



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.06.2015 Bulletin 2015/25

(51) Int Cl.:
F28F 3/10 ^(2006.01) **F28F 19/00** ^(2006.01)

(21) Application number: **13197164.0**

(22) Date of filing: **13.12.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

- **Nilsson, Mats**
SE-226 47 Lund (SE)
- **Anehamre, Jonas**
SE-226 47 Lund (SE)

(71) Applicant: **Alfa Laval Corporate AB**
221 00 Lund (SE)

(74) Representative: **Alfa Laval Attorneys**
Alfa Laval Corporate AB
Patent Department
P.O. Box 73
221 00 Lund (SE)

(72) Inventors:
• **Wictor, Clemens**
SE-262 65 Ängelholm (SE)

(54) **Method for producing a plate heat exchanger**

(57) The invention relates to a method for producing a plate heat exchanger (1) comprising a plurality of heat exchanger plates (3), wherein the heat exchanger plates (3) are provided adjacent each other and form a plate package (2) with first plate interspaces (16) for a first medium and second plate interspaces (17) for a second medium, wherein each of the heat exchanger plates comprises portholes (15) which form ports (8, 9, 10, 11) extending through the plate package, a heat transfer area (12), an edge area (13) extending outside the heat transfer area (12) and the ports (8, 9, 10, 11), a gasket groove

(19) extending in the edge area (13) outside the heat transfer area (12) and the ports (8, 9, 10, 11), and wherein a gasket is provided in the gasket groove (19) for tight abutment against an adjacent plate (3) in the plate heat exchanger (1), the heat exchanger plates (3) being at least partly coated with an antifouling coating.

The invention also relates to a heat exchanger plate produced according to the method and to a plate heat exchanger comprising a plurality of such heat exchanger plates.

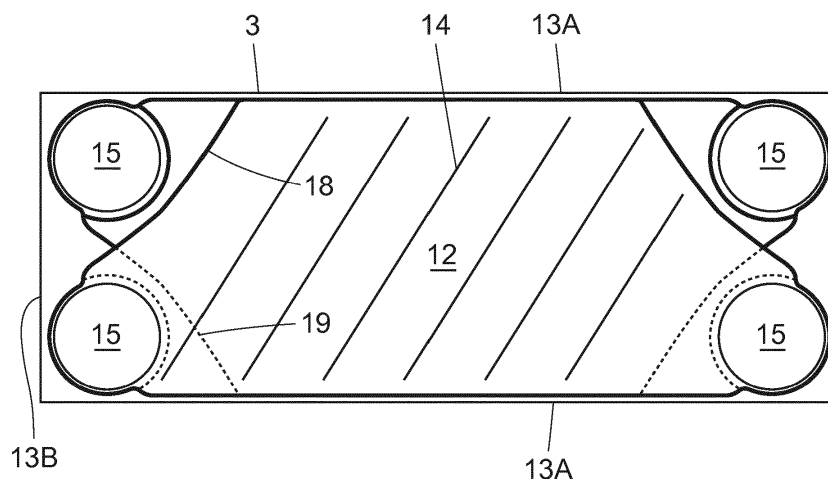


Fig.4

Description

Technical Field

[0001] The invention relates to a method for producing a plate heat exchanger according to the preamble of claim 1.

[0002] The invention also relates to a heat exchanger plate for a plate heat exchanger produced according to the method and to a plate heat exchanger comprising a plurality of such heat exchanger plates.

Background

[0003] Plate heat exchangers provided with gaskets normally comprise a package of heat exchanger plates arranged adjacent to one another. Gaskets are disposed between the heat exchanger plates, or the plates may also be permanently joined together in pairs to form so-called cassettes, e.g. by welding, with gaskets placed between the respective cassettes. The gaskets are accommodated in gasket grooves formed during the form-pressing of the heat exchanger plates. Plate heat exchangers further comprise inlet and outlet ports, which extend through the plate package, for two or more media.

