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(54) Heat exchanger, especially a condenser

(57) The invention relates to a heat exchanger between a first fluid and a second fluid, said heat exchanger comprising a core (1) made of stacked plates (3) defining flow passages for said first fluid and said second fluid to have both fluids exchanging heat, said heat exchanger further comprising a receiver (11) for said first fluid, said heat exchanger being configured so that said first fluid flows successively through a first zone (13) of the core, said receiver (11) and a second zone (15) of the core, said receiver (11) being located on a same side (17) of the core than ports through which said first and/or second fluids enter and/or exit said core.

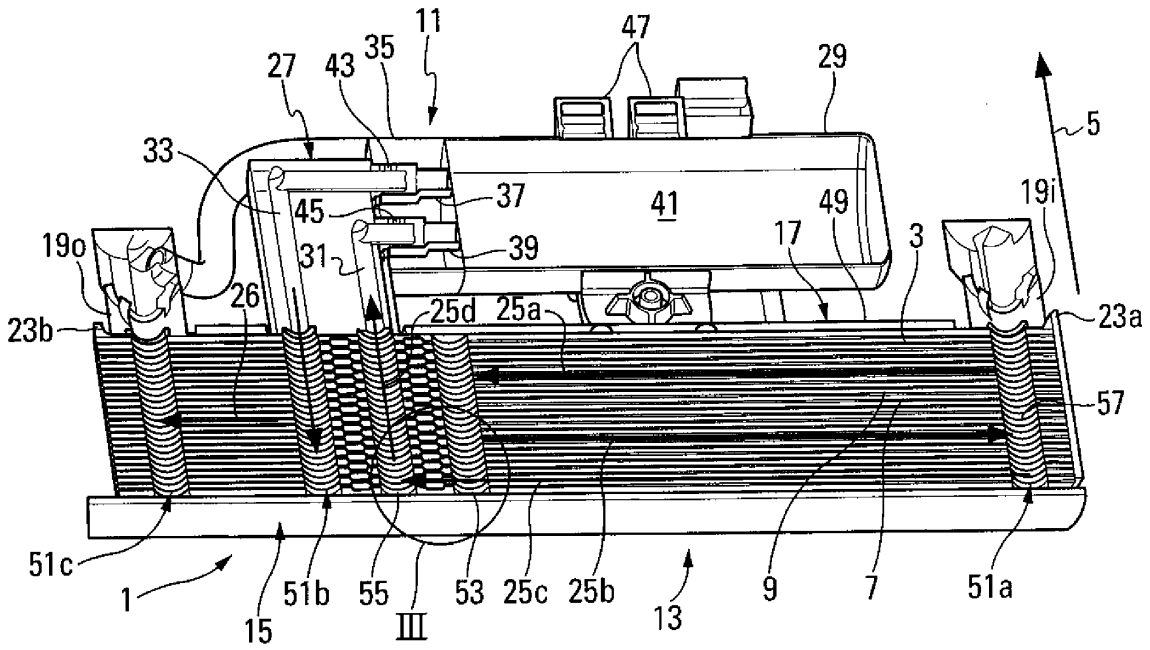

Fig. 1

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Description

[0001] The invention relates to a heat exchanger, especially a condenser. While being developed to be used in an air conditioning unit of an automotive vehicle, it shall not be limited thereto.

[0002] In automotive applications, it is widely used condensers located in a vehicle front end. They are made of a core comprising tubes and fins located between the tubes. They provide a heat exchange between a refrigerant fluid flowing in the tubes and an air flow flowing through the fins. The core is generally provided with a condensing portion and a sub cooling portion in which the refrigerant fluid flows coming from a receiver attached to the core.

[0003] It is also known condensers comprising two cores made of plates stacked along a stacking direction, said plates alternatively defining passages for the refrigerant fluid and a cooling liquid to have both fluids exchanging heat. The condensing portion and the sub cooling portions are defined by a corresponding number of plates. The solutions already proposed to integrate a receiver in such condensers can be improved.

[0004] The invention proposes in that view a heat exchanger between a first fluid and a second fluid, said heat exchanger comprising a core made of stacked plates defining flow passages for said first fluid and said second fluid to have both fluids exchanging heat, said heat exchanger further comprising a receiver for said first fluid, said heat exchanger being configured so that said first fluid flows successively through a first zone of the core, said receiver and a second zone of the core, said receiver being located on a same side of the core than ports through which said first and/or second fluids enter and/or exit said core.

[0005] Thanks to such location of the receiver only one core of stacked plates can be used instead of two in the prior art while the size of the receiver is not limited by the number of plates. Moreover, thanks to the location of the ports and the receiver on the same side of the core, the integration of the heat exchanger in its environment is optimised.

[0006] According to various features of the invention which can be taken together or separately:

