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

(11) EP 4 361 548 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
01.05.2024 Bulletin 2024/18

(21) Application number: **22203388.8**

(22) Date of filing: **24.10.2022**

(51) International Patent Classification (IPC):
F28D 1/053 *(2006.01)* ***F28D 7/16*** *(2006.01)*
F28F 9/02 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F28D 1/05375; F28D 7/1692; F28F 9/0251;
F28F 2009/0297

(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 ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

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(54) A HEAT EXCHANGER

(57) The object of the invention is, among others, a heat exchanger (1) for heat exchange between a first fluid and a second fluid comprising: a first manifold (100) and a second manifold (200) spaced apart from the first manifold (100), wherein the second manifold (200) is substantially parallel with respect to the first manifold(100), a plurality of flat tubes (300) stacked between the first manifold (100) and the second manifold (200), the plurality of flat tubes (300) being configured to provide the fluidal communication between the first manifold (100) and the second manifold (200), a bottle (400) fluidly connected to the first manifold (100), the bottle (400) comprising at least one passage (401) for the fluid, wherein the heat exchanger (1) comprises a first block (10) and a second block (20), both first and second blocks (10, 20) being fluidly connected to the first manifold (100), and at least one third block (30) fluidly connected to the first manifold (100) or the second manifold (200).

EP 4 361 548 A1

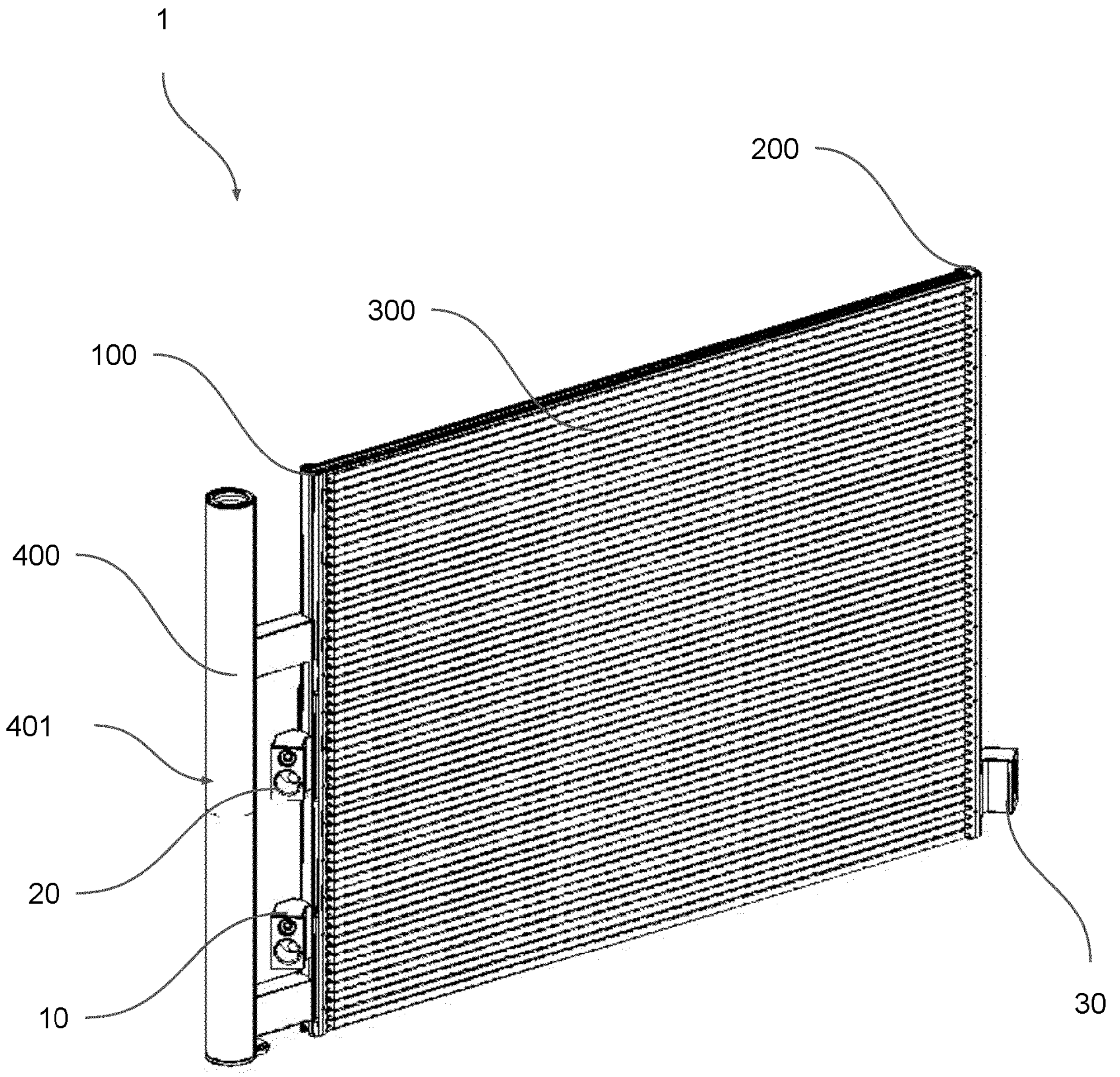


Fig. 3

Description

FIELD OF THE INVENTION

[0001] The invention relates to the heat exchanger. In particular, this invention relates to the heat exchanger for a motor vehicles.

BACKGROUND OF THE INVENTION

[0002] The invention relates to the field of heat exchangers, for example heat exchangers suitable for operating with a reversible air conditioning circuit intended in particular to heat or to cool the passenger compartment of a vehicle. In vehicles comprising a combustion engine, the comfort thermal is ensured, on the one hand, for the heating requirements, by the use of the heat of the engine and, on the other hand, for the cooling requirements, by a system of conditioned air operating with a mechanical compressor.

[0003] On the other hand, for electric vehicles, it is not possible to use the heat released by the heat engine, the only source of energy available inside the vehicle being electrical energy. It is therefore this electrical energy which is used in order to meet the heating and cooling requirements in the passenger compartment.

[0004] Thus it is known to ensure thermal comfort in electric vehicles by a conventional air conditioning system operating with an electrical compressor for the cooling requirements and by an electric radiator for the heating requirements. However, such radiators consume a considerable amount of electrical energy and, for the purpose of increasing the autonomy of electric vehicles, it is advantageous to produce thermal energy, for heating and cooling, by means of a single air conditioning system having a greater efficiency.

[0005] Known heat exchangers may operate in two different modes, i.e. the heat pump mode and in the condenser mode.

[0006] It is known to let the fluid pass through one heat exchanger in both modes. In the condenser mode the refrigerant may flow through the heat exchanger in the same direction as it does in heat pump mode. In this scenario the inlet for refrigerant may be common for both condenser and heat pump mode, whereas the outlet for the refrigerant may also be common for both condenser and heat pump mode. Alternatively, the in the condenser mode the refrigerant may flow through the heat exchanger in different direction than it does in heat pump mode. In this scenario the inlet for refrigerant in condenser mode may be outlet for refrigerant in the heat pump mode, whereas the inlet for refrigerant in the heat pump mode may be the outlet for refrigerant in condenser mode.

[0007] In all aforementioned scenarios the refrigerant is forced to flow through the bottle of the heat exchanger in the heat pump mode. This is not beneficial in terms of overall efficiency of the heat exchanger and therefore undesired. Further, the reversed flow or the gradient of temperatures between the heat pump mode and the condenser modes may increase the deterioration of the components of the bottle.

[0008] Thus it would be desired to provide the heat exchanger which would mitigate the aforementioned disadvantages.

[0009] Further, it would be desired to provide a heat exchanger of compact design, which would integrate the two operational modes of the heat exchanger, while increasing its efficiency.

[0010] It would also be desired to mitigate the drawbacks of the presence of the bottle in the heat pump mode of the heat exchanger.

SUMMARY OF THE INVENTION

[0011] The object of the invention is, among others, a heat exchanger for heat exchange between a first fluid and a second fluid comprising: a first manifold and a second manifold spaced apart from the first manifold, wherein the second manifold is substantially parallel with respect to the first manifold, a plurality of flat tubes stacked between the first manifold and the second manifold, the plurality of flat tubes being configured to provide the fluidal communication between the first manifold and the second manifold, a bottle fluidly connected to the first manifold, the bottle comprising at least one passage for the fluid, wherein that the heat exchanger comprises a first block and a second block, both first and second blocks being fluidly connected to the first manifold, and at least one third block fluidly connected to the first manifold or the second manifold.

[0012] Advantageously, the plurality of flat tubes further comprises a first pass, a second pass, and at least one third pass, wherein the first pass is located between the second pass and the third pass.

[0013] Advantageously, the first manifold comprises a first section fluidly connected with at least the first pass, a second section fluidly connected with at least second pass and at least one third section fluidly connected with at least third section.

[0014] Advantageously, the second manifold comprises a fourth section fluidly connected with at least the first pass, a fifth section fluidly connected with at least second pass and at least one sixth section fluidly connected with at least third pass.

[0015] Advantageously, the heat exchanger further comprises: a first circuit for the first fluid comprising: a first block a first section, the first pass, the fourth section, the fifth section, the second pass, the second section and the second block.

[0016] Advantageously, the heat exchanger is configured to operate in a heat pump mode, wherein the first fluid leaving the heat exchanger through the second block is of the same phase as the first fluid entering the heat exchanger through the first block.

[0017] Advantageously, the bottle block the passage for the first fluid, so that it flows directly to the second block.

[0018] Advantageously, the heat exchanger further comprises: a second circuit for the first fluid comprising: a first block a first section, a first pass, the fourth section, the fifth section, the second pass, the bottle, the second section, the third pass, the sixth section and the third block.

