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(12) # EUROPEAN PATENT SPECIFICATION

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(56) References cited:
**DE-C- 832 975**
**FR-A-2 156 131**
**FR-A-2 295 389**
**GB-A- 493 490**
**GB-A- 513 724**
**GB-A-2 028 996**
**GB-A-2 075 656**
**US-A-4 377 204**

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**Description**

This invention relates to plates for heat transfer apparatus, such as heat exchangers or evaporators.

In such heat transfer apparatus heat is transferred between two thin, broad streams, which may be both of liquid or one stream of liquid and one stream of vapour or two streams of vapour, or in some cases one or both streams may have mixed liquid and vapour phases. The streams are separated by plates assembled in a spaced face to face relationship to provide flow spaces between the adjacent faces of the plate. The boundaries of the flow spaces are enclosed and sealed by flexible or resilient gaskets surrounding the flow spaces between the flow spaces and entry and exit ports. The ports, in plate heat exchangers usually one at each corner of the plate, are similarly surrounded or part-surrounded by gaskets.

A substantially similar construction to that used in plate heat exchangers has also been employed in tissue-culture vessels, which makes advantageous use of the large surface area afforded by such a construction. In such vessels the gasketing contains a possibly pathogenic organism and in some embodiments is subjected to the thermal shock associated with steam cleaning, it is therefore of the utmost importance that the gaskets sealing ability is not compromised.

Each gasket is normally of a one piece construction set within a pressed groove formed in the plate.

The manufacture of the gasket is normally carried out in moulds, but according to the size of the plate or the manufacturing techniques used the gasket may be assembled from two or more smaller components. The gaskets are normally moulded of an elastomeric material.

The sealing force against the fluid pressure in the flow space is obtained by compression of the gaskets in a direction normal to the plate surface and the resistance to gasket extrusion from the proper sealing position in the groove is normally enhanced by securing the gasket to the plate surface by the application of a system of adhesion, which is necessary in certain applications in order to minimise gasket movement which would result in leakage. Such movements can arise because changes in the loading condition of one gasket will alter the condition of the gasket on either side, and, perhaps of greater importance, the gaskets are assembled into the groove which is formed from this sheet material and which is therefore flexible. This system of adhesion is frequently complex and time consuming, involving the application of an adhesive to both the gasket and the plate surface, and assembly of the two components together. According to the system which is adopted, it may be necessary to prepare the mating surface of either component before assembly and it may be necessary to subject the assembled components to a process designed for curing the bond after assembly.

The foregoing description covers the initial manufacturing process. It is common practice that as the elastomeric gasket material hardens and deforms in use with the passage of time, the servicing of the plate heat exchanger at the user's factory requires the replacement of the gasket. Removal of the old gasket requires destruction of the adhesive bond and cleaning of the groove. Also, it is not always possible to subject the newly assembled gasket to the optimum process of adhesion such as would be applied during initial manufacture by the supplier.

It is an object of the invention to provide mechanical engagement of the gasket with the plate so as to avoid the necessity for a system of adhesion.

It is well understood in industrial practice to form a seal groove in the face of one component, which groove has an opening smaller in dimension than the resilient gasket which has to be inserted through the opening. The gasket is thus releasably secured by its own resilience. Such a groove is difficult to form in a pressed plate in that it would not be readily produced in a one-hit pressing operation.

It is a known practice in the manufacture of plate heat exchangers to attach a resilient gasket to an aperture in a substrate material by pushing somewhat oversize projections through apertures located in the floor of the groove.

It has also been suggested, that the gasket should be secured to a surface by fixing means such as a mask, or such as tabs which are attached to or integral with the gasket and are secured to the surface outside of the sealing area. The latter method is illustrated in the DE—C—832 975.

A further known gasket, as best illustrated in the US—A—4 377 204 teaches that the tab should lie in a trough, and be attached by the known oversize projection method related above.

