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(54) Dual plane condenser

(57) Dual plane heat exchanger (1), especially condenser for a refrigerant system, including a first core (2) and a second smaller core (3), each of said cores (2, 3) being configured to enable a heat exchange between a first fluid flowing successively in said cores (2, 3) and a second fluid flowing successively through said cores (2, 3), the first (2) and second (3) cores being attached together by brazing to form the dual plane heat exchanger (1).

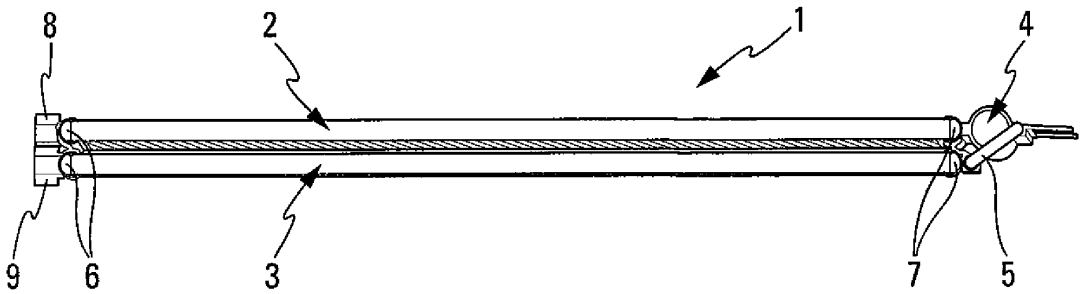


Fig. 2

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Description

[0001] This present invention relates to a dual plane heat exchanger for cooling a refrigerant fluid, as well as a dual plane condenser, in particular for a motor car.

[0002] Condensers are devices that condense into liquid, a high-temperature and high-pressure refrigerant gas discharged from a compressor, by dissipating the heat of the refrigerant gas to a cooling fluid, the air for instance. Generally, in cars, these condensers are part of a cooling module comprising other exchangers used for other cooling loops, like engine cooling loops.

[0003] It is known condensers comprising parallel tubes constituting a path to drive the refrigerant fluid that flows into the tubes. The tubes are spaced to allow the circulation of air between them, and then the heat exchange. A condenser may be divided into passes, made of several tubes, the fluid flowing successively from one pass to the other in serpentine way. In normal way, refrigerant flows from top to bottom and the last pass is located on the condenser bottom. The last pass can be, for instance, a subcooling pass for the refrigerant.

[0004] Such construction is disadvantageous when a direct charged air cooler (CAC) is mounted in a first raw of the cooling module, upstream the bottom of the condenser. Consequently, hot air coming from the CAC deteriorates the condenser performance by heating-up refrigerant.

[0005] A first solution to this problem, is to use a condenser having an inverted flow, as described in patent EP1887295. Then the refrigerant flows from the bottom to the top of the condenser in order to avoid having the CAC in front of the subcooling pass.

[0006] Nevertheless, an inverted condenser is non standard and induces higher oil retention that negatively influences performance and life-time of the compressor.

[0007] One solution to avoid these drawbacks could be to make use of a second core to form a dual condenser.

[0008] Nevertheless, if both cores are manufactured separately and connected together mechanically on the cooling module afterwards, this solution leads to expensive costs of production.

[0009] The present invention aims to overcome such drawbacks, and to provide a dual plane heat exchanger, easy to produce without mechanical connection, and enhancing the cooling module performance.

[0010] To this end, the invention relates to a dual plane heat exchanger, especially a condenser for a refrigerant system, including a first core and a second smaller core, each of said cores being configured to enable a heat exchange between a first fluid flowing successively in said cores and a second fluid flowing successively through said cores, the first and second cores being attached together by brazing to form the dual plane heat exchanger.

[0011] In other words, the first and second cores are assembled without mechanical connection. Consequently, the heat exchanger doesn't need another processing step to be made, and the second smaller core can be easily arranged on any part of the first core to form the heat exchanger.