[0019] Advantageously, the heat exchanger is configured to operate in a condenser mode, wherein the first fluid leaving the heat exchanger through the third block is of different phase than the first fluid entering the heat exchanger through the first block.

[0020] Advantageously, the second block blocks the passage for the first fluid, so that it flows directly to the bottle.

[0021] Advantageously, the flat tubes comprise at least one insulating means located between the first and the third pass.

[0022] Advantageously, the first block is located in the lower half of the first section.

[0023] Advantageously, the second block is located at the higher level than the first block, the level being measured along an axis of elongation of the manifolds.

[0024] Advantageously, the second block is located in the lower half of the second section.

[0025] Advantageously, the third block is located substantially in the middle of the sixth section, preferably in the lower half of the sixth section.

[0026] Advantageously, the third block is located at the level lower than the first block and the second block, the level being measured along an axis of elongation of the manifolds.

[0027] Advantageously, the one manifold comprise greater number of blocks than the other manifold.

[0028] Advantageously, at least one the block is fixed to the outermost portion of respective manifold, so that said block is substantially coplanar with the tubes.

[0029] Advantageously, at least one block is fixed to the respective manifold, so that said block is at an angle with respect to the general plane of the tubes.

[0030] Advantageously, the bottle comprise a substantially tubular body closed on both sides, at least one first bottle opening configured to enable the first fluid flow into tubular body and at least one second bottle opening configured to enable first fluid exit the tubular body.

[0031] Advantageously, the bottle comprise a first connector configured to provide a fluidal communication between the first opening and the first manifold, and a second connector configured to provide a fluidal communication between the second opening and the first manifold.

[0032] Advantageously, the direr means are integrated into the first manifold.

[0033] Advantageously, the first pass is at least twice the size of the third pass, preferably triple the size thereof, the size being measured as the number of tubes forming each pass.

[0034] Advantageously, the second pass is between 1,5 to 2,0 times the size of the first pass, the size being measured as the number of tubes forming each pass.

[0035] Advantageously, the first manifold further comprises a seventh section, and the second manifold comprises an eight section fluidly connected with the sixth section, so that the tubes connecting said sections forms a fourth pass for the first fluid.

[0036] Advantageously, the third pass comprises a secondary third pass comprising a seventh section, and the second manifold comprises an eight section fluidly connected with the sixth section.

[0037] Advantageously, the third block is fluidly connected with the seventh section.

[0038] The invention further concerns a system for a motor vehicle comprising at least one heat exchanger, wherein the heat exchanger is configured as evaporator for refrigerant. The invention also concerns a system for a motor vehicle comprising at least one heat exchanger, wherein the heat exchanger is configured as condenser for refrigerant.

BRIEF DESCRITPTION OF DRAWINGS

[0039] Examples of the invention will be apparent from and described in detail with reference to the accompanying drawings, in which:

Fig. 1 shows a prior art heat exchanger, wherein the fluid flows in the same direction both in the heat pump mode and in the condenser mode.

Fig. 2 shows a prior art heat exchanger, wherein the fluid in the heat pump mode flows in the opposite direction than in the condenser mode.

Fig. 3 shows a perspective view of the exemplary heat exchanger with three blocks.

Fig. 4 shows a schematic view of the standalone heat exchanger with 3 blocks, similar to the heat exchanger depicted in Fig.3.

Fig. 5 shows the schematic view heat exchanger from Fig. 4, wherein the heat exchanger operates in heat pump mode.

Fig. 6 shows the schematic view heat exchanger from Fig. 4, wherein the heat exchanger operates in condenser mode.

Fig. 7 shows the schematic view heat exchanger comprising additional pass for the fluid in the subcooling section of the heat exchanger.

Fig. 8 shows the schematic view heat exchanger comprising additional pass for the fluid in the second pass.

Fig, 9 shows the perspective view of the heat exchanger comprising three blocks, wherein both blocks and connectors for the bottle are in angular configuration.

Fig. 10 shows the perspective view of the heat exchanger comprising a jumper line.

DETAILED DESCRIPTION OF EMBODIMENTS

[0040] The present invention relates to a heat exchanger 1 for heat exchange between a first fluid and a second fluid. The first fluid may be, for example, refrigerant, whereas the second fluid may be, for example, air. The ram air having the lover temperature flows across the heat exchanger 1, so that the refrigerant having the higher temperature and flowing through said heat exchanger transfers the calories to the air.

[0041] The known heat exchangers are depicted in Fig. 1 and in Fig. 2.

[0042] Referring to Fig. 1, a known heat exchanger 2 may comprise only two blocks, wherein one block serves the purpose of inlet for the first fluid, whereas the second block serves the purpose of the outlet for the first fluid. The black arrows depict intended fluid flow in a heat pump circuit 5 when the heat exchanger 2 operates in heat pump mode, and the white arrows depict intended fluid flow in a condenser circuit 4 when the heat exchanger 2 operates in condenser mode. Both circuits 4 and 5 show the flow in the same direction. It is to be noted, that in the heat pump mode the fluid must travel through the bottle.

[0043] Referring to Fig. 2, a known heat exchanger 3 may also comprise only two blocks, wherein one blocks serve different purpose according to the operational mode of the heat exchanger 3. The black arrows depict intended fluid flow in a heat pump circuit 5 when the heat exchanger 2 operates in heat pump mode, whereas the white arrows depict intended fluid flow in a condenser circuit 4 when the heat exchanger 3 operates in condenser mode. The circuits 4, 5 are arranged in so-called counter flow. It is to be noted, that in the heat pump mode the fluid must travel through the bottle.

[0044] Figures 3-6 show substantially the same type of the heat exchanger, Figs 3 and 4 may show structural features of the standalone heat exchanger 1, whereas Figs 5 and 6 may show the flow pattern of the first fluid, according to the operational mode of the heat exchanger 1.

[0045] Fig 3. shows a perspective view of the exemplary heat exchanger 1 according to an embodiment of invention.

[0046] The heat exchanger 1 may be located in front of the vehicle, wherein the expected air flow for moving motor vehicle is the biggest. However, other locations of the heat exchanger 1 within the vehicle are also possible. In other words, as long as the sufficient flow of the second fluid is provided, the heat exchanger 1 may be located anywhere in the vehicle.

[0047] The term "vehicle" may refer to any type of the motor vehicle, for example, vehicles with internal combustion engines (ICE), electric vehicles (EVs), and all types of hybrid vehicles.

[0048] As described in further paragraphs, the heat exchanger 1 may comprise at least two operational modes. The first is the heat pump mode which in, for example, in the EV may be used for the heating of the cabin. Moreover, energy efficiency could be dramatically improved by operating the vapor compression cycle as a heat pump in winter, effectively giving much-improved range for the EV in cold ambient conditions. In the other operational mode, the heat exchanger 1 may serve as a condenser. The condenser in which the refrigerant changes phase from vapor to liquid, so that cooling of the cabin in hot ambient is possible.

[0049] The heat exchanger 1 may comprise, inter alia, a first manifold 100 and a second manifold 200. The manifolds 100, 200 may be spaced apart from each other, wherein the second manifold 200 may substantially parallel with respect to the first manifold 100. It is to be noted that the term manifold 100, 200 may refer to different configurations. In the first configuration, the manifolds 100, 200 may be in form of unitary elements. They may comprise baffles within their structure for directing the flow of the refrigerant within the heat exchanger. In the second configuration, the manifolds 100, 200 may be regarded as two groups of sub-components, each group comprising smaller manifold units which do not form the unitary element. A group of such smaller manifolds arranged in the vicinity of each-other are still to be regarded as the first manifold 100 and/or second manifold 200, respectively.

[0050] The manifolds 100, 200 may comprise a header with plurality of slots, and a cover configured to be fixed to the header, so that the channel for the fluid is formed within the manifold 100, 200. The open ends of the manifolds 100, 200 may be closed by closure caps, however, other means of closing the manifolds 100, 200 are also envisaged. In case the first fluid is of high pressure, such as supercritical fluid, the manifolds 100, 200 may formed in the process of extrusion or metal casting. This allows the manifolds 100, 200 to withstand high operating pressure of the first fluid.

[0051] The heat exchanger 1 may further comprise a plurality of flat tubes 300 stacked between the first manifold 100 and the second manifold 200. The term "flat tubes" refers mainly to the general shape of the tubes in which each tube comprises two longer parallel walls connected on its longer sides by two shorter walls. It is to be noted, that the flat tubes 300 may refer both to folded tubes, and to extruded tubes.

[0052] The plurality of flat tubes 300 (or simply: the tubes 300) may be configured to provide the fluidal communication between the first manifold 100 and the second manifold 200. The tubes 300 are configured to be inserted into the slots formed in the headers of respective manifolds 100, 200.

[0053] The heat exchanger 1 may further comprise bottle 400. The direr means (or simply: bottle 400 may be fixed to one of the manifolds 100, 200. The bottle 400 is required mainly if the heat exchanger 1 in operating in the condenser mode.

[0054] The bottle 400 may by fluidly connected to the first manifold 100, it means that the bottle 400 comprise at least one passage 401 for the first fluid, so that it can be transferred form one area of the manifold 100 to the other.

[0055] Fig. 4 further shows a schematic view of the standalone heat exchanger with 3 blocks, similar to the heat exchanger depicted in Fig.3.

[0056] As already discussed, the heat exchanger 1 may comprise the plurality of flat tubes 300. The heat exchanger may comprise one or more paths for the first fluid within the tubes. The paths may differ in the hydraulic diameter and the intended first fluid flow direction. Therefore, the tubes 300 may comprise a first pass 310, a second pass 320, and at least one third pass 330. The term pass refers to one or more consecutive tubes in which the first fluid may flow in the same direction.

[0057] In one of the examples of the heat exchanger, the first pass 310 may be located between the second pass 320 and the third pass 330. However, other configurations of the passes are also envisaged.

