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

(11) EP 3 816 568 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
05.05.2021 Bulletin 2021/18

(51) Int Cl.:
F28F 9/02 (2006.01) *F28F 13/08* (2006.01)

(21) Application number: 19461597.7

(22) Date of filing: 30.10.2019

(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

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(54) HEAT EXCHANGER

(57) A heat exchanger for a vehicle is provided. The heat exchanger includes a first manifold and a second manifold spaced apart from the first manifold. Further, a plurality of heat exchange elements is fluidically connected between the first manifold and the second manifold. Further, the heat exchanger includes at least one first block is adapted to be coupled to the first manifold. The at least one first block further comprising a second passage and a first passage fluidically connected to the second passage. Further, at least a part of the first passage is having a progressively diverging cross-section and is adapted to be fluidically coupled to the first manifold.

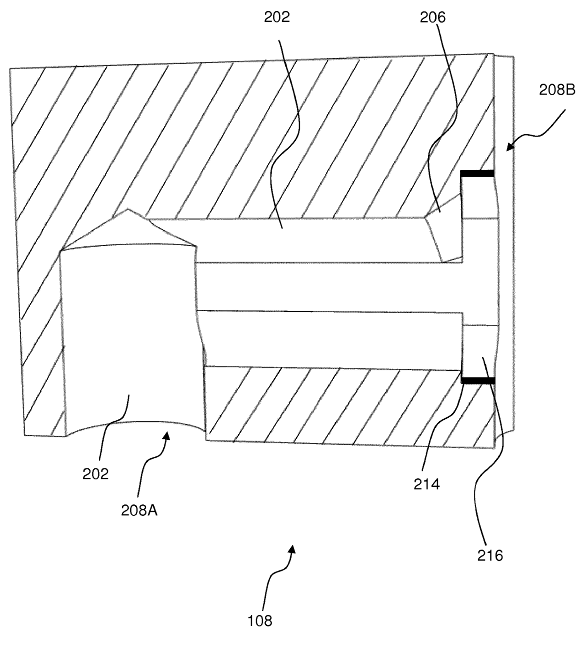

FIG. 2B

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Description

[0001] The present invention generally relates to a heat exchanger, and in particularly, to a condenser provided with a connector having a diverging cross-section to enable uniform distribution of a refrigerant in a core of the condenser.

[0002] Generally, heat exchangers, preferably condensers, are provided in Heating Ventilation Air-Conditioning (HVAC) system to reduce heat of the refrigerant flowing in the condenser. The condenser generally receives high pressure refrigerant in form gas from the compressor and condensate said high pressure refrigerant into liquid by reducing heat from the refrigerant. The condensers enable heat exchange between the refrigerant flowing into a core of the condenser and ambient air or coolant flowing around the core of the condenser, thereby reducing heat from the refrigerant. Further, the heat exchanger is provided with an inlet connector and an outlet connector to supply refrigerant to and from the core of the heat exchanger. The core having a plurality of heat exchanger tubes extended between a pair of manifolds. The pair of manifolds may include an inlet opening to receive the inlet connector, and an outlet opening to receive the outlet connector. Further, a baffle/blocking member is provided in a manifold to divide the heat exchanger tubes into a first portion of tubes and a second portion of tubes in a fluid communication with each other. Conventionally, the inlet connector having uniform cross-section is connected to the inlet opening of the heat exchanger, which may cause non-uniform distribution of refrigerant in the heat exchanger tubes due to not uniform positioning of said inlet connector in relation to geometrical center of the first and second portion of tubes. Such non-uniformly distributed refrigerant may create dead zones in the heat exchanger tubes, in which heat exchange between the refrigerant and the ambient air is sub-optimal, thereby, efficiency of the heat exchanger is reduced. In case, the inlet opening is provided in an end of the manifold corresponding the first portion of tubes, refrigerant flow in the tubes in the top portion of the first portion of tubes is low as comparted to rest of the tubes in the first portion of tubes, thereby dead zones are created in the first portion of tubes. To overcome such situation, the manifold is provided with more than inlet openings and a jumper line is connected to the inlet connector. In other words, the inlet connector is connected to one inlet opening and the jumper line connected with the inlet connector is connected to another inlet opening, thereby enabling uniform distribution of refrigerant. However, such configuration of having a jumper line with the inlet connector increases weight of the heat exchanger, is more problematic in terms of packaging and performance may be negatively affected.

[0003] Accordingly, there is a need for a simple connector for a heat exchanger that enable uniform distribution of refrigerant across the heat exchanger. Further, there is a need for a heat exchanger with a connector that improves performance of the heat exchanger without modifying core structure of the heat exchanger such as fin density, heat exchange tubes geometry and number of channels in the heat exchange tubes.

[0004] 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.