[0012] According to various embodiments of the invention, that could be used together or separately:

- the dual plane heat exchanger further comprises brackets configured to enable a preassembly of said cores before brazing,
- said brackets are brazed with said cores,
- said brackets are clinched on manifolds of said cores,
- the first core is configured to have the first fluid flowing from the top to the bottom of the core,
- the second core is mounted beside an upper part of the first core,
- the first core comprises an inlet for the first fluid on the upper part,
- the first core further comprises an integrated receiver configured to drive the first fluid from said first core to said second core,
- the receiver comprises a channel to drive the first fluid from the bottom to the top of the receiver,
- a pipe links the top of the receiver and the second core for driving the first fluid, said pipe is brazed to the receiver and to the second core,
- the second core comprises an outlet for driving the refrigerant fluid out of the dual heat exchanger,
- the second core has one pass,
- the first core has multiple passes.

[0013] This invention also relates to a dual plane condenser defined by a dual plane heat exchanger as described previously.

[0014] This invention still relates to a process for making a dual plane heat exchanger, the first and second condensers being brazed together in one shot. In other words, the process according to the invention comprises:

- a first step where the first and second cores are brazed, and
- a second step where the first and second cores are brazed together, said first and second steps being held simultaneously.

[0015] The present invention will be described more specifically with reference to the following drawings, in which:

- Figure 1 shows a dual plane heat exchanger according to an embodiment of the invention in a perspective view,
- Figure 2 shows a dual plane heat exchanger according to an embodiment of the invention from an upper view,
- Figure 3 shows a side of the dual plane heat exchanger according to an embodiment of the inven-

tion from an upper view,

- Figure 4 shows a side of the dual plane heat exchanger according to an embodiment of the invention from an upper view.

[0016] In the following description, same numerical references are used to designate same elements.

[0017] As shown in figures 1 and 2, the dual plane heat exchanger 1 according to the invention includes a first core 2 and a second smaller core 3, that are arranged in parallel.

[0018] Each of said cores 2, 3 is configured to enable a heat exchange between a first fluid flowing successively in said cores 2, 3 and a second fluid flowing successively through said cores 2, 3. Each core 2, 3 is made of a plurality of parallel tubes configured to form a circuit for the first fluid, and which are spaced between them to allow the flow of a second fluid. Said tubes are held at their both ends by manifolds 6, 7 in which the first fluid coming from or going into the tubes flows.

[0019] The tubes are made for instance of aluminum and/or aluminum alloy. They are advantageously flat tubes having two opposite parallel flat faces laterally linked by radius. The tubes can be multi-channel tubes. They are for instance extruded tubes. In another embodiment they are folded tubes internally equipped with an internal fin separating the channels. External fins can be provided between the tubes to enhance heat exchange with the second fluid.

[0020] For an air conditioning system, the first core 2 is a condenser and the second core 3 is a subcooling core. The first fluid flowing in the tubes is a refrigerant and the second fluid flowing between them is ambient air. The condenser transforms the gas coming from a compressor into liquid along the circuit, while the subcooling core lowers even more the temperature of the liquid.

[0021] The first core 2 has multiple passes to transform the refrigerant gas into liquid, for instance an uneven number of passes, whereas the second core 3 has one pass for subcooling. Consequently, the second core 3 is smaller than the first one 2.

[0022] The subcooling core is facing the top part of the condenser, in order to let the bottom part free for arranging a charge air cooler (CAC), that can be set there in some configurations of front-end heat exchange module. Consequently, the subcooling core is not subjected to the heated air coming from the CAC.

[0023] The first core 2 is configured to have the first fluid flowing from the top to the bottom. This configuration is better for condenser performance than an inverted flow condenser. The first core 2 comprises an inlet 8 on the upper part for the gas refrigerant, that follows afterwards the circuit until the bottom of the condenser.

[0024] Then, the refrigerant liquid is driven to the second core 3 through a pipe 5 linking the top of the condenser to the subcooling core either directly or, as described, through a receiver 4. The subcooling core is provided with an outlet 9 for driving the refrigerant fluid out of the dual heat exchanger 1.

[0025] As already said the first core 2 can further comprise an integrated receiver 4 configured to drive the first fluid from said first core 2 to said second core 3. The receiver 4 improves condensing efficiency through gas-liquid separation and is able to remove moisture from the refrigerant. Additionally, the receiver 4 comprises a channel 11 to drive the first fluid from the bottom to the top of the receiver 4.