[0058] In order to provide a sufficient flow of the first fluid through the respective passes 310, 320, 330, the first manifold 100 may comprise a first section 101 fluidly connected with at least the first pass 310. Similarly, the first manifold 100 may comprise a second section 102 fluidly connected with at least second pass 320 and at least one third section 103 fluidly connected with at least third section 303.

[0059] Analogically to the first manifold 100, the second manifold 200 may comprise a fourth section 201 fluidly connected with at least the first pass 310, a fifth section 202 fluidly connected with at least second pass 320 and at least one sixth section 203 fluidly connected with at least third pass 330. It is to be noted that the sections 101, 102, 103 of the first manifold 100 may be directly fluidly connected with each other, as well as the sections 201, 202, 203 of the second manifold 200.

[0060] The heat exchanger may comprise a means of introducing the first fluid into the heat exchanger 1, as well as means of exiting thereof.

[0061] The heat exchanger 1 may comprises a first block 10 a second block 20, and a second block 30. The first block 10 may be fixed to the first manifold 100. The second block 200 may also be fixed to the first manifold 100. The third block 30 may be fixed to the second manifold 200. It is to be noted, that the term "block" refers to any means which allow fluid flow into or out of the heat exchanger 1 via respective openings in the manifolds 100, 200. For example, the blocks 10, 20, 30 may be connector blocks, as shown in the figures, yet other variants of blocks 10, 20, 30 such as, for example, tubes brazed directly to the manifolds 100, 200 are also envisaged.

[0062] In the preferred configuration, the first and second blocks 10, 20 may be fluidly connected to the first manifold 100, whereas at least one third block 30 may be fluidly connected to the second manifold 200.

[0063] The present configuration allows to operate the heat exchanger 1 both in the heat pump mode, as well as in condenser mode. It is to be noted that the inlet for both heat pump and condenser modes is common, i.e. the first fluid flows in the same direction, from the first block 10 to the fist manifold 100.

[0064] Such integration of operational modes into one heat exchanger 1 allows to decrease the overall cost of the heat exchanger.

[0065] Figs. 5 and 6 and 7 show the schematic view of the heat exchanger 1 according to the operational mode thereof. Unlike in Figs 1 and 2, there is no need to distinguish said modes by the color of the arrows since they are depicted in separate Figures and denoted by reference signs. Thus, it is to be noted that the medium flowing through the heat exchanger 1 in one mode may be of different properties than the same medium flowing in the other operational mode of the heat exchanger 1.

[0066] In view of the operational modes discussed in previous paragraphs, the heat exchanger 1 may further comprise a first circuit 1000 for the first fluid. The first circuit 1000, as well as a second circuit 2000 described in further paragraphs, are indicated by respective arrows showing the intended first fluid flow direction within the heat exchanger 1.

[0067] The first circuit 1000 may comprise, inter alia, the first block 10 the first section 101, the first pass 310, a fourth section 201, the fifth section 202, the second pass 320, the second section 102 and the second block 20. The sequence of fluidal communication and the intended first fluid flow direction may be regarded as the same as described in the present paragraph.

[0068] In other words, the first circuit 1000 comprises sub-components which allow the heat exchanger 1 to operate in a heat pump mode. As the heat exchanger 1 is configured to operate in a heat pump mode, the first fluid leaving the heat exchanger 1 through the second block 20 is of the same phase as the first fluid entering the heat exchanger 1 through the first block 10.

[0069] It is noticeable, that the bottle 400 do not form a part of the first circuit 1000 despite the fluidal communication between the second section 102 and said bottle 400. The heat exchanger 1 operating in the heat pump mode is configured to block the passage for the first fluid, so that it flows directly to the second block 20. This may be achieved in several ways. One of the solutions may comprise a valve (not shown) located between the direr means 400 and the second section 102. The valve may be closed to block the passage for the fluid and as consequence, force the first fluid to flow directly towards the second block 20.

[0070] Alternatively, the same valve may be located between the bottle 400 and the first section 101. The valve may be closed to block the passage for the first fluid forcing it to fill the volume of the bottle and, as the consequence, force the first fluid to flow directly towards the second block 20. The valve located anywhere in the bottle 400 is also envisaged, as long as it does not impede the overall performance of the heat exchanger 1.

[0071] In the drawings, the areas of the heat exchanger 1 through which the first fluid is stopped from flowing have been marked with two angular lines crossing each other in the middle. This indicates lack of flow through these sub-components.

[0072] Last but not least, the valve may be located after the first fluid exits the heat exchanger 1, i.e. between the third block 30 and the refrigerant loop (not shown). The valve may be closed to block the passage for the first fluid forcing it to fill the volume of the third block 30, the volume of the third pass 330, the volume of the bottle 400 and, as the consequence, force the first fluid to flow directly towards the second block 20.

[0073] It is to be noted, that the blocks 10, 20, 30 may comprise the valves integrated into their structure or, as an alternative, the valves may be located between the block 10, 20, 30 and its respective section 101, 102, 201. Other means of stopping the first fluid flow giving the same effect as aforementioned valves are also envisaged.

[0074] In the second operational mode of the heat exchanger, i.e. when the heat exchanger 1 is intended to operate as condenser, the heat exchanger 1 may comprise the second circuit 2000 for the first fluid.

[0075] Referring to Figs 6 and 7, the second circuit 2000 may comprise, inter alia: the first block 10, the first section 101, 310 first pass, the fourth section 201, the fifth section 202, the second pass 320, the bottle 400, the second section 102, the third pass 330, the sixth section 203 and the third block 30. The sequence of fluidal communication and the intended first fluid flow direction may be regarded as the same as described in the present paragraph.

[0076] Generally, if the heat exchanger 1 is configured to operate in a condenser mode, the first fluid leaving the heat exchanger 1 through the third block 30 is of different phase than the first fluid entering the heat exchanger 1 through the first block 10. This is not necessarily the case when the heat exchanger 1 is intended to operate in the heat pump mode. In the heat pump mode, the bottle 400 is not required. Therefore the flow of the first fluid through said bottle generates undesired pressure losses which may impact the overall efficiency of the heat exchanger 1. Therefore, forcing the fluid directly into the second block 20 mitigates undesired effects in this mode.

[0077] Moreover, the inlet for the first fluid, i.e. the first block 10 is common for the first circuit 1000 and the second circuit 2000. This further allows to optimize the flow within the heat exchanger 1.

[0078] Further, as the first fluid may fill the volumes of the third pass 330 and the bottle 400, the heat exchanger 1 is ready for operation when switching from the heat pump to condenser mode, i.e. form the first circuit 1000 to the second circuit 2000.

[0079] Analogically, when the heat exchanger 1 is intended to operate in the condenser mode, the second block 20 may block the passage for the first fluid, so that it flows directly to the bottle 400, and further towards the third pass 330 and the third block 30. The means of blocking the fluid flow are the same as already discusses, i.e. the valve (not shown) may be located after the first fluid exits the heat exchanger 1 through the second block 20, i.e. between the second block 20 and the refrigerant loop (not shown). The valve may be closed to block the passage for the first fluid forcing it towards the fluidal connection between the second section 102 and the bottle 400.

[0080] In case the heat exchanger 1 is intended to operate in the condenser mode, the plurality of flat tubes 300 may comprise at least one insulating means 301. The insulating means 301 may be located in-between any of the tubes 300, however it is desired that said insulating means are located between the first pass 310 and the third pass 330. The third pass 330 in the condenser mode comprises the first fluid having significantly lower temperature than the first fluid that has just entered the heat exchanger 1 and flows through the first pass 310, thus blocking the heat transfer between these passes may significantly increase the overall efficiency of the heat exchanger 1. In other words, the third pass 330 may operate as so-called subcooling section of the heat exchanger 1 operating in condenser mode.

[0081] The insulating means 301 may be carried out in several ways. For example, the insulating means may be in form of insulating material located in-between the tubes 300 which partially blocks the heat transfer. However, this solution may have many drawbacks related to feasibility and costs.

[0082] The more feasible insulating means 301 may comprise at least one tube of the plurality of tubes 300, through which flows no fluid. This is achieved by blocking the fluid flow either on the open ends of said tubes, or by implementing baffles blocking the flow, wherein said baffles are located in the respective manifolds 100, 200. These tubes are commonly known as "dead tubes".

[0083] An orientation of the heat exchanger 1 may vary depending on its location in the motor vehicle. As already discussed, the common location of the heat exchanger 1 is in front of the vehicle, just behind the front bumper, wherein the front of the vehicle should be regarded as the side of the vehicle which is leads the vehicle during its forward movement. The orientation of the heat exchanger 1 depicted in the figures may be regarded as its nominal position, i.e. the most common one. Thus, the directions, such as up and down refer to the direction normal to ground surface. The orientations of the heat exchanger 1 which is different than the nominal one are also envisaged. The heat exchanger 1 may be inclined with respect to its nominal orientation as long as it does not impede its performance.

[0084] Accordingly, the first block 10 may located in the lower half of the first section 101. It means that the fist block 10 is located at the half of the first section 101 being closer to ground level.

[0085] The second block 20 may be located at the higher level than the first block 10, the level being measured along an axis of elongation of the manifolds 100,200.

[0086] The second block 20 may be located in the lower half of the second section 102. It means that the second block 20 may be located at the half of the first section 101 being further to ground level.

[0087] The third block 30 may be located substantially in the middle of the sixth section 203, preferably in the lower half of the sixth section 203. It means that the third block 30 may be located at the median part of the sixth section 203, or at the lower half of the sixth section 203, being further to ground level.

[0088] Further, the third block 30 may located at the level lower than the first block 10 and the second block 20, the level being measured along an axis of elongation of the manifolds 100,200. It means, that the third block 30 may be located closest to the ground level.

[0089] It should be noted that the above-mentioned relative orientations may change if, for example, the heat exchanger 1 is flipped upside-down, thus relative orientations of sub-components should not be regarded as limiting.

