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(54) **HEAT EXCHANGER PLATE AND COMBINATION OF A HEAT EXCHANGER PLATE AND A GASKET**

(57) A heat exchanger plate (2) is described comprising an edge (11), a groove (12) running along the edge (11), and a corrugated area (13) having crests (14, 20) and troughs (15) between the groove (12) and the edge (11), wherein crests (14, 20) run perpendicular to the edge (11).

Mounting a plate-type heat exchanger should be fa-

cilitated.

To this end the corrugated area (13) comprises at least two of three different sections (16-18), wherein in the first section (16) adjacent crests (14) are connected by a first connecting wall (19), in a second section (17) a space between the crest (14) is open to the groove (12) and a third section (18) forms a click-on tap position.

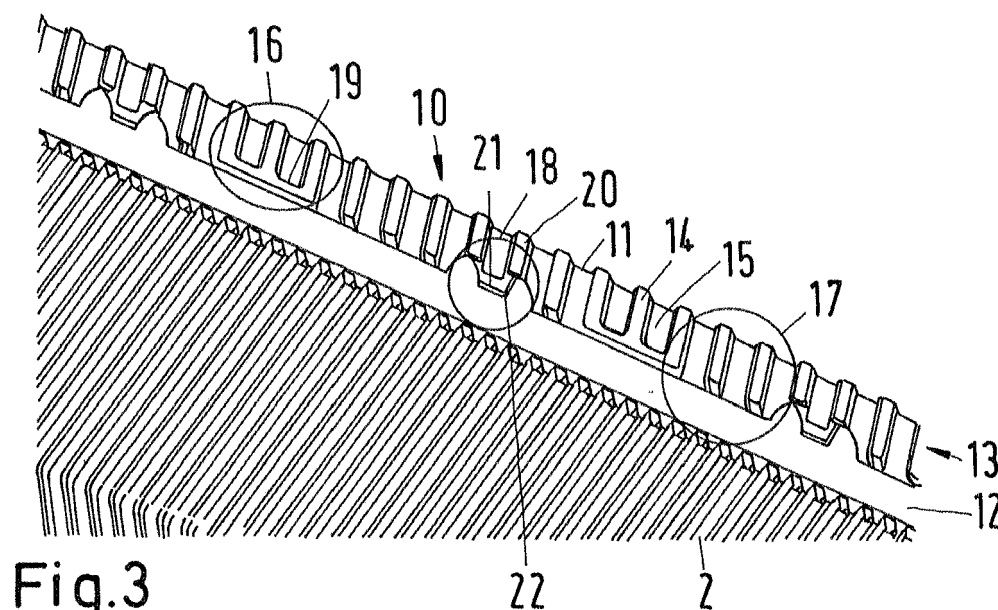


Fig.3

Description

[0001] The present invention relates to a heat exchanger plate comprising an edge, a groove running along the edge, and a corrugated area having crests and troughs between the groove and the edge, wherein crests run perpendicular to the edge.

[0002] The invention is in particular used for a high-pressure gasket heat exchanger having a stack of such heat exchanger plates, wherein a gasket is arranged between two adjacent plates. The corrugated area along the edge forms contact points to the neighbouring plates and at the same time a supporting wall for the gasket.

[0003] For mounting the heat exchanger the gasket has to be positioned in the groove and the heat exchanger plates have to be positioned one above the other. This can be complicated and requires some skill of a worker, since there is the risk that the gasket leaves the position in the groove when the heat exchanger plates are moved to the stack position.

[0004] The object of the invention is to facilitate mounting of a plate-type heat exchanger.

[0005] This object is solved with a heat exchanger plate as described at the outset, in that the corrugated area comprises at least two of three different sections, wherein in a first section adjacent crests are connected by a first connecting wall, in a second section at least one crest is flanked at both sides by a space between the crests that is open to the groove.

[0006] In an embodiment the heat exchanger plate further comprises a third section that form a click-on tap position.

