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(73) Proprietor: **APV INTERNATIONAL Limited**
Manor Royal
Crawley West Sussex RH10 2QB (GB)

(72) Inventor: **Bond, Michael Peter**
"Cedar House" 2 Cobbett Close Pound Hill
Crawley Sussex (GB)

(74) Representative: **Smith, Geoffrey Leonard et al,**
Marks & Clerk 57/60 Lincoln's Inn Fields
London WC2A 3LS (GB)

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Heat transfer plate having a gasket groove and method of forming such a groove

This invention relates to the gasketing of plate heat transfer apparatus.

A plate heat transfer apparatus, i.e. either a plate heat exchanger or a plate evaporator, consists of a series of plates arranged in a spaced, face-to-face, parallel relationship to form flow spaces between the plates. The boundaries of the flow spaces are formed and sealed by gaskets which are normally mounted in grooves pressed into the plates. The gaskets are normally of a rubber or rubber-like material and are retained in their respective grooves by adhesive. The initial mounting of the gaskets in the grooves is a fairly time consuming process involving surface preparation, application of adhesive, location of the gasket in the groove and probably curing of the adhesive. When the gasket needs to be replaced, the old gasket has to be stripped out, the metal surface cleaned of old adhesive and then the new gasket has to be mounted with all that entails.

If, instead of being pressed, the gasket recesses were precision machined grooves, the sealing could be more easily obtained by using preformed O-ring, lip or other similar seals which would be a close mechanical fit in the grooves and would therefore not need to be retained by adhesive. However, when using the usual metal thickness (e.g. 0.7 mm) of plate heat transfer apparatus, precision machining of grooves is not practicable and for many years the use of adhesive has been the normal practice in the industry.

A possible solution to this problem was disclosed in GB—A—1 273 139, which provides a single sealing element so shaped in cross-section that when compressed between a pair of adjacent plates a groove opens on its inner periphery, the groove being arranged to receive pressurized fluid, expand the groove and urge the sealing element more firmly into engagement with the adjacent plates. However, only minor variations would be catered for by this sealing element and the flexibility of the sealing element demanded the provision of integral plate spacing portions.

It is intended that the present invention should disclose a replaceable seal and a method of forming a seal which does not require an accurately machined groove in the metal plate, adhesive fixing of the sealing gasket or a specially manufactured sealing gasket.

According to a first aspect of the present invention, there is provided a pressed metal heat transfer plate having a pressed gasket groove characterized in that said pressed groove is at least partially filled with a rigid plastics material which adheres to the plate metal and which is formed in situ with an accurate recess adapted to receive and retain by a close mechanical fit, a preformed seal of O-ring, lip or other appropriate type.

By using an intermediate filling of plastics material permanently attached to the plate metal, no adhesive is required to attach the sealing gasket, conventional commercially available gasket forms may be used, the gasket loading may be reduced, which leads to easier tightening of the frame of the heat transfer apparatus, the application of the gasket can be automated more easily and the replacement of gaskets is facilitated.

Conveniently the heat transfer plate may be characterised in that the plastics material is formed with two or more accurate recesses to receive seals so as to provide a double or multi-fold seal between the flow spaces and the environment.

Preferably the heat transfer plate may be characterised in that the space between the seals of the double seal is monitored for leaking fluid.

More preferably the heat transfer plate may be characterised in that the monitoring is achieved by circulating a gas or liquid through the space.

According to a second aspect of the invention, there is provided a method of forming an accurately profiled gasket recess in a pressed metal heat-transfer plate, characterised by the steps of forming a pressed groove in the metal plate, at least partially filling the pressed groove with a rigid plastics material which adheres to the metal of the plate, and accurately forming, in situ, the gasket recess in the plastics material.

Conveniently the method may be characterised in that two or more parallel gasket recesses are formed in the plastics material.

Conveniently the method may be characterised in that the or each gasket recess may be formed by moulding or by machining the plastics material.

According to a third aspect of the invention there is provided a heat transfer apparatus comprising a pack of heat transfer plates as above defined.