[0090] In general, one manifold 100 may comprise greater number of blocks 10, 20, 30 than the other manifold 200. However, an embodiment wherein the number of blocks per manifold are equal, or wherein the second manifold 200 comprises more blocks 10, 20, 30 than the first manifold 100.

[0091] Fig. 7 refers to and embodiment in which all blocks 10, 20, 30 are located on the same manifold 100. The third pass 330 may comprise a secondary third pass 330' which may also be referred to as the fourth pass 340. The first manifold 100 may further comprises a seventh section 104, and the second manifold 200 may further comprise an eight section 204 fluidly connected with the sixth section 203, so that the tubes 300 connecting said sections 104, 204 forms a fourth pass 340 for the first fluid. It is to be noted that the fourth pass 340 was achieved by dividing the third section 330. From the functional point of view, the fourth pass 340 should still be regarded as part of the third section 330 since it belongs to sub-cooling section of the heat exchanger 1. In this configuration the heat exchanger 1 has additional subcooling section which may increase the efficiency of the heat exchanger, thus the secondary third pass 330' is to be implemented in case a need to improve the heat exchanger's efficiency in condenser mode.

[0092] Additionally, the third block is fluidly connected with the seventh section 104. As presented in Fig. 7, this allows the third block 30 to be located on the same side of the heat exchanger 1 as the first block 10 and the second block 20, i.e. on the first manifold 100.

[0093] Referring to Fig. 8, the heat exchanger may comprise additional second pass 320 for the fluid. It is to be noted that said additional pass may be created by dividing the second pass 320 into two parts. Accordingly the heat exchanger may comprise a secondary second pass 320' fluidly connected with a seventh section 102' formed on the first manifold 100, and an eight section 202' formed on the second manifold 200. Consequently, the third block 30 may be fluidly connected with the third section 103, so that the third block 30 is located on the same side as the first block 10 and the second block 20.

[0094] This also allows the third block 30 to be located on the same side of the heat exchanger 1 as the first block 10 and the second block 20, i.e. on the first manifold 100.

[0095] As shown in Figs 1 to 9, in one of the variants of the heat exchanger 1, at least one the block 10, 20, 30 may be fixed to the outermost portion of respective manifold 100, 200, so that said block 10, 20, 30 is substantially coplanar with the tubes 300. The outermost portion of the manifold should be regarded as a portion or wall of the manifold 100, 200 shifted furthest from the central part of the plurality of the flat tubes 300.

[0096] Alternatively, as shown in Figs 9 and 10, the heat exchanger 1 may comprise at least one block 10, 20, 30 which is fixed to the respective manifold 100, 200, so that said block 10, 20, 30 is at an angle with respect to the general plane of the tubes 300. In such embodiment, the block is not fixed to the outermost portion of manifold 100, 200. The angular position of the block 10, 20, 30 may be measured with respect to the general plane formed by the stacked plurality of tubes 300. The block 10, 20, 30 may be aligned at an angle ranging from 90 to 180 degrees with respect to the general plane of the tubes 300, wherein at 180 degrees, the block is located at the outermost portion of the manifold 100, 200.

[0097] Alternatively, the block 10, 20, 30, may be formed as an L-shaped portion, so that the bottle 400 is in consequence shifter away from the general pane formed by the plurality of stacked tubes 300.

[0098] As shown in all respective figures from 3 to 9, the bottle 400 may comprise a substantially tubular body 410 closed on both sides. The closure may be removable or non-removable, depending on the preferences. Further, the bottle 400 may comprise at least one first bottle opening 402 configured to enable the first fluid flow into tubular body 410 and at least one second bottle opening 403 configured to enable first fluid exit the tubular body 410. The bottle 400 may be also known as a -bottle.

[0099] The bottle 400 may be fixed to the respective connector 411, 412, by means of a screw, or by brazing.

[0100] Accordingly, the bottle 400 may comprise a first connector 411 configured to provide a fluidal communication between the first opening 402 and the first manifold 100, and a second connector 412 configured to provide a fluidal communication between the second opening 403 and the first manifold 100. It should be noted, that the connectors 411, 412 may be fixed to the outermost portion of the manifold 100, 200, however, an angular positions of the connectors 411, 412 are also envisaged, wherein the angles of the connectors 411, 412 should be measured analogically to the angle of the blocks 10, 20, 30.

[0101] Fig. 10 shows the perspective view of the heat exchanger comprising a jumper line 500.

[0102] The heat exchanger may comprise at least one jumper line 500 extending between the connectors 411, 412. The jumper line 500 may comprise a channel which is fluidly connected with said connectors 411, 412. Jumper line 500 allows the first fluid to at least partially bypass the bottle 400, so that the fluidal communication between the second pass 320 and the third pass 330 is provided.

[0103] In an alternative embodiment which is not shown in the figures, the direr means 400 are integrated into the first manifold 100. Integrated means that distinguishing the bottle 400 from the manifold 100 is difficult or impossible. In other words, the bottle 400 integrated into the manifold 100 may look like one sub-component, without visible distinctive features between one and the other. Despite this fact, both the bottle 400 and the manifold 100 serve their intended purpose. This embodiment however is not preferred one, due to complexity of the integrated bottle.

[0104] The tubes 300 may comprise passes, 310, 320, 330. Each pass 310, 320, 330 may comprise an equal number of tubes. Alternatively, each pass may comprise different number of tubes, as shown in the figures.

[0105] As consequence, the first pass 310 may be at least twice the size of the third pass 330. Preferably, the first pass 310 is triple the size of the third pass 330. The size may be measured as the number of tubes 300 forming each pass 310, 330.

[0106] Similarly, the second pass 320 may be between 1,5 to 2,0 times the size of the first pass 310, the size being measured as the number of tubes 300 forming each pass 310, 320.

[0107] The heat exchanger 1 may be included in the refrigerant loop of the motor vehicle. A system 3000 (not shown) for a motor vehicle comprising such heat exchanger may be configured as evaporator for refrigerant or as a condenser for refrigerant. It is to be noted that it is the same heat exchanger unit, but operating differently, depending on the actual mode.

[0108] Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of drawings, the disclosure, and the appended claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to the advantage.

Claims

1. A heat exchanger (1) for heat exchange between a first fluid and a second fluid comprising: a first manifold (100) and a second manifold (200) spaced apart from the first manifold (100), wherein the second manifold (200) is substantially parallel with respect to the first manifold(100), a plurality of flat tubes (300) stacked between the first manifold (100) and the second manifold (200), the plurality of flat tubes (300) being configured to provide the fluidal communication between the first manifold (100) and the second manifold (200), a bottle (400) fluidly connected to the first manifold (100), the bottle (400) comprising at least one passage (401) for the fluid, wherein the heat exchanger (1) comprises a first block (10) and a second block (20), both first and second blocks (10, 20) being fluidly connected to the first manifold (100), and at least one third block (30) fluidly connected to the first manifold (100) or the second manifold (200).

2. The heat exchanger (1) according to claim 1, wherein the plurality of flat tubes (300) further comprises a first pass (310), at least one second pass (320), and at least one third pass (330), wherein the first pass (310) is located between the second pass (320) and the third pass (330).

3. The heat exchanger (1) according to claim 2, wherein the first manifold (100) comprises a first section (101) fluidly connected with at least the first pass (310), at least one second section (102) fluidly connected with at least second pass (320) and at least one third section (103) fluidly connected with at least third section (303).

4. The heat exchanger (1) according to any of claims 2 or 3, wherein the second manifold (200) comprises a fourth section (201) fluidly connected with at least the first pass (310), at least one fifth section (202) fluidly connected with at least second pass (320) and at least one sixth section (203) fluidly connected with at least third pass (330).

5. The heat exchanger (1) according to any of the preceding claims, wherein the heat exchanger (1) further comprises: a first circuit (1000) for the first fluid comprising: a first block (10) a first section (101), the first pass (310), the fourth section (201), the fifth section (202), the second pass (320), the second section (102) and the second block (20).

6. The heat exchanger (1) according to the preceding claim, wherein the heat exchanger (1) is configured to operate in a heat pump mode, wherein the first fluid leaving the heat exchanger (1) through the second block (20) is of the same phase as the first fluid entering the heat exchanger (1) through the first block (10).

7. The heat exchanger (1) according to any of claims 5 to 6, wherein the bottle (400) blocks the passage for the first fluid, so that it flows directly to the second block (20).

8. The heat exchanger (1) according to any of the preceding claims, wherein the heat exchanger (1) further comprises: a second circuit (2000) for the first fluid comprising: a first block (10) a first section (101), a first pass (310), the fourth section (201), the fifth section (202), the second pass (320), the bottle (400), the second section (102), the third pass (330), the sixth section (203) and the third block (30).

9. The heat exchanger (1) according to the preceding claim, wherein the heat exchanger (1) is configured to operate in a condenser mode, wherein the first fluid leaving the heat exchanger (1) through the third block (30) is of different phase than the first fluid entering the heat exchanger (1) through the first block (10).

10. The heat exchanger (1) according to any of claims 8 to 9, wherein the second block (20) blocks the passage for the first fluid, so that it flows directly to the bottle (400).

11. The heat exchanger (1) according to any of the preceding claims, wherein the first manifold (100) further comprises a seventh section (104), and the second manifold (200) comprises an eight section (204) fluidly connected with the sixth section (203), so that the tubes (300) connecting said sections (104, 204) forms a fourth pass (340) for the first fluid.

12. The heat exchanger (1) according to any of the preceding claims comprising a secondary third pass (330’) fluidly connected with a seventh section (104) formed on the first manifold (100), and an eight section (204) formed on the second manifold (200).

13. The heat exchanger (1) according to any of the preceding claims comprising a secondary second pass (320’) fluidly connected with a seventh section (102’) formed on the first manifold (100), and an eight section (202’) formed on the second manifold (200).