[0004] Heat exchanger plates are normally made by form-pressing of sheet metal and are arranged in the plate package in such a way as to form first plate intermediate spaces which communicate with the first inlet port and the first outlet port, and second plate intermediate spaces which communicate with the second inlet port and the second outlet port. The first and second plate intermediate spaces are disposed alternately in the plate package.

[0005] A heat exchanger plate for a plate heat exchanger, normally includes a heat transfer area and a border area, which is located outside the heat transfer area and which extends along and delimits the heat transfer area. Such a heat exchanger plate further has a number of open portholes. The heat exchanger plates are kept together to a plate package by means of tie bolts.

[0006] The gaskets, which are used between the heat exchanger plates in the plate heat exchanger, are manufactured separately, for instance by compression moulding or injection moulding. The gaskets are usually manufactured in any relatively hard rubber material such as nitrile; EFDM or fluorine rubber. The gasket may be attached to the heat exchanger plate by gluing. The gasket may also include various guide members, for instance so called T-tabs, which extend outwardly from the gasket and which are pressed to attachment in corresponding grooves in the heat exchanger plate.

[0007] Plate heat exchangers are used in many applications where the object is to transfer heat to or from a media having a tendency to stick to a surface, e.g. dairy products. Over time the plates of the plate heat exchangers in use may get fouled by deposits arising e.g. from the fluids in the equipment, microbial growth and/or dirt,

which leads to a decreased heat transfer and increased pressure drop. This results in an overall reduced performance of the heat exchanger. Eventually, it will be necessary to open the plate heat exchanger and clean the heat exchanger plates. Depending on the fluids used in the heat exchanger, the plates may be seriously fouled and difficult to clean, requiring strong detergents and/or powerful mechanical cleaning over a substantial time period in order to restore the performance of the heat exchanger. The cleaning of the plates may both be time consuming and costly. Also, the process system in which the plate heat exchanger is installed may have to be shut down during said cleaning of the plate heat exchanger.

[0008] The plates of heat exchangers are predominantly made of metal sheets. The base material, i.e. metals used, have a high surface free energy resulting in that most liquids easily wet the surface of the sheets. Also, when heat exchanger plates are produced the forming operation of sheet metal increases the surface roughness which often is associated with faster build-up of fouling deposits. In order to avoid sticking of the media to the heat transfer surface different kinds of anti-fouling coatings are used in order to prevent media from adhering to the surface of the plates and to keep the heat exchangers running for longer time periods. Anti-fouling coatings further provides for easier cleaning and a reduced shut down time for processes where plate heat exchangers are involved.

[0009] A problem encountered with presently known plate heat exchanger provided with antifouling coatings is the phenomenon of "snakeing", i.e. a phenomenon wherein the plates of the plate package slide when they are assembled or a short period after they are assembled. This problem is related to the non-sticking surface properties of anti-fouling coated plates and to the lack of or low friction between the anti-fouling surface in the gasket groove and the gasket. Furthermore, cracks in the coating may occur due to torque and tension forces acting on the plates when the plate package is exhibiting snakeing.

Summary

[0010] It is an object of the invention to at least partly overcome one or more limitations of the prior art.

[0011] Another objective is to provide a method for producing a plate heat exchanger provided with an antifouling coating wherein the phenomenon of "snakeing" has been eliminated or at least alleviated in comparison with previously known plate heat exchangers.

[0012] This object has been achieved by a method for producing a plate heat exchanger which is characterized in that the longitudinal portions of the gasket groove are covered by a sealing material on each side of the plate before the anti-fouling coating is applied, the plates are coated by an anti-fouling coating, and the sealing material is removed.

[0013] A further object is to provide a plate for a plate

heat exchanger and a plate heat exchanger having an antifouling coating that can be manufactured at low cost. These objects have been achieved by the plate according to claim 2 and by the plate heat exchanger according to claim 3.

[0014] Still other objects, features, aspects and advantages of the present invention will appear from the following detailed description, from the attached claims as well as from the drawings.