[0007] The first connecting wall squeezes the gasket and keeps it in place by friction. The first connecting wall further assists in making the heat exchanger plate rigid and strong to support high-pressures. The second section comprises a space or a plurality of spaces which are open to the groove. Here the material of the compressed gasket is allowed to move into the open spaces assisting in keeping the gasket in position. The third section is provided to position a click-on tap in order to secure the gasket in the groove.

[0008] In an embodiment of the invention the corrugated area comprises the first section, the second section, and the third section. In this case all three different possibilities are used.

[0009] In an embodiment of the invention a bottom of the troughs is coplanar with a bottom of the groove. This is in particular useful in the region of the second section since the gasket has not to be moved over a step which is positive for the lifetime of the gasket and for the tightness of the heat exchanger.

[0010] In an embodiment of the invention the first section comprises at least three crests. In other words, the first connecting wall extends at least over two troughs. The squeezing area of the gasket is quite large and the stiffness of the heat exchanger plate in this area is increased.

[0011] In an embodiment of the invention in the second section the space between the crests is open to the edge. The space into which the gasket can move is preferably not limited in a direction towards the edge.

[0012] In an embodiment of the invention in the third section the crests are shorter than in the first section or the second section. Accordingly, there remains a space between the crests in the third section and the groove which can be used for parts of the click-on tap.

[0013] In an embodiment of the invention in the third section the crests are connected by a second connecting wall, wherein the second connecting wall has a height smaller than the height of the crests. The second connecting wall has basically the same advantages as the first selecting wall, i.e. it can squeeze the gasket and it can enhance the stiffness and rigidity of the plate to support high pressures. Furthermore, it can be used as a mounting means for the click-on tap.

[0014] In an embodiment of the invention a click-on tap is positioned in the third section, wherein the click-on tap comprises a first portion reaching into a distance between crests and a second portion reaching under a crest. Such an embodiment secures the click-on tap in a direction perpendicular to a plane of the heat exchanger plate.

[0015] In an embodiment of the invention the click-on tap comprises a third portion reaching in a space between a crest and the groove. This is possible, because the crests in the third section are shorter than the crests in the first section and/or the second section are. The third portion of the click-on tap can be used to secure the tap in a direction parallel to the plane of the heat exchanger plate.

[0016] In an embodiment of the invention the third portion is positioned over the second connecting wall. It is thus held by the crests in the third section.

[0017] The invention relates in a second aspect to a combination of the heat exchanger plate as described above and a gasket wherein the gasket has a volume that is larger than a volume of the groove.

[0018] The volume of the gasket can slightly be larger than that of the groove, for example, by 20 to 25 %. When the gasket is mounted in the groove, it is squeezed, in particular by the first connecting wall, so that it is kept tight in the groove.

[0019] A preferred embodiment of the invention will now be described in more detail with reference to the drawing, wherein:

Fig. 1 shows a side view of a plate-type heat exchanger with stacked heat exchanger plates,

Fig. 2 shows four heat exchanger plates stacked on top of each other,

Fig. 3 shows an edge region of a heat exchanger plate,

Fig. 4 shows a deformed gasket material in a groove,

and

Fig. 5 shows click-on taps in an edge region of the heat exchanger plate.

[0020] Fig. 1 shows schematically a side view of a plate-type heat exchanger 1 having a number of heat exchanger plates 2 squeezed between a bottom plate 3 and a top plate 4. Openings 5, 6 are provided to form access of fluid to flow paths formed between the plates 2. In addition, there are two further openings 7, 8 which are visible in Fig. 2 only. The first openings 5, 6 can be used for a fluid flowing through the primary side of the heat exchanger 1 and the second openings 7, 8 can be used for a fluid flowing through the secondary side of the heat exchanger 1.