According to the present invention there is provided a heat transfer plate at least partially bounded by a groove receiving a gasket in general conformity therewith and protruding somewhat thereabove so as to seal against an adjacent similar plate, wherein

(a) said groove comprises an inner side wall and an outer side wall,

(b) the outer side wall of the groove is provided with a number of lateral bays, the gasket being formed with a number of corresponding spaced projections engaging in and matching with the said bays,

(c) the said projections including means for locally and mechanically securing the gasket to the plate at the location of the said bays (see GB—A—2 075 656). This plate is characterised in that

(d) the base of each said lateral bay is at a level intermediate that of the base of the outer side wall of the groove and the upper level thereof, and in that

(e) each bay is closed at its outer end by a wall formed integrally with the plate so that it does not communicate with the ambient, thereby limiting

movement of the gasket material along the bay.

In an embodiment, the means for securing the gasket to the plate comprises an aperture in the plate which co-operates with a stud provided on the gasket.

The invention will be further described with reference to the accompanying drawings in which:—

Figure 1 is a plan view of a known heat transfer plate;

Figure 2 is a section on the ine X—X of Figure 1;

Figure 3 is an elevational view of one form of gasket groove.

Figure 4 is an enlarged section on the line Y—Y of Figure 3, with the gasket added;

Figure 5 is an elevation of another form of gasket; and

Figure 6 is an enlarged section of Figure 5.

Figure 1 shows an outline of a conventional heat exchanger plate in which the plate 1 has the usual entry and exit ports 2 and the central heat transfer area 3 surrounded by a resilient gasket 4. As shown in Figure 2, which is a section XX through the gasket (shown dashed), the gasket 4 is mounted in a pressed groove 5 and attached to the plate by means of an oversizxe projection 6, which protrudes through a hole 11, at a fixing point located in a trough 7.

One problem with this arrangement is that the considerable overpressures which occur in the flow spaces of a heat exchanger extrude the gasket 4 along the trough 7, and cause the sealing to fail at these fixing points.

In another well known form of plate design the gasket groove 19, as shown in Figure 3, is provided with lateral enlargements in the vertical wall 20 as shown at 11. By this means the width of the gasket groove is locally enlarged. It is proposed that between some or all of these enlargements the groove edge 20 should be formed with a rear wall as indicated by the numeral 27 and as shown in Figure 4, to provide lateral bays 21 in the gasket groove.

In a preferred form of the invention the lateral bays 21 are provided with apertures 25 and protuberances 10 are provided on the gasket, being manufactured to such dimensions that the protuberances will be slightly compressed when entering the apertures so that the gasket 8 and plate 3 will remain assembled, but can be disassembled by pulling the gasket away from the plate.

It should be noticed that the wider portions of the gasket groove are normally positioned to alternate one with another from plate to plate, and thus in this embodiment the protuberances 10 remain unaffected by compression when the plate pack is tightened to operable conditions, because the apertures 25 and protuberances 10 are well removed to one side of the sealing surface of the gaskets.

It should be understood that the apertures 25 are not restricted in their placement to the base of the bay 21 but may be located in such side walls.

In an alternative form of the invention shown in figures 5 and 6, the bay 30 is not located between two enlargements, but provided in the flat outer wall 31 of a gasket groove 32. An aperture 33a is provided in the base of the bay thereby enabling the gasket to be secured to the heat transfer plate. Furthermore, in this embodiment the bay 30 is rectilinear rather than curvilinear as in the embodiment of figure 3.

The embodiments of the invention illustrated in the accompanying drawings and described herein have a common feature that the gasket sealingly engages the rear wall generally indicated by the numeral 27. This engagement limits extrusion of the gasket material along the bay of the groove and thereby prevents "blowing out" of the gasket at these points. Furthermore the floor of the bay, (for example indicated as 33 in figure 6) is always at a level other than the floor of the groove (indicated by 34 in figure 6). This difference in level aids engagement between the gasket and the heat-transfer plate.

Various modifications may be made within the scope of the invention, for example, the gasket may be formed with recesses in the exposed face adapted to seal against the adjacent plate to receive the ends of the projections from the gasket in the groove in that adjacent plate.