Brief Description of the Drawings

[0015] The invention will now be described in more detail with reference to the appended schematic drawings, in which

Fig. 1 discloses schematically a side view of a plate heat exchanger.

Fig. 2 discloses schematically a plan view of the plate heat exchanger in Fig. 1.

Fig. 3 discloses schematically a heat exchanger plate of the plate heat exchanger in Fig. 1.

Fig. 4 discloses the heat exchanger plate in Fig. 3 with gaskets provided.

Detailed Description of Embodiment Examples

[0016] Figs 1 and 2 disclose a plate heat exchanger 1 comprising a plate package 2 having heat exchanger plates 3 which are provided beside each other. The plate package 2 is provided between two end plates 4 and 5 which may form a frame plate and a pressure plate, respectively. The end plates 4 and 5 are pressed against the plate package 2 and against each other by means of tie bolts 6 which extend through the end plates 4 and 5. The tie bolts 6 comprise threads and the plate package 2 may thus be compressed by screwing nuts 7 on the tie bolts 6 in a manner known per se. In the embodiment disclosed, four tie bolts 6 are indicated. It is to be noted that the number of tie bolts 6 may vary and be different in different applications.

[0017] The plate heat exchanger 1 comprises according to the embodiments described also a first inlet port 8 and a first outlet port 9 for a first medium, and a second inlet port 10 and a second outlet port 11 for a second medium. The inlet and outlet ports 8-11 extend in the embodiments disclosed through one of the end plates 4 and the plate package 2. The ports 8-11 may be arranged in many different ways and also through the second end plate 5.

[0018] Each heat exchanger plate 3 comprises a heat transfer area 12 and an edge area 13, which extends around and outside the heat transfer area 12. The heat transfer area 12 is in the embodiment disclosed substantially centrally located on the heat exchanger plate 3, and in a known manner provided with a corrugation 14 of ridges and valleys. The corrugation 14 is obtained through compression-moulding of the metal sheet. In the

embodiment disclosed, the corrugation 14 has merely been indicated schematically as extending obliquely over the heat transfer area 12. It is to be noted that the corrugation 14 also may comprise significantly more complicated extensions of the ridges and valleys, for instance along the fishbone pattern known per se. Also heat exchanger plates 3 having a substantially plane heat transfer area may be used within the scope of this invention. The edge area 13 have longitudinal portions 13A extending along the longitudinal edges of the heat exchanger plates 3 and short end portions 13B situated in the edge area 13 of the short ends of the plates 3.

[0019] Each heat exchanger plate 3 also comprises a number of portholes 15, in the embodiment disclosed four portholes 15, which extend through the heat exchanger plate 3 and are located inside and in the proximity of the edge area 13. The portholes 15 are located in the proximity of a respective corner of the heat exchanger plate 3 and are substantially concentric with the above mentioned inlet and outlet ports 8-11 of the plate heat exchanger 1.

[0020] The base material for the plates may be chosen from several metals and metal alloys. Preferably, the base material is chosen from titanium, nickel, copper, any alloys of the before mentioned, stainless steel and/or carbon steel. However, titanium, any alloys of the before mentioned or stainless steel is preferred.

[0021] The heat exchanger plates 3 are provided in such a manner in the plate package 2 that first plate interspaces 16, which communicate with the first inlet port 8 and the first outlet port 9, and second plate interspaces 17, which communicate with the second inlet port 10 and the second outlet port 11, are formed, see fig 1. The first and second plate interspaces 16 and 17 are provided in an alternating order in the plate package 2.

[0022] Such a separation of the plate interspaces 16, 17 may be achieved by means of one or several gaskets 18, which extend in gasket grooves 19 which are formed during the compression-moulding of the heat exchanger plates 3. The gasket groove 19 of each heat exchanger plate 3 extends, as can be seen in fig. 3, between the heat transfer area 12 and the edge area 13, in the longitudinal portions 13A extending along the longitudinal edges of the heat exchanger plates 3 and in the short end portions 13B situated in the edge area 13 of the short ends of the plates 3, around the heat transfer area 12 and around each of the portholes 15.

