

⑫

EUROPEAN PATENT SPECIFICATION

④⑤ Date of publication of patent specification: **08.03.89**

⑥① Int. Cl.⁴: **F 28 F 3/08, F 28 D 9/02**

②① Application number: **84116425.4**

②② Date of filing: **28.12.84**

⑤④ **Plate heat exchanger.**

③⑥ Priority: **29.12.83 SE 8307215**
27.09.84 SE 8404845

④③ Date of publication of application:
10.07.85 Bulletin 85/28

④⑤ Publication of the grant of the patent:
08.03.89 Bulletin 89/10

⑧④ Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

⑤⑥ References cited:
FR-A-2 317 617
FR-A-2 318 398
FR-A-2 377 598
GB-A- 510 197
GB-A- 510 206
GB-A-2 071 838
US-A-2 596 642
US-A-3 893 509
US-A-4 298 061

⑦⑧ Proprietor: **Fläkt Aktiebolag**
Sickla Allé 13
S-131 34 Nacka (SE)

⑦② Inventor: **Holmberg, Poy**
Stattutgatan 51
S-552 59 Jönköping (SE)

⑦④ Representative: **Eitle, Werner, Dipl.-Ing. et al**
Hoffmann, Eitle & Partner Patentanwälte
Arabellastrasse 4
D-8000 München 81 (DE)

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European patent convention).

Description

The present invention relates to a plate heat exchanger designed for heat exchange between gaseous media in accordance with the preamble of Claim 1.

Such a heat exchanger is known from GB—A—510 206. Plate heat exchangers of this type are used primarily in heat recovery systems in ventilation plants. As a rule, it is the heat from an exhaust air flow to an intake air flow that is transmitted in that the respective flows pass through the heat exchanger in separate flow passages in so-called cross-current.

A common design feature of such heat exchangers is cross-laid flat plates provided with distance members, the latter being formed by and comprising a part of the plate and elaborated as round nipples or oblong nipples extending in the flow direction. The distance between these distance members must be selected large in relation to their height to avoid unfavourable generation of turbulence in the heat exchanger. Consequently, the material thickness of the plates, which are often made of aluminium, must be chosen relatively large in order for the plates to be able to withstand the large pressure differential between the plates which is common without their deflection becoming excessive. Since the material cost comprises a significant portion of the cost of a finished heat exchanger the relatively large material thickness thus constitutes a considerable disadvantage for this type of heat exchanger.

Another common design of plate heat exchanger for heat recovery features cross-laid flat plates with interlying corrugated plates which comprise distance members to the flat plates, which latter plates separate the two flows of gas. A common embodiment of the corrugated plates gives triangular flow passages and permits the choice of small material thicknesses. One disadvantage, however, is that the triangular shape of the flow passage together with laminar flow necessitates a large heating area, which results in narrow flow passages to prevent the volume of the heat exchanger from becoming excessively large. The narrow flow passages give, among other things, an undesirably high increase in pressure drop upon condensate precipitation.

Furthermore, it is well known through the German 'Offenlegungsschrift 26 30 905' that in a heat exchanger made with only cross-laid plates which are furnished with distance members, these latter are formed as corrugations in the plate extending in the flow direction, whereupon rectangular flow passages are formed so that the gas flows through the heat exchanger. It is known that the rectangular cross-sectional shape is highly advantageous from the viewpoint of flow, but a disadvantage of this embodiment is also the necessity of a high material thickness as otherwise the strength will be too low. As an example it may be mentioned that the material thickness of this type of plates is at least 0.3 mm, and that the distance

between distance members/pleats is up to about 100 mm. A further disadvantage is that the laminar flow formed with flat plates also in this case leads to narrow flow passages. A seal for this type of heat exchanger plates is usually achieved by means of some kind of seal compound between the plates, alternatively by folding one edge of the plate around the edge of the adjacent plate which as a result provides an acceptable seal with a flat plate of the thickness indicated above.

A plate heat exchanger as known from GB—A—510 206 which consists of a number of plates stacked upon each other and provided with distance members lengthwise in a flow direction in a form of fins, the latter being formed by and comprising a part of the plates, where every second plate is offset 90 degrees in relation to the adjacent plate in order to form flow passages of largely rectangular cross-sections. Further, a fine structure is provided between the lengthwise distance members to improve heat transfer.

The plates are secured together by soldering for example, and the attaching of separate angle pieces and U-shaped end portions is shown. The disadvantage of this heat exchanger relates to the manufacturing method particularly how adjacent plates are joined and sealed together.