[0026] In such configuration the pipe 5 links the top of the receiver 4 and the second core 3 for driving the first fluid from the channel 11 to the second core 3.

[0027] According to the invention, the first 2 and second 3 cores are brazed one shot to form the dual plane heat exchanger 1. In other words the components of each core 2, 3 are brazed in the same time as both cores are linked together by brazing. The integrated receiver 4 can be brazed to the first core 2 and/or the pipe 5 can be brazed to the first and second cores 2, 3, advantageously one shot therewith. As it is well known, the brazing consists in heating up a preassembly of the heat exchanger components, to a molten temperature of a provision metal. The components fixation is fulfilled by capillarity diffusion on the components surface of the provision metal.

[0028] The process undertaken to form the dual plane heat exchanger 1 is hence simple to operate because the definitive assembly of the cores 2, 3 doesn't rely on added mechanical components. Then, the production of heat exchanger 1 gains time and is less expensive than current ones that need several step to be assembled.

[0029] On figure 3 and 4, the dual plane heat exchanger 1 is provided with brackets 10 configured to enable a preassembly of said cores 2, 3 before brazing. The brackets 10 are clinched on manifolds 6, 7 of said cores 2, 3 and are brazed in the same time than the other components.

[0030] The manifolds 6, 7 can comprise a collecting plate 20 and a cover 22. The collecting plate 20 comprises slits in which the extremities of the tubes are inserted. The cover 22 closes the volume of the manifold 6, 7 in which the first fluid flows, together with longitudinal baffles 24.

[0031] The preassembling brackets 10 can be clinched on the manifold 6, 7 of one of the cores 2, 3 and blocked or linked to an inlet and/or outlet bracket 10 of the other core. They comprise for instance a cradle 30 angularly in contact with a part of one of the manifolds 6, 7 and an arm 32 linking the cradle 30 with an inlet and/or outlet bracket 10 of the core 2, 3 either directly or through fingers 34 originated from the arm 32.

[0032] The dual plane heat exchanger 1 may also comprise brackets 10 configured to attach the exchanger on a support. They are provided for instance on the first core 2 and/or the receiver 4.

[0033] The invention still relates to a cooling system provided with a dual plane heat exchanger 1 as described previously, such module further comprising for instance

a cooling radiator, a charge air cooler and/or a fan.

Claims

1. Dual plane heat exchanger (1), especially condenser for a refrigerant system, including a first core (2) and a second smaller core (3), each of said cores (2, 3) being configured to enable a heat exchange between a first fluid flowing successively in said cores (2, 3) and a second fluid flowing successively through said cores (2, 3), the first (2) and second (3) cores being attached together by brazing to form the dual plane heat exchanger (1).

2. Dual plane heat exchanger according to claim 1, further comprising brackets (10) configured to enable a preassembly of said cores (2, 3) before brazing.

3. Dual plane heat exchanger according to claim 2, wherein said brackets (10) are brazed with said cores (2, 3).

4. Dual plane heat exchanger according to claim 3, wherein brackets (10) are clinched on manifolds (6, 7) of said cores (2, 3).

5. Dual plane heat exchanger according to claim 1, wherein the first core (2) is configured to have the first fluid flowing from the top to the bottom of the core (2).

6. Dual plane heat exchanger according to any of preceding claims, wherein the second core (3) is mounted beside an upper part of the first core (3).

7. Dual plane heat exchanger according to any of preceding claims, wherein the first core (2) comprises an inlet (8) for the first fluid on the upper part.

8. Dual plane heat exchanger according to any of preceding claims, wherein the first core (2) further comprises an integrated receiver (4) configured to drive the first fluid from said first core (2) to said second core (3).

9. Dual plane heat exchanger according to claim 5, wherein the receiver (4) comprises a channel (11) to drive the first fluid from the bottom to the top of the receiver (4).

10. Dual plane heat exchanger according to claim 5 or 6, wherein a pipe (5) links the top of the receiver (4) and the second core (3) for driving the first fluid, said pipe being brazed to the receiver (4) and to the second core (3).

11. Dual plane heat exchanger according to any of preceding claims, wherein the second core (3) comprises an outlet (9) for driving the refrigerant fluid out of the dual heat exchanger (1).