[0021] Each heat exchanger plate 2 is provided with a gasket 9. The arrangement of gaskets is shown in Fig. 2. In the heat exchanger plate 2 which is fully visible in Fig. 2 the gasket 9 allows a flow from the first opening 5 to the second opening 6, i.e. through the primary side of the heat exchanger 1. The next heat exchanger plate 2 has a slightly different path of the sealing 9. Here, the openings 5, 6 are sealed against the interior and (not visible) a flow path is established between the openings 7, 8, i.e. through the secondary side of the heat exchanger.

[0022] Fig. 3 shows an edge area 10 of the heat exchanger plates 2. It is not necessary that the edge area 10 surrounds completely the heat exchanger plate 2. In most cases it is sufficient that the edge area extends along an edge connecting the openings 5, 6 or along an edge connecting the openings 7, 8.

[0023] The edge area 10 extends from an edge 11 towards the interior of the heat exchanger plate 2.

[0024] The edge area 10 comprises a groove 12 running along the edge 11, i.e. substantially in parallel to the edge 11. A corrugated area 13 is arranged between the edge 11 and the groove 12. The corrugated area comprises crests 14 and troughs 15, wherein the crests 14 and thus the troughs 15 run perpendicular to the edge 11. A bottom of the troughs 15 is coplanar with a bottom of the groove 12, i.e. there is no step between the bottom of the troughs 15 and the groove 12 or such a step has a neglectable height.

[0025] The corrugated area 13 at the edge 11 forms contact points to the neighbouring heat exchanger plates 2 and at the same time a supporting means for a gasket to be positioned in the groove 12.

[0026] The corrugated area 13 comprises at least two of three different sections 16, 17, 18. In a preferred embodiment the corrugated area 13 comprises all three different sections 16, 17, 18.

[0027] In the first section 16 crests 14 are connected by a first connecting wall 19. The connecting wall 19 connects at least three crests 14, i.e. it bridges at least two troughs 15. In other words, the first section 16 comprises at least three crests 14. The first section 16 can be re-

peatedly arranged along the edge 11.

[0028] The connecting wall 19 provides support for the gasket 9 when it is in position within groove 12.

[0029] The volume of the gasket 9 can be slightly larger than that of the groove 12, for example by 20 % to 25 %. Thus, the first connecting wall 19 squeezes the gasket 9 keeping it in place.

[0030] Furthermore, the connecting wall 19 assists in making the heat exchanger plate rigid and strong to support high-pressures.

[0031] In the second section 17 a space between the crests 14 is open to the groove 12. It can be totally open, i.e. it can be as well open to the edge 11. As can be seen in Fig. 4, the material of the compressed gasket 9 is allowed to move into the troughs 15 assisting in keeping the gasket 9 in position.

[0032] The number crests 14 of the first section 16 connected by the connecting wall 19 defines a stiffens, or rigidity, of the heat exchanger plate 2 in the edge area 10, but at the same time makes an obstacle to the material of the compressed gasket 9. A good number has been found to be in the range of 2-5 crests 14, where the illustrated embodiments show three crests 14.

[0033] As seen in fig. 3, the crests 14 in the second section 17 are isolated, meaning they are not connected to any connecting wall 19 at either side. They thus are flanked at both sides by troughs 15 with spaces being totally open to the edge 11 allowing compressed gasket 9 to move into the troughs 15.

[0034] In the same manner, the number of crests 14 if the second defines the area where the compressed gasket 9 is allowed to move into the troughs 15, but also reduces the stiffness, or rigidity, by reducing the number of crests 14 connected by connecting wall 19. However, in the same manner as for the first section 16, a good number of crests 14 in the second section 17 has been found to be in the range of 1-5.

[0035] In an embodiment the number of crests 14 in the first section equals the number of crests 14 in a second section, such as seen in fig. 3.

[0036] In an embodiment the edge area 10 comprise a plural of at least first sections 16 and second sections 17 positioned in succession, and in a related embodiment also third sections 18, where e.g. a first section 16 is neighboured at one side by a second section 17, that again is neighboured by a third section 19.

[0037] As illustrated in fig. 3, when plural of second sections 17 the number of e.g. the crests 14 in the second section 17 may be different, meaning some e.g. have one crest 14 only, others two, three etc.

