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(54) **A HEAT EXCHANGER**

(57) A heat exchanger comprising a first conduit for a first fluid being a high pressure fluid, a second conduit for a second fluid, a connecting block 10 comprising a front surface 10A and opposing lateral surfaces 10B, the front surface 10A comprising an opening 12 connected fluidly with the first conduit, a housing 30 encompassing the first conduit and forming the second conduit; wherein the connecting block 10 protrudes out of an opening formed by a collar 31 in the housing 30 so that the front surface 10A is unobstructed by the collar 31, while the lateral surfaces 10B comprise an upper part unobstructed by the collar 31 and a lower part covered by the collar 31, wherein the upper parts of at least two opposing lateral surfaces 10B comprise recesses 11 for anchoring a test device.

Prior art

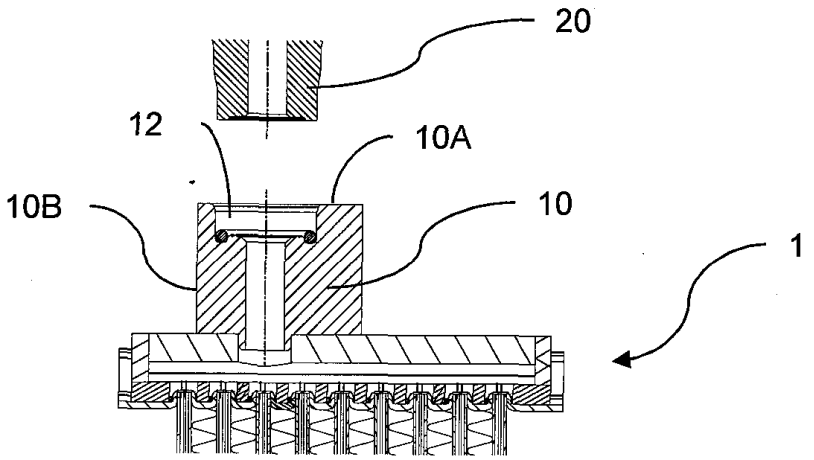

Fig. 1a

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Prior art

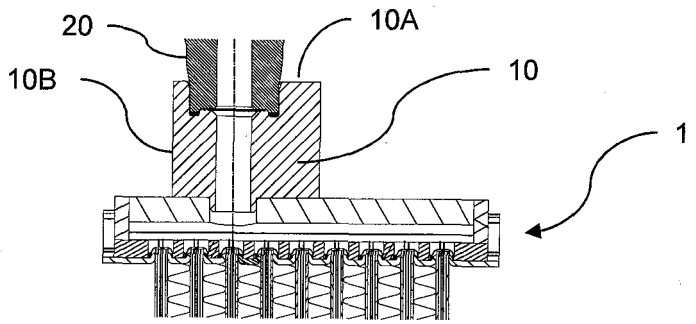

Fig. 1b

Description

FIELD OF THE INVENTION

[0001] The invention relates to heat exchangers. In particular, it relates to high pressure heat exchangers used in the automotive industry.

BACKGROUND OF THE INVENTION

[0002] One of the standard quality-assurance procedures for heat exchangers manufacturing is their tightness control. This is usually performed by connecting the exchanger to a testing unit by means of an interface, which is a part of testing machine. This interface forms a tight connection with entry port or ports localized on the connecting block in the heat exchanger. Subsequently, the system is filled with testing medium under pressure, and, depending of testing method, its pressure drop or presence outside tested circuit is being measured and/or detected.

[0003] For high pressure operating heat exchangers, especially designed for CO_2 (R744) as working medium, the test is performed with pressure exceeding 100 Bars.

[0004] The usual design of connecting blocks for products operating with CO_2 assumes facial contact between the mating surfaces. In other words, the flat surface of the testing tool is met with flat surface of the connecting block, the connection being sealed with use of an elastic washer. The proper connection with adequate pressing force is assured by defined torque setting on a connecting screw, which is used to effect a releasable attachment.