- said ports comprise a first fluid inlet, a first fluid outlet, a second fluid inlet and a second fluid outlet,
- said inlets and outlets are all located on said core side,
- the receiver extends in parallel to said core side,
- said ports are located at the proximity of opposite edges of said core side,
- said receiver is located between said ports,
- said receiver comprises a socket attached to said core side and a bottle attached to said socket, said socket being configured to let the first fluid flow from said first zone to said bottle and from said bottle to said second zone,
- said socket is fixedly attached to the core,
- said bottle is attached in a removable way to said socket,
- said heat exchanger further comprise a bracket configured to attach said bottle to said core,
- said bracket is located in a median area of said bottle along a longitudinal axis of said bottle,
- said heat exchanger further comprises a reinforcing plate on said core side,
- said reinforcing plate has an opening trough which said receiver is attached to said core side,
- said bracket is attached to said reinforcing plate,
- said core defines one or several passes for said first fluid in said first zone, said passes being configured so that said first fluid flows successively from one pass to the other while changing of direction between each pass,
- the number of said passes is odd,
- said first zone comprises a header for said first fluid being configured to let said first fluid flow from said first zone to said receiver.
- said first zone comprises a first header for said first fluid and a second header for said first fluid, said first header for said first fluid being configured to let said first fluid flow in each first fluid passage, said second header for said first fluid being configured to let said first fluid flow from said first zone to said receiver,
- said first zone further comprises a by-pass between said first and second headers for the first fluid to create a passage there trough for said first fluid,
- one of said stacked plates, called bottom plate, is on a side of said core located opposite to said core side on which said receiver and said ports are located,
- said bottom plate and another plate of said stacked plates adjacent to said bottom plate in said stacking direction defining one of said first fluid passages,
- said by-pass is located between said bottom plate and said another plate,
- said bottom plates comprises embossed portions oriented opposite to said another plate, in the area of said by pass,
- said bottom plates comprises dimples in contact with said another plate, in the area of said by pass,
- a final plate of said stacked plates situated on a side of said core located opposite to said core side on which said receiver and said ports are located, especially said bottom plate, is thicker than the other plates of said stacked plates,
- said first and second zones have common second fluid passages,
- said first and second zones have separate second fluid passages.

[0007] According to an aspect of the invention, said heat exchanger is configured to allow a heat exchange between a refrigerant fluid as said first fluid and a coolant liquid as said second fluid. More precisely, said heat exchanger is advantageously configured to be a condenser.

[0008] Other characteristics and advantages of the invention will appear in the description which follows and which refers to a detailed embodiment thereof, in reference to the figures in which, respectively:

- figure 1 is a longitudinal cut in a perspective view of a first embodiment of a heat exchanger according to the invention,
- figure 2 is a perspective view of the heat exchanger of figure 1, especially showing a top side thereof,
- figure 3 is a perspective view of the heat exchanger of figure 1 showing more in detail an area illustrated III in figure 1,
- figure 4 is a bottom view, of a first kind of plates of the heat exchanger of figure 1,
- figure 5 is a bottom view of a second kind of plates of the heat exchanger of figure 1,
- figure 6 is a bottom view, of a third kind of plates of the heat exchanger of figure 1,
- figure 7 is a bottom view of a forth kind of plates of the heat exchanger of figure 1,
- figure 8 is perspective view from below of a bottom plate of the heat exchanger of figure 1, in a first embodiment,
- figure 9 is perspective view from below of a bottom plate of the heat exchanger of figure 1, in another embodiment,
- figure 10 is a longitudinal cut in a perspective view of a variant of a heat exchanger according to the invention,
- figures 11a and 11b are bottom views illustrating a pair of plates of the heat exchanger of figure 10.

[0009] According to figures 1, the invention relates to a heat exchanger between a first fluid and a second fluid, especially a condenser for an air conditioning unit, more especially for automotive applications.

[0010] Said first fluid is for instance a refrigerant fluid, as the fluids known under R134a or R1234yf. The heat exchanger is configured to have it enter under gaseous phase and exit under liquid phase. The second fluid is for instance a cooling liquid as water added with some anti freeze like glycol. In other words, the cooling liquid may be a mixture of water and glycol.

[0011] Said heat exchanger comprises a core 1 made of plates 3 stacked along a stacking direction 5 to define flow passages for said first fluid and said second fluid to have both fluids exchanging heat. In a preferred embodiment, a same plate 3 defines a passage 7 for the first fluid together with one of the adjoining plate 3 and a passage 9 for the second fluid with the other adjoining plate 3. In other words, passages 7 for the first fluid and passages 9 for the second fluid alternate. Said core 1 has here a parallelepipedic shape.

[0012] Said plates 3 are for instance obtained by stamping a laminated plate of metal, especially aluminium and/or an aluminium alloy.

[0013] Said heat exchanger further comprises a receiver 11 for said first fluid. In case of a condenser said receiver 11 aims at separating the part of said refrigerant fluid potentially still in an gaseous phase from the part in liquid phase to let only said liquid phase part flow downstream. It may also aim at filtering and/or drying said refrigerant fluid

[0014] As far as the first fluid is concerned, said receiver 11 is connected upstream with a first zone 13 of the core and downstream with a second zone 15 of the core. In other words, said heat exchanger is configured so that said first fluid flows successively through said first zone 13 of the core, said receiver 11 and said second zone 15 of the core.

[0015] Thanks to the invention, two different zones, more precisely a condensing zone and a subcooling zone in case of a condenser, are defined by the same single core 1.

[0016] As can be better seen on figure 3, the receiver is advantageously located on a same side of the core, here a top side 17, than ports through which said first and/or second fluids enter and/or exit said core.

[0017] The invention thus gives the possibility to obtain a high degree of integration together with the use of a receiver which is easy to manufacture.

[0018] Said ports comprise a first fluid inlet 19i, a first fluid outlet 19o, a second fluid inlet 21i and a second fluid outlet 21o, said inlets and outlets all being located on said top side 17. Said inlets and outlets 19i, 19o, 21 i, 21 o are located, for instance, at the proximity of opposite edges 23a, 23b of said top side 17, here at the vicinity of top side corners. Said first fluid inlet 19i and said first fluid outlet 19o are here located on a same longitudinal edge 23c of said top side 17 while said second fluid inlet 21i and said second fluid outlet 21o are located on the opposite longitudinal edge 23d of said top side 17.

[0019] The first fluid enters the core 1 trough said first fluid inlet 19i as show by 25i. It flows trough the first zone 13 as shown by 25a to 25d (figure 1). It flows then through the receiver 11 and comes back to the core 1 where it flows through said second zone 15 as shown by 26 (figure 1). It exits finally said core 1 through said first fluid outlet 19o as shown by 25o.