[0023] At each heat exchanger plate 3 a gasket 18 is, in the embodiments disclosed, provided before the mounting of the plate heat exchanger 1. The gasket 18 extends in a part of the gasket groove 19 in such a way that the gasket 18 encloses the heat transfer area 12 and two of the portholes 15 and also each of the two remaining portholes 15. The gasket 18 thus forms three separate areas which are delimited from each other by means of the gasket 18. It is to be noted that the gasket 18 does not necessarily need to be shaped as one single gasket but may also consist of several different gaskets.

[0024] During the mounting, every second heat exchanger plate 3 may be rotated 180°, for instance around a central normal axis or round a central longitudinal axis. Thereafter the heat exchanger plates 3 are compressed so that the desired first and second plate interspaces are obtained. In the plate package 2, the first medium may be introduced through the first inlet port 8, through the first plate interspaces 16 and out through the first outlet port 9. The second medium may be introduced through the second inlet port 10, through the second plate interspaces 17 and out through the second outlet port 11. The two media may for instance be conveyed in a counter current flow, as indicated in figs. 2 and 3, or in parallel flow in relation to each other.

[0025] In the embodiments described, the portholes 15 have a cylindrical or substantially circular shape. The portholes 15 may however also have any other suitable regular or irregular shape, for instance an oval shape or a polygonal shape, for instance a triangular, a square, a pentagonal etc. shape suitably with somewhat rounded corners. Furthermore, the heat exchanger plate 3 may be used in various plate heat exchanger applications and include fewer or more than the portholes disclosed.

[0026] According to the method of the invention the gasket groove 19 in the longitudinal portions 13A of the edge area 13 extending along the longitudinal edges of the heat exchanger plates 3 is covered by a sealing material before the antifouling coating is applied. The plates are then coated on at least one side by the antifouling coating, such that the antifouling coating is not applied on the surfaces of the gasket groove. If both sides of the plate is to be coated by the antifouling coating, then both sides of the gasket groove 19 should be covered by the sealing material. The sealing material may cover only the gasket groove per se or all of the longitudinal portions 13A of the edge area 13. The sealing material may be a removable piece of adhesive or tape, known in the art. The gasket groove may also be masked by a fixture holding the plate and covering the gasket groove 19 on one side or both the front and back sides during the coating. After the antifouling coating step the sealing material is removed.

[0027] By protecting the gasket groove 19 from being coated by the antifouling material a clean metal surface is achieved in the gasket groove. The clean metal has a higher friction to the gasket 18 which is to be arranged in the gasket groove 19 when the heat exchanger is assembled. The higher friction between the gasket groove 19 and the gasket 18 prevents the gasket 18 from sliding and accordingly the plates 3 in the plate package 2 from sliding. The method is quick, cheap and easy to implement in order to manufacture a plate heat exchanger which does not show the phenomenon of "snakeing" i.e. gliding of the gaskets and the plates in the plate package such that the plate package is distorted. The method of the invention provides a quick and easy method by which a higher friction is achieved between the plates and the gaskets at the same time as the remaining part of the

plates are covered by the antifouling coating and experiencing all the benefits of the coating.

[0028] The coating used according to the present invention may be referred to as a non-stick coating or an antifouling coating and makes it easy to clean the plates of a fouled heat exchanger. The coated plates according to the present invention show a better heat transfer over time compared to conventional heat exchanger plates since the latter ones gets fouled much quicker and thus decrease the heat transfer performance to a larger extent. The coating of the plates also results in a much more even surface thus resulting in better flow characteristics. Also the pressure drop is reduced over time for a plate heat exchanger according to the present invention in comparison with conventional plate heat exchangers, since the buildup of impurities, microorganisms and other substances is not as pronounced.

[0029] The coated plates according to the present invention may easily be cleaned just using high pressure washing with water. With a plate according to the present invention there is no need for extensive time consuming mechanical cleaning or cleaning using strong acids, bases or detergents, such as e.g. NaOH and HNO₃.

