a wall defining the second path arranged in the second part of the block. The word "cooperate" here means that the wall defining the second path of the second part have a specific shape and specific dimensions adapted to hold in place said at least one retaining means. For instance, a notch can be arranged within said wall defining the second path of the second part, this notch being adapted to retain the retaining means of the filter.

[0016] According to a variant of the second embodiment of the invention, the first part of the block is formed by a duct extending from the outlet of the heat exchanger. According to this variant of the second embodiment, the male part of the male-female connection arranged between the first part and the second part is formed by a free end of the duct. In other words, the duct comprises at least a first end connected to the outlet of the heat exchanger and at least a second end which forms the male part of the male-female connection.

[0017] According to the invention, the filter can present a conical shape, the frame of the filter forming, at least, the base of this conical shape. Advantageously, the frame also comprises at least one arm emerging from the base of the conical shape, this at least one arm holding the filtering part of the filter. Even more advantageously, the frame of the filter comprises three arms, each of these arms emerging from the base of the filter and these three arms being merged together at an end opposed to the base of the filter, thus forming the apex of the conical shape of the filter. The filtering part of the filter is then arranged between said three arms. Alternately, the filter can present a cylindrical shape.

[0018] According to the invention, the filtering part of the filter comprises a meshed element adapted to retain particles which present a diameter bigger than 50μm.

[0019] Advantageously, the heat exchanger according to the invention can be adapted to undertake a heat exchange between the refrigerant fluid and an air flow or between the refrigerant fluid and a liquid. For instance this liquid can be a refrigerant liquid or water flowing in another cooling loop. In other words, the heat exchanger according to the invention can be arranged at an interface between the refrigerant fluid loop and said cooling loop,

[0020] Other features, details and advantages of the invention can be inferred from the specification of the invention given hereunder. Various embodiments are represented in the figures, wherein:

- figure 1 is a schematic representation of a refrigerant fluid loop comprising at least one heat exchanger according to the invention, this heat exchanger comprising at least one block in which a filter is arranged ;
- figure 2 is a perspective view of the heat exchanger according to the invention;
- figures 3 and 4 are perspective views of a block adapted to be arranged at an outlet of the heat exchanger according to the invention, figure 3 illustrating a first example of such block and figure 4 illustrating a second example of this block;
- figure 5 and 6 respectively illustrates perspective views of a filter intended to be received in one of the blocks illustrated on figures 3 and 4 according, respectively, to a first example and to a second example of such filter;
- figures 7 and 8 are cross-section views of the block according, respectively, to a first variant and to a second variant of a first embodiment of the invention;
- figures 9 to 11 are cross-section views of the block, figures 9 illustrating a first variant of a second embodiment of the invention, figure 11 illustrating a second variant of the second embodiment of the invention and figure 10 illustrating an enlargement of an attachment area formed between the filter and the block according to the second embodiment of the invention.

[0021] In the following specification, the words "upstream" and "downstream" both refer to a direction of circulation of a refrigerant fluid in the concerned object.

[0022] Figure 1 is a schematic view of a refrigerant fluid loop 100 intended to be accommodated in a motor vehicle. This refrigerant fluid loop 100 comprises at least a compressor 110 configured to increase the pressure of a refrigerant fluid R circulating through the loop 100, a first heat exchanger 120 configured to undertake a heat exchange between the refrigerant fluid R and a first airflow AF1, an expansion device 130 configured to decrease the pressure of the refrigerant fluid R and a second heat exchanger 140 configured to undertake a heat

exchange between the refrigerant fluid R and a second airflow AF2. For instance, the first airflow AF1 is taken outside the motor vehicle in which the refrigerant fluid loop 100 is accommodated, and the second airflow AF2 is reserved to be sent in a passenger compartment of said motor vehicle.

[0023] According to an embodiment of the invention which is not illustrated here, the first heat exchanger can be adapted to undertake a heat exchange between the refrigerant fluid that flows through it and a liquid which flows in another heat exchanger arranged on a different coolant loop, the coolant flowing through this coolant loop being, for instance, water. In other words, according to this non-illustrated embodiment, the first heat exchanger according to the invention is arranged at an interface between the refrigerant fluid loop and said different coolant loop.

[0024] According to the illustrated embodiment, the first heat exchanger 120 is realized according to the invention and comprises a block 200 in which, as explain in more details below, a filter 300 is arranged. According to the invention, this filter 300 is located at an outlet 122 of the heat exchanger, that is to say that the block 200 which houses said filter 300 is arranged downstream the first heat exchanger 120 along a flowing direction of the refrigerant fluid R, this flowing direction being illustrated by the arrow R.

[0025] First, the refrigerant fluid R exits the compressor 110 in a gaseous state and reaches the first heat exchanger 120, and more precisely it reaches an inlet 121 of the first heat exchanger 120. Once the refrigerant fluid R has entered the first heat exchanger 120, a transfer of calories is undertaken between said refrigerant fluid R circulating in this first heat exchanger 120 and the first airflow AF1 that flows through it. More precisely, the refrigerant fluid R gives calories to the first airflow AF1 and liquefies. In other words, the first heat exchanger 120 acts, in this particular example, as a condenser. As a result, the refrigerant fluid R exits the first heat exchanger 120 in a liquefied state and reaches the block 200 wherein it is filtered by the filter 300. In other words, it is to be understood that the block 200 is connected on one hand to an outlet 122 of the first heat exchanger 120 configured to allow the refrigerant fluid R to exit said first heat exchanger 120 and on the other hand to a pipe 101 of the refrigerant fluid loop 100. Then the refrigerant fluid R goes through the expansion device 130 in which its pressure is reduced before it reaches the second heat exchanger 140. In this second heat exchanger 140, the refrigerant fluid R takes calories from the second airflow AF2 and evaporates. The second airflow AF2 can then be sent to the passenger compartment to drop the temperature of this compartment and the refrigerant fluid R, which is again in a gaseous state, can again reach the compressor 110 to start a new cycle.

[0026] Generally speaking, the first heat exchanger 120 and the second heat exchanger 140 are similar and differs in the fact that the block 200 encompassing the filter 300 is arranged only at the outlet 122 of the first heat exchanger 120.

[0027] Figure 2 is a perspective view of the first heat exchanger 120 according to the invention. As shown, this first heat exchanger 120 comprises at least two header tanks 123, 124 arranged at two opposed extremities of a heat exchange area 125 wherein the heat exchange between the refrigerant fluid and the first airflow takes place. According to the invention, the inlet of the first heat exchanger 120 is arranged in a first header tank 123 and the outlet 122 of this first heat exchanger 120 is arranged in a second header tanks 124 of this first heat exchanger 120. As previously mentioned, the block 200 is fixed to the second header tanks 124, that is to say to the header tanks 124 in which the outlet 122 of the heat exchanger 120 is arranged. For instance, the block 200 can be welded or brazed to the second header tank 124. Obviously it is only an example of the invention and any other means for fixing the block to the second header tank 124 of the first heat exchanger 120 could be used within the scope of the invention.