12. Dual plane heat exchanger according to any of preceding claims, wherein the second core (3) has one pass.

13. Dual plane heat exchanger according to any of preceding claims, wherein the first core (2) has multiple passes.

14. Dual plane condenser, in particular for a motor car, defined by a dual plane heat exchanger (1) according to any of preceding claims.

15. Process for making a dual plane heat exchanger (1) according to any of claims 1 to 14, comprising :

    - a first step where the first and second cores are brazed, and
    - a second step where the first and second cores are brazed together, said first and second steps being held simultaneously.

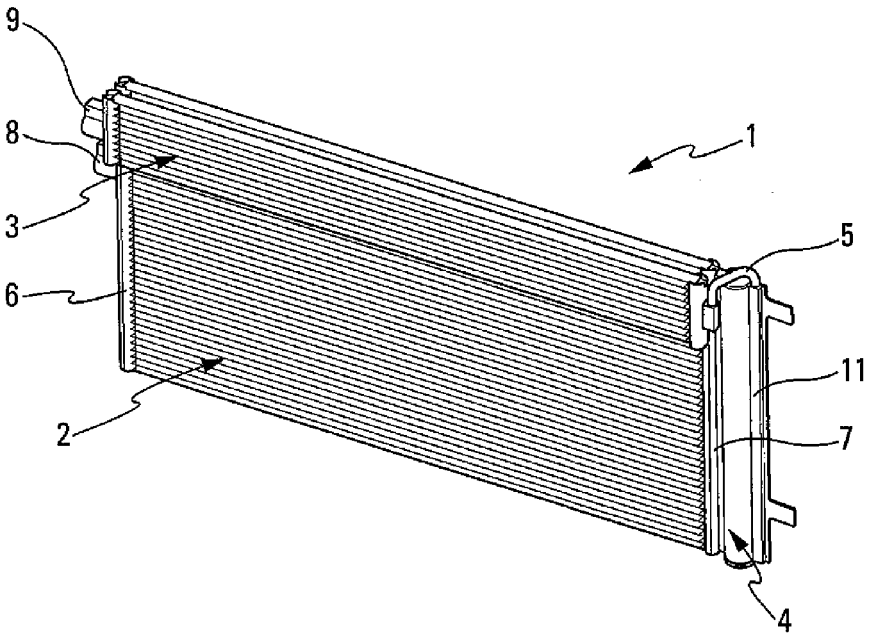


Fig. 1

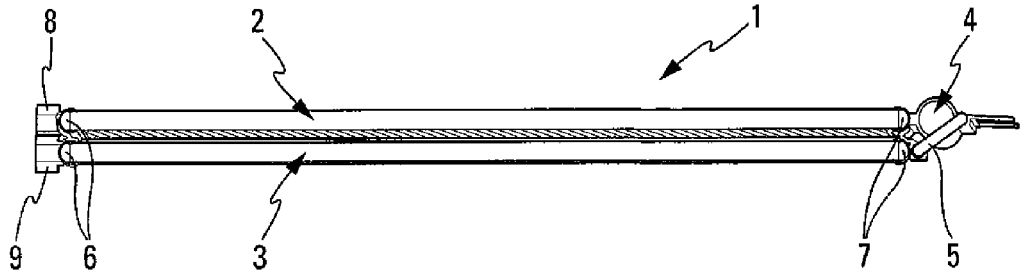


Fig. 2

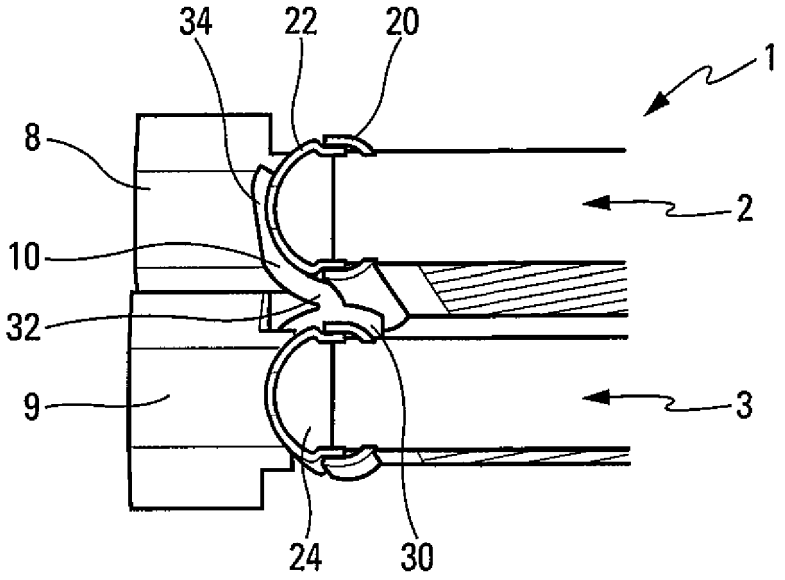


Fig. 3

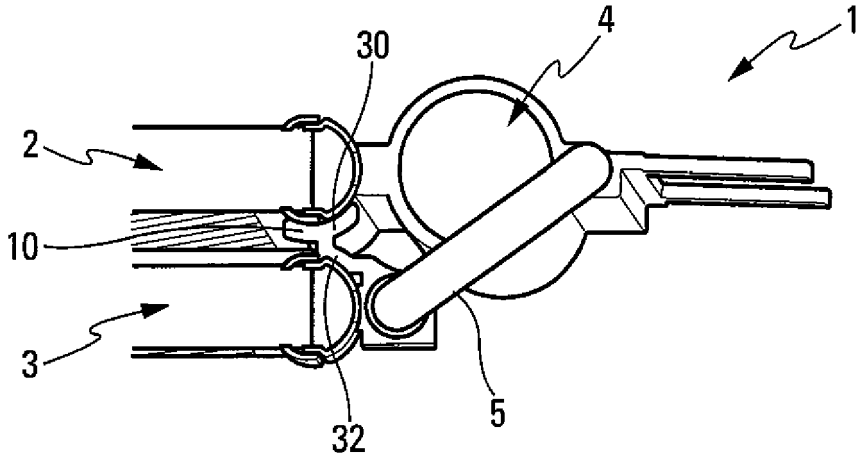


Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 13 46 1540

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 Y	JP 2001 124439 A (SHOWA ALUMINUM CORP) 11 May 2001 (2001-05-11) * paragraphs [0001], [0014] - [0018]; figures *	1-7, 11-15 1-3,5, 7-14	INV. F28D1/04
X	JP H11 211279 A (SHOWA ALUMINUM CORP) 6 August 1999 (1999-08-06) * paragraphs [0001], [0016] - [0018]; claims; figures *	1,5,7,8, 11-15	