**Claims**

1. A heat transfer plate at least partially bounded by a groove (32) receiving a gasket (8) in general conformity with the groove and protruding somewhat thereabove so as to seal against an adjacent similar plate, wherein said groove (32) comprises an inner side wall and an outer side wall (31), the outer side wall (31) of the groove (32) is provided with a number of lateral bays (30), the gasket (8) being formed with a number of corresponding spaced projections engaging in and matching with the said bays (30), the said projections including means for locally and mechanically securing the gasket (8) to the plate at the location of the said bays (30), characterised in that the base (33) of each said lateral bay (30) is at a level intermediate that of the base (34) of the outer side wall (31) of the groove (32) and the upper level thereof, and in that each bay is closed at its outer end by a wall (27) formed integrally with the plate so that it does not communicate with the ambient, thereby limiting movement of the gasket material along the bay.

2. A plate according to claim 1, characterised in that the means for securing the gasket to the plate comprises an aperture (33a) in the plate in the region of the lateral bay and a matching stud or protuberance on the projection.

3. A heat transfer apparatus comprising a pack of plates according to claim 1 or 2.

**Patentansprüche**

1. Zumindest teilweise durch eine Rille (32) begrenzte Wärmeübertragungsplatte, die eine der Rille im allgemeinen entsprechende und etwas

überstehende Dichtung (8) aufnimmt, um gegen eine angrenzende ähnliche Platte abzudichten, wobei die genannte Rille (32) eine innere Seitenwand und eine äußere Seitenwand (31) aufweist, die äußere Seitenwand (31) der Rille (32) mit einer Anzahl von Ausbuchtungen (30) versehen ist, und die Dichtung (8) eine Anzahl von korrespondierenden mit Abstand angeordneten Vorsprüngen aufweist, die in die genannten Ausbuchtungen (30) eingreifen und diesen entsprechen und Mittel aufweisen, mit denen die Dichtung (8) örtlich und mechanisch in den genannten Ausbuchtungen (30) befestigt werden kann, dadurch gekennzeichnet, daß der Boden (33) jeder Ausbuchtung (30) auf einer Ebene zwischen jener des Bodens (34) der äußeren Seitenwand (31) der Rille (32) und deren Obergrenze liegt, und daß jede Ausbuchtung an ihrem äußeren Ende von einer Wand (27) abgeschlossen ist, die mit der Platte einstückig geformt ist, sodaß sie mit der Umgebung nicht in Verbindung steht, und die Bewegung des Dichtungsmaterials entlang der Ausbuchtung eingeschränkt ist.

2. Platte nach Anspruch 1, dadurch gekennzeichnet, daß die Mittel zur Befestigung der Dichtung an der Platte eine Öffnung (33a) in der Platte im Bereich der Ausbuchtung und entsprechend einen Ansatz oder eine Noppe auf dem Vorsprung aufweisen.

3. Wärmeübertragungsvorrichtung mit einem Stapel von Platten nach Anspruch 1 oder 2.

**Revendications**

1. Plaque pour le transfert de chaleur délimitée au moins partiellement par une gorge (32) recevant un joint d'étanchéité (8) épousant cette gorge dans son ensemble et faisant saillie légèrement au-dessus de celle-ci de façon à assurer l'étanchéité contre une plaque analogue voisine, la gorge (32) comportant une paroi latérale intérieure et une paroi latérale extérieure (31), la paroi latérale extérieure (31) de la gorge (32) présentant un certain nombre de parties latérales en forme de niche (30), le joint d'étanchéité (8) présentant un certain nombre de saillies espacées correspondantes s'engageant dans ces parties en forme de niche (30) et les épousant, lesdites saillies comportant des moyens permettant de fixer localement et mécaniquement le joint d'étanchéité (8) sur la plaque à l'emplacement desdites parties en forme de niche (30), caractérisée en ce que le fond (33) de chacune desdites parties latérales en forme de niche (30) est situé à un niveau qui est intermédiaire entre celui de la base (34) de la paroi latérale extérieure (31) de la gorge (32) et son niveau supérieur et en ce que chaque partie en forme de niche est fermée à son extrémité extérieure par une paroi (27) réalisée venue de matière avec la plaque de façon qu'elle ne communique pas avec l'environnement, limitant ainsi le déplacement de la matière du joint d'étanchéité le long de la partie en forme de niche.