[0038] In one embodiment the third sections 18 are neighboured at both sides by second sections 17.

[0039] In the third section 18 the crests 20 are shorter than the crests 14 in the first and second section 16, 17. The crests 20 of the third section 18 are connected by a second connecting wall 21. The second connecting wall 1 has a height smaller than a height of the crests 14, 20. The second connecting wall comprises rounding's 22

matching similar shapes of the gasket 9.

[0040] As can be seen in Fig. 5, a click-on tap 23 can be positioned in the third section 18. The click-on tap 23 can be positioned over the second connection wall 21.

[0041] As can be seen in Fig. 5, the click-on tap 23 comprises a part 24 reaching below the crests 14 and a part 25 reaching into the trough 15. Furthermore, click-on tap 23 may include a projection 26 reaching into a not visible projection in a bottom of a further plate above the plate 2 shown.

[0042] The effect of the click-on tap 23 is to assist during mounting of the gasket 9 and to keep it more stable in place.

[0043] The projection 26 is positioned over the second connecting wall 21 and is positioned between the groove 12 and the crests 20, so that it is held stable in position even against pulling forces acting parallel to a plane of the heat exchanger plate 2.

Claims

1. Heat exchanger plate (2) comprising an edge (11), a groove (12) running along the edge (11), and a corrugated area (13) having crests (14, 20) and troughs (15) between the groove (12) and the edge (11), wherein crests (14, 20) run perpendicular to the edge (11), **characterized in that** the corrugated area (13) comprises at least two different sections (16, 17), wherein in a first section (16) adjacent crests (14) are connected by a first connecting wall (19), in a second section (17) at least one crest (14) is flanked at both sides by a space between the crests (14) that is open to the groove (12).

2. Heat exchanger plate (2) according to claim 1, further comprising a third section (18) that forms a click-tap position.

3. Heat exchanger plate according to claim 2, **characterized in that** the corrugated area (13) comprises the first section (16), the second section (17), and the third section (18).

4. Heat exchanger plate according to claim 1 or 2, **characterized in that** a bottom of the troughs (14, 20) is coplanar with a bottom of the groove (12).

5. Heat exchanger plate according to any of claims 1 to 3, **characterized in that** the first section (16) comprises at least three crests (14).

6. Heat exchanger plate according to any of claims 1 to 4, **characterized in that** in the second section (17) the space between the crests (14) is open to the edge (11).

7. Heat exchanger plate according to any of claims 1

to 5, **characterized in that** in the third section (18) the crests (20) are shorter than in the first section (16) or the second section (17).