[0005] For leak testing purpose, an adequate pressing force must be applied directly by the interface of testing machine. This force is imparted directly to the heat exchanger structure, and may result in its deformation and thus destruction. As some heat exchangers comprise housings which are serving as a conduit for one of the fluids participating in the heat exchange, the provision of sufficient mechanical strength and robustness needed for pressure-test becomes complicated.

[0006] It is therefore an aim of the present invention to provide a high-pressure heat exchanger with housing, wherein the heat exchanger would be adapted for high-pressure leak tests in a cost-efficient and streamlined fashion.

SUMMARY OF THE INVENTION

[0007] The object of the invention is a heat exchanger comprising a first conduit for a first fluid being a high pressure fluid, a second conduit for a second fluid, a connecting block comprising a front surface and opposing lateral surfaces, the front surface comprising an opening connected fluidly with the first conduit, a housing encompassing the first conduit and forming the second conduit; wherein the connecting block protrudes out of an opening formed by a collar in the housing so that the front surface is unobstructed by the collar, while the lateral surfaces comprise an upper part unobstructed by the collar and a lower part covered by the collar, wherein the upper parts of at least two opposing lateral surfaces comprise recesses for anchoring a test device.

[0008] Preferably, the outline of the connecting block is contained within the outline of the opening formed by the collar.

[0009] Preferably, the recesses are in form of oblong slots.

[0010] Preferably, recesses are in form of grooves on the opposing lateral surfaces.

[0011] Preferably, recesses are in form of a groove which is continuous along the circumference of the connecting block.

[0012] Preferably, the recesses are in form of slots triangular in cross-section, wherein the upper inner wall of the slot is parallel to the front surface of the connecting block, while the lower inner wall of the slot is oblique with respect to this front surface.

[0013] Preferably, the recesses are in form of slots with a shape defined as a segment of vertical cylinder, and are placed in each lateral wall of the connecting block.

[0014] Preferably, the groove has a half-circle shaped cross-section.

[0015] Preferably, the groove has a rectangular shaped cross-section.

[0016] Preferably, the groove has a triangular shaped cross-section.

BRIEF DESCRITPTION OF DRAWINGS

[0017] Examples of the invention will be apparent from and described in detail with reference to the accompanying drawings, in which:

Figs. 1a-1b show stages of a pressure test of a heat exchanger in the prior art;
Fig. 2 shows a heat exchanger according to the invention;
Fig. 3 shows cooperation of the heat exchanger according to the invention with a testing tool,
Figs. 4a-4f show embodiments of the invention with a first type of connecting block;
Figs. 5a-5c show embodiments of the invention with a second type of connecting block;
Fig. 6 shows embodiment of the invention with a third type of connecting block;
Figs. 7a-7c show exemplary variations of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0018] Figs. 1a-1b show stages of a pressure test of a heat exchanger in the prior art. In the known arrangements, a test tool 20 is brought in the vicinity of the heat exchanger 1, and in particular in the vicinity of its connecting block 10. The connecting block 10 is communi-

cated fluidly with the internal fluid conduit of the heat exchanger 1. It comprises a front surface 10A and lateral surfaces 10B. In the front surface 10A there is situated an opening 12 for connecting the conduit with external sources. The test tool 20 is adapted to cooperate with this opening. After insertion of the test tool 20 into the opening, as seen in Fig. 1b, the tool 20 is pressed with a predefined force to effect a sealed connection which will be leak-tight under testing pressure. With high pressures, this force has to be substantial, and its imparting can be dangerous for the structure of the heat exchanger, especially in case of heat exchangers with plastic housing forming a conduit for one of the fluids taking part in the heat exchange.

[0019] To overcome the abovementioned problem, a heat exchanger with recesses in the connecting block is proposed for anchoring the test tool.