2. Plaque suivant la revendication 1, caractérisée en ce que les moyens permettant de fixer le joint d'étanchéité sur la plaque comprennent une ouverture (33a) ménagée dans cette plaque dans la zone de la partie latérale en forme de niche et un téton ou protubérance prévu sur la saillie et épousant cette ouverture.

3. Apparail pour le transfert de chaleur comprenant un empilement de plaques suivant la revendication 1 ou 2.

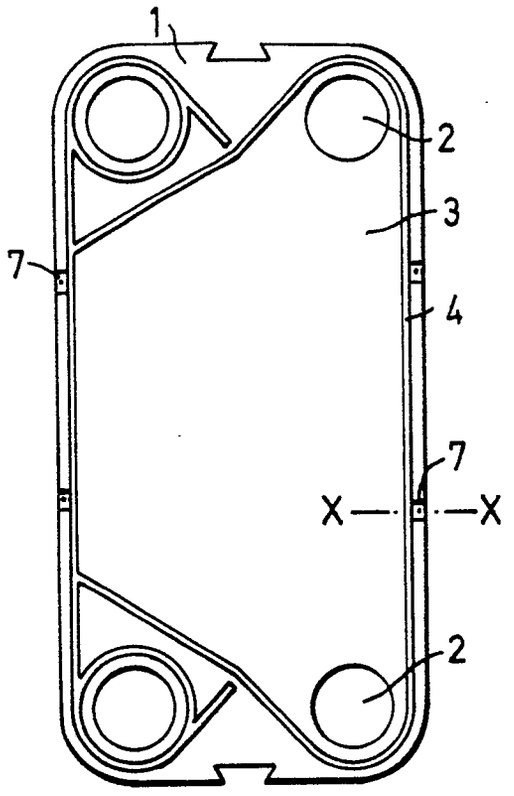



FIG.1.

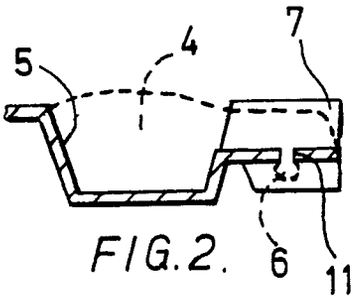



FIG.2.

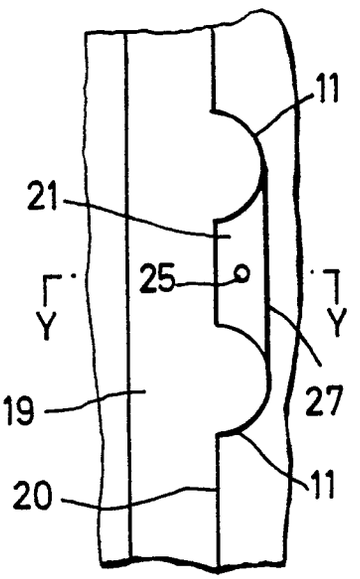



FIG.3.

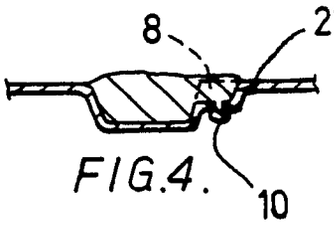
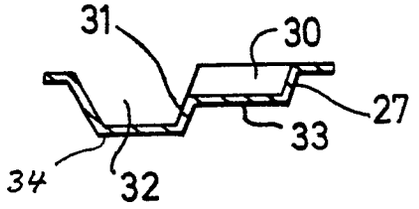



FIG.4.



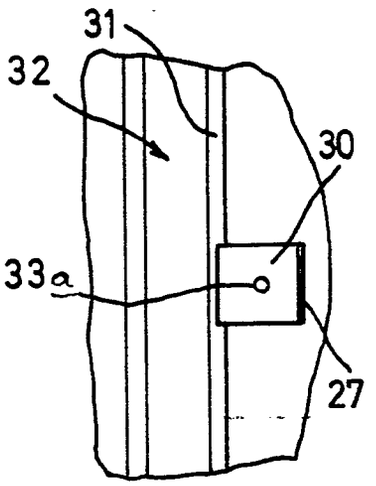




FIG.5.