[0028] According to the example illustrated on figure 2, the first heat exchanger 120 comprises a dryer 400 attached to the first header tank 123, that is to say the header tank in which the inlet of the first heat exchanger 120 is arranged. As illustrated, at least one fixing means 410 is also arranged on this other block 400, this at least one fixing means being adapted to fix the first heat exchanger 120 to a structural element of the motor vehicle.

[0029] We are now going to describe with more details the block 200 connected to the first heat exchanger 120. For the rest of the specification, the words "first heat exchanger" and "heat exchanger" will be used with no distinction. Anyway, it is understood that the block 200 arranged downstream the outlet 122 of the first heat exchanger 120 could be placed downstream an outlet of the second heat exchanger without departing from the scope of the invention.

[0030] Figures 3 and 4 illustrate, respectively, a first example and a second example of the block 200 according to the invention.

[0031] According to any of this examples, the block 200 comprises at least a first part 210 and a second part 220 connected to each other. As detailed below, the first part 210 and the second part 220 are connected to each other thanks to a male-female connection, that is to say that, according to the examples illustrated here, the first part 210 comprises a male part adapted to be received in a female part arranged in the second part 220 of the block 200. In other words, the first part 210 comprises a portion which extends in the second part 220, this portion forming the male-part of the male-female connection. The block 200 also comprises at least one inlet 201 configured to allow the refrigerant fluid to enter the block 200 and at least one outlet 202 configured to allow the refrigerant fluid to exit the block 200 and adapted to be connected to the pipe of the refrigerant fluid loop described above. As especially illustrated on figure 4, the inlet 201

of the block 200 is connected to the outlet of the heat exchanger, that is to say to the second header tank 124 of such heat exchanger. The filter arranged in this block 200 is not visible on figures 3 and 4 but, according to the invention, it is arranged between the inlet 201 and the outlet 202 of the block 200 and it extends, at least, in the second part 220 of said block 200. In other words, the filter is adapted to filter the refrigerant fluid after its passage through the heat exchanger 120 and before it reaches the pipe, and consequently the rest of the refrigerant loop 100. This filter will be described with more details below.

[0032] Referring now only to the first example of the block 200 illustrated on figure 3, the first part 210 and the second part 220 are aligned one on top of the other along an axis X and they are fixed to each other thanks to an attaching means 203. According to the first example illustrated on figure 3, this attaching means 203 is formed by a screw which penetrates both the first part 210 and the second part 220 but it is understood that this is only an example and that any other attaching means could be used without departing from the scope of the invention. We also note that the second part 220 of the block 200 comprises at least one hole 221, advantageously two holes 221, adapted to receive at least one fixation means configured to attach the block 200 to the second header tank of the heat exchanger. Finally, we note that the inlet 201 of the block 200 is arranged in the second part 220 while the outlet 202 of said block 200 is arranged in the first part 210. Again, it is only an example which does not limit of the present invention.

[0033] The second example of the block 200 illustrated on figure 4 differs from the first example of such block 200 essentially in that the first part 210 is formed by a duct 213 which extends from the outlet 122 arranged in the second header tank 124 of the heat exchanger, a free end of this duct 213 forming the male part of the male-female connection earlier described and which contributes to connect the first part 210 to the second part 220. We also note that the second part 220 is attached to the second header tank 124 without any fixation means. In other words, the second part 220 is, for instance, soldered or brazed to said second header tanks 124. The second example of the block 200 also differ from the first example of such block 200 in the position of the inlet 201 and the outlet 202 of the block 200. As shown on figure 4, the outlet 202 is arranged in the second part 220 and the inlet 202 is formed by an end of the duct 213 thanks to which said duct 213 is connected to the outlet 122 of the heat exchanger. As the duct 213 forming the first part 210 of the block 200 is curved, the first part 210 and the second part 220 of the block 200 according to the second example are only partially aligned along the axis X. According to any of the examples illustrated on figures 3 and 4, the first part 210 and the second part 220 of the block 200 are aligned along the axis X, at least in the region of the male-female connection described below.

[0034] Figure 5 and figure 6 illustrate the filter 300 according, respectively, to a first example and to a second example of such filter 300. According to any of this examples, the filter 300 comprises at least a frame 301 which holds a filtering part 302, that is to say that the frame 301 forms a structural element of the filter 300 which gives a determined shape to the filtering part 302 of said filter 300 and also which maintains such shape of the filtering part 302. This filtering part 302 is, according to the examples illustrated here, realized by a meshed element adapted to filter particles that present a diameter bigger than 50μm. In other words, the meshed element which forms the filtering part 302 of the filter 300 is adapted to retain particles which present a diameter bigger than 50μm.

[0035] The filter 300 according to the first example illustrated on figure 5 has a cylindrical shape, thus comprising a base 303 from which extends a cylindrical wall 304, this cylindrical wall 304 revolving around the axis X and defining, at an extremity opposed to the base 303, an opening 305. This opening 305 is more precisely defined by a collar 306 which extends in a plane perpendicular, or sensibly perpendicular to the cylindrical wall 304. As partially shown, the base 303 and the cylindrical wall 304 are formed by both the frame 301 and the filtering part 302 of the filter 300 while the collar 306 is made only of the frame 301. We also note that the collar 306 comprises a rib 307 which, as detailed below, forms, together with the collar 306, a sealing device adapted to be arranged between the first part and the second part of the block. As shown, this rib 307 extends continuously all around the collar 306, and more particularly, this rib 307 also contributes to define the opening 305 of the filter 300. For instance, the rib 307 and the collar 306 can form a single piece, that is to say that the collar 306 and the rib 307 cannot be separated without damaging at least the rib 307 or the collar 306.

[0036] The filter 300 according to the second example illustrated on figure 6 has a conical shape revolving around the axis X. This conical shape comprises a base 313 in which an opening 315 is formed, this base 313 being formed only by the frame 301 of the filter 300. The frame 301 of the filter 300 according to this second example also comprises at least one arm 311, according to the example illustrated three arms 311, which holds the filtering part 302 of the filter 300. On figure 6 only two of these arms 311 are visible. As shown, each of these arms 311 emerges from the base 313 of the filter 300 and these arms 311 all converge to an apex 312 of the conical shape. As the filter 300 presents a conical shape, the filtering part 302 is arranged between the arms 311 and present a triangular, or sensibly triangular, shape.

[0037] Finally, we can see that the filter 300 according to the second example illustrated on figure 6 comprises at least one retaining means 321. According to the example illustrated, the filter 300 comprises three of these retaining means 321, only two of them being visible on figure 6. As shown, each of these retaining means 321

emerges from the frame 301. Especially, each retaining means 321 emerges from the base 313 of the conical shape of the filter 300, one of the arm 311 previously described emerging from said retaining means 321. We also note that each of these retaining means 321 extends transversally, advantageously perpendicularly, to the arm 311 that emerges from it. As a result, each retaining means 321 comprises at least one flat edge 331. The word "emerges" here means that each retaining means 321 forms, with the base 313 and with the concerned arm 311 a single piece which cannot be separated without damaging at least the retaining means 321 of the concerned arm 311. As detailed hereunder, those retaining means 321, and more precisely, the flat edges 331 of these retaining means 321, are adapted to cooperate with the first part and/or with the second part of the block in order to hold the filter 300 in a determined position. For instance, these retaining means 321 can be formed by protrusions.