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

Figure 1 is an elevation of a form of heat exchanger plate in accordance with a form of the present invention and having a double seal gasket;

Figure 2 is a section on the line II—II of Figure 1; and

Figures 3 and 4 are each diagrammatic sections similar to Figure 2 showing a form of single seal applied according to the techniques of the present invention.

For the sake of clarity the mechanical retention of the seal is not shown in Figures 2 to 4.

Turning first to Figure 1, a heat exchanger plate is illustrated at 1 and as having four corner

ports 2, 3, 4 and 5. The line of a peripheral gasket, of double seal form is indicated at 6, and it will be noted that the corner ports 4 and 5 also have port gaskets 7, also of double seal nature.

Figures 2 to 4 each show a portion of the heat exchanger plate 1 as being provided with a pressed in gasket recess 8.

In order that this recess 8 may be converted to a form sufficiently accurate for a preformed seal 6, it is filled with a plastics material 9 which has the property of adhering to the metal of the plate 1 and which is formed, either by pressure moulding or by machining, or a combination of both, with an accurately formed recess 10 to receive the seal.

The plastics material can be moulded under pressure so as simultaneously to fix it in the pressed groove and to form a suitably profiled recess 10, for the seal. Alternatively, the plastics material can be roughly sculptured and, when cured, machined to form the final shape of the recess 10.

In Figure 3 the seal is shown in the form of a single O-ring seal 12.

In Figure 4, the O-ring seal 12 is shown as being replaced by a lip seal 13.

In accordance with a preferred form of the present invention, Figure 2 shows a construction in which the filling 9 is formed with a pair of such recesses 10, each of which is shown as receiving an O-ring seal 11 to form the double seal. The configurations of the port gaskets 7 may be similar.

It will be appreciated that when dealing with hazardous fluids, a seal of this nature is beneficial, especially if the space between them is monitored for leakage of the hazardous fluid so that this leakage is detected before the hazardous fluid leaks past the second seal into the ambient atmosphere. For this purpose, the space between the two seals 11 may have an appropriate fluid pumped through it and in circuit with a detector to detect the presence of the hazardous fluid in the diluent. Suitable micro-bore piping may be used to make the connections.

Various modifications may be made within the scope of the invention. Thus, although the grooves 10 of Figure 2 are shown as receiving O-ring seals, lip or other seals could be used instead.

Claims

1. A pressed metal heat transfer plate having a pressed groove (8) characterised in that the said pressed groove (8) is at least partially filled with a rigid plastics material (9) which adheres to the plate metal and which is formed in situ with an accurate recess (10) adapted to receive and retain by a close mechanical fit, a preformed seal (11) of O-ring, lip or other appropriate type.

2. A heat transfer plate as claimed in claim 1,

characterised in that the plastics material (9) is formed with two or more accurate recesses (10) to receive seals (11) so as to provide a double or multifold seal between the flow spaces and the ambient.

3. A heat transfer plate as claimed in claim 2, characterised in that the space between the seals (11) of the double seal is monitored for leaking fluid.

4. A heat transfer plate as claimed in claim 3, characterised in that the monitoring is achieved by circulating a gas or liquid through the space.

5. A method of forming an accurately profiled gasket recess (10) in a pressed metal heat transfer plate, characterised by the steps of forming a pressed groove (8) in the metal plate, at least partially filling the pressed groove (8) with a rigid plastics material (9) which adheres to the metal of the plate, and accurately forming, in situ, the gasket recess (10) in the plastics material.

6. A method as claimed in claim 5, characterised in that two or more parallel gasket recesses (10) are formed in the plastics material.

7. A method as claimed in claim 5 or 6, characterised in that the or each gasket recess (10) is formed by moulding the plastics material (9).

8. A method as claimed in claim 5 or 6, characterised in that the or each gasket recess (10) is formed by machining the plastics material (9).

9. Heat transfer apparatus comprising a pack of pressed metal heat transfer plates each having a pressed groove (8), characterised in that the said pressed groove (8) is at least partially filled with a rigid plastics material (9) which adheres to the plate metal and which is formed in situ with an accurate recess (10) receiving and retaining by a close mechanical fit, a preformed seal (11) of O-ring, lip or other appropriate type.