14. A system (3000) for a motor vehicle comprising at least one heat exchanger (1), wherein the heat exchanger is configured as evaporator for refrigerant.

15. A system (3000) for a motor vehicle comprising at least one heat exchanger (1), wherein the heat exchanger is configured as condenser for refrigerant.

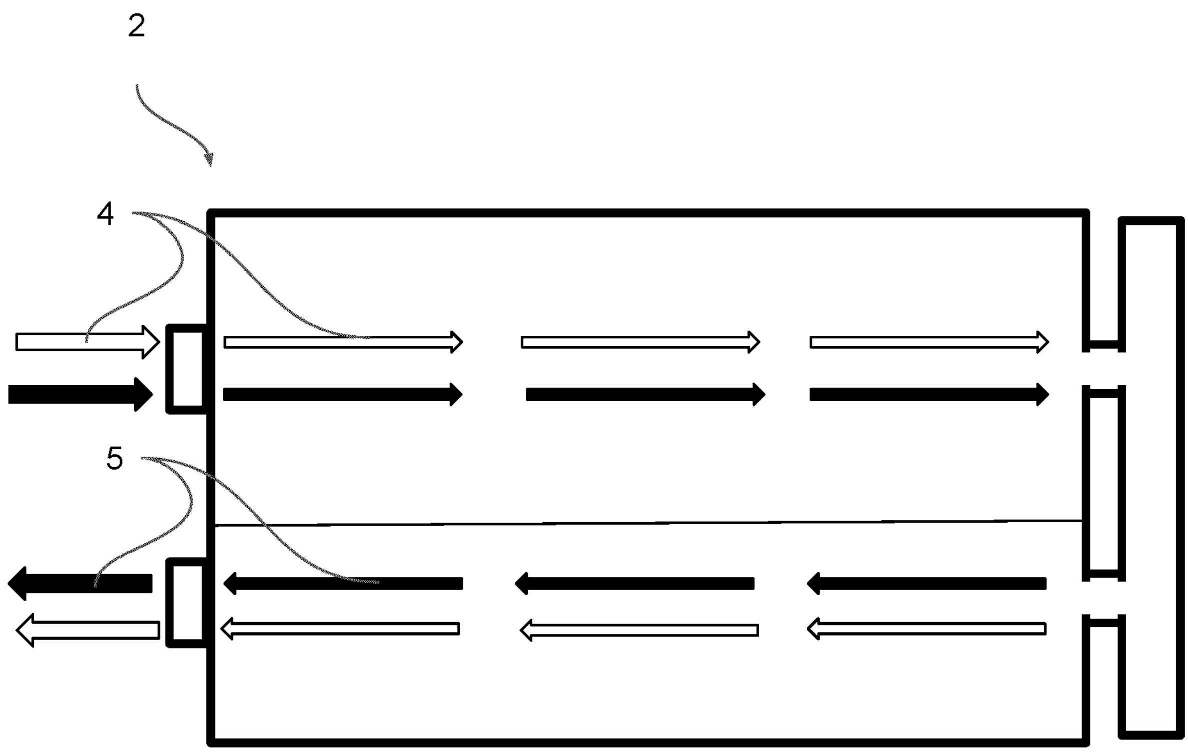


Fig. 1
(Prior art)