[0030] The invention is not limited to the described embodiments but may be varied and modified within the scope of the following claims.

Claims

1. Method for producing a plate heat exchanger (1) comprising a plurality of heat exchanger plates (3), wherein the heat exchanger plates (3) are provided adjacent each other and form a plate package (2) with first plate interspaces (16) for a first medium and second plate interspaces (17) for a second medium, wherein each of the heat exchanger plates comprises portholes (15) which form ports (8, 9, 10, 11) extending through the plate package, a heat transfer area (12), an edge area (13) extending outside the heat transfer area (12) and the ports (8, 9, 10, 11), a gasket groove (19) extending in the edge area (13) outside the heat transfer area (12) and the ports (8, 9, 10, 11), and wherein a gasket is provided in the gasket groove (19) for tight abutment against an adjacent plate (3) in the plate heat exchanger (1), the heat exchanger plates (3) being at least partly coated with an antifouling coating, **characterized in that** longitudinal portions (13A) of the gasket groove (19) are covered by a sealing material on at least one side of the plates (3) before the antifouling coating is applied the plates (3) are coated by an anti-fouling coating on at least one side, and

the sealing material is removed.

2. A heat exchanger plate for a plate heat exchanger produced according to the method of claim 1, **characterised in that** the heat exchanger plate (3) on at least one side has an antifouling coating on the heat transfer area (12) and on the edge areas (13) on the short end portions (13B) of the plate (3). 5
3. A plate heat exchanger comprising a plurality of heat exchanger plates (3) according to claim 2, the heat exchanger plates (3) being arranged beside each other to define several first plate interspaces (16) for a first medium and several second plate interspaces (17) for a second medium. 10 15