Revendications

1. Plaque de transfert de chaleur en métal embouti ayant une rainure emboutie (8), caractérisée par le fait que ladite rainure emboutie (8) est au moins partiellement remplie d'une matière plastique rigide (9) qui adhère au métal de la plaque et qui est formée *in situ* avec un évidement précis (10) prévu pour recevoir et retenir, par un ajustage mécanique serré, un joint (11) formé à l'avance de type torique, à lèvres ou d'un autre type approprié.

2. Plaque de transfert de chaleur selon la revendication 1, caractérisée par le fait que la matière plastique (9) est formée avec deux évidements précis (10) ou plus pour recevoir des joints (11), de façon à assurer une étanchéité double ou multiple entre les espaces d'écoulement et l'espace ambiant.

3. Plaque de transfert de chaleur selon la revendication 2, caractérisée par le fait que

l'espace entre les joints (11) de la double étanchéité est contrôlé en ce qui concerne les fuites de fluide.

4. Plaque de transfert de chaleur selon la revendication 3, caractérisée par le fait que le contrôle est effectué par mise en circulation d'un gaz ou d'un liquide à travers l'espace.

5. Procédé de formation d'un évidement pour joint profilé avec précision (10) dans une plaque de transfert de chaleur en métal embouti, caractérisé par les étapes consistant à former un rainure emboutie (8) dans la plaque de métal, à remplir au moins partiellement la rainure emboutie (8) d'une matière plastique rigide (9) qui adhère au métal de la plaque et à former avec précision, *in situ*, l'évidement pour joint (10) dans la matière plastique.

6. Procédé selon la revendication 5, caractérisé par le fait que l'on forme deux évidements parallèles pour joint (10), ou plus, dans la matière plastique.

7. Procédé selon la revendication 5 ou 6, caractérisé par le fait que l'on forme l'évidement pour joint (10) ou chacun d'eux par moulage de la matière plastique (9).

8. Procédé selon la revendication 5 ou 6, caractérisé par le fait que l'on forme l'évidement pour joint (10) ou chacun d'eux par usinage de la matière plastique (9).

9. Appareil de transfert de chaleur comprenant un ensemble de plaques de transfert de chaleur en métal embouti, ayant chacune un rainure emboutie (8), caractérisé par le fait que la rainure emboutie (8) est au moins partiellement remplie d'une matière plastique rigide (9) qui adhère au métal de la plaque et qui est formée *in situ* avec un évidement précis (10) recevant et retenant, par un ajustage mécanique serré, un joint (11) formé à l'avance, de type torique, à lèvres ou d'un autre type approprié.

Patentansprüche

1. Wärmeübertragungsplatte aus gepreßtem Metall mit einer eingepreßten Nut (8), dadurch gekennzeichnet, daß die besagte eingepreßte Nut (8) wenigstens teilweise mit einem steifen Kunststoffmaterial gefüllt ist, das an dem Plattenmaterial haftet und das an Ort und Stelle mit einer genauen Ausnehmung (10) ausgeformt ist, die angepaßt ist zur Aufnahme und zum Halten einer vorgeformten Dichtung (11) nach Art eines O-Ringes, einer Lippendichtung oder dgl. durch eine enge mechanische Pas-

sung.

2. Wärmeübertragungsplatte nach Anspruche 1, dadurch gekennzeichnet, daß das Kunststoffmaterial (9) mit zwei oder mehr genauen Ausnehmungen (10) zur Aufnahme von Abdichtungen (11) ausgeformt ist, so daß eine doppelte oder mehrfache Dichtung zwischen den Strömungsräumen und der Umgebung geschaffen wird.

3. Wärmeübertragungsplatte nach Anspruch 2, dadurch gekennzeichnet, daß der Raum zwischen den Dichtungen (11) der Doppeldichtung bezüglich ausleckendem Fluid überwacht wird.

4. Wärmeübertragungsplatte nach Anspruch 3, dadurch gekennzeichnet, daß die Überwachung durch Zirkulieren eines Gases oder einer Flüssigkeit durch den Raum erfolgt.