[0005] In view of the foregoing, an embodiment of the invention herein provides a heat exchanger provided with at least one first block and a second block to enable flow of heat exchange fluid in the heat exchanger. The heat exchanger includes a first manifold and a second manifold spaced apart from the first manifold. Further, a plurality of heat exchange elements is fluidically connected between the first manifold and the second manifold. The at least one first block is adapted to be coupled to the first manifold. The at least one first block further comprising a first passage. Further, at least a part of the first passage is having a progressively diverging cross-section and is adapted to be fluidically coupled to the first manifold.

[0006] Further, the heat exchange includes a second passage fluidically connected to the first passage.

[0007] Further, the heat exchanger includes a second block adapted to be coupled to any one of the first manifold and the second manifold to receive the heat exchange fluid from the plurality of heat exchange elements.

[0008] In one embodiment, the first manifold comprises a first opening adapted to be in a fluid communication with the at least one first block, and a second opening adapted to be in a fluid communication with the second block.

[0009] In another embodiment, the second manifold comprises a second opening adapted to be in a fluid communication with the second block.

[0010] Further, the first opening of the first manifold is provided with a collar to receive a perpendicular thrilling from the first passage of the at least one first block and comprising a brazing area for brazing the at least one first block with the collar of the first manifold.

[0011] In one embodiment, the first passage of the at least one first block is any one of cylindrical, ellipse and oblong shape.

[0012] Further, geometry of the first passage may be constant from one end of the first passage to another end of the first passage.

[0013] In another embodiment, geometry of the first passage is progressively diverging from one end of the first passage to another end of the first passage.

[0014] In another embodiment, the at least one first block is an inlet connector adapted to introduce the heat exchange fluid to the plurality of heat exchange elements, and the second block is an outlet connector adapted to receive the heat exchanger fluid from the plurality of heat exchange elements.

[0015] Further, the second passage of the at least one first block is of a cylindrical shape having uniform cross-section throughout the second passage.

[0016] In yet another embodiment, the second passage formed in the at least one first block is perpendicular to the first passage formed in the at least one first block.

[0017] Further, the part of the first passage is having larger cross-section than of rest of the first passage.

[0018] In one embodiment, the first passage having an end proximate to a second side is inclined at angle to form the progressively diverging cross-section of the first passage.

[0019] Other characteristics, details and advantages of the invention can be inferred from the description of the invention hereunder. A more complete appreciation of the 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, in accordance with an embodiment of the present invention; and

Fig. 2A is a perspective view of a first block of the heat exchanger, in accordance with an embodiment of the present invention;

Fig. 2B is a cross-sectional view of the first block of the heat exchanger of Fig, 2A;

Fig. 2C is a schematic view of the first block with a first manifold of the heat exchanger of Fig. 1; and

Fig. 3 illustrates a cross-section view of the first block of Fig. 1, in accordance with an embodiment of the present invention.

[0020] 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.

[0021] The present invention relates to a heat exchanger, preferably a condenser, provided with a pair of connectors to supply a heat exchange fluid to and from the heat exchanger. As the inlet connector connected to a manifold of the heat exchanger provides constant pressure of the heat exchange fluid, the heat exchange fluid may distributed non-uniformly in heat exchanger tubes of the heat exchanger, which negatively impacts performance of the heat exchanger. In order to attain uniform distribution of the heat exchange fluid in the heat exchanger tubes, internal pressure drop of the heat exchanger fluid at an inlet opening of the manifold can be decreased, thereby increasing the heat exchange fluid flow in the heat exchanger tubes of the heat exchanger. The internal pressure drop at the inlet opening can be achieved by modifying a section of an inlet connector connected at the inlet opening. Further, cross-section of at least a portion of the inlet connector is modified to be non-uniform to increase the heat exchange fluid flow in the heat exchanger. In one embodiment, at least a portion of the inlet connector is modified to have larger cross-section than of rest of the inlet connector. Therefore, internal pressure drop of the heat exchange fluid at the inlet opening is reduced, so that heat exchange fluid can be uniformly distributed throughout the heat exchanger tubes.

[0022] While aspects relating to modifying cross-section of an inlet connector to reduce pressure drop of heat exchange fluid at a first section of heat exchange tubes as described above and henceforth can be implemented in an outlet connector to reduce pressure drop of the heat exchange fluid at a second section of heat exchange tubes, the embodiments are described in the context of the following system(s).