[0020] Fig. 2 shows a heat exchanger according to the invention. The connecting block 10 protrudes from an opening in housing 30, in particular in the opening formed by a collar 31. A first part of the lateral surface 10b, i.e. the upper part, is above the collar 31. In other words, the connecting block 10 protrudes of the collar 31 with the upper (first) part of its later surfaces 10B. At least two opposing lateral surfaces 10B comprise in their upper parts recesses 11 for anchoring the test tool.

[0021] Fig. 3 shows cooperation of the heat exchanger according to the invention with a testing tool 20. The anchoring arms 21 of the test tool 20 are introduced into the recesses 11 of the opposing lateral surfaces 10B of the connecting block 10. Consequently, all the forces are concentrated on the connecting block and are not transferred to other elements of the heat exchanger. The housing 30 is thus unaffected by the tool 20. As explained above, the upper part of the lateral surfaces 10B protrudes out of the collar 31 of the housing 30. The lower part of the lateral surfaces 10B is located in the collar 31 or even partially below it. In other words, the front surface 10A is unobstructed by the collar 31, while the lateral surfaces 10B comprise an upper part unobstructed by the collar 31 and a lower part covered by the collar 31. In a design where the housing portion with the collar 31 is a single piece element, the opening in the housing 30 for the connecting block 10 puts restraints on the shape of connecting block itself. In particular, it is important to have the lower portion of the lateral surfaces 10B which is not shifted inward into the block body with respect to the upper portion. It should be at least at the level of the upper portion, or possibly shifted outwards out of the block body in relation to the upper part. At the same time, the outline of the connecting block 10 as a whole is contained within the outline of the opening formed by the collar 31 so that insertion of the connecting block 10 through the opening of the collar 31 is enabled. The reason is that the sealing of the block 10 is made in relation to a housing 30 which incorporates the heat exchanger core and part of the connecting block 10, and which forms a conduit for the second fluid so that the heat exchange can be enabled between the first and the second fluid. If the connecting block 10 protrudes out of the housing portion with the collar 31, and this portion is uniform (i.e. constituted by a single part), then this condition has to be observed in order to allow pushing the block through the opening. Said housing portion can subsequently be connected with the remaining portions of the housing 30 and form the complete assembly.

[0022] Figs. 4a-4f show embodiments of the invention with a first type of connecting block. The first type of the connecting block 10 is a block with two openings 12, for example an inlet and an outlet of the high-pressure fluid. These openings are located in the front surface 10A of the block 10. The front surface 10A can further comprise opening 13 for a screw and an opening 14 for a positioning pin.

[0023] In Fig. 4a, the recesses 11 are in form of oblong slots on the opposing lateral surfaces 10B.

[0024] In Fig. 4b, the recesses 11 are in form of grooves on the opposing lateral surfaces 10B.

[0025] In Fig. 4c, the recesses 11 are in form of grooves formed in all lateral surfaces 10B of the block 10, i.e. the groove is continuous along the circumference of the connecting block 10.

[0026] In Fig. 4d, the recesses 11 are in form of slots triangular in cross-section, wherein the upper inner wall of the slot is parallel to the front surface 10A of the connecting block 10, while the lower inner wall of the slot is oblique with respect to this front surface 10A.

[0027] In Fig. 4e, the recesses 11 are in form of a shape defined as a segment of vertical cylinder, and are placed in each lateral wall 10B of the connecting block 10.

[0028] In Fig. 4f, the recesses 11 are in form of grooves on the opposing lateral surfaces 10B, wherein the upper inner wall of the groove is parallel to the front surface 10A of the connecting block 10, while the lower inner wall of the groove is oblique with respect to this front surface 10A.

[0029] Figs. 5a-5c show embodiments of the invention with a second type of connecting block. The second type of the connecting block is similar to the first type, but it does not have openings for screws and pins, and is generally of smaller dimensions.

[0030] Fig. 5a comprises recesses 11 in form of slots of a shape defined as a segment of vertical cylinder, and are placed in each lateral wall 10B of the connecting block 10.