[0020] In a first embodiment, as shown, the second fluid enters the core 1 through said first fluid inlet 21i as shown by 22i and directly flows through the core to said second fluid outlet 21 o where it exits the core as shown by 22o.

[0021] In a variant, not shown, two different second fluid circuits are used. A first circuit for the first zone 13 and a second circuit for the second zone 15. In such a case, two additional second fluid ports are used, advantageously on the same top side 17 as the others.

[0022] The receiver 11 extends advantageously in parallel to said core side. Said receiver 11 is located here between said ports 19, 21. As a consequence, depending of the length hence available for the receiver, its transversal section will be adapted to match the desired volume. Thanks to such feature, the ports 19, 21 can be

more easily accessed.

[0023] Said receiver 11 comprises, for instance, a socket 27 fixedly attached to said top side 17 and a bottle 29 attached in a removable way to said socket 27.

[0024] Going back to figure 1, said socket 27 is configured to let the first fluid flow from said first zone 13 to said bottle 29, through a first channel 31, and from said bottle 29 to said second zone 15, through a second channel 33. Said socket 27 extends perpendicularly to said top side 17 and said bottle extends in parallel to said top side 17. Said socket 27 is advantageously brazed to the core 1, for instance one shot.

[0025] Said bottle 29 comprises a base 35 provided with two tubular passages 37, 39 for the first fluid, opening on an interior volume 41 of said bottle 29. Said tubular passages 37, 39 match with corresponding flanges 43, 45 of the socket 27 through which said first and second channels 31, 33 communicates with said bottle 29.

[0026] Said heat exchanger may further comprise a bracket 47 configured to attach said bottle 29 to said core 1. Said bracket 47 is here located in a median area of said bottle 29 along a longitudinal axis of said bottle. Said bracket 47 has for instance a ring shape. Said ring is designed to be open to allow the introduction of said bottle 29 and closed to attach the bottle to the core 1, said bracket having a radial projection to be fixed to the core 1.

[0027] Said heat exchanger may further comprise a reinforcing plate 49 on said top side 17. Said reinforcing plate 49 has here an opening 51 (figure 3) trough which said receiver 11 is attached to said top side 17. Said bracket 47 is attached to said reinforcing plate 49.

[0028] Said core advantageously defines several passes, here three passes 25a, 25b, 25c, for said first fluid in said first zone 13. Said passes 25a, 25b, 25 are configured so that said first fluid flows successively from one pass to the other while changing of direction between each pass. Such kind of circulation of first fluid enhance heat exchange while limiting pressure drop, especially when the number of passages allocated to each pass decrease from one pass to other along the first fluid flow, as far as the first zone 12 is a condensing zone for said first fluid.

[0029] Preferrably, the number of said passes is odd to optimize the relative location of the receivier 11 and the first fluid inlet 19i.

[0030] Said heat exchanger comprises here headers to have said first fluid flowing from one of said passage for the first fluid to the next passage for the first fluid and said second fluid flowing from one of said passage for the second fluid to the next passage for the second fluid. Each header is managed through the plates 3. More precisely, the first zone 13 comprises a first fluid inlet header 51 a connected to said first fluid inlet 19i and a second fluid outlet header (not shown) connected to said second fluid outlet 21o. The second zone 15 comprises a first fluid inlet header 51 b connected to the receiver 11, a first fluid outlet header 51 c connected to said first fluid outlet 19o and a second fluid inlet header (not shown) connected to said second fluid inlet 21 i. The first zone first fluid inlet header 51a, the second zone first fluid outlet header 51c and the second fluid inlet and outlet headers are located here along lateral edges of the core 1, in parallel to said stacking direction 5.

[0031] The first zone 13 comprises two further headers 53, 55 for the purpose of the multi pass circulation. A first 53 of said further headers for said first fluid is configured to let said first fluid flow in each first fluid passage. A second 55 of said further headers for said first fluid is configured to let said first fluid flow from said first zone 13 to said receiver 11. Said first header 53 is located in the first zone between said first fluid inlet header 51a and said second header 55.

[0032] The first fluid inlet header 51 and the first header 53 comprise baffles 57. Said baffles are located within each header 51 a, 53 to generate said mutli pass circulation thanks to an offset between the location of the first header baffles and the first fluid inlet header baffle.

[0033] As can be better seen on figure 3 and as will be more detailed below, said first zone further 13 comprises a by-pass 59 between said first and second headers 53, 55. Said by-pass 59 generates a passage there trough for said first fluid.

[0034] Coming now to figures 4 to 7, said plates 3 may be of rectangular shape. Said plates 3 comprise for instance a rising edge, defining with a bottom of said plate a volume in which said fluids flow. The plates are joined, for instance brazed, by said rising edges.

[0035] The plates 3 are used by pair. A first kind of pairs corresponds to the plates shown in figure 4 and 5 which are suitable for creating the pass 25a. A second kind of pairs corresponds to the plate shown in figure 6 which is to be used with a plate like the plate of figure 5 which are suitable for creating the pass 25b. A third kind of pairs correspond to the plate shown in figure 7 which is also to be used with a plate like the plate shows in figure 5 for creating the pass 25c.

[0036] In each pair, a first plate 3 is provided with a first linear embossed area 65 configured to match a first plane area 67 of a second plate 3 of the same pair. Said first linear embossed area 65 and said first plane area 67 separates the first and second zones 13, 15 as far as the first fluid is concerned. It therefore extends from one longitudinal side of the plates to the other. A second linear embossed portion 66 is provided in the first plate to match a second plane area 68 of the second plate. Said second linear embossed area 66 and said second plane area 68 separates an area of the first zone where the first fluid multi pass circulation occurs and an area of the first zone where the first fluid flow through said second header 55 to the receiver 11.