[0038] Referring now to figures 7 to 11, we are going to detail the block 200 according to different embodiments of the invention, those figures 7 to 11 illustrating the block 200 in cross-section views realized by a plane crossing at least the first part 210, the second part 220 of the block 200. The cross-section views illustrated on figures 7, 8 and 9 are realized by a plane which crosses the first part 210, the second part 220 and the attaching means 203. As earlier described, the block 200 according to any of these embodiment comprises at least the first part 210 and the second part 220 between which a male-female connection is realized. As shown on the figures, at least a first path 211 is arranged within the first part 210 and at least a second path 221 is arranged within the second part 220, this first path 211 and this second path 221 being, at least partially, coaxial. Especially, the first path 211 and the second path 221 are, at least partially, coaxial around the axis X. In other words, the first path 211 and the second path 221 are aligned one on top of the other, along the axis X. According to the invention, the first path 211 is arranged, at least partially, within the male part 212 of the male-female connection, while the second path 221 forms the female part of this male-female connection.

[0039] Figures 7 and 8 illustrate cross-section views of the block 200 according to a first and a second variant of a first embodiment of the invention. According to this first embodiment, the block 200 is realized according to the first example illustrated on figure 3 and the filter 300 is interposed between the first part 210 and the second part 220 of the block 200, that is to say that the filter 300 is both in contact with the first part 210 and with the second part 220 of the block 200.

[0040] The first variant and the second variant of this first embodiment essentially differ from one another in the shape of the filter 300, the block 200 according to the first variant of the first embodiment of the invention comprising the filter 300 according to the first example illustrated on figure 5 and the block 200 according to the second variant of the first embodiment of the invention comprising the filter 300 according to the second example illustrated on figure 6.

[0041] According to the first variant of the first embodiment of the invention, the filter 300 thus present the cylindrical shape with the collar 306. As shown on figure 7, it is more particularly this collar 306 which is interposed between the first part 210 and the second part 220. Advantageously, this collar 306 together with the rib 307 arranged on this collar 306 form a sealing device 500 which prevent any refrigerant fluid leakage that could occur between the first part 210 and the second part 220. To ensure a good sealing, the rib 307 and the collar 306 can form a single piece, that is to say that they cannot be separated without damaging at least one of them.

[0042] As illustrated, the collar 306 and the rib 307 are received in a groove 222 arranged in the second part 220 of the block 200, and more precisely in a face 225 of this second part 220 which faces the first part 210 when they are attached together. Obviously it is only an example of the invention and the groove could, for instance, be arranged in the first part 210 of the block, for instance in a face of this first part which faces the second part of the block, without departing from the scope of the invention.

[0043] We also note that the filter 300, and especially the cylindrical wall 304 of this filter 300, surrounds the male part 212 of the male-female connection arranged between the first part 210 and the second part 220 of the block 200. It is thus understood that the male part 212 of the male-female connection presents a diameter D1 smaller than a diameter D2 of the cylindrical wall 304 of the filter 300. These diameters D1, D2 each corresponds to a largest dimension of the concerned object, measured in a plane perpendicular to the axis X, that is to say a plane in which extends the collar 306 of the filter 300.

[0044] As a result, the filter 300 is interposed between the first part 210 and the second part 220 along the axis X, and also viewed in a plane perpendicular to this axis X, that is to say in the plane in which the collar 306 extends.

[0045] As illustrated on figure 7, the refrigerant fluid R that reaches the filter 300 reaches, immediately after, the first path 211 arranged in the male part 212 of the male-female connection. For instance, the filter 300 can be threaded onto this male part 212 of the male-female connection. Alternately, the filter 300 can be positioned within the second path 221, the collar 306 being **received** in the groove 222 and the male part 212 can then be inserted within the filter 300, through its opening 305.

[0046] Finally, we note that, according to the first variant of the first embodiment of the invention, the filtering part 302 of the filter 300 completely extends in the second part 220, and more particularly in the second path 221 arranged in this second part 220. Especially, this filtering part 302 of the filter 300 extends in the direction of the inlet 201 of the block 200, that is to say in the direction of the outlet of the heat exchanger to which the block 200 is connected.

[0047] As mentioned above, the second variant of the first embodiment illustrated on figure 8 differs from the first variant of the first embodiment of the invention in the shape of the filter 300. In other words, according to this second variant of the first embodiment, the filter 300 present the conical shape illustrated on figure 4, thus comprising the retaining means 321. As shown, when the first part 210 and the second part 220 are brought closer to one another, a space 204 is created between this first part 210 and this second part 220, this space 204 being adapted to receive one of the retaining means 321. We also note that a remaining of this space 204 still exists when the retaining means 321 is positioned in said space 204, In other words, the retaining means 321 present smaller dimensions than the dimensions of the space 204.

[0048] As described above, the retaining means 321 extends transversally to the arm 311 of the frame 301, thus generating the flat edge 331 against which abuts the first part 210, and more precisely a free end of the male part 212 of the male-female connection arranged between the first part 210 and the second part 220 of the block 200. As a result, the retaining means 321 are wedged between the first part 210 and the second part of the block 220, thus ensuring the attachment of the filter 300 to the block 200. As partially shown on figure 8, according to the second variant of the first embodiment, the filtering part 302 and the frame 301 of the filter 300 both extend in the first path 211 of the first part 210 of the block 200 and in the second path 221 of the second part 220 of the block 200. According to this second variant, the base 313 of the conical shape faces the inlet of the block. In other words, the refrigerant fluid R that reaches the block through its inlet then enters the filter 300 through its opening 315 arranged in the base 313. The refrigerant fluid R then crosses the filtering part 302 to reach the first path 211 of the first part 210 of the filter 300. We also note that a gap 205 is created between the filter 300 and a wall defining said first path 211, thus increasing the surface of the filtering part 302 which actually filters the refrigerant fluid R, that is to say which is actually crossed by this refrigerant fluid R and which actually retains the biggest particles.

[0049] Figures 9 to 11 finally illustrate a first and a second variants of a second embodiment of the invention. According to this second embodiment of the invention, the filter 300 is realized according to the second example illustrated and described above with reference to figure 6. In other words, the filter 300 according to the second embodiment of the invention presents a conical shape and its frame 301 comprises retaining means 321.

[0050] According to the second embodiment, these retaining means 321 are adapted to cooperate with a wall 223 which defines the second path 221 arranged in the second part 220 of the block 200. In other words, this wall 223 defining the second path 221 arranged in the second part 220 of the block 200 present a specific shape which is adapted to retain the retaining means 321. As illustrated on figure 10 which illustartes an enlargement of an attachment area 322 of the filter 300 to the second part 220 of the block, a notch 224 is formed within said wall 223 defining the second path 221, this notch 224 cooperating with the retaining means 321 of the filter 300. It is understood from figure 10 that the dimensions of the retaining means 321 and of the notch 224 are chosen in order for the retaining means 321 to be forced in the notch 224, thus ensuring the maintaining of such retaining means 321 in said notch 224, and thus ensuring the maintaining of the filter 300 in a determined position.