[0031] Fig. 5b comprises recesses 11 in form of grooves on the opposing lateral surfaces 10B.

[0032] Fig. 5c comprises recesses 11 in form of grooves formed in all lateral surfaces 10B of the block 10, i.e. the groove is continuous along the circumference of the connecting block 10.

[0033] Fig. 6 shows embodiment of the invention with a third type of connecting block. This block type comprises a single opening. The recess 11 are in form of deep grooves located on the opposing lateral surfaces 11B.

[0034] Figs. 7a-7c show exemplary variations of the

invention. In particular, they present various types of groove types forming recesses 11.

[0035] Fig. 7a presents a groove with half-circle vertical cross-section. Fig. 7b presents a groove with a rectangular cross-section. Fig. 7c presents a groove with triangular cross-section, wherein the upper inner wall of the groove is parallel to the front surface 10A of the connecting block 10, while the lower inner wall of the groove is oblique with respect to this front surface 10A.

[0036] 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 comprising a first conduit for a first fluid being a high pressure fluid, a second conduit for a second fluid, a connecting block 10 comprising a front surface 10A and opposing lateral surfaces 10B, the front surface 10A comprising an opening 12 connected fluidly with the first conduit, a housing 30 encompassing the first conduit and forming the second conduit; wherein the connecting block 10 protrudes out of an opening formed by a collar 31 in the housing 30 so that the front surface 10A is unobstructed by the collar 31, while the lateral surfaces 10B comprise an upper part unobstructed by the collar 31 and a lower part covered by the collar 31, wherein the upper parts of at least two opposing lateral surfaces 10B comprise recesses 11 for anchoring a test device.

2. A heat exchanger according to any preceding claim, wherein the outline of the connecting block 10 is contained within the outline of the opening formed by the collar 31.

3. A heat exchanger according to claim 1 or 2, wherein the recesses 11 are in form of oblong slots.

4. A heat exchanger according to claim 1 or 2, wherein recesses 11 are in form of grooves on the opposing lateral surfaces 10B.

5. A heat exchanger according to claim 1 or 2, wherein recesses 11 are in form of a groove which is continuous along the circumference of the connecting block 10.

6. A heat exchanger according to claim 1 or 2, wherein the recesses 11 are in form of slots triangular in cross-section, wherein the upper inner wall of the slot is parallel to the front surface 10A, of the connecting block 10, while the lower inner wall of the slot is oblique with respect to this front surface 10A.

7. A heat exchanger according to claim 1 or 2, wherein the recesses 11 are in form of slots with a shape defined as a segment of vertical cylinder, and are placed in each lateral wall 10B of the connecting block 10.