[0037] Said second zone 15 is also the same for each kind of pairs. The plates 3 comprise two holes 69b, 69c for the first fluid, respectively corresponding to said second zone first fluid inlet header 51b and said first fluid outlet header 51c. They comprise a third hole 71i corresponding to said second fluid inlet header. In the second

plate of each pair the holes 69b, 69c for the first fluid are located in an embossed area 69b', 69c' designed to match with a plane area 69b", 69c" of the other plate of the same pair. Oppositely, said other plate is provided with an embossed area 71i' designed to match with a plane area 71 i" provided on the second plate. In other words, the holes of the embossed portion of one of said plate are in communication with the holes provided in the flat portion of the bottom of one of the adjoining plate. As a consequence, a passage for the first fluid is defined between the plates of the pair and a passage is defined for the second fluid between the adjoining plates of two different pairs.

[0038] Said first zone 13 is different from one kind of pair to the other. In figures 4 and 5, the plates 3 comprise three holes 69a, 73, 75 for the first fluid, respectively corresponding to said first zone first fluid inlet header 51a, said first header 53 and said second header 55. They comprise a fourth hole 71 o corresponding to said second fluid outlet header. In the second plate of each pair the holes 69a, 73, 75 for the first fluid are located in an embossed area 69a', 73', 75' designed to match with a plane area 69a", 73",75" of the other plate of the same pair. Oppositely, said other plate is provided with an embossed area 71o' designed to match with a plane area 71o" provided on the second plate. In other words, as above, the holes of the embossed portion of one of said plate are in communication with the holes provided in the flat portion of the bottom of one of the adjoining plate. As a consequence, a passage for the first fluid is defined between the plates of the pair and a passage is defined for the second fluid between the adjoining plates of two different pairs.

[0039] In figure 6 the plate differs from the plates of figure 4 in that the embossed area 69a' corresponding to the first zone first fluid inlet header 51a is not provided with any hole thereby creating a baffle 57 as mentioned above. In the embodiment shown on the figure, the core 1 comprises one such plate.

[0040] In figure 7 the plates differs from the plates of figure 4 in that the embossed area 73' corresponding to the first header 53 is not provided with any hole thereby creating a baffle 57 too. In the embodiment shown on the figures, the core 1 comprises two such plates. One of them corresponds to the baffle 57 shown in figure 3.

[0041] It can hence be understood that such baffles 57 are integral with the plates 3.

[0042] The circulation of the second fluid here does not depend of the kind of pair of plates. For all of them, a same kind of passage is defined guiding the second fluid from the second fluid inlet header to the second fluid outlet header.

[0043] The plates 3 are here further provided with corrugations 77located between the embossed and plane areas to create turbulations in the fluids and/or joining points between the plates 3.

[0044] In a variant as shown in figure 10, the first zone 13 of the heat exchanger defines a 1-pass configuration. It here obtained by using pairs of plates 3 corresponding to the plates shown in figures 11a and 11b.

[0045] In comparison with the 3-passes condensing part of the heat exchanger shown in figure 1, the 1-pass condensing part of figure 10 does not contain the first header 53. The first header 53 being removed, its function is achieved by a header 54 also having the function of the second header 55 which is to say let the first fluid flow from said first zone 13 to said receiver 11. Consequently, the plates 3 don't comprise any second linear embossed area or any corresponding second plane area. There is also no need for a by-pass between first and second headers and after one pass of the first fluid into the first zone 13, the fluid flows only through the header 54 which is in fluid communication with the inlet of the socket 27.

[0046] The other features of the heat exchanger are similar to those of the previous embodiment, especially as regards the receiver 11, the ports 19i, 19o and the core 1 including the first fluid headers 51a, 51b, 51c, the second fluid headers, not shown, the first linear embossed area 65 and its corresponding plane area 67 as well as the holes 100 made in plane areas 110 or embossed areas 120 of the plates 3 to separately generate first and second fluids flows. Corrugations 77 can also be used in such variant.

[0047] Going back to figure 3, one 3b of said stacked plates, called bottom plate, is on a side 79 of said core located opposite to said core side 17 on which said receiver 11 and said ports are located. Said bottom plate 3b and another plate of said stacked plates adjacent to said bottom plate in said stacking direction 5 defines here one of said first fluid passage. In a variant, such last passage can be a second fluid passage.

[0048] In the embodiment where the last passage is a first fluid passage, said by-pass 59 is located between said bottom plate 3b and its adjacent plate 3 in the area located between said first and second headers 73, 75.

[0049] In the embodiment provided figure 8, the bottom plate 3b is plane except for a linear embossed portion 81 corresponding to the first linear embossed area 65 of the first plate of each pair of the core. In other words, said linear embossed portion 81 is provided to define said first zone 13 and said second zone 15 within said last passage.

[0050] Another embossed portion 83 is provided to match the adjacent plate 3 in order to close the second fluid outlet.

[0051] In the embodiment of figure 9, said bottom plates 3b comprises a further embossed portion 85 oriented opposite to said adjacent plate 3 to enlarge said by pass 59 and/or direct the first fluid flowing through said last passage toward said by pass 59. Dimples 87 in contact with said adjacent plate 3 may also be provided in the area of said further embossed portion 85 provided on said bottom plate 3b. Such features increase the resistance to internal pressure between said bottom plate 3b and its adjacent plate 3. In the same purpose the bot-

tom plate 3b may be thicker than the other plates 3 of said stacked plates.