[0023] Fig. 1 illustrates a schematic view of a heat exchanger 100, in accordance with an embodiment of the present invention. The heat exchanger 100 is provided with at least one first block 108 and a second block 110 to enable heat exchange fluid flow in the heat exchanger 100. The heat exchanger 100 includes a first manifold 102 and a second manifold 104 spaced apart from the first manifold 102. The heat exchanger 100 further includes a plurality of heat exchange elements 106 extended between the first manifold 102 and the second manifold 104. The plurality of heat exchange elements 106 is fluidically connected to the first manifold 102 and the second manifold 104. In one embodiment, the heat exchange fluid can be refrigerant and the plurality of heat exchange elements 106 can be heat exchanger tubes/plates. The first manifold 102 includes at least one baffle 105 provided in the first manifold 102 to divide the plurality of heat exchange elements 106 into a first section of heat exchange elements 106A, hereinafter referred to as first section of tubes, and a second section of heat exchange elements 106B, hereinafter referred to as second section of tubes. Further, the at least one first block 108 is fluidically connected to the first manifold 102, corresponding to the first section of tubes 106A, to introduce the heat exchange fluid, hereinafter referred to as refrigerant, into the first section of tubes 106A.

[0024] The second block 110 is fluidically connected to the first manifold 102, corresponding to the second section of tubes 106B, to receive the refrigerant from the second section of tubes 106B. Generally, the refrigerant flows from the at least one first block 108 to the first section of tubes 106A and flows to the second section of tubes 106B through the second manifold 104. The refrigerant flowing in the heat exchange elements 106 release heat to the air flowing across the heat exchanger 100. In one embodiment, the at least one first block 108 and the second block 110 is a part of an inlet connector and an outlet connector respectively. In case the heat exchanger 100 includes more than one first blocks 108, the first blocks 108 may be connected at both ends of the first manifold 102, corresponding to the first section of tubes 106A. Further, the first manifold 102 further includes a first opening 112 adapted to be in fluid communication with the at least one first block 108 and a second opening 114 adapted to be in fluid communication with the second block 110. The first opening 112 can be formed at an end of the first manifold 102 or can be formed in between both ends of the first manifold 102.

[0025] In another aspect of the invention, the at least one first block 108 is connected to the first manifold 102 and the second block 110 is connected to the second manifold 104. In such cases, the first opening 112 is provided in the first manifold 102 corresponding to the at least one first block 108 and the second opening 114 is provided in the second manifold 104 corresponding to the second block 110. In this aspect of the invention, the heat exchanger 100 has single section of the plurality of heat exchange elements 106. Further, the first opening 112 and the second opening 114 are formed in a such way the first opening 112 and the second opening 114 are fluidically coupled to the at least one first block 108 and the second block 110. For the sake of brevity and clarity, the present invention is described with one first block 108 and the second block 110. Further, the internal pressure drop of the refrigerant at the plurality of heat exchange elements 106, hereinafter referred to as heat exchange elements, is reduced by increasing cross-section of at least a part of the first block 108, so the amount of refrigerant flow in the heat exchange elements 108 is increased, thereby increasing performance of the heat exchanger.

[0026] Figs. 2A and 2B illustrate simplified views of the first block 108 of Fig. 1, in accordance with an embodiment of the present invention. In an example, Fig. 2A is a perspective view of the first block 108 of the heat exchanger 100 and Fig. 2B is a cross-sectional view of the first block 108 of the heat exchanger 100. The first block 108 includes 204 a first passage 202 and a second passage 204 fluidically connected to the first passage 202. Further, the second passage 204 and the first passage 202 are formed in the first block 108 to enable refrigerant circulation to the first opening 112 formed in the first manifold 102. The second passage 204 of the first block 108 may be in a fluid communication with the inlet connector or conduits carrying the refrigerant and the first passage 202 of the first block 108 may be in a fluid communication with the first opening 112 of the heat exchanger 100. The second passage 204 may have uniform cross-section throughout the second passage 204, whereas the first passage 202 may have non-uniform and progressively diverging cross-section at a part of the first passage 202. In one embodiment, at least a part 206 of the first passage 202 has bigger cross-section than of the rest of the first passage 202. As the cross-section of the first passage 202 proximate to the first opening 112 is more than of rest of the first passage 202, pressure drop of the refrigerant at the first opening 112 is reduced, thereby increasing refrigerant flow in the heat exchange elements 106. In one aspect, geometry of the first passage 202 of the first block 108 is constant from one end to another end of the first passage 202, while the cross-section of the first passage 202 is progressively diverging from the one end to another end of the first passage 202. In another aspect, geometry and cross-section of the first passage 202 of the first block 108 is progressively diverging from the one end to another end of the first passage 202. In one embodiment, the geometry of the first passage 202 can be any shape such as, for example, cylindrical, oblong, ellipse, rectangular etc.