8. A heat exchanger according to claim 4, wherein the groove has a half-circle shaped cross-section.

9. A heat exchanger according to claim 4, wherein the groove has a rectangular shaped cross-section.

10. A heat exchanger according to claim 4, wherein the groove has a triangular shaped cross-section.

Prior art

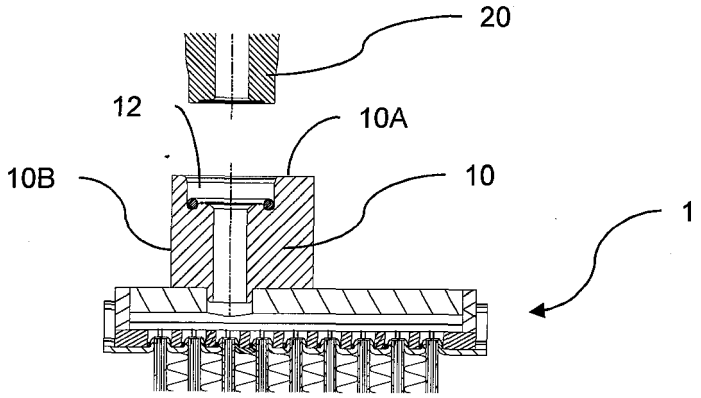

Fig. 1a

Prior art

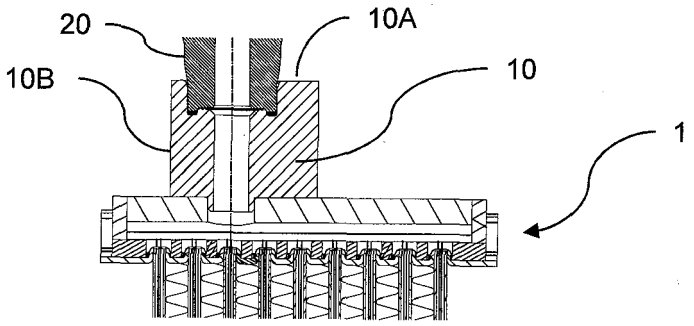

Fig. 1b

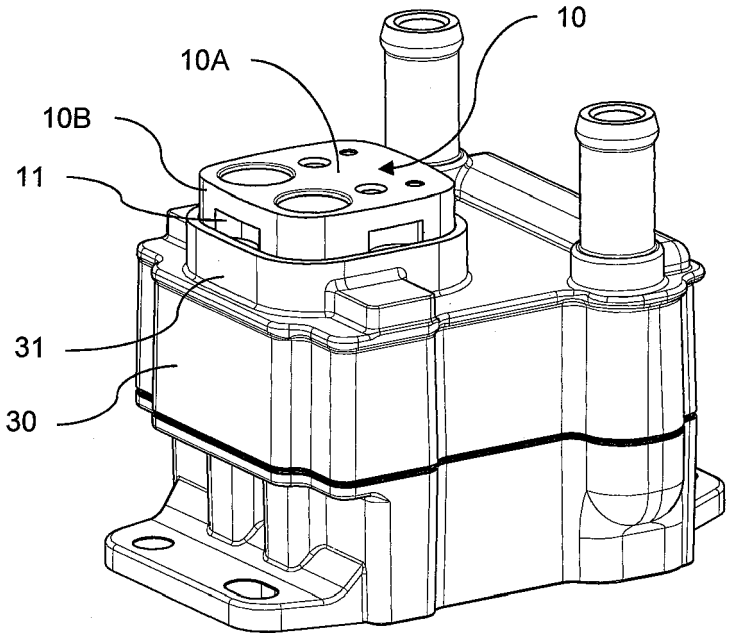

Fig. 2

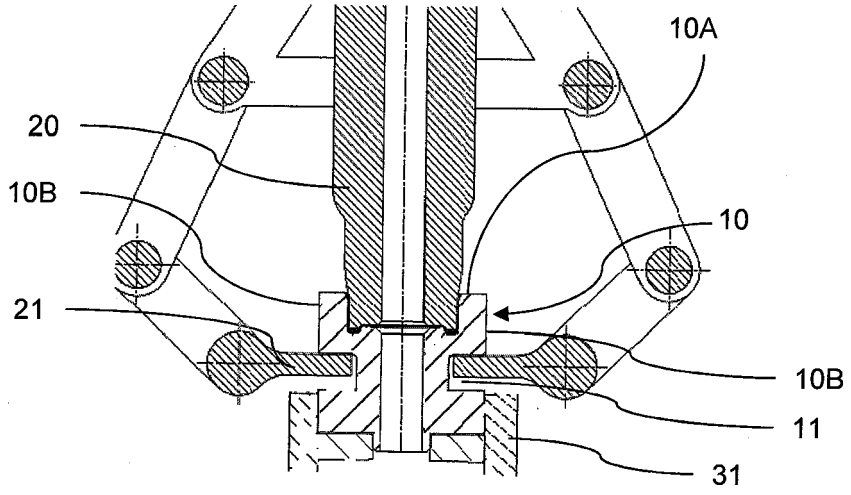

Fig. 3

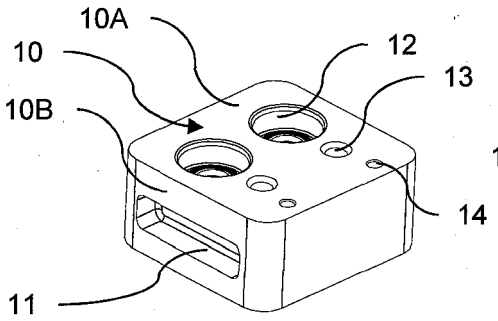

Fig. 4a

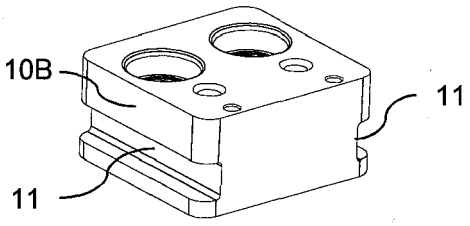

Fig. 4b

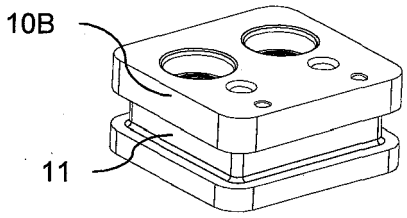

Fig. 4c

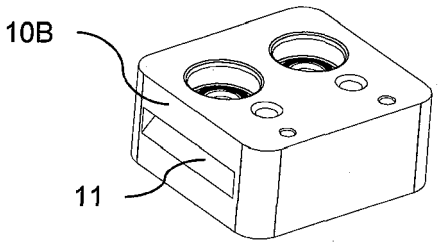

Fig. 4d

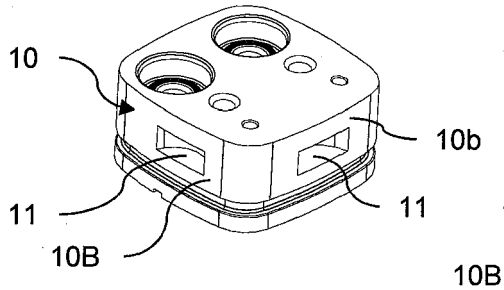

Fig. 4e

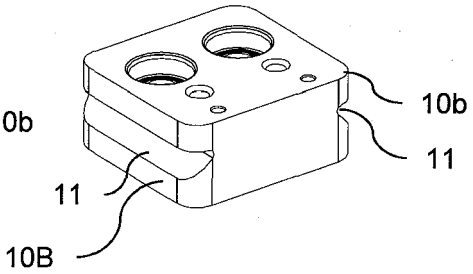

Fig. 4f

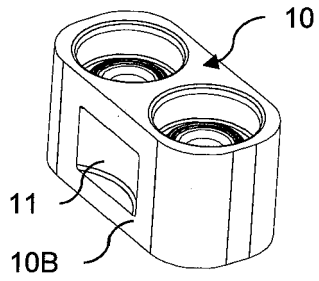

Fig. 5a

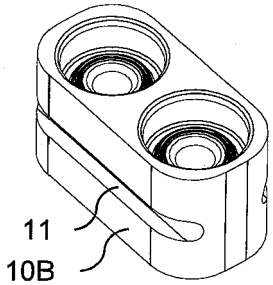

Fig. 5b

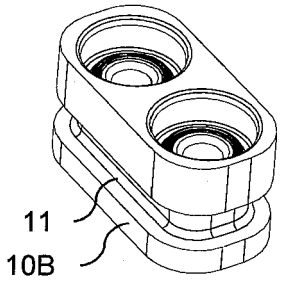

Fig. 5c

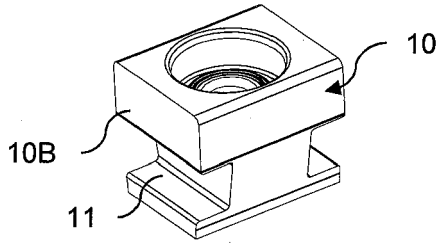

Fig.6

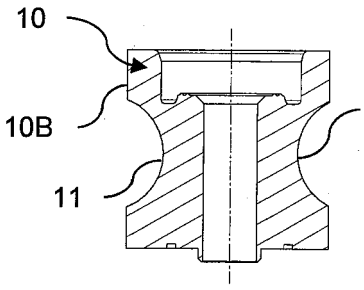

Fig. 7a