[0051] According to the first variant of the second embodiment illustrated on figure 9, the filter 300 extends both in the first path 211 and in the second path 221. More precisely, the base 313 of the filter 300 is arranged at the inlet 201 of the block 200 and the apex 312 of the conical shape extends in the first path 211. In other words, the filtering part 302 of this filter 300 extends in the direction of the first part 210 of the block 200. As a result, the refrigerant fluid R that reaches the inlet 201 of the block 200 immediately enters the filter 300 through its opening 315 arranged in the base 313 of the conical shape. In other words, according to this first variant of the second embodiment, the opening 315 of the filter 300 and the inlet 201 of the block 200 form a single aperture.

[0052] A sealing device 501 is otherwise interposed between the first part 210 and the second part 220 of the block 200, preventing, as earlier mentioned, any refrigerant fluid leakage. According to the first variant of the second embodiment illustrated on figure 9, this sealing device 501 is realized by a flat ring and is received in the groove 222 arranged in the face of the second part 220 that faces the first part 210, as described above. According to another variant of the second embodiment not illustrated here, the flat ring can comprise a rib, in a similar way to what have been previously described, with reference to the first variant of the first embodiment.

[0053] The second variant of the second embodiment illustrated on figure 11 essentially differs from the first variant of this second embodiment in that the first part 210 of the block 200 is realized by the duct 213 described with reference to figure 4. This duct 213 extends between a first end which is connected to the outlet of the heat exchanger and a second end 214 which forms the male part 212 of the male-female connection arranged between the first part 210 and the second part 220 of the block 200. The attachment area 322 between the filter 300 and the second part 220 is identical to the attachment area 322 of the first variant of the second embodiment described above with reference to figure 10.

[0054] According to this second variant of the second embodiment, the wall 223 defining the second path 221 also comprises an abutment surface 226 against which abuts the second end 214 of the duct 213, that is to say the male part 212 of the male-female connection. This abutment surface 226 advantageously permits to prevent a sliding of this male part 212 which could lead to a clogging of the second path 220, such abutment surface 226

thus ensuring the efficiency of the filtration of the refrigerant fluid.

[0055] According to the second variant of the second embodiment, the filter 300 extends both in the first path 211 and in the second path 221. The base 313 of the filter 300 here faces the outlet 202 of the block 200, this base 313 being arranged at a non-null distance of said outlet 202 and the apex 312 of the filter 300 extends in the first path 211. In other words, the refrigerant fluid R here enters the filter 300 through its filtering part 302 and exits said block 200 through the opening 315 arranged in the base 313 of the filter 300.

[0056] Again, a sealing device 502 is interposed between the first part 210 and the second part 220 of the block 200 to prevent refrigerant fluid leakage. According to this second variant of the second embodiment of the invention, the sealing device 502 is compressed between the face 225 of the second part 220 which faces the first part 210 of the block 200 and a seam 215 which surrounds the duct 213. This seam 215 also contributes to avoid the sliding of the male part 212 which could lead to the clogging of the second path 221.

[0057] Obviously, the features that have just been described in relation with any of the embodiment illustrated can be combined with features describe in relation with another embodiment without departing from the scope of the invention.

[0058] It will be understood from the foregoing that the present invention provides a simple, easily adaptable and easily replaceable means to filter the refrigerant fluid that exit a heat exchanger accommodated on a refrigerant fluid loop so as to prevent any damage on other components of such a refrigerant fluid loop. Advantageously, said means can be mounted directly or indirectly to the heat exchanger, allowing its use in a various number of refrigerant loops.

[0059] However, the invention cannot be limited to the means and configurations described and illustrated herein, and it also extends to any equivalent means or configurations and to any technically operative combination of such means. In particular, the shape and arrangement of the parts of the block and/or of the filter can be modified insofar as they fulfil the functionalities described in the present document.

Claims

1. Heat exchanger (120) for a refrigerant fluid loop (100), the heat exchanger (120) comprising at least one inlet (121) configured to allow a refrigerant fluid (R) to enter into the heat exchanger (120), at least one outlet (122) configured to allow the refrigerant fluid (R) to exit the heat exchanger (120), the heat exchanger (120) comprising at least one block (200) in which a filter (300) is arranged, this filter (300) comprising at least one frame (301) which holds a filtering part (302), the block (200) comprising at least one first part (210) and one second part (220), **characterized in that** the block (200) is arranged downstream the outlet (122), **in that** a portion (212) of the first part (210) extends in the second part (220), and **in that** the filter (300) extends, at least, in the second part (220) of the block (200).

2. Heat exchanger (120) according to the preceding claim, wherein a first path (211) is arranged in the first part (210) of the block (200), wherein a second path (221) is arranged in the second part (220) of the block (200), wherein the first path (211) and the second path (221) are, at least partially, coaxial, and wherein the filter (300) extends at least in the second path (221).

3. Heat exchanger (120) according to the preceding claim, wherein the portion (212) of the first part (210) which extends in the second part (211) of the block (200) forms a male-part of a male-female connection arranged between the first part (210) and the second part (220) of the block (200), the second path (221) of the second part (220) forming the female part of said male-female connection, and wherein the first path (211) of the first part (210) is arranged, at least, in said male-part (212).

4. Heat exchanger (120) according to any of the preceding claims, wherein the filter (300) is interposed between the first part (210) and the second part (220) of the block (200).

5. Heat exchanger (120) according to the preceding claim, wherein the frame (301) of the filter (300) comprises a collar (306) interposed between the first part (210) and the second part (220) of the block (200), and wherein at least the filtering part (302) of the filter (300) surrounds the portion (212) of the first part (210) of the block (200) which extends in the second part (220) of such block (200).

6. Heat exchanger (120) according to the preceding claim, wherein at least the collar (306) of the filter (300) forms a sealing device (500) arranged between the first part (210) and the second part (220) of the block (200).

7. Heat exchanger (120) according to any of claims 1 to 4, wherein the frame (301) of the filter (300) comprises at least one retaining means (321) which cooperates with the first part (210) and/or with the second part (220) of the block (200) in order to attach the filter (300) to the block (200).

8. Heat exchanger (120) according to any of the preceding claims, wherein the first part (210) of the block (200) is formed by a duct (213) extending from the outlet (122) of the heat exchanger (120).

9. Heat exchanger (120) according to any of the preceding claim, wherein the filter (300) present a conical shape, and wherein the frame (301) of the filter (300) forms, at least, the base (313) of this conical shape.

10. Heat exchanger (120) according to any of the preceding claims, wherein the filtering part (302) of the filter (300) comprises a meshed element adapted to retain particles which present a diameter bigger than 50μm.