[0027] Further, the first block 108 may include a first side 208A that is adapted to be in-contact with the inlet connector when the second passage 204 of the first block 108 is in fluid communication with the inlet connector. The first block 108 may further include a second side 208B that is in adapted to be in-contact to the first manifold 102 when the first passage 202 is in fluid communication with the first manifold 102. In one embodiment, the first passage 202 having an end proximate to the second side 208B of the first block 108 is inclined at angle to achieve non-uniform cross-section of the first passage 202. Further, the inclination may be formed, an end proximate to the second side 208B, in upper portion of the first passage 202 or throughout the first passage 202 depends on coupling position of the first block 108 with the first manifold 102. In one embodiment, the second passage 204 is perpendicularly formed with respect to the first passage 202 formed in the first block 108. In another embodiment, the second passage 204 is parallel formed with respect to the first passage 202. In yet another embodiment, the second passage 204 is oblong to the first passage 202 of the first block 108. Further, the second passage 204 may be formed from the first side 208A of the first block 108 and the first passage 202 may be formed from the second side 208B of the first block 108. The second side 208B may be in-contact with the first manifold 102 in such a way that the first passage 202 is in a fluid communication with the first opening 112 formed in the first manifold 102. The second passage 204 formed in the first side 208A in such a way that the second passage 204 is in a fluid communication with the inlet connecter or conduits carrying the refrigerant to the heat exchanger 100.

[0028] Fig. 3 illustrates a cross-section view of the first block 108 of Fig. 1, in accordance with an embodiment of the present invention. In this embodiment, the cross-section of the first passage 202 is progressively diverging throughout the first passage 202. In other words, the first passage 202 is progressively diverging from an end to another end of the first passage 202, which is proximate to the second side 208B of the first passage 202. In simple words, cross-section of the first passage 202 at one end, which is proximate to the second side 208B of the first passage 202, is more than of another end of the first passage 202. In one embodiment, the second passage 204 and the first passage 202 can be any one of cylindrical or oblong in shape. Further, the first block 108 and the second block 110 can be brazed to any one of the first manifold 102 and the second manifold 104. Further, the first opening 112 of the first manifold 102 is provided with a collar 210 to receive a perpendicular thrilling 214 from the first passage 202 of the first block 108 and provide brazing area 216 for brazing the at least one first block 108 with the collar 210 of the first manifold 102. As shown in the schematic view of the first block 108 with the first manifold 102, the collar 210 is provided in the first opening 112 of the first manifold 102. In one example, the first block 108 can be the inlet connector to introduce the refrigerant to the heat exchanger 100 and the second block 110 can be the outlet connector to receive the refrigerant from the heat exchanger 100. As the first passage having non-uniform cross-section, pressure drop of the refrigerant at the heat exchange elements 106 is reduced and refrigerant is uniformly distributed in the heat exchanger elements 106, thereby performance of the heat exchanger 100 is optimum. Although the present invention is described with the first block 108 having non-uniform cross-section, it can be applied to the second block 108.

[0029] 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 (100), comprising:

a first manifold (102);
a second manifold (104) spaced apart from the first manifold (102);
a plurality of heat exchange elements (106) fluidically connected between the first manifold (102) and the second manifold (104);
at least one first block (108) adapted to be coupled to the first manifold (102), wherein the at least one first block (108) further comprising:
a first passage (202), wherein at least a part (206) of the first passage (202) is having a progressively diverging cross-section and is adapted to be fluidically coupled to the first manifold (102).

2. The heat exchanger (100) as claimed in claim 1, further includes a second passage (204) fluidically connected to the first passage (202).

3. The heat exchanger (100) as claimed any of the preceding claims, further includes a second block (110) adapted to be coupled to any one of the first manifold (102) and the second manifold (104) to receive the heat exchange fluid from the plurality of heat exchange elements (106).

4. The heat exchanger (100) as claimed in claim 3, wherein the first manifold (102) comprises a first opening (112) adapted to be in a fluid communication with the at least one first block (108).

5. The heat exchanger (100) as claimed in claim 4, wherein the first manifold (102) further comprises a second opening (114) adapted to be in a fluid communication with the second block (110).

6. The heat exchanger (100) as claimed in claim 4, wherein the second manifold (104) comprises a second opening (114) adapted to be in a fluid communication with the second block (110).

7. The heat exchanger (100) as claimed in any of claims 4 to 6, wherein the first opening (112) of the first manifold (102) is provided with a collar (210) to receive a perpendicular thrilling (214) from the first passage (202) of the at least one first block (108) and comprising a brazing area (216) for brazing the at least one first block (108) with the collar (210) of the first manifold (102).

8. The heat exchanger (100) as claimed in any of preceding claims, wherein the first passage (202) of the at least one first block (108) is any one of cylindrical, ellipse, and oblong shape.

9. The heat exchanger (100) as claimed in any of claims 1 to 8, wherein geometry of the first passage (202) is constant from one end of the first passage (202) to another end of the first passage (202).