Claims

1. Heat exchanger between a first fluid and a second fluid, said heat exchanger comprising a core (1) made of stacked plates (3) defining flow passages for said first fluid and said second fluid to have both fluids exchanging heat, said heat exchanger further comprising a receiver (11) for said first fluid, said heat exchanger being configured so that said first fluid flows successively through a first zone (13) of the core, said receiver (11) and a second zone (15) of the core, said receiver (11) being located on a same side (17) of the core than ports through which said first and/or second fluids enter and/or exit said core.

2. Heat exchanger according to claim 1 wherein said ports comprise a first fluid inlet (19i), a first fluid outlet (19o), a second fluid inlet (21 i) and a second fluid outlet (21o), said inlets and outlets all being located on said core side (17).

3. Heat exchanger according to any preceding claims wherein the receiver (11) extends in parallel to said core side (17).

4. Heat exchanger according to any preceding claims wherein said ports are located at the proximity of opposite edges (23a, 23b) of said core side and said receiver (11) is located between said ports.

5. Heat exchanger according to any preceding claims wherein said receiver (11) comprises a socket (27) fixedly attached to said core side (17) and a bottle (29) attached in a removable way to said socket (27), said socket (27) being configured to let the first fluid flow from said first zone (13) to said bottle (29) and from said bottle (29) to said second zone (15).

6. Heat exchanger according to claim 5 further comprising a bracket (47) configured to attach said bottle (29) to said core.

7. Heat exchanger according to any preceding claims further comprising a reinforcing plate (49) on said core side.

8. Heat exchanger according to any preceding claims wherein said core (1) defines at least one pass (25a) for said first fluid in said first zone (13),.

9. Heat exchanger according to claim 8 wherein said first zone (13) comprises a header (54) for said first fluid being configured to let said first fluid flow from said first zone to said receiver.

10. Heat exchanger according to claim 8 wherein said core (1) defines several passes (25a, 25b, 25c) for said first fluid in said first zone (13), said passes (25a, 25b, 25c) being configured so that said first fluid flows successively from one pass to the other while changing of direction between each pass, the number of said passes (25, 25b, 25c) being odd.

11. Heat exchanger according to claim 10 wherein said first zone (13) comprises a first header (53) for said first fluid and a second header (55) for said first fluid, said first header (53) for said first fluid being configured to let said first fluid flow in each first fluid passage, said second header (55) for said first fluid being configured to let said first fluid flow from said first zone to said receiver, said first zone (13) further comprising a by-pass (59) between said first and second headers (53, 55) for the first fluid to create a passage there trough for said first fluid.

12. Heat exchanger according to claim 11 wherein one (3b) of said stacked plates, called bottom plate, is on a side (79) of said core located opposite to said core side (17) on which said receiver (11) and said ports are located, said bottom plate (3b) and another plate of said stacked plates (3) adjacent to said bottom plate in said stacking direction defining one of said first fluid passages.

13. Heat exchanger according to claim 12 wherein said by-pass (59) is located between said bottom plate (3b) and said another plate.

14. Heat exchanger according to claim 13 wherein said bottom plates (3b) comprises embossed portions (85) oriented opposite to said another plate and/or dimples (87) in contact with said another plate, in the area of said by pass.

15. Heat exchanger according to any preceding claims wherein a final plate (3b) of said stacked plates situated on a side (79) of said core located opposite to said core side (17) on which said receiver (11) and said ports are located, is thicker than the other plate of said stacked plates.

16. Heat exchanger according to any preceding claims configured to allow a heat exchange between a refrigerant fluid as said first fluid and a coolant liquid as said second fluid.

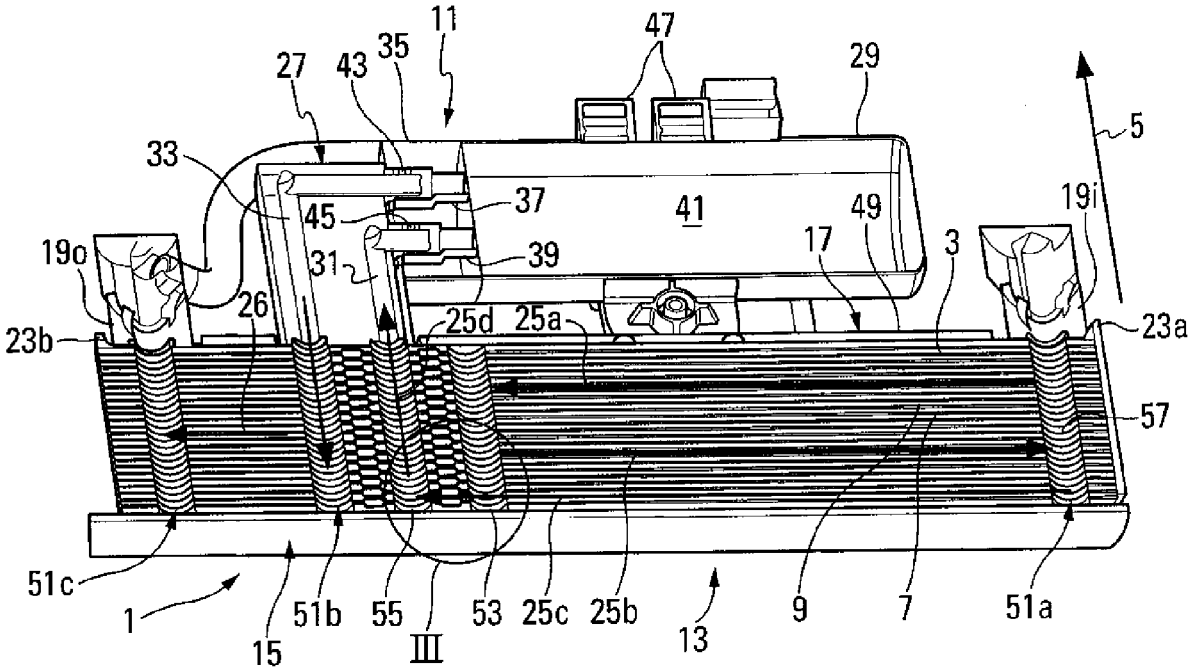
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Fig. 1