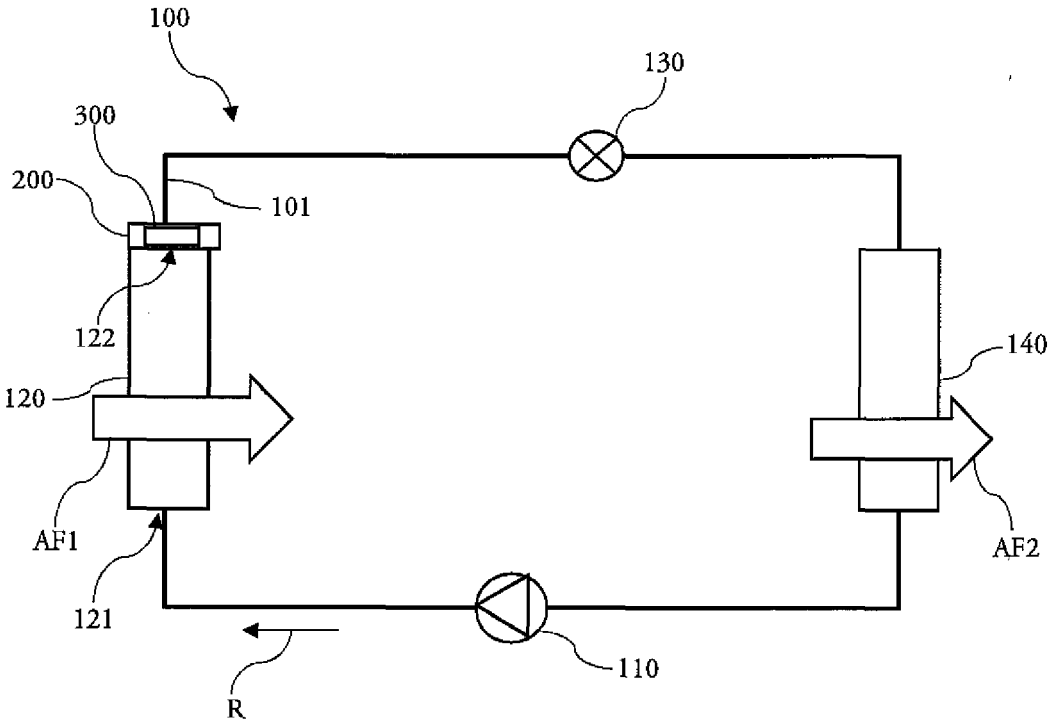
100
130
300
200
101
122
140
120
AF1
AF2
121
110
R