5. Verfahren zum Ausformen einer akkurat profilierten Dichtungsausnehmung (10), in einer Wärmeübertragungsplatte aus gepreßtem Metall, gekennzeichnet durch die Schritte der Ausformung einer gepreßten Nut (8) in der Metallplatte, wenigstens teilweises Ausfüllen der ausgepreßten Nut (8) mit einem starren Kunststoffmaterial (9), welches an dem Metall der Platte haftet und genaues Ausformen an Ort und Stelle von Dichtungsausnehmungen (10) in dem Kunststoffmaterial.

6. Verfahren nach Anspruch 5, dadurch gekennzeichnet, daß zwei oder mehrer parallele Dichtungsausnehmungen (10) in dem Kunststoffmaterial ausgeformt werden.

7. Verfahren nach Anspruch 5 oder 6, dadurch gekennzeichnet, daß die oder jede Dichtungsausnehmung (10) ausgeformt wird durch Gießformen des Kunststoffmaterials (9).

8. Verfahren nach Anspruch 5 oder 6, dadurch gekennzeichnet, daß die oder jede Dichtungsausnehmung (10) durch Ausarbeiten des Kunststoffmaterials (9) gebildet wird.

9. Wärmeübertragungsapparat, der einen Stapel von Wärmeübertragungsplatten aus gepreßtem Metall umfaßt, welche jede eine ausgepreßte Nut (8) aufweist, dadurch gekennzeichnet, daß die ausgepreßte Nut (8) wenigstens teilweise mit einem starren Kunststoffmaterial (9) ausgefüllt wird, welches an dem Plattenmetall haftet und welches an Ort und Stelle mit genauen Ausnehmungen (10) ausgebildet wird, welche durch eine enge mechanische Passung eine vorgeformte Dichtung (11) in Form eines O-Ringes, einer Lippe oder eines anderen Typs aufnimmt und hält.

FIG.1.