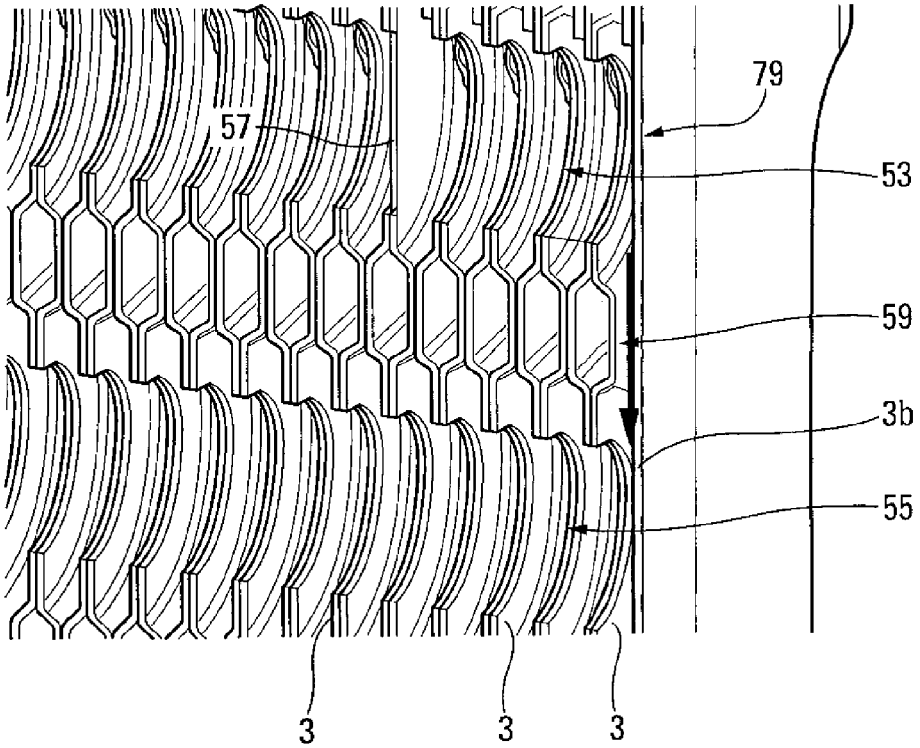
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Fig. 3