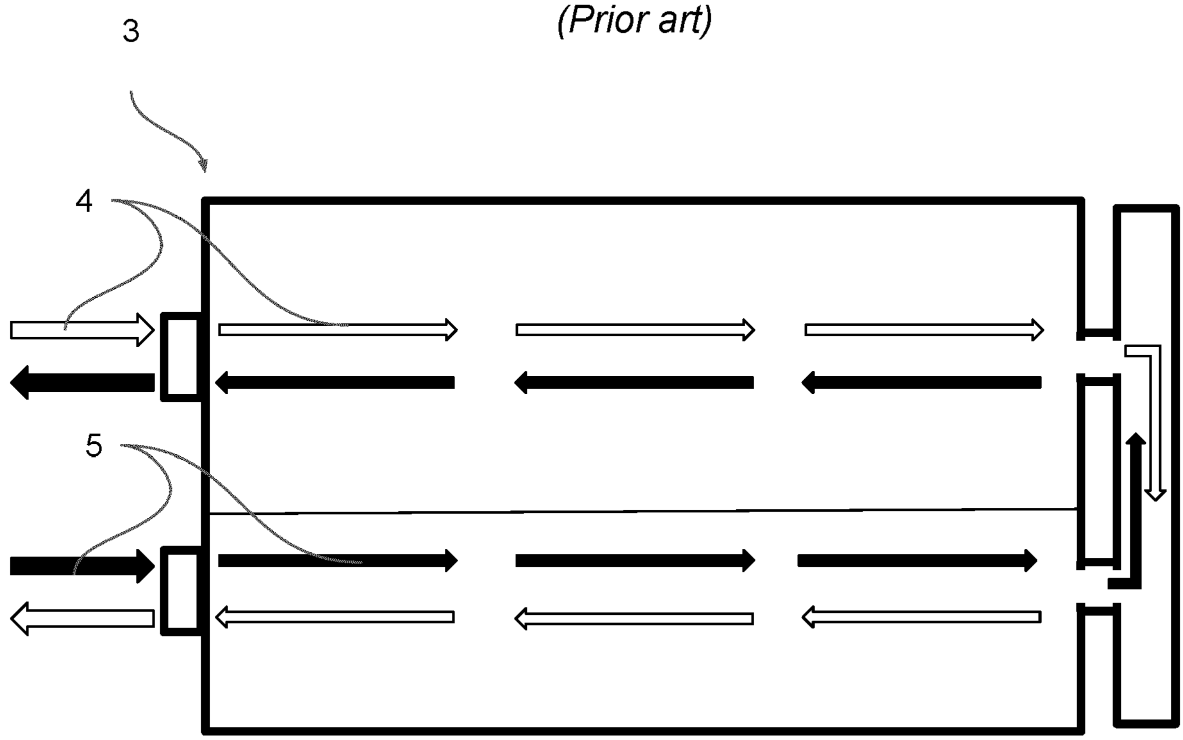


Fig. 2

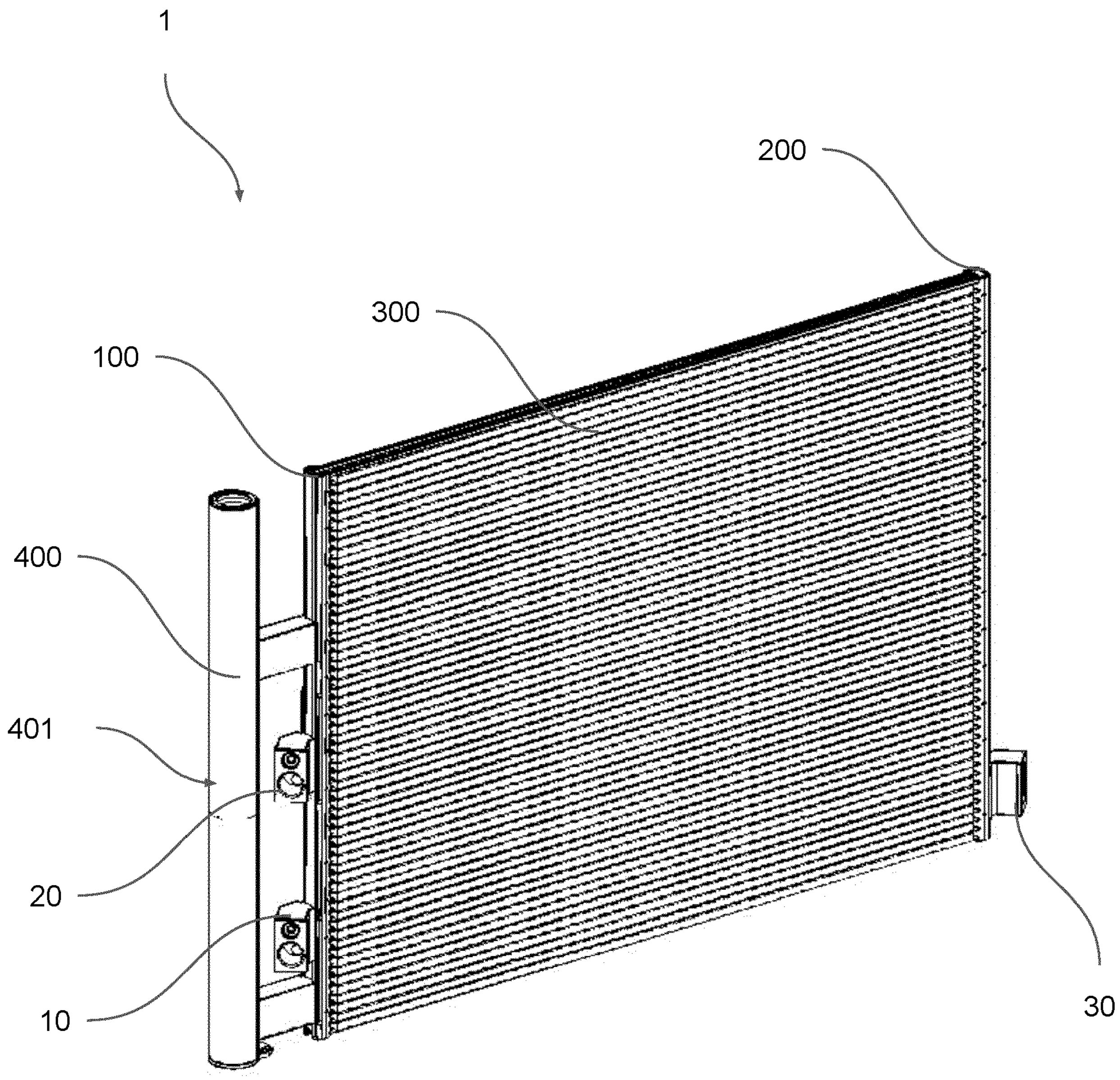


Fig. 3

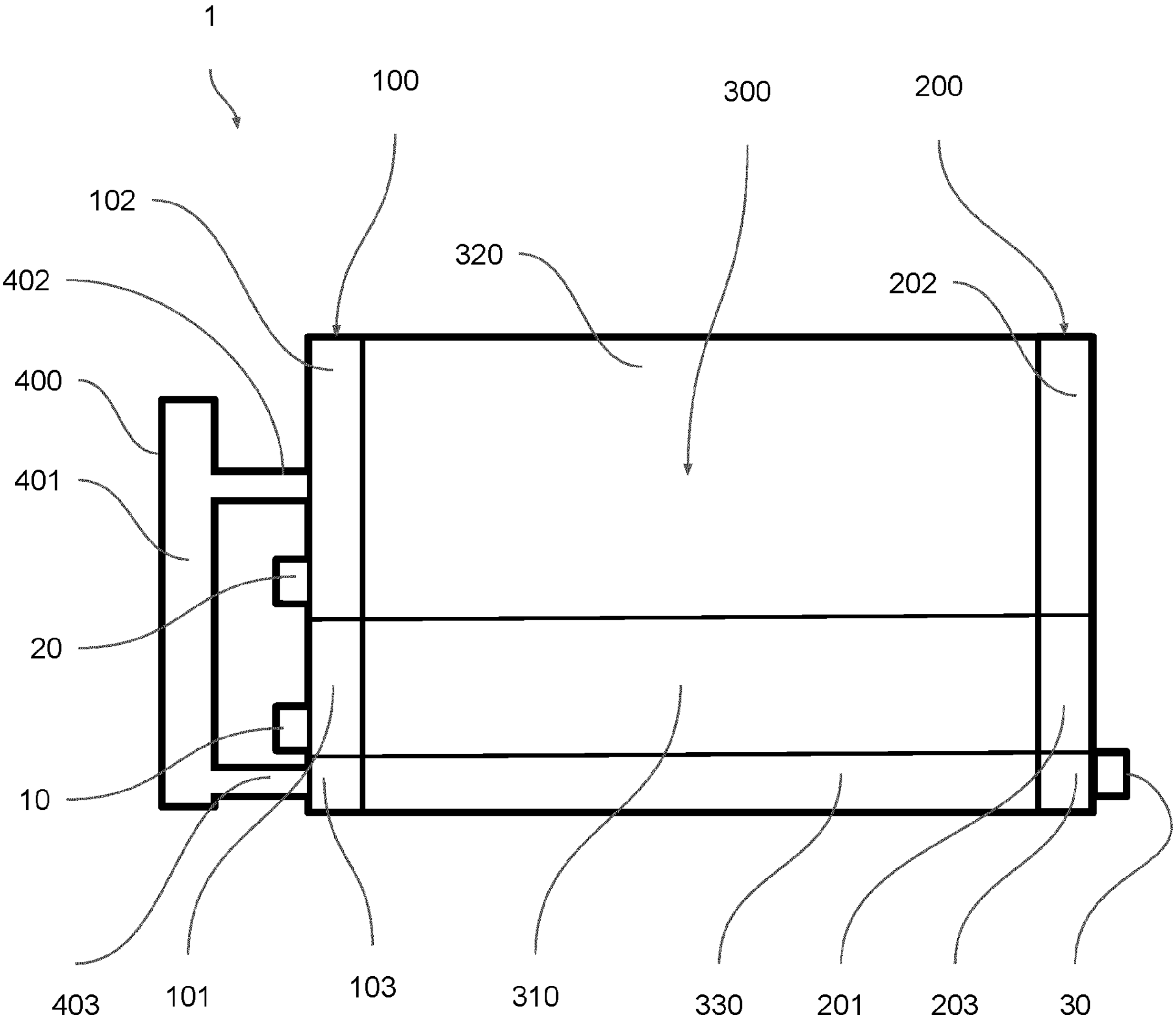
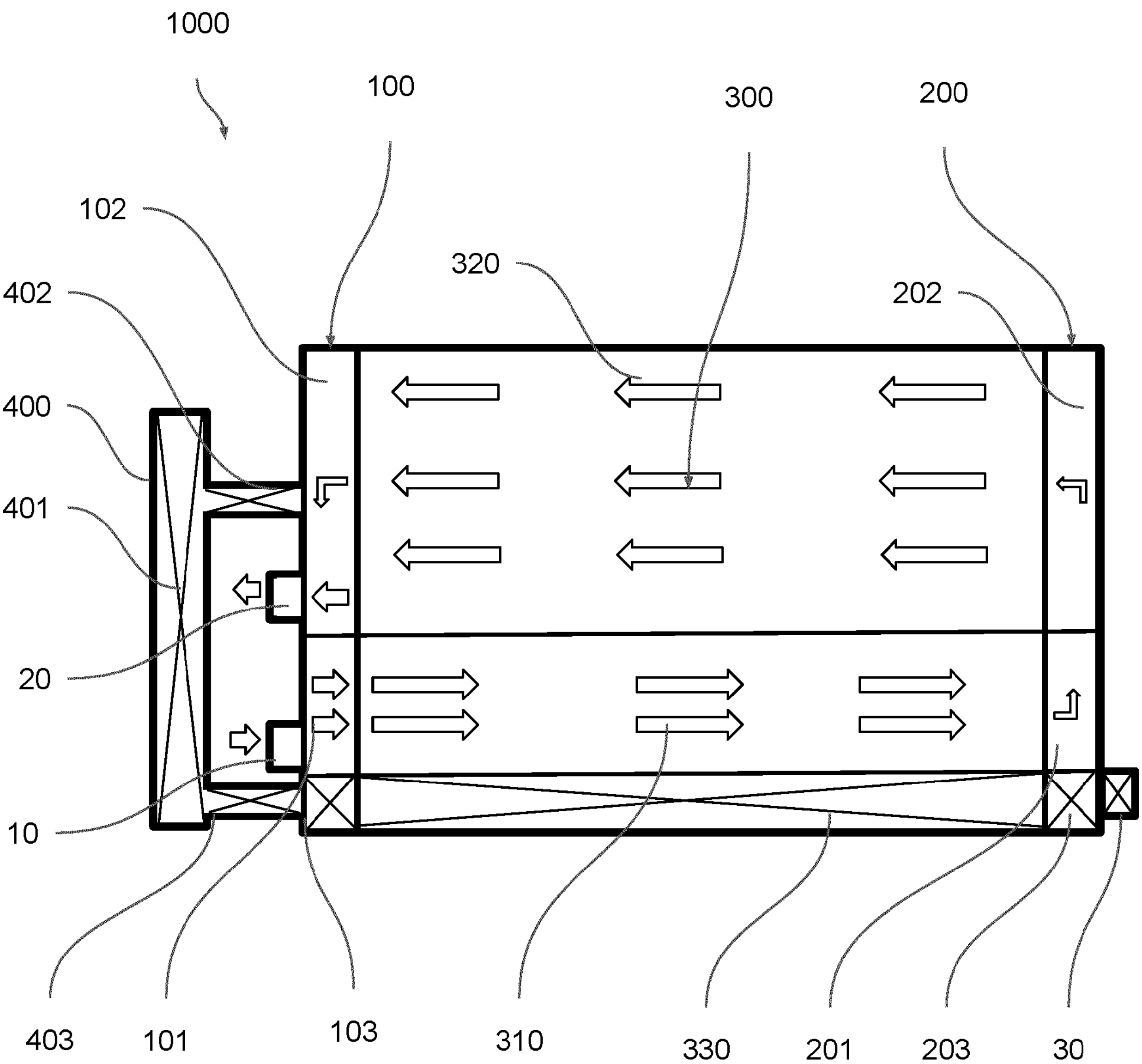