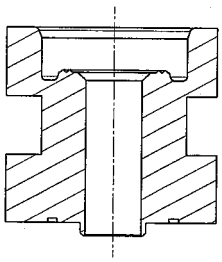

Fig. 7b

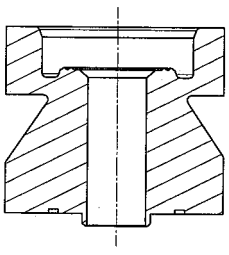

Fig. 7c

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EUROPEAN SEARCH REPORT

Application Number
EP 18 46 1522

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 10 2015 111393 A1 (HALLA VISTEON CLIMATE CONTROL [KR]) 21 April 2016 (2016-04-21) * paragraphs [0031] - [0050]; figure 2 *	1-10	INV. F28F7/02 F28D7/16 F28F9/02
A	WO 2015/000046 A1 (MAHLE METAL LEVE SA [BR]) 8 January 2015 (2015-01-08) * the whole document *	1-10	
A	FR 2 950 682 A1 (VALEO SYSTEMES THERMIQUES [FR]) 1 April 2011 (2011-04-01) * figures 1, 2 *	1-10	
A	WO 2009/068547 A1 (VALEO SYSTEMES THERMIQUES [FR]; MAGNIER-CATHENOD ANNE-SYLVIE [FR]; MAR) 4 June 2009 (2009-06-04) * figure 6 *	1-10	
A	EP 2 402 694 A1 (VALEO SYSTEMES THERMIQUES [FR]) 4 January 2012 (2012-01-04) * figures 2, 5 *	1-10	TECHNICAL FIELDS SEARCHED (IPC) F28F F28D
A	DE 10 2014 202466 A1 (MAHLE BEHR GMBH & CO KG [DE]) 13 August 2015 (2015-08-13) * the whole document *	1-10	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 August 2018	Louchet, Nicolas