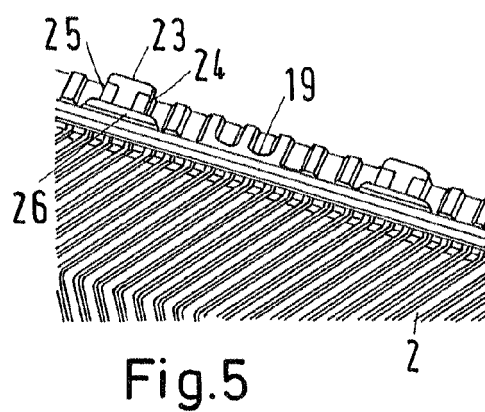
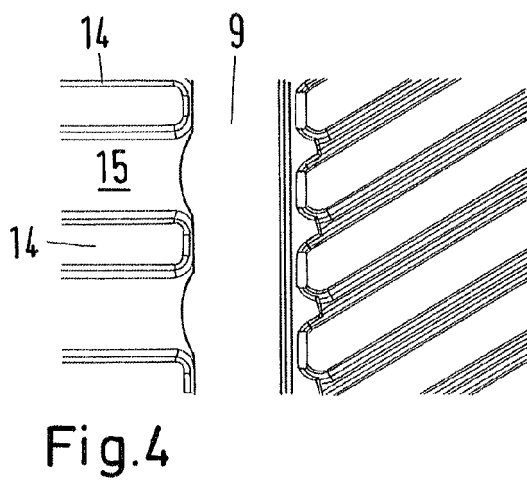
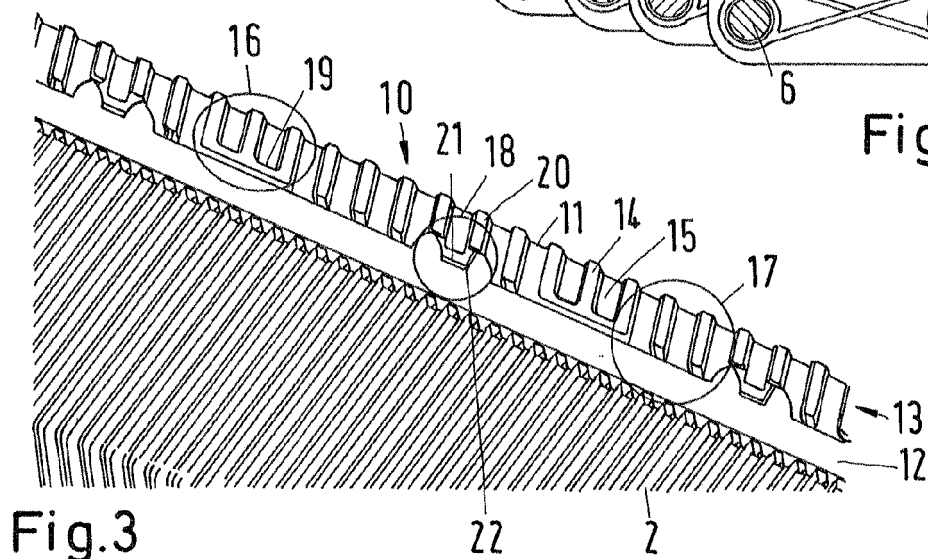
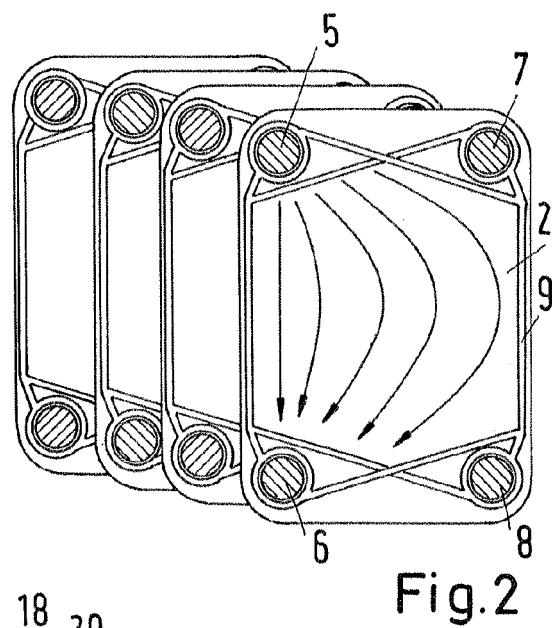
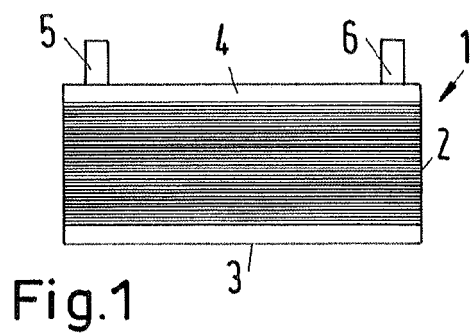
8. Heat exchanger plate according to claim 6, **characterized in that** in the third section (18) the crests (20) are connected by a second connecting wall (21), wherein the second connecting (21) wall has a height smaller than a height of the crests (20).