1
100
300
200
102
320
402
202
400
401
20
10
403
101
103
310
330
201
203
30

Fig. 4


1000
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30

Fig. 5

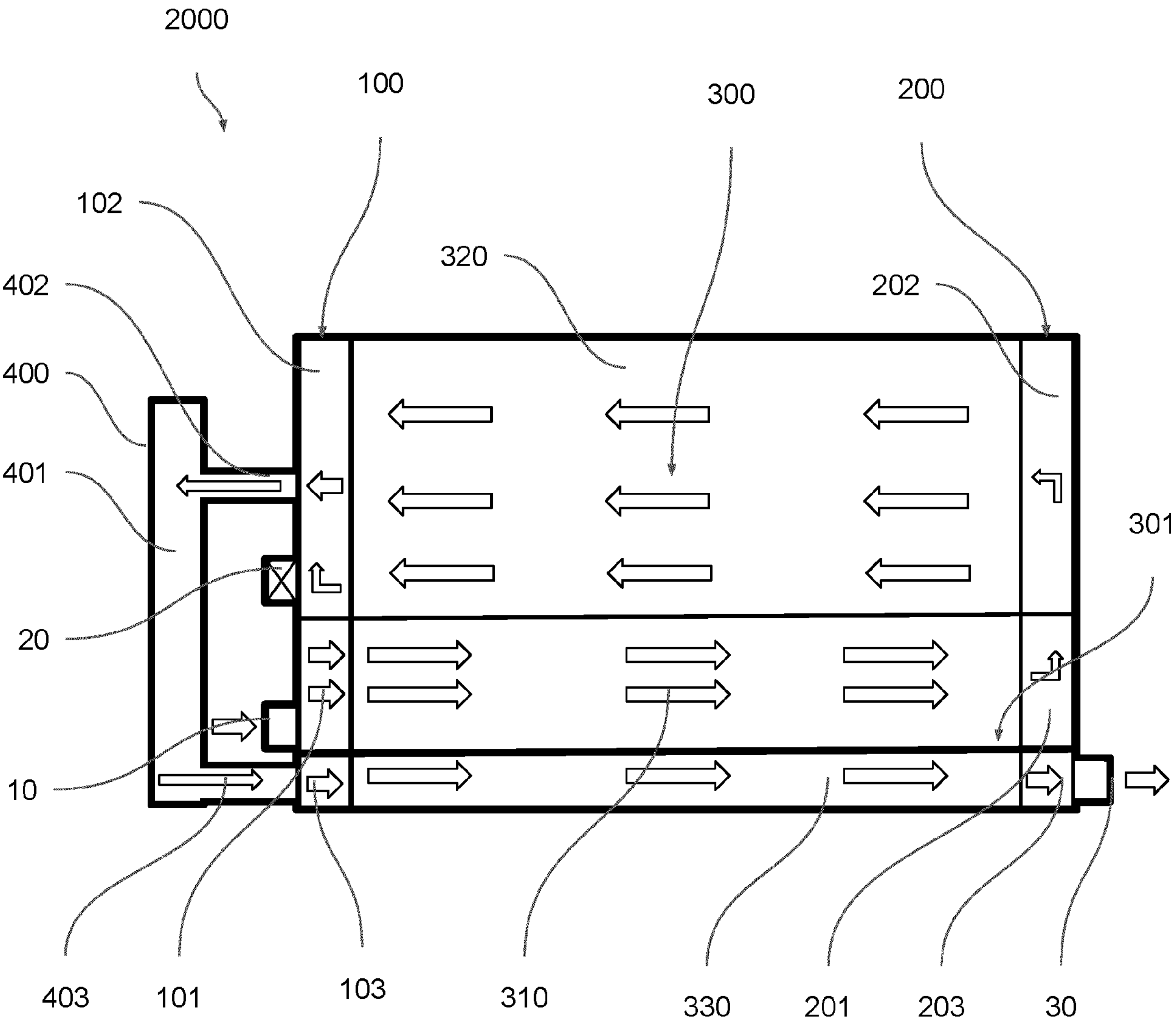
2000
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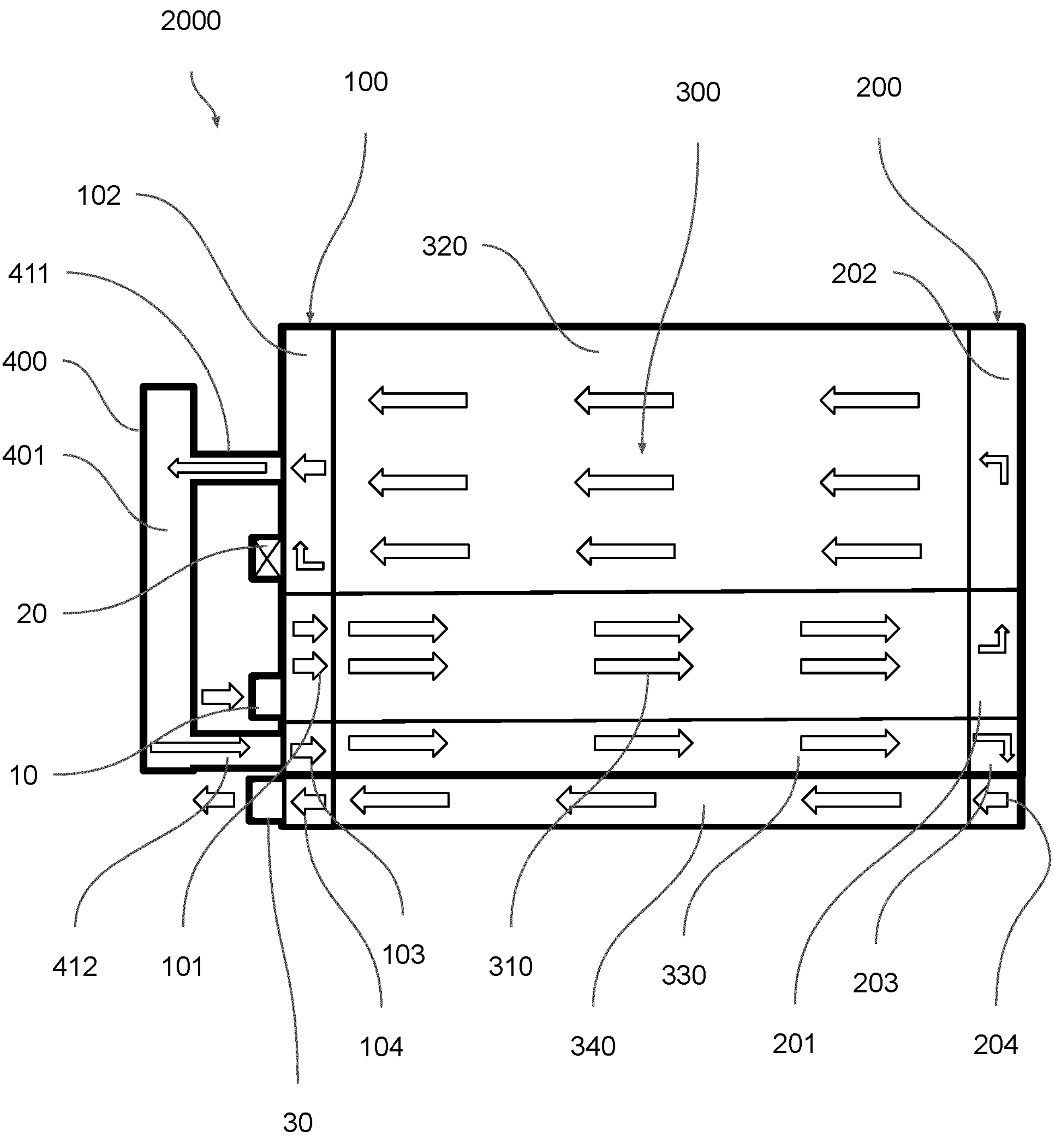
Fig. 6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320
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20
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412
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330
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104
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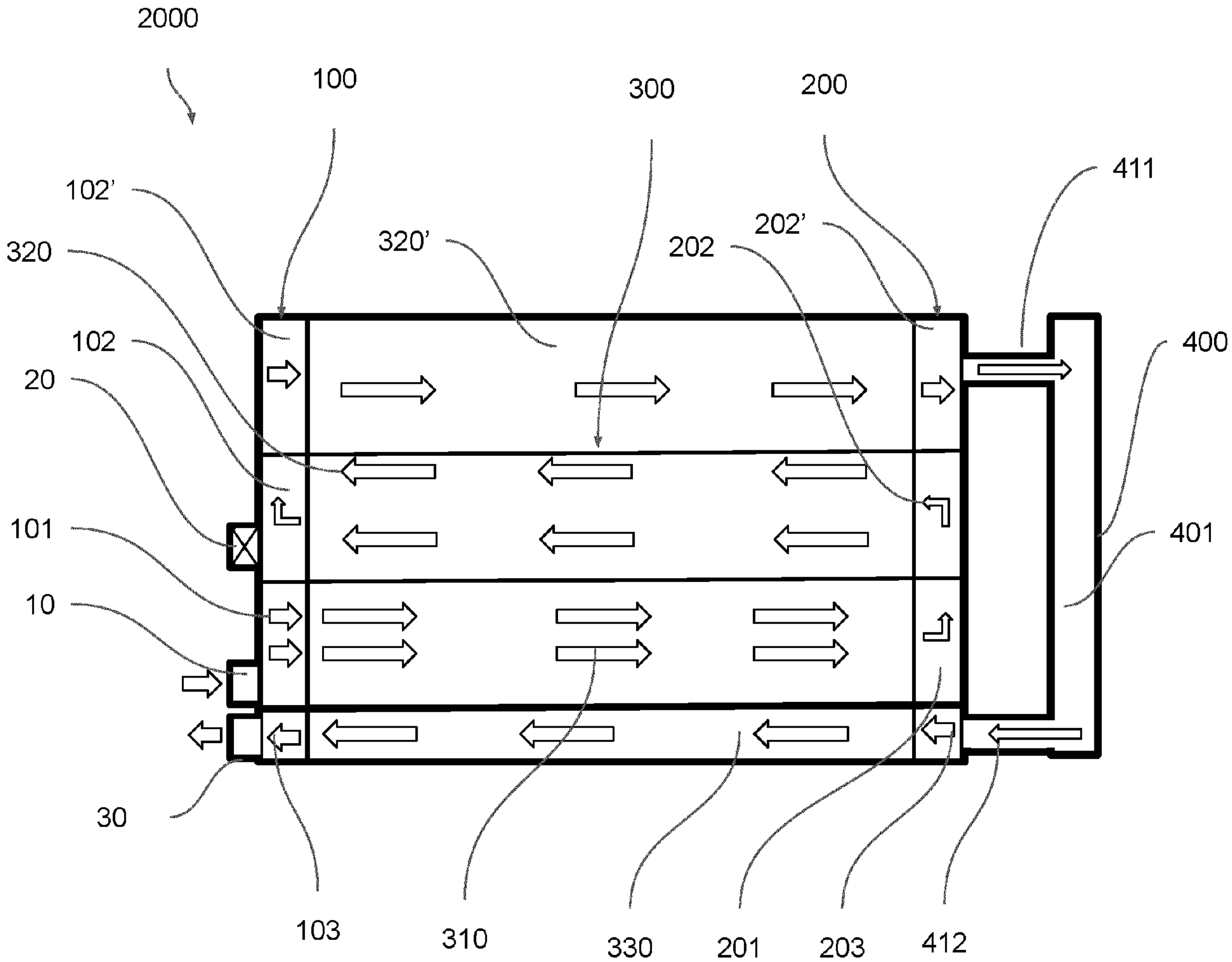
30