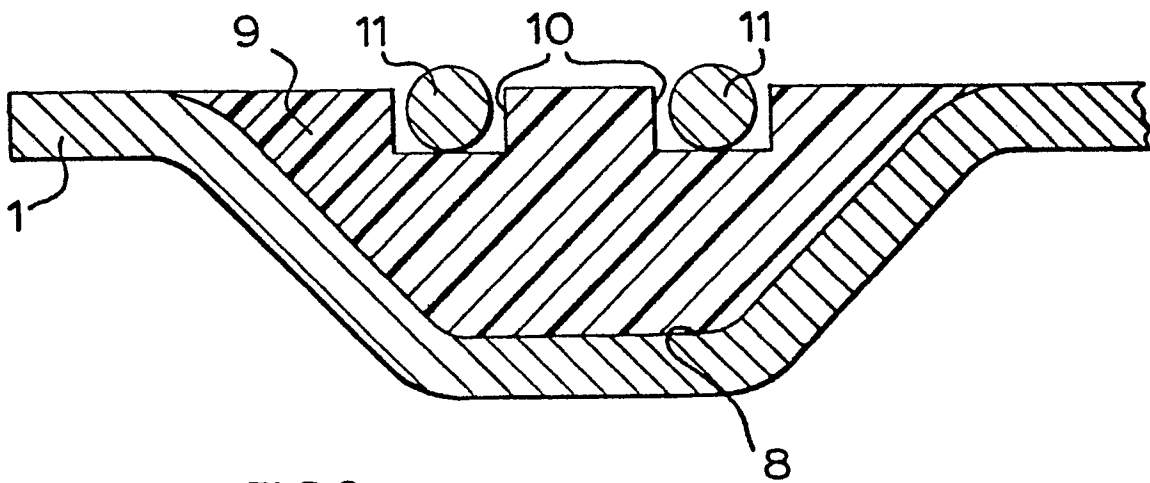
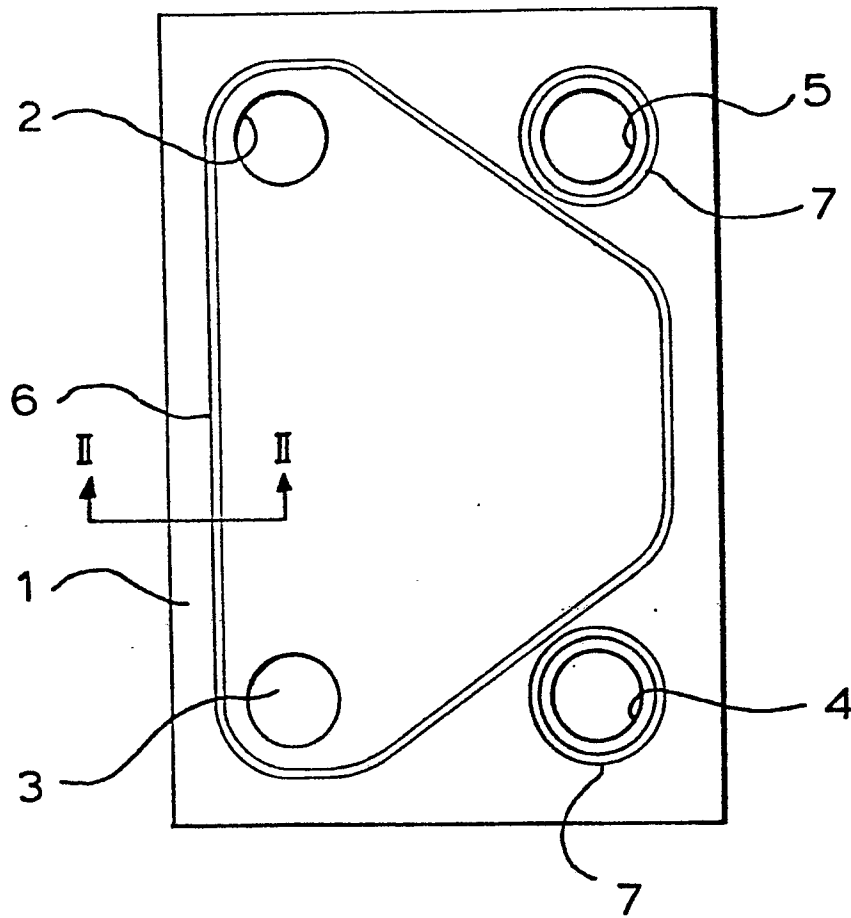


FIG.2.

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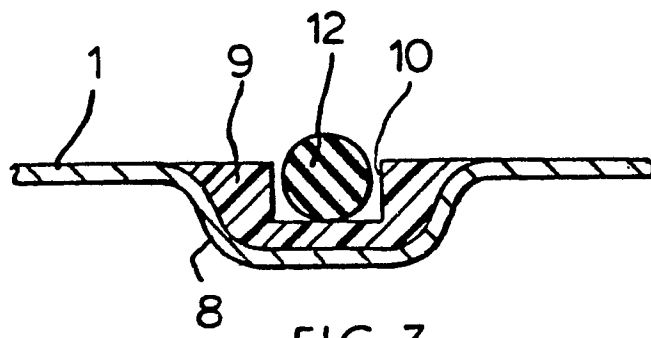


FIG. 3.

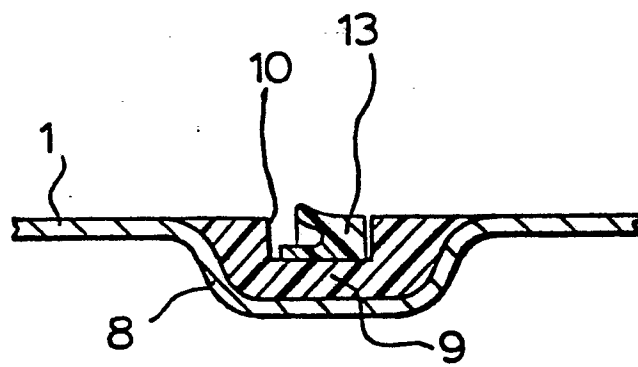


FIG. 4.