10. The heat exchanger (100) as claimed in any of claims 1 to 8, wherein geometry of the first passage (202) is progressively diverging from one end of the first passage (202) to another end of the first passage (202).

11. The heat exchanger (100) as claimed in any of preceding claims, wherein the at least one first block (108) is an inlet connector adapted to introduce the heat exchange fluid to the plurality of heat exchange elements (106), and the second block (110) is an outlet connector adapted to receive the heat exchanger fluid from the plurality of heat exchange elements (106).

12. The heat exchanger (100) as claimed in claim 2, wherein the second passage (204) of the at least one first block (108) is of a cylindrical shape having uniform cross-section throughout the second passage (204).

13. The heat exchanger (100) as claimed in any of preceding claims, wherein the second passage (204) formed in the at least one first block (108) is perpendicular to the first passage (202) formed in the at least one first block (108).

14. The heat exchanger as claimed in any of preceding claims, wherein the part (206) of the first passage (202) is having larger cross-section than of rest of the first passage (202).

15. The heat exchanger as claimed in any of preceding claims, wherein the first passage (202) having an end proximate to a second side (208B) is inclined at angle to form the progressively diverging cross-section of the first passage (202).

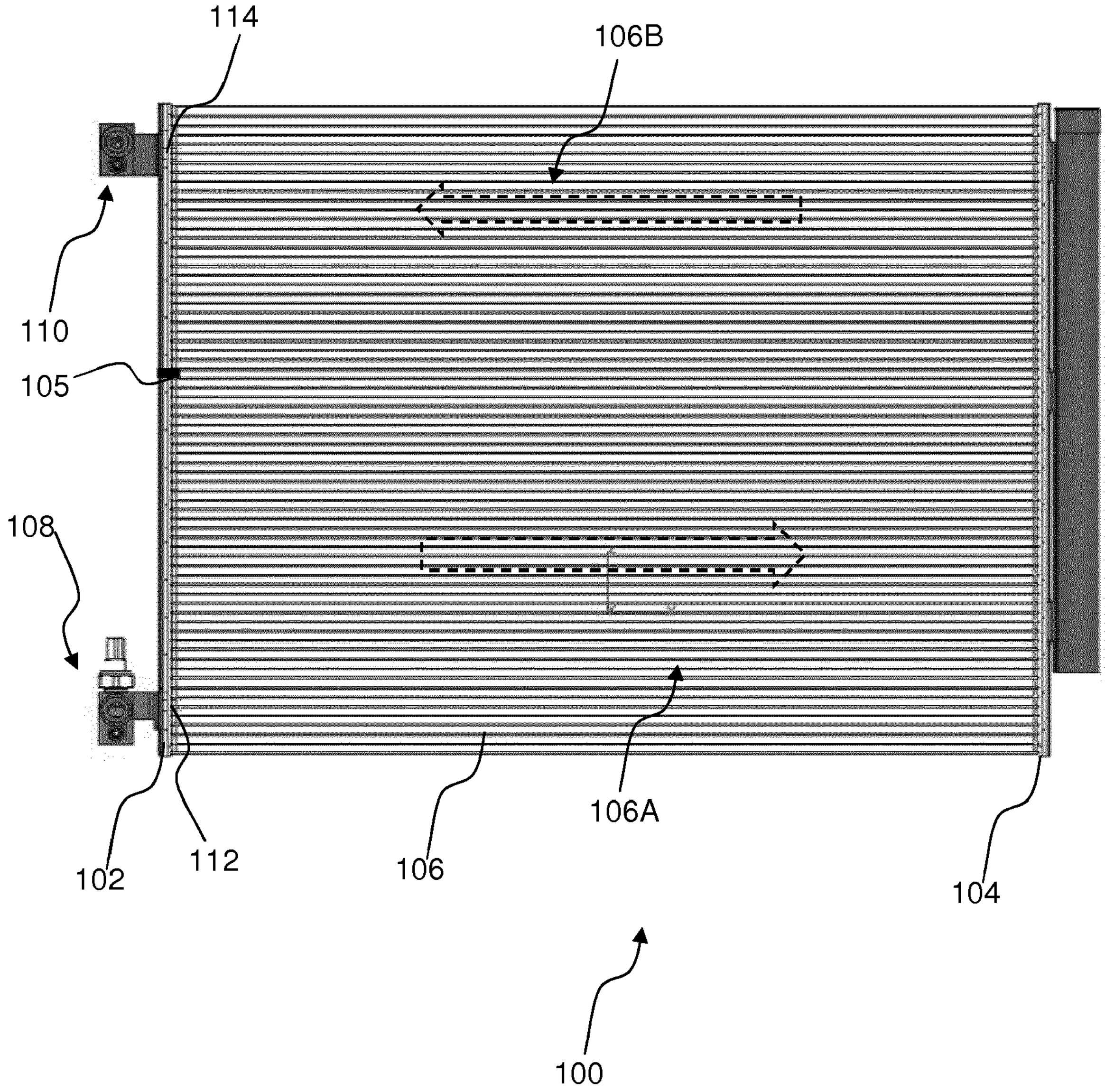