Fig. 7


2000
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411
102'
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20
101
401
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310
330
201
203
412

Fig. 8

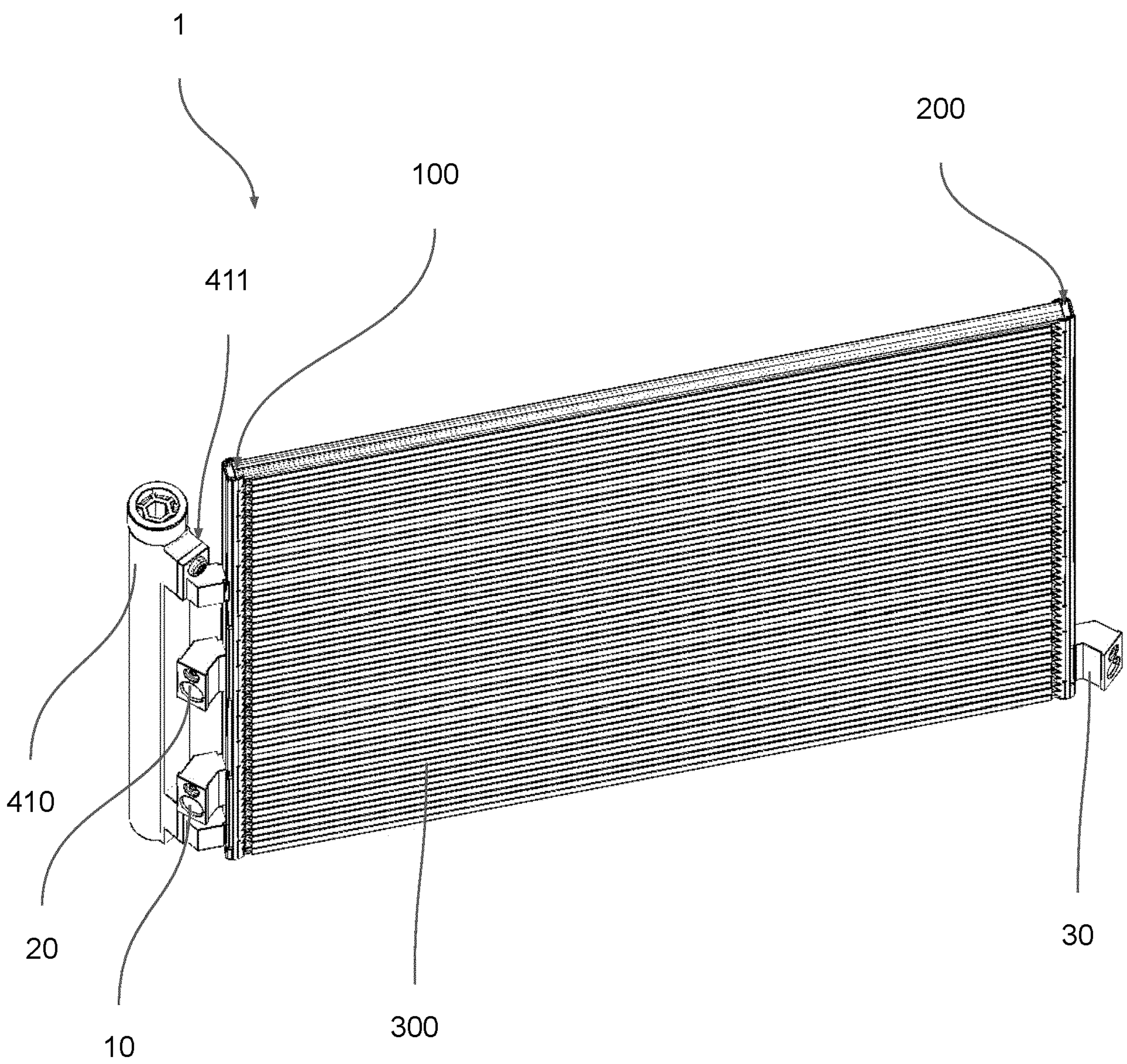

Fig. 9

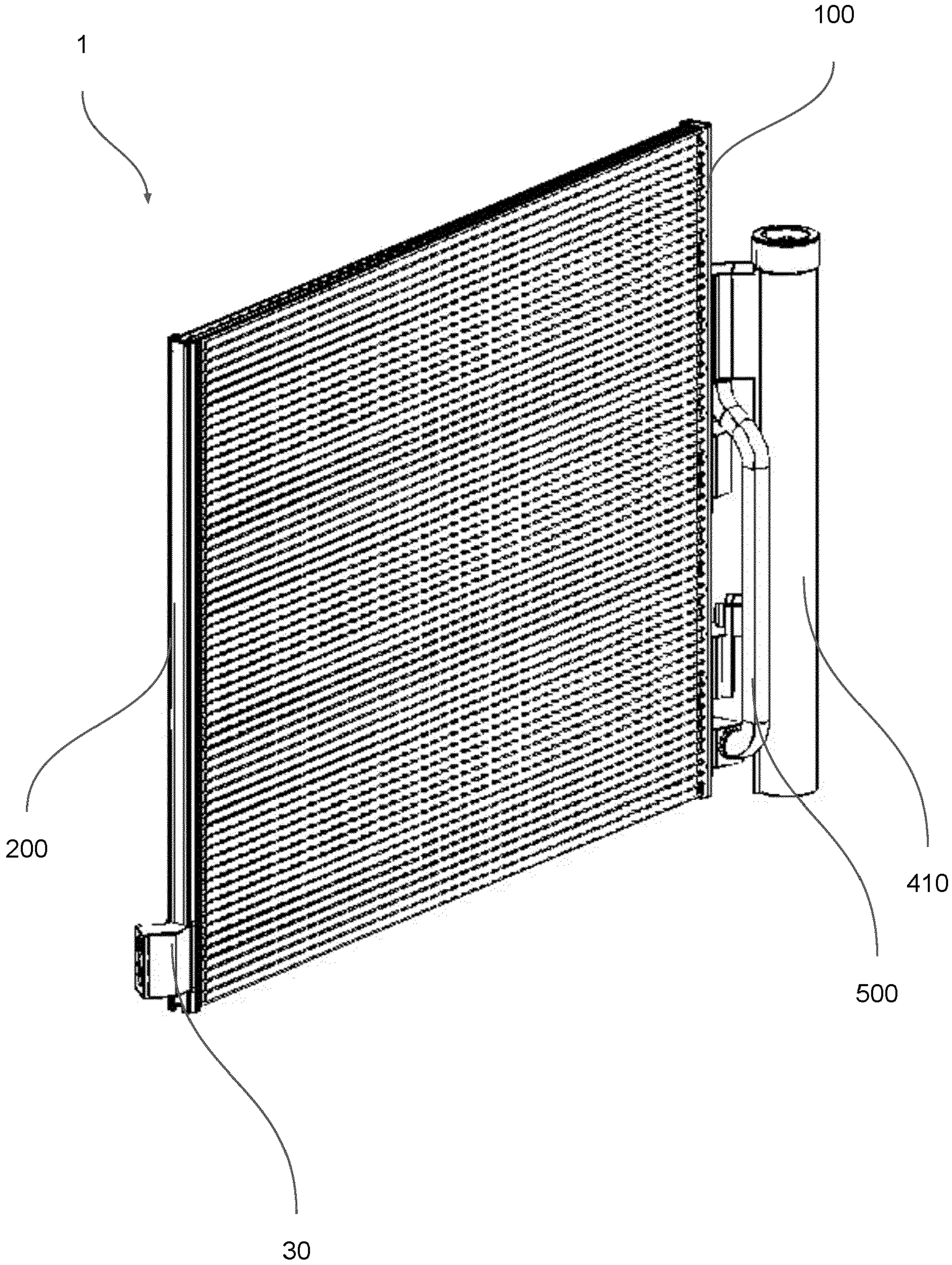

Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 22 20 3388

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	US 2011/272130 A1 (YAMAZAKI MAKOTO [JP]) 10 November 2011 (2011-11-10) * paragraphs [0102] - [0130]; figures 1-8 * -----	1-15	INV. F28D1/053 F28D7/16 F28F9/02
X	US 5 884 503 A (INABA HIROYUKI [JP]) 23 March 1999 (1999-03-23) * column 4, line 50 - column 9, line 11; figures 1, 5 * -----	1-15	
X	US 2007/062215 A1 (YAMAZAKI HIDEKAZU [JP] ET AL) 22 March 2007 (2007-03-22) * paragraphs [0040] - [0045]; figure 1 * -----	1-15	
X	US 5 901 573 A (KOBAYASHI HIDEO [JP]) 11 May 1999 (1999-05-11) * column 10, line 30 - column 13, line 67; figure 7 * -----	1-15	
X	JP 2013 002774 A (SHARP KK) 7 January 2013 (2013-01-07) * paragraphs [0047] - [0053]; figure 5 * -----	1-15	TECHNICAL FIELDS SEARCHED (IPC) F28D F28F

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	6 March 2023	Axters, Michael

CATEGORY OF CITED DOCUMENTS

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06-03-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011272130 A1	10-11-2011	JP 5324378 B2	23-10-2013
		JP 2010105656 A	13-05-2010
		US 2011272130 A1	10-11-2011
		WO 2010038672 A1	08-04-2010
US 5884503 A	23-03-1999	JP H10122705 A	15-05-1998
		US 5884503 A	23-03-1999
		US 6052899 A	25-04-2000
US 2007062215 A1	22-03-2007	CN 1936486 A	28-03-2007
		JP 4782520 B2	28-09-2011
		JP 2007085616 A	05-04-2007
		US 2007062215 A1	22-03-2007
US 5901573 A	11-05-1999	KR 970028267 A	24-06-1997
		US 5901573 A	11-05-1999
JP 2013002774 A	07-01-2013	NONE	

EPO FORM P0459

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