Fig. 1

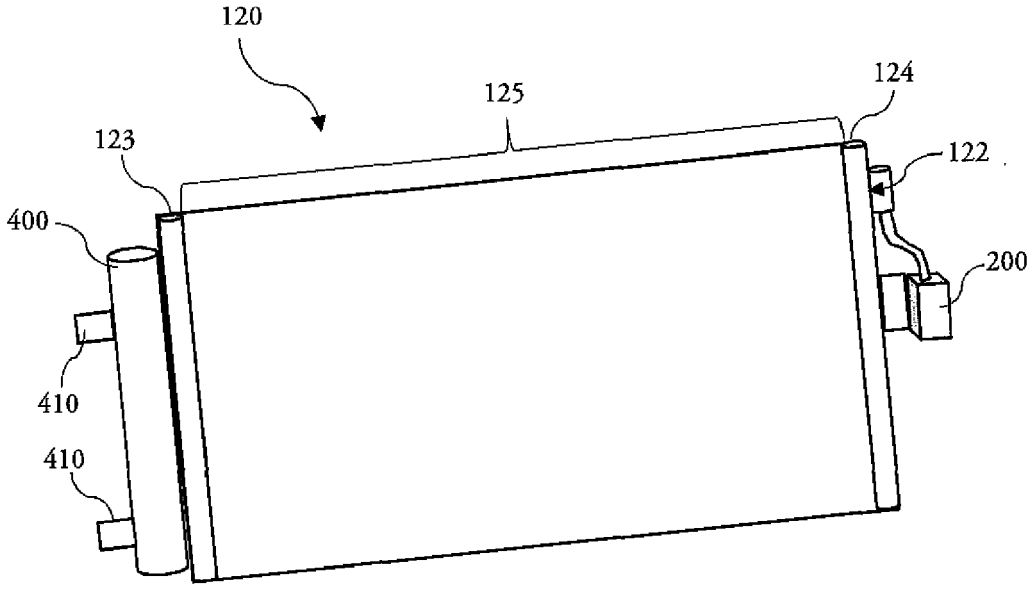
120
125
124
123
122
400
200
410
410

Fig. 2

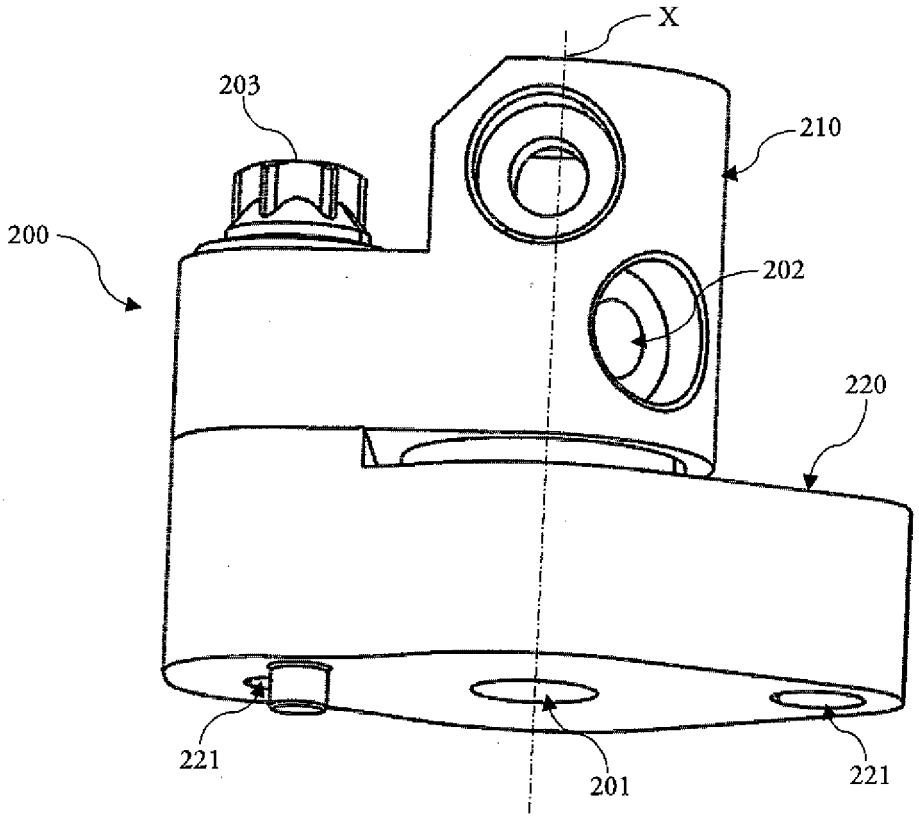
X
203
210
200
202
220
221
201
221

Fig. 3

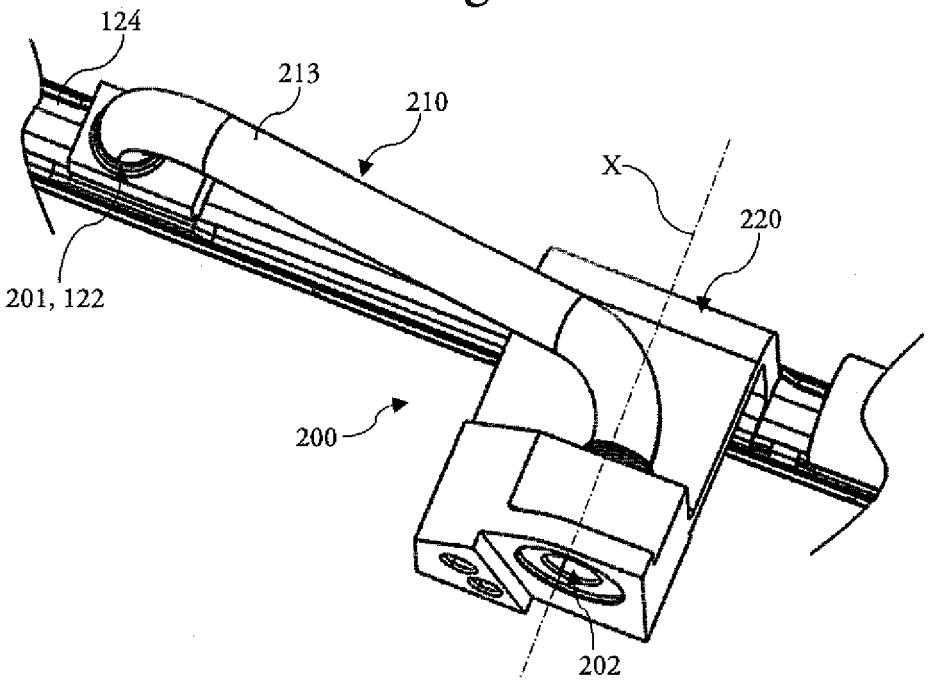
124
213
210
X
220
201, 122
200
202

Fig. 4

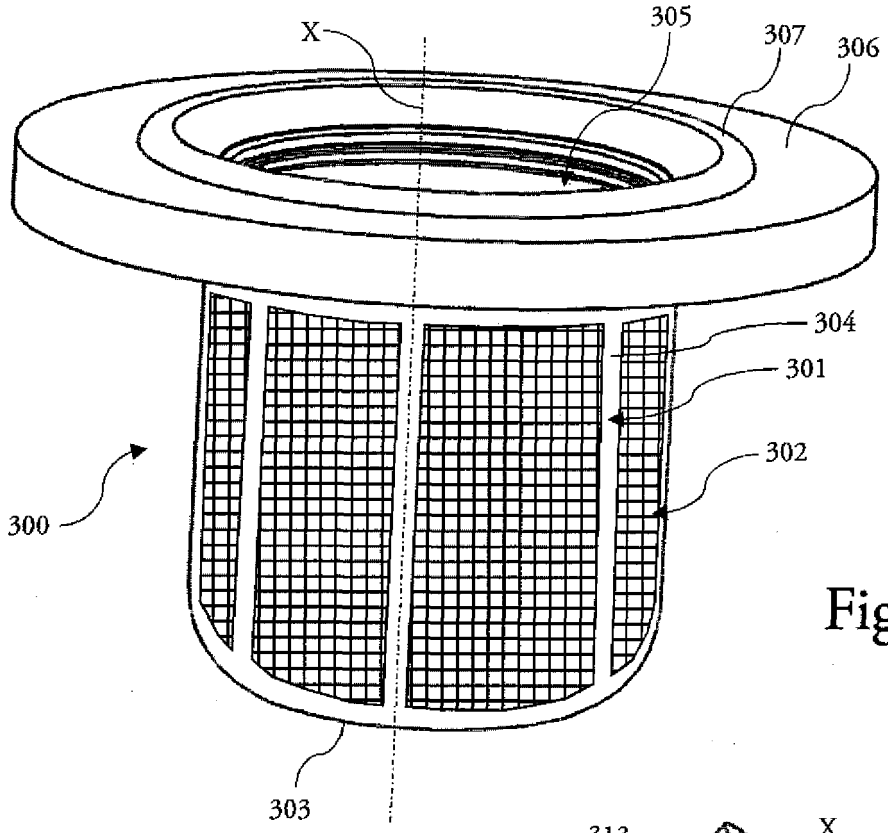
X
305
307
306
304
301
302
300
303

Fig. 5

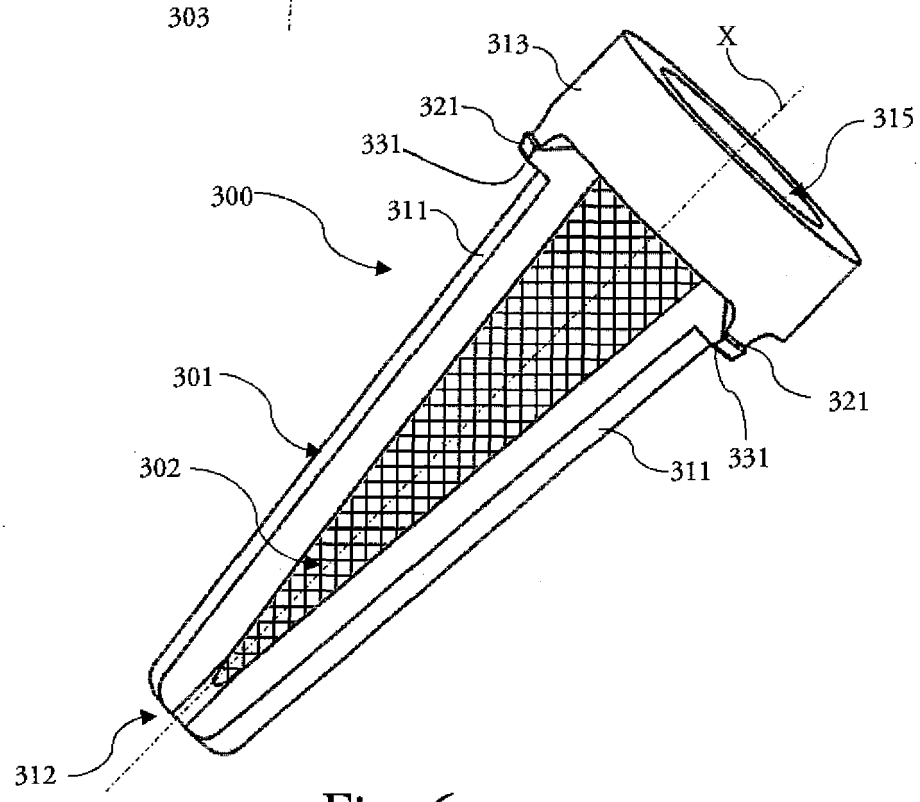
313
X
321
315
331
300
311
301
321
302
331
311
312