FIG. 1

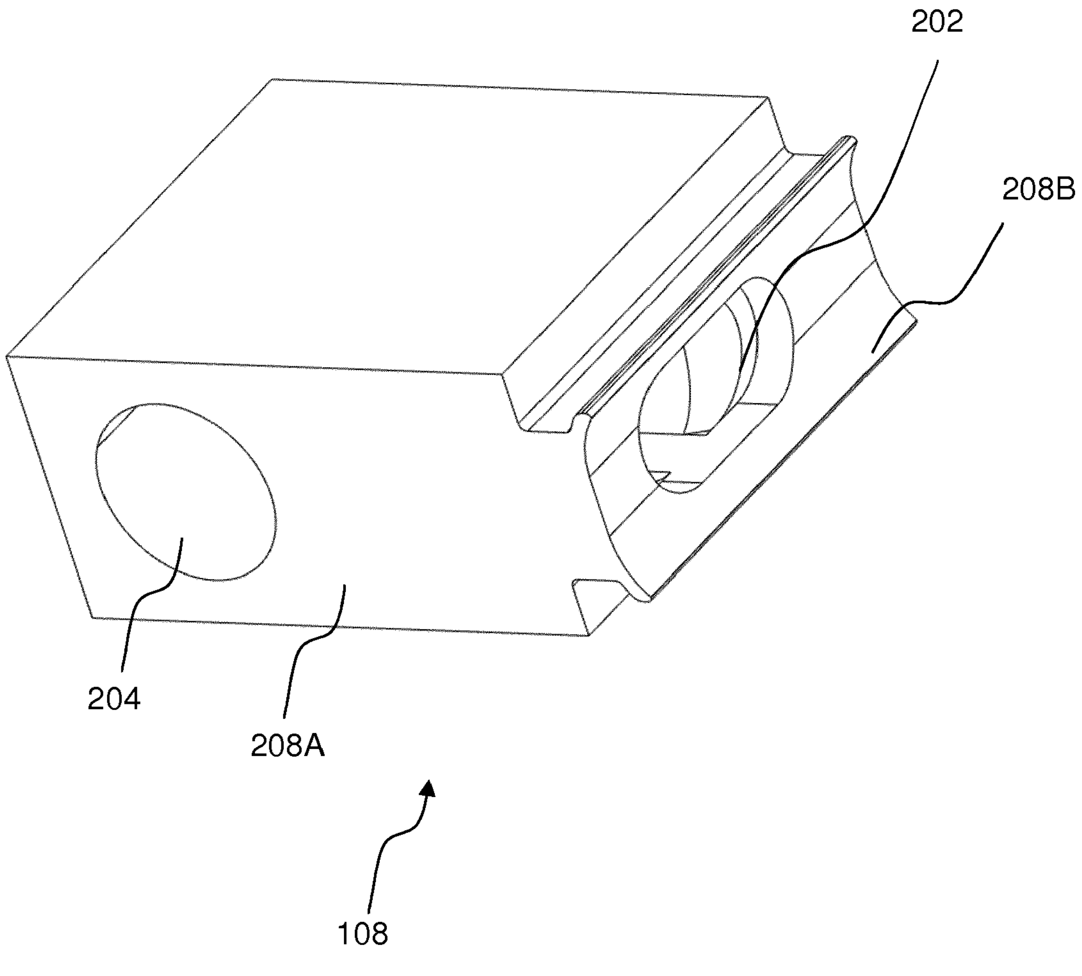

FIG. 2A

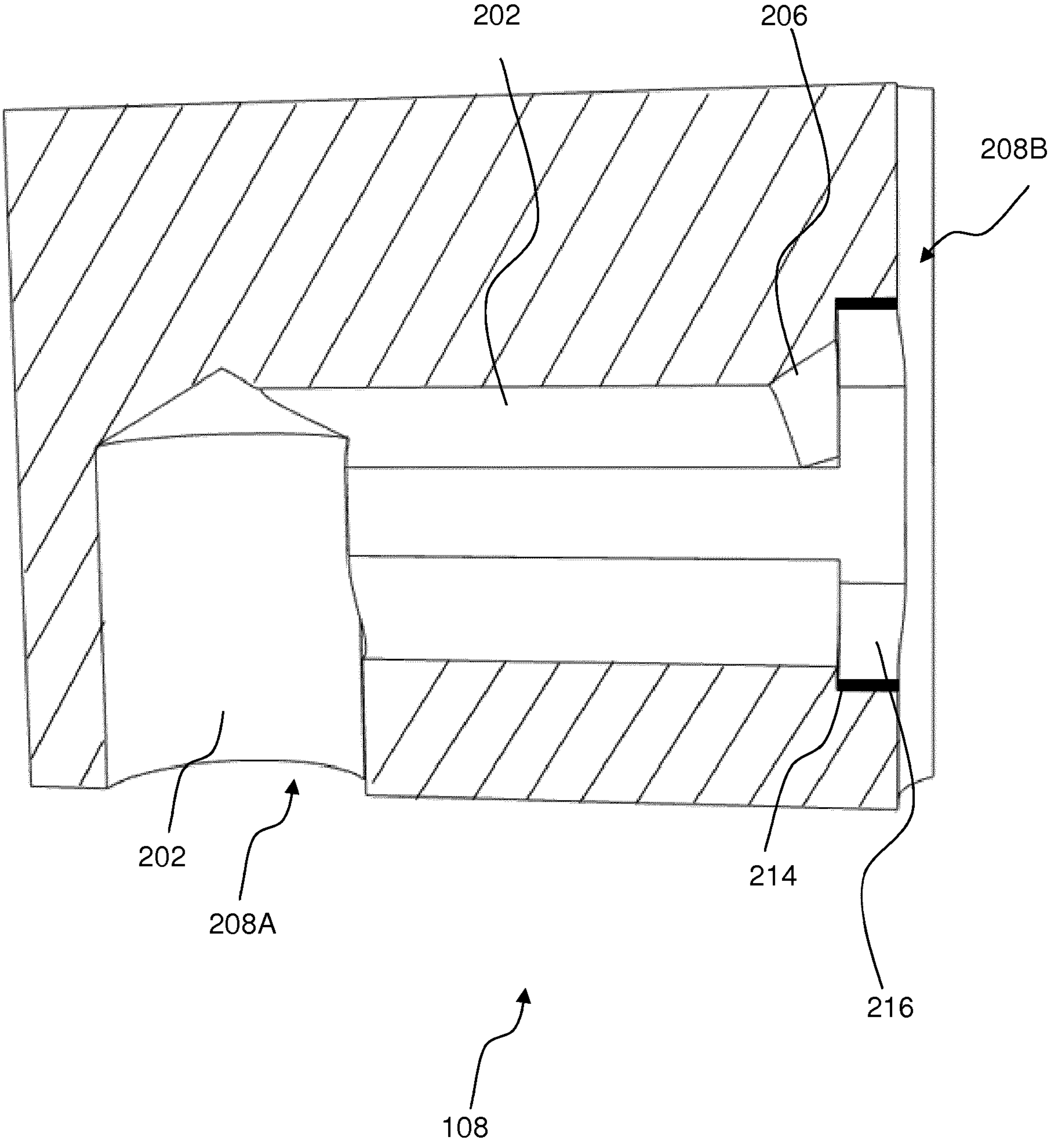

FIG. 2B

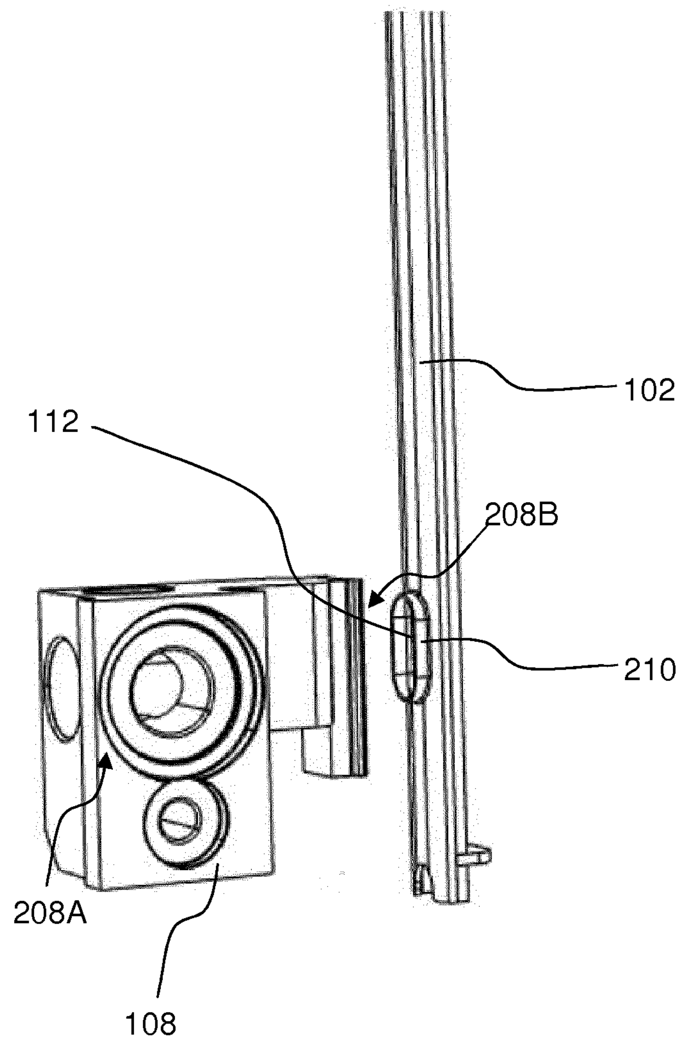

Fig. 2C

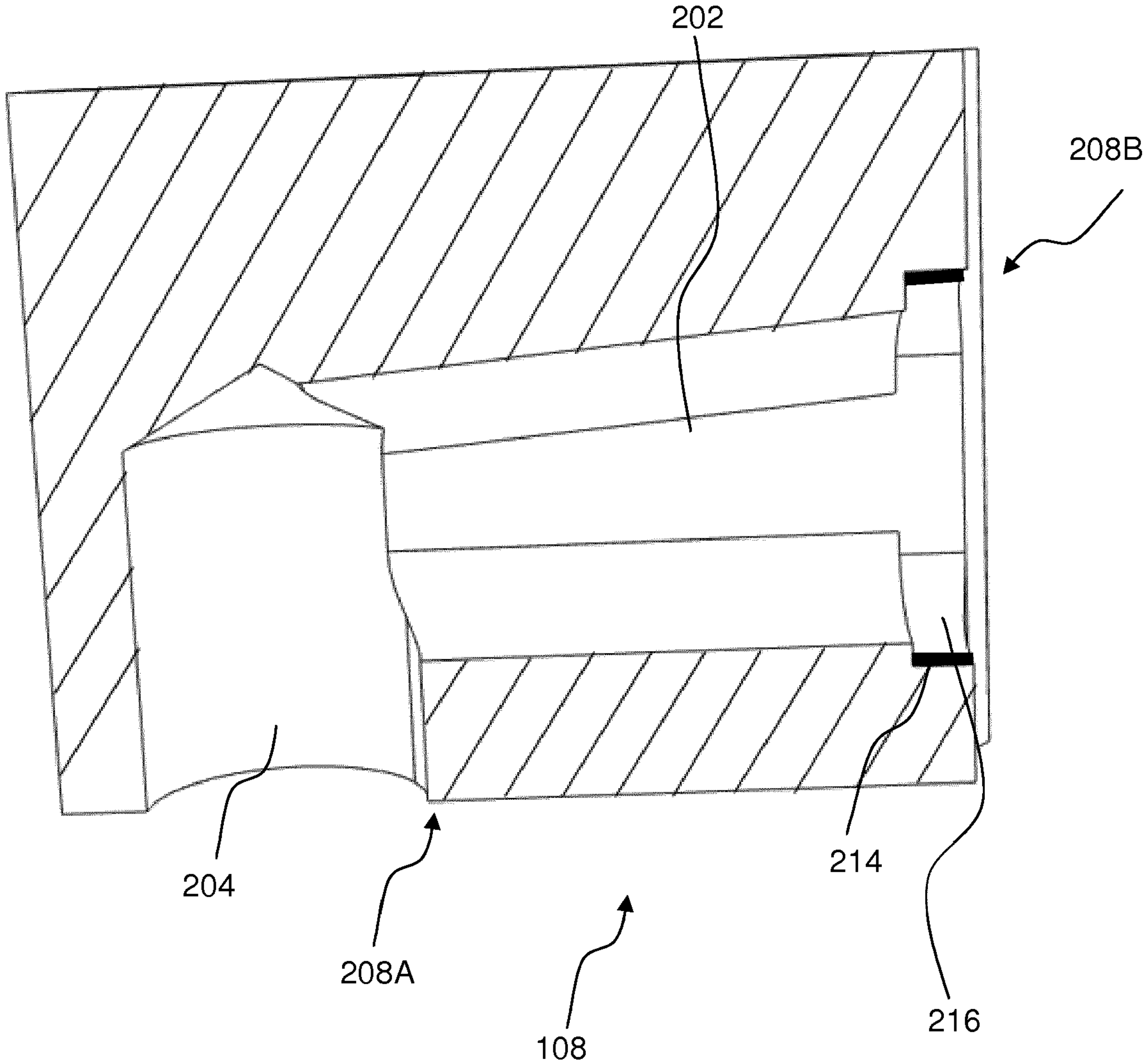

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 19 46 1597

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F28F

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	10 March 2020	Schindler, Martin

CATEGORY OF CITED DOCUMENTS

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