9. Heat exchanger plate according to claim 6 or 7, **characterized in that** a click-on tap (23) is positioned in the third section (18), wherein the click-on tap (23) comprises a first portion (25) reaching into a distance between crests (20) and a second portion (24) reaching under a crest (20).

10. Heat exchanger plate according to claim 8, **characterized in that** the click-on tap (23) comprises a third portion (26) reaching in a space between a crest (20) and the groove (12).

11. Heat exchanger plate according to claim 9, **characterized in that** the third portion (26) is positioned over the second connecting wall (21).

12. Combination of a heat exchanger plate according to any of claims 1 to 10 and a gasket (9), wherein the gasket (9) has a volume that is larger than a volume of the groove (12).





EUROPEAN SEARCH REPORT

Application Number
EP 19 20 5283

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	DE 199 00 629 A1 (APV HEAT EXCHANGER AS [DK]) 15 July 1999 (1999-07-15) * column 2, line 17 - column 4, line 9; figures 1-4 *	1-12	INV. F28F3/10 F28F3/08 F28F3/04
Y	WO 2010/056183 A2 (ALFA LAVAL CORP AB [SE]; HOLM MARTIN [SE] ET AL.) 20 May 2010 (2010-05-20) * page 6, line 13 - page 19; figures 1-4 *	1-12	
A	WO 2009/080692 A1 (ALFA LAVAL CORP AB [SE]; KRANTZ JOAKIM [SE]; SVENSSON MAGNUS [SE]) 2 July 2009 (2009-07-02) * the whole document *	1-12	
A	WO 2010/092556 A1 (CIPRIANI LUCA [IT]) 19 August 2010 (2010-08-19) * the whole document *	1-12	
A	WO 2005/045346 A1 (APV PRODUCTS AS [DK]; SOEHOLM FINN [DK]; JENSEN BENNY [DK]) 19 May 2005 (2005-05-19) * the whole document *	1-12	TECHNICAL FIELDS SEARCHED (IPC) F28F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 7 April 2020	Examiner Axters, Michael
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 19 20 5283

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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07-04-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19900629 A1	15-07-1999	DE 19900629 A1	15-07-1999
		DK 2798 A	13-07-1999
		JP H11248391 A	07-09-1999
		US 6073687 A	13-06-2000
WO 2010056183 A2	20-05-2010	BR PI0921060 A2	15-12-2015
		CN 102239378 A	09-11-2011
		DK 2344826 T3	04-07-2016
		EP 2344826 A2	20-07-2011
		ES 2573485 T3	08-06-2016
		JP 5553836 B2	16-07-2014
		JP 2012508863 A	12-04-2012
		KR 20110069861 A	23-06-2011
		PL 2344826 T3	31-08-2016
		PT 2344826 E	02-06-2016
		RU 2011123885 A	20-12-2012
		SE 0802382 A1	13-05-2010
		US 2011247790 A1	13-10-2011
		WO 2010056183 A2	20-05-2010
WO 2009080692 A1	02-07-2009	AU 2008340051 A1	02-07-2009
		BR PI0821554 A2	16-06-2015
		CA 2707654 A1	02-07-2009
		CN 101918784 A	15-12-2010
		EP 2232189 A1	29-09-2010
		ES 2574633 T3	21-06-2016
		JP 5698984 B2	08-04-2015
		JP 2011506907 A	03-03-2011
		KR 20100102613 A	24-09-2010
		NZ 585719 A	29-06-2012
		RU 2010130536 A	27-01-2012
		US 2010276125 A1	04-11-2010
		WO 2009080692 A1	02-07-2009
WO 2010092556 A1	19-08-2010	EP 2396617 A1	21-12-2011
		ES 2524722 T3	11-12-2014
		PL 2396617 T3	29-05-2015
		WO 2010092556 A1	19-08-2010
WO 2005045346 A1	19-05-2005	AT 428899 T	15-05-2009
		DK 1709381 T3	17-08-2009
		EP 1709381 A1	11-10-2006
		WO 2005045346 A1	19-05-2005

EPO FORM P0459

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