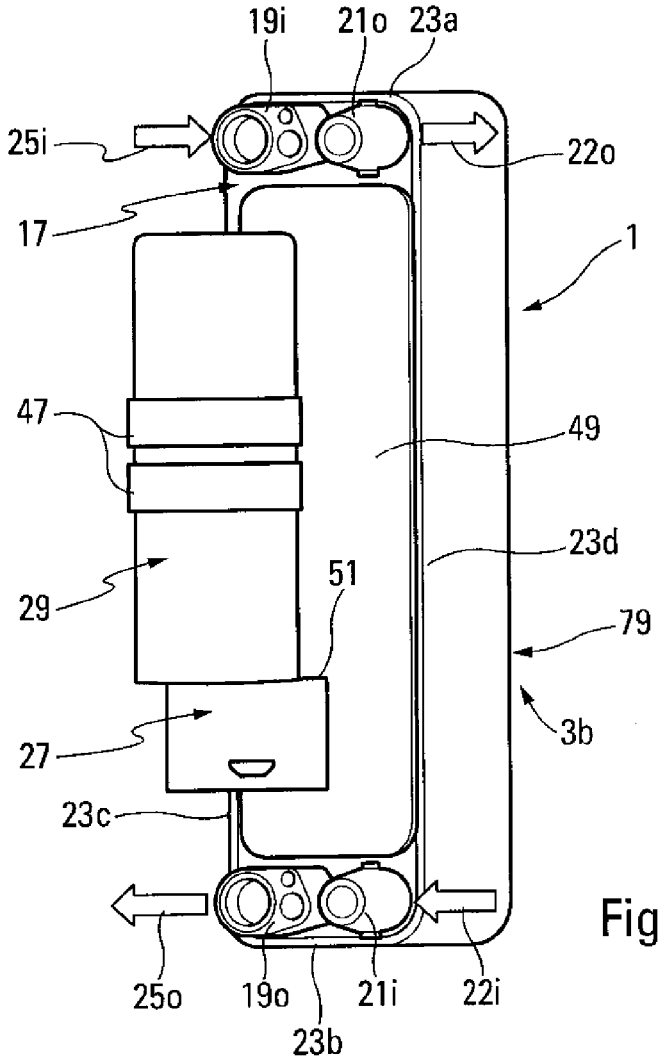

Fig. 2

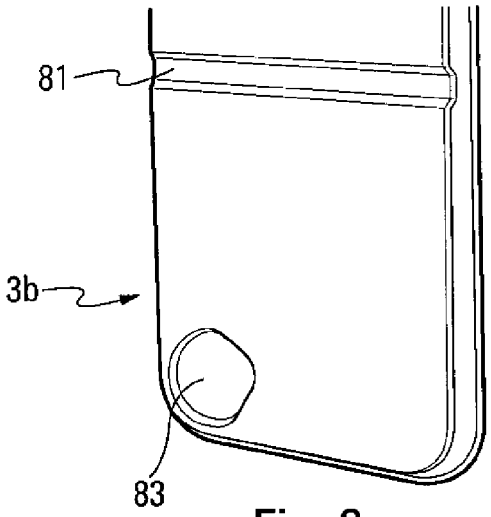

Fig. 8

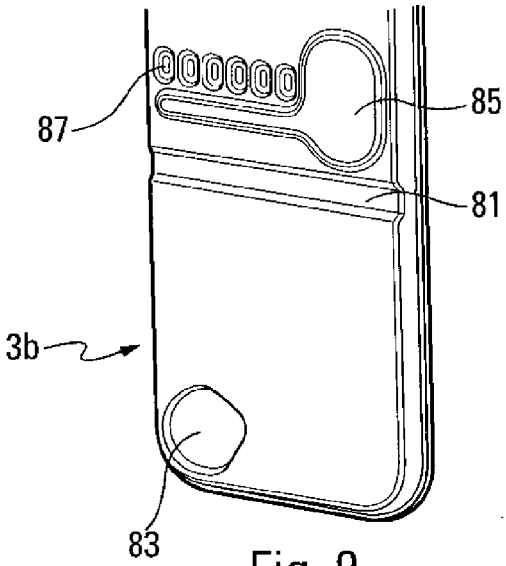

Fig. 9

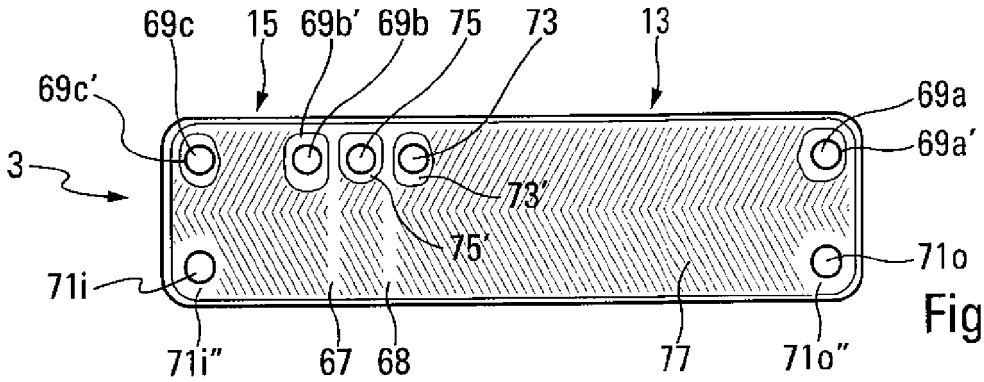

Fig. 4

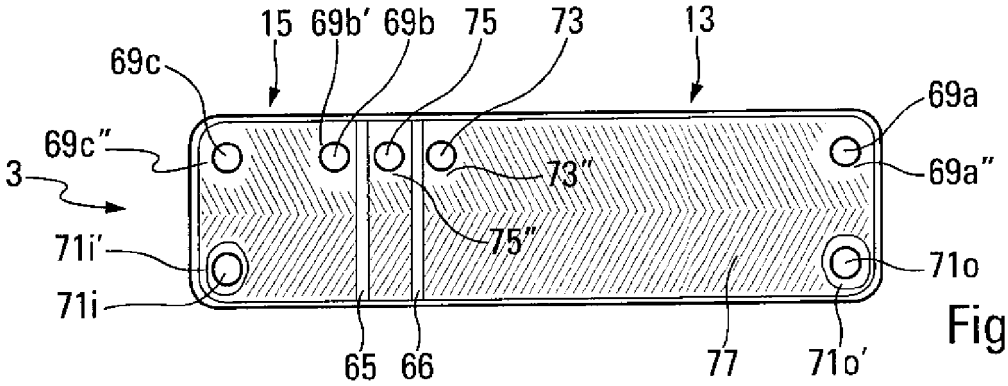

Fig. 5

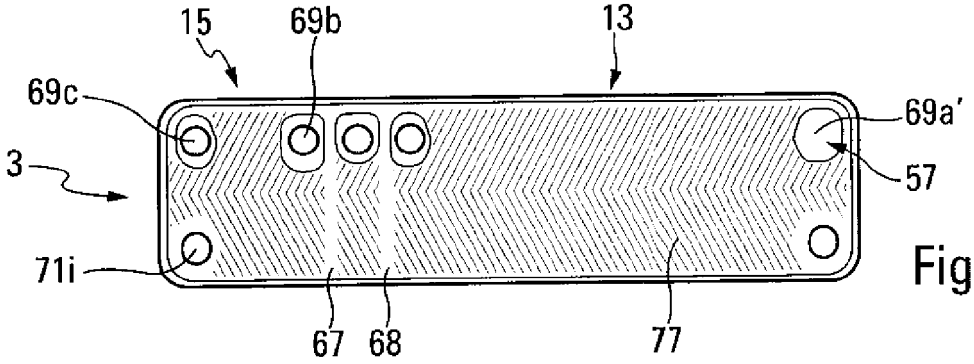

Fig. 6

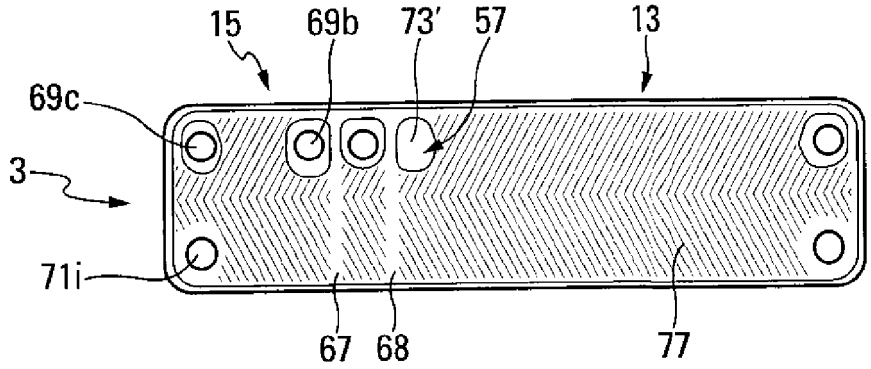

Fig. 7

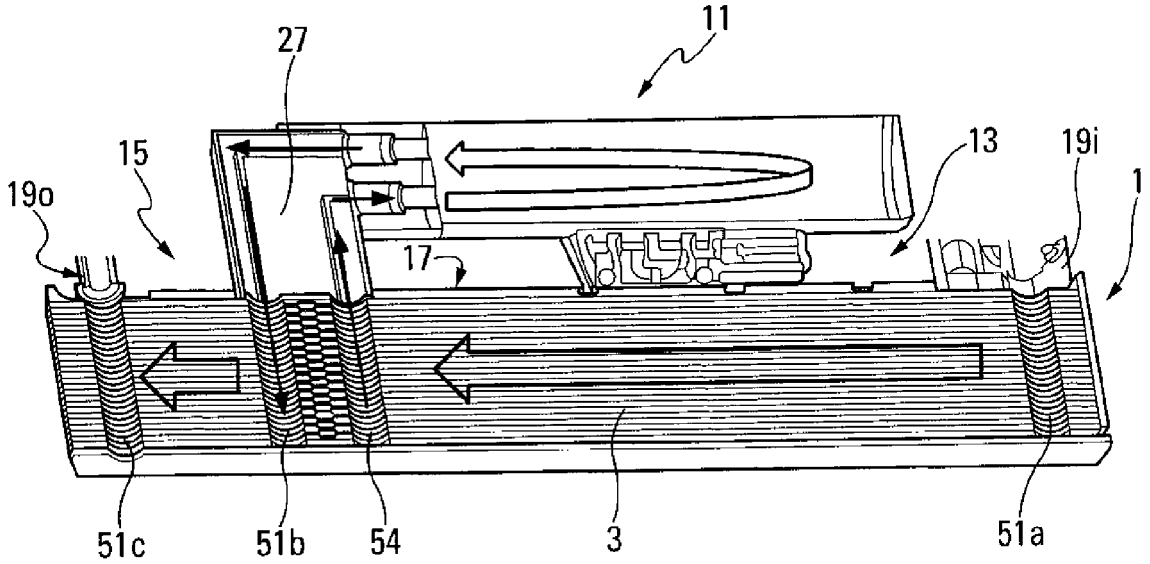

Fig. 10