CATEGORY OF CITED DOCUMENTS

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31-08-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102015111393 A1	21-04-2016	DE 102015111393 A1	21-04-2016
		KR 20160045007 A	26-04-2016
WO 2015000046 A1	08-01-2015	BR 102013017095 A2	30-06-2015
		CN 105612339 A	25-05-2016
		EP 3017177 A1	11-05-2016
		ES 2661407 T3	28-03-2018
		JP 6377150 B2	22-08-2018
		JP 2016524078 A	12-08-2016
		US 2016160813 A1	09-06-2016
		WO 2015000046 A1	08-01-2015
FR 2950682 A1	01-04-2011	CN 102639953 A	15-08-2012
		EP 2483620 A1	08-08-2012
		FR 2950682 A1	01-04-2011
		JP 2013506809 A	28-02-2013
		US 2012234523 A1	20-09-2012
		WO 2011039186 A1	07-04-2011
WO 2009068547 A1	04-06-2009	EP 2252845 A1	24-11-2010
		FR 2924490 A1	05-06-2009
		WO 2009068547 A1	04-06-2009
EP 2402694 A1	04-01-2012	EP 2402694 A1	04-01-2012
		FR 2962199 A1	06-01-2012
DE 102014202466 A1	13-08-2015	DE 102014202466 A1	13-08-2015
		EP 3105525 A1	21-12-2016
		KR 20160119226 A	12-10-2016
		US 2017016685 A1	19-01-2017
		WO 2015121038 A1	20-08-2015

EPO FORM P0459

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