20

25

30

35

40

45

50

55

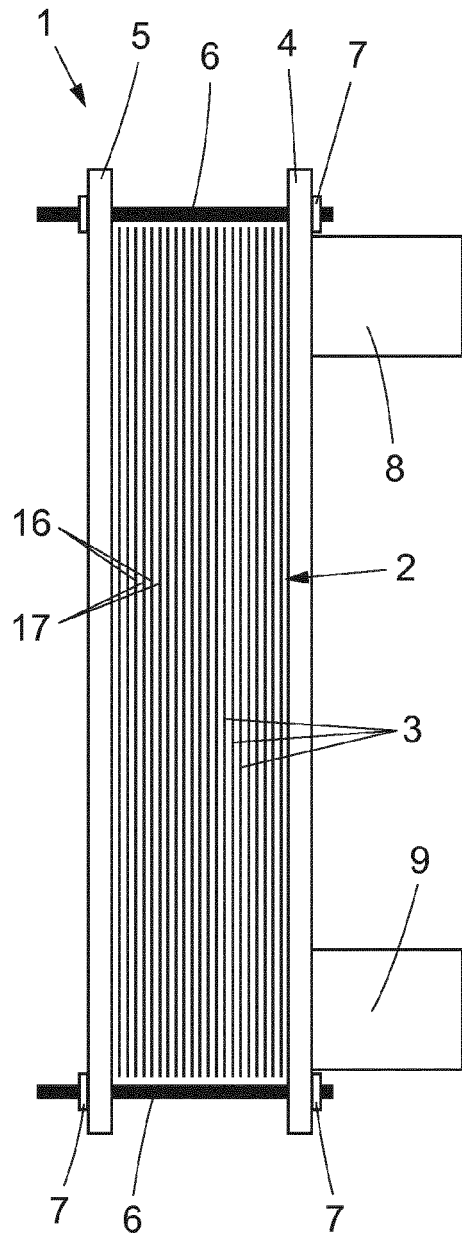


Fig.1

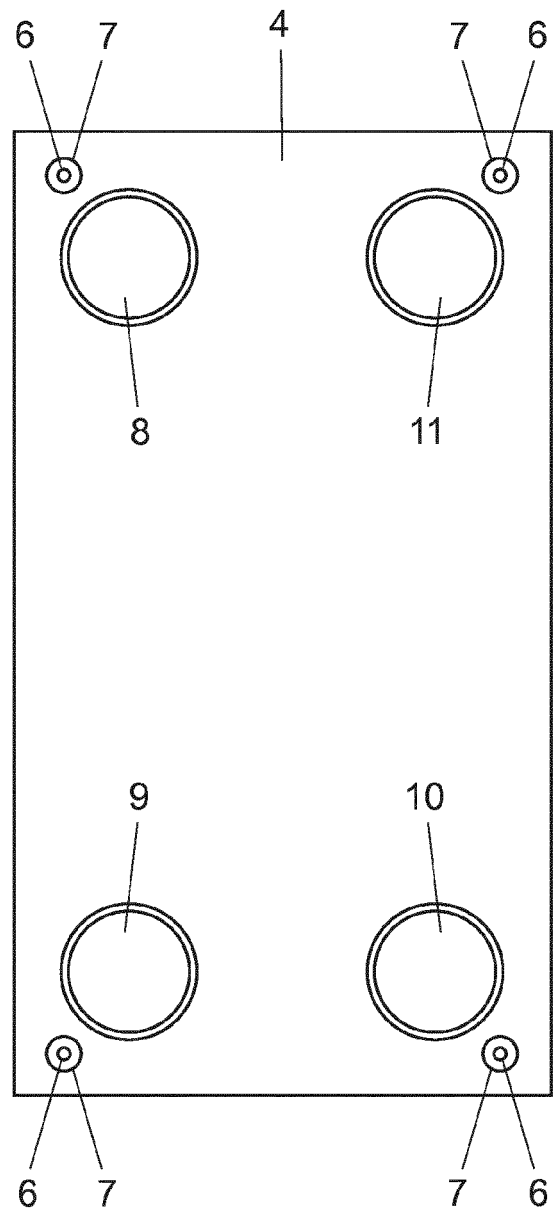


Fig.2

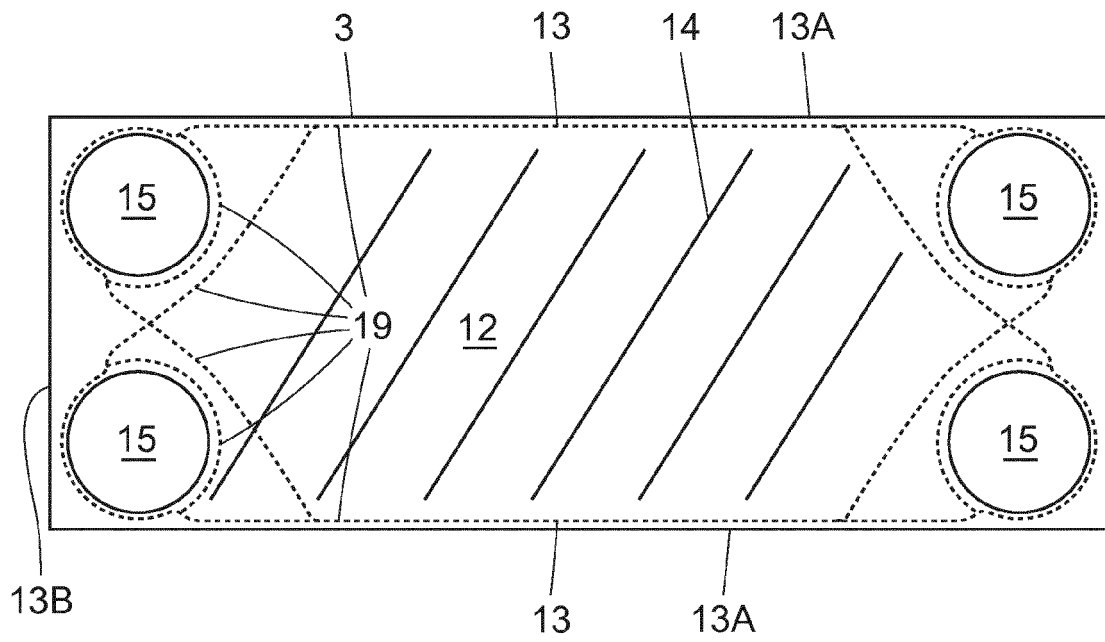


Fig.3

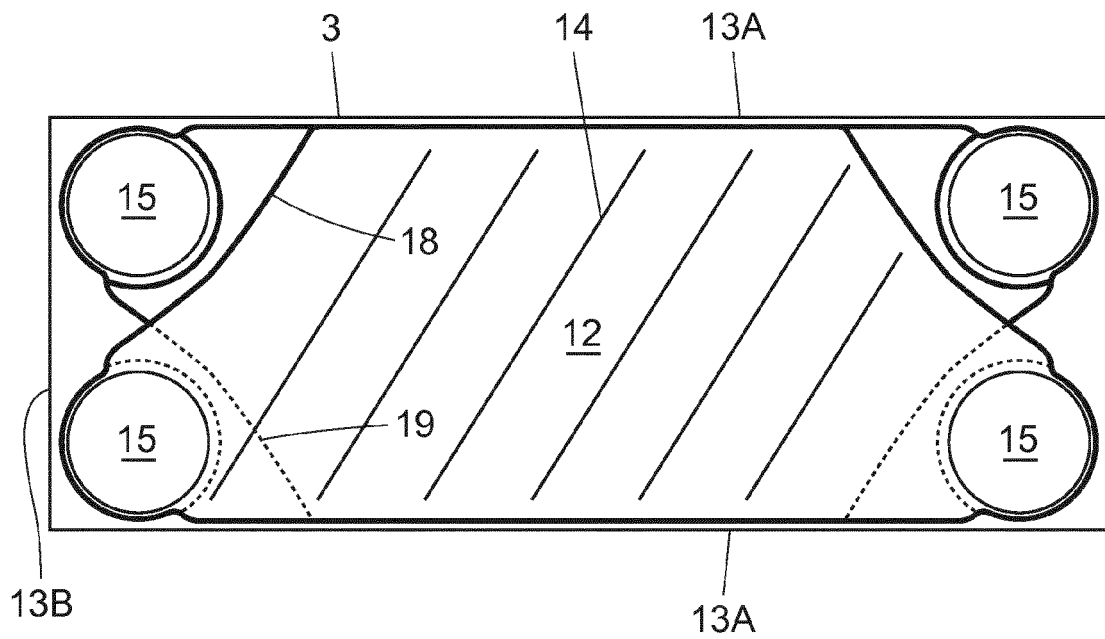


Fig.4



EUROPEAN SEARCH REPORT

Application Number
EP 13 19 7164

5

10

15

20

25

30

35

40

45

50

55

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	WO 2012/018296 A1 (ALFA LAVAL CORP AB [SE]; ANEHAMRE JONAS [SE]) 9 February 2012 (2012-02-09) * page 1, line 2 - line 5 * * figure 2 * * page 5, line 25 - line 31 * * page 5, line 19 - line 25 * * page 5, line 31 - page 6, line 2; figure 1 * * page 5, line 21 - line 22 * -----	1-3	INV. F28F3/10 F28F19/00
Y	US 6 261 422 B1 (MINGAZHEV ASKAR DZHAMILEVICH [RU]) 17 July 2001 (2001-07-17) * column 1, line 18 - line 36 * -----	1-3	TECHNICAL FIELDS SEARCHED (IPC) F28F
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 16 June 2014	Examiner Mendão, João
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 03.92 (P04C01)

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

EP 13 19 7164

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

16-06-2014

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2012018296 A1	09-02-2012	CA 2798153 A1	09-02-2012
		CN 102906527 A	30-01-2013
		EP 2577209 A1	10-04-2013
		JP 2013528276 A	08-07-2013
		WO 2012018296 A1	09-02-2012

US 6261422 B1	17-07-2001	NONE	

15

20

25

30

35

40

45

50

55

EPO FORM P0459

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