Fig. 6

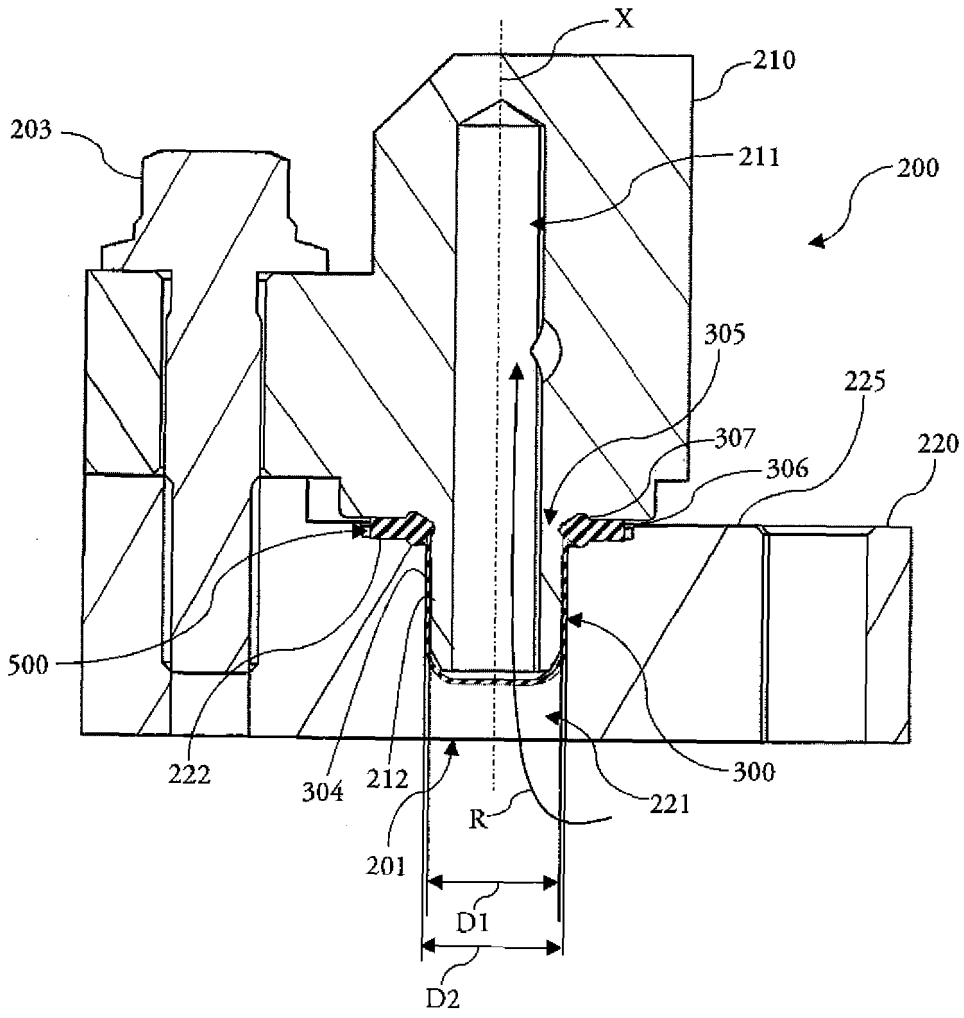
X
210
203
211
200
305
225
307
220
306
500
222
304
212
300
221
R
201
D1
D2