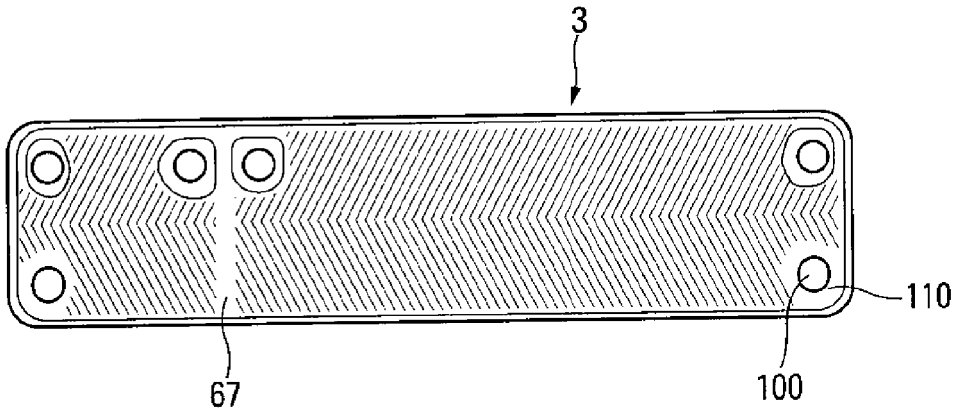

Fig. 11a

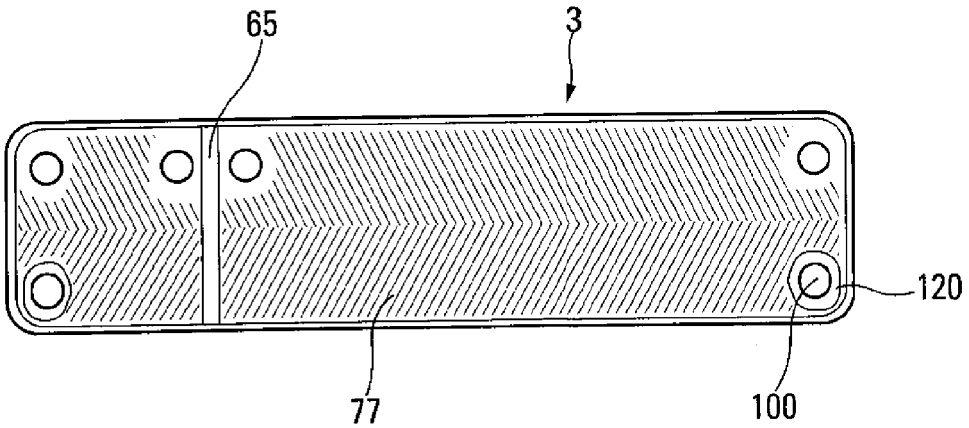

Fig. 11b

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EUROPEAN SEARCH REPORT

Application Number
EP 14 46 1522

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F28D
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 June 2014	Bain, David

CATEGORY OF CITED DOCUMENTS

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