Y	DE 101 04 374 A1 (BEHR GMBH & CO [DE]) 8 August 2002 (2002-08-08) * paragraph [0011]; claims; figures *	1-3,5-8, 11-14	
Y	US 2011/219817 A1 (ESAKI HIDENORI [JP]) 15 September 2011 (2011-09-15) * paragraphs [0075] - [0076]; figure 1 *	6,8	
Y	JP H11 211276 A (SHOWA ALUMINUM CORP) 6 August 1999 (1999-08-06) * abstract; figures 4,6 *	8-10	TECHNICAL FIELDS SEARCHED (IPC)
A	WO 2006/007969 A1 (BEHR GMBH & CO KG [DE]; ALCAINE MANUEL [ES]; HARICH MARTIN [DE]; HASSD) 26 January 2006 (2006-01-26) * page 2, line 15 - page 5, line 32 * * page 10, line 13 - line 32 * * claims 1,9,19; figures *	1-3	F28D F25B F28F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 February 2014	Oliveira, Casimiro

CATEGORY OF CITED DOCUMENTS

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06-02-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2001124439 A	11-05-2001	NONE	
JP H11211279 A	06-08-1999	JP 4043577 B2	06-02-2008
		JP H11211279 A	06-08-1999
DE 10104374 A1	08-08-2002	NONE	
US 2011219817 A1	15-09-2011	JP 5200045 B2	15-05-2013
		JP 2011190982 A	29-09-2011
		US 2011219817 A1	15-09-2011
JP H11211276 A	06-08-1999	JP 4052706 B2	27-02-2008
		JP H11211276 A	06-08-1999
WO 2006007969 A1	26-01-2006	EP 1771695 A1	11-04-2007
		WO 2006007969 A1	26-01-2006

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1887295 A **[0005]**