Fig. 7

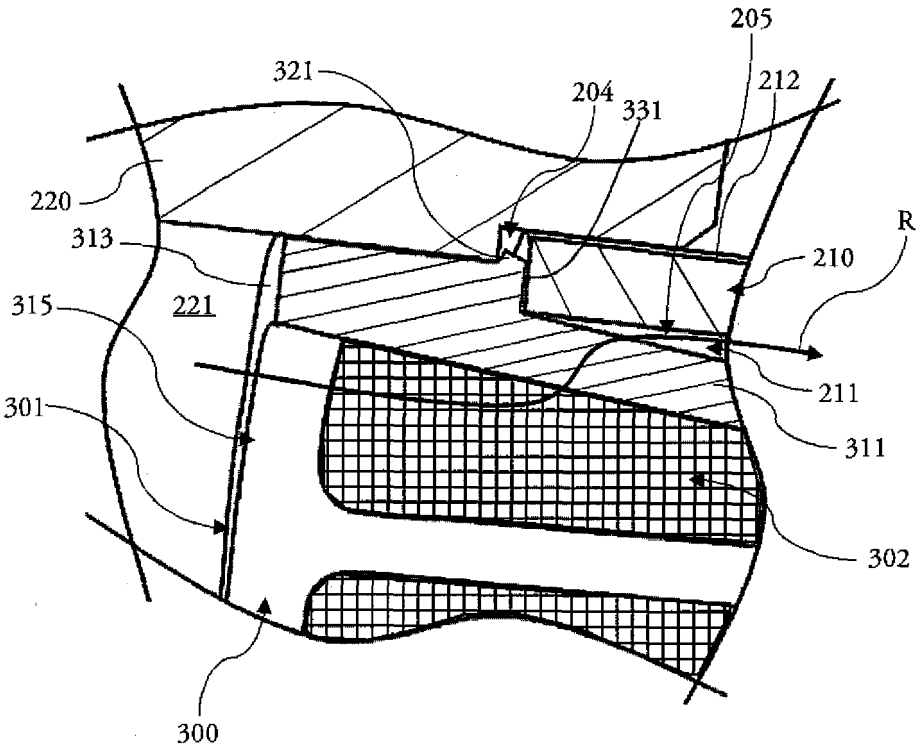

Fig. 8

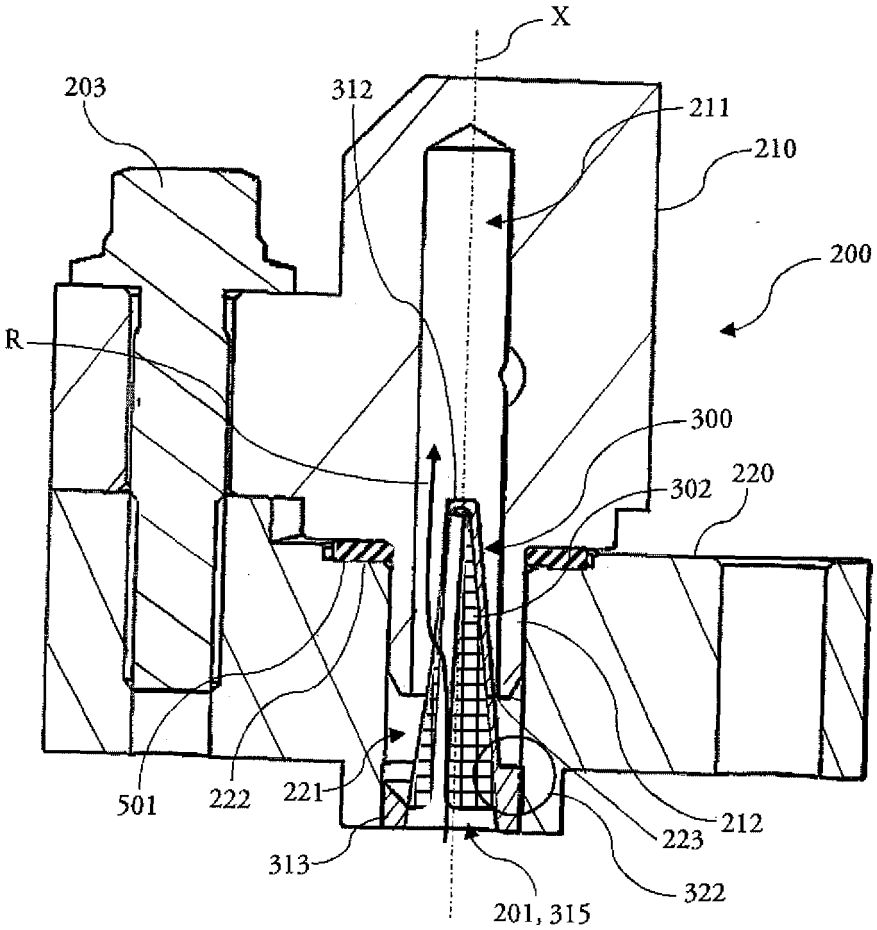
X
203
312
211
210
200
R
300
302
220
501
222
221
212
223
313
322
201, 315

Fig. 9

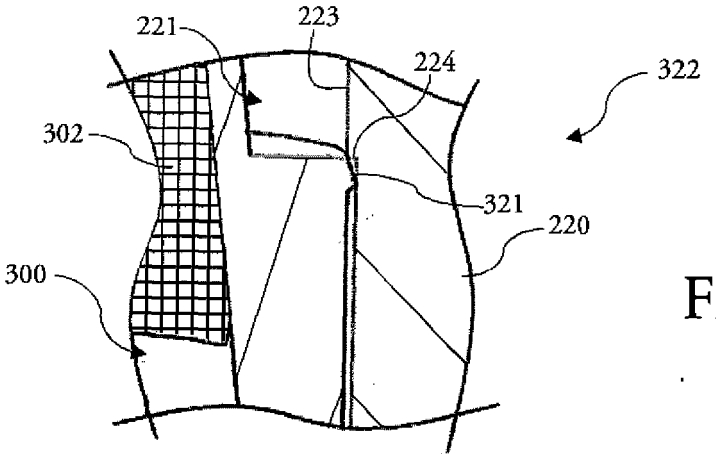
221
223
224
322
302
321
220
300

Fig. 10

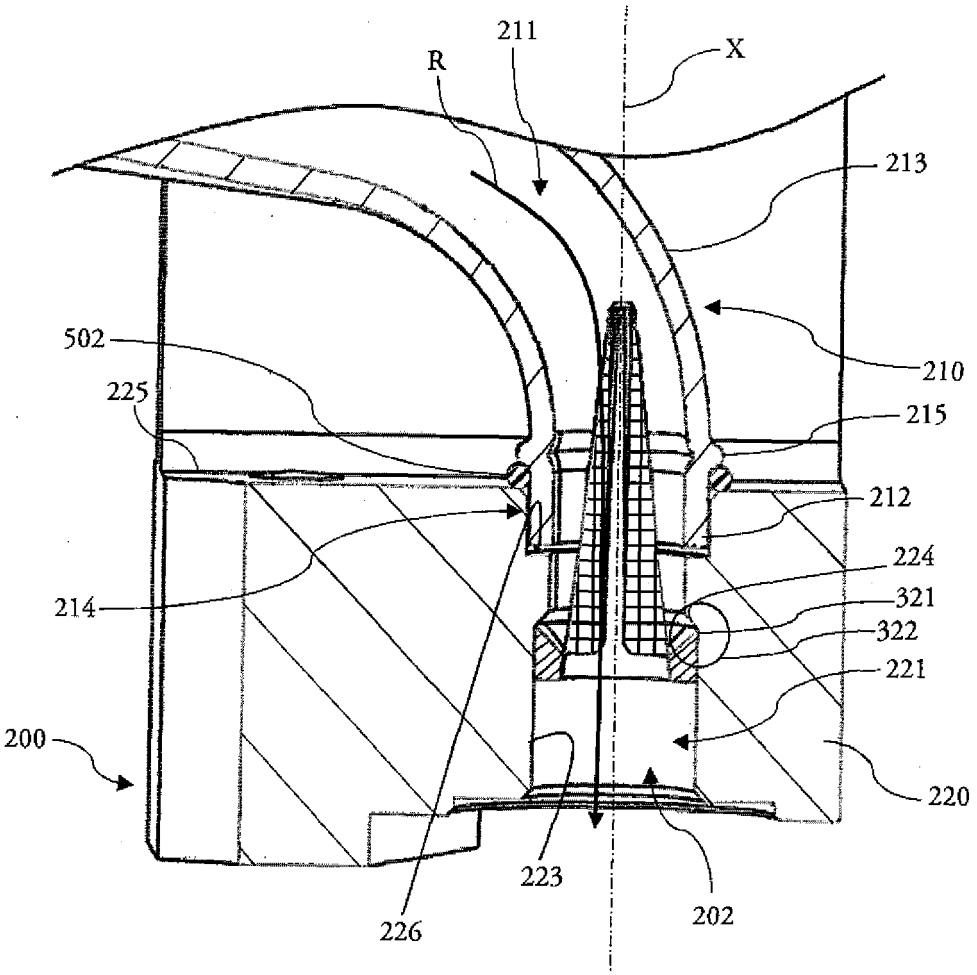
211
R
X
213
502
210
225
215
212
224
214
321
322
221
200
220
223
202
226

Fig. 11

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 19 46 1513

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP H11 316065 A (SHOWA ALUMINUM CORP) 16 November 1999 (1999-11-16) * paragraphs [0014] - [0027]; figures 1-5 *	1-10	INV. F28F19/01 F25B39/04 F25B43/00
X	EP 1 562 010 A2 (BEHR GMBH & CO [DE]) 10 August 2005 (2005-08-10)	1	
A	* paragraphs [0058] - [0066]; figure 1 *	2-10	
A	US 2005/132743 A1 (BERNINI MICHELE [IT] ET AL) 23 June 2005 (2005-06-23) * paragraphs [0023] - [0038]; figures 1-5 *	1-10	

TECHNICAL FIELDS SEARCHED (IPC)

F28F
F25B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 March 2019	Amous, Moez

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 46 1513

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-03-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP H11316065 A	16-11-1999	NONE	
EP 1562010 A2	10-08-2005	DE 102004059799 A1	25-08-2005
		EP 1562010 A2	10-08-2005
US 2005132743 A1	23-06-2005	NONE	

EPO FORM P0459

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