A further plate heat exchanger is known from FR—A—23 18 398 which consists of a number of plates stacked upon each other and provided with distance members lengthwise in the flow direction, whereby every second plate is again offset in relation to the adjacent plate to form flow passages. The edge seal of each plate is formed in such a way that the end of one plate is folded around the edge of an adjacent plate to form a folding edge. The joint so formed may be reinforced by bonding with an adhesive or brazing where it is necessary to ensure a tight joint. As mentioned above such a folded edge seal is acceptable with a flat plate provided the plate material is of the adequate thickness.

The object of the present invention is to provide a heat exchanger which does not display the disadvantages of the prior art heat exchangers, but is made with a greatly simplified assembly procedure which simultaneously provides a reliable and effective seal between adjacent plates despite the use of thinner material for the plates than in conventional heat exchangers.

The above object is solved in accordance with the characterising clause of claim 1.

The invention is based on the insight that by means of a lengthwise pleating of the folded connecting edge of the plates, the folded part of the plate is prevented from springing back, i.e., in that locking of the connecting edge is achieved.

As a result, it has been possible to combine the plates into a heat exchanger package with a great heat transfer capacity, low pressure drop, considerable tightness between the flow passages and stable surfaces on the sides of the package, as well as withstanding great differences in pressure between the flow passages, all this thanks to the combination of a fine structure of

the thin plates and the connection of the separate plates designed according to the invention. Practical embodiments of the heat exchanger are evident from the following sub-claims.

The invention will now be described in greater detail and with reference to the accompanying drawings, wherein

Fig. 1 shows schematically in perspective three heat exchanger plates stacked upon each other but without demonstrating the means of their connection,

Fig. 2a shows schematically an end view of two heat exchanger plates stacked upon each other,

Fig. 2b shows schematically a cross-section of a heat exchanger plate,

Fig. 3 shows a heat exchanger body,

Fig. 4 shows schematically in detail how two heat exchanger plates are joined together,

Fig. 5a shows schematically a detail of the connection of two plates,

Fig. 5b shows schematically a cross-section of the connection of two plates,

Fig. 6 shows schematically a full view of a heat exchanger plate.

Shown in Fig. 1 is the principle of how three heat exchanger plates 1a, 1b and 1c, are stacked upon each other and offset 90° in relation to each other. This figure does not show the means of how the separate plates are connected with each other. Each plate is equipped with lengthwise distance members 2, devised as pleats in the plate. This results in the formation of extended rectangular flow passages designated 3a and 3b for the air which is thus made to pass in cross-current. The air flows are indicated by the arrows A and B, respectively. The width "b" (Fig. 2a) of the flow passages is between 10 to 50 mm, preferably between 20—30 mm, and their height "h" corresponding to the pleat height of the distance members is greater than 1.5 mm, preferably 2—10 mm. It has been found that this form of flow passages is beneficial in view of heat transfer, pressure drop, strength and production technology. Preferably, the plates of heat exchanger are made of aluminium material.

According to the invention the plates are equipped with a friction pressure drop forming fine structure 4 in the form of corrugations as shown in Fig. 2a and 2b. The corrugations are preferably arranged at right angles to the distance members. Also the distance members can be designed with a fine structure.

The design of the fine structure in greater detail is demonstrated by the schematic Fig. 2b which shows a cross-section of a contact plate. The corrugations of the fine structure display a pleat height S which amounts to between 0.1 and 1 mm. The fine structure of the plate 1b has a wavelength λ of between 1 and 5 mm, preferably 3 mm, and its shape is triangular as indicated in the figure. The shape may also be sinusoidal or some interlying shape. A fine structural plate has a material thickness (t) of less than 0.1 mm, and the fine structural thickness (T) of the plates, defined as the total thickness of the plate areas

with undeformed fine structure (4), i.e., S plus t, amounts to 0.1 and 1 mm, preferably 0.5 mm.

It has been found that by means of the fine structure a favourable generation of turbulence is achieved in the flow passage, which actively increases the heat transfer capacity without the pressure drop losses increasing to an unjustifiably high extent. The invention is thus based partly on the insight that the fine structure, in accordance with the above connection to the shaping of the flow passage, is given a favourable generation of turbulence in the duct and, as opposed to prior art devices, does not give rise to a dissolution flow. Thanks to the stiffening function given by the fine structure the material thickness of the plates can be shown as small as 0.1 mm or less. This gives a total material consumption of the order of 25 per cent in comparison with the material consumption for a conventional heat exchanger with the corresponding heat transfer capacity and pressure drop.

Shown in detail and schematically in Fig. 2a is an end view of two heat exchanger plates 1a and 1b. Formed between two distance members 2 in the lower plate and the upper plate is the air flow passage 3 which is thus shown in cross-section. The sides 5a and 5b of the distance members 2 are according to one embodiment pressed together towards each other to form a small gap 6 at the underside of the plate. One effect of the gap 6 is that it contributes towards some generation of turbulence in the air on the underside of the plate, which is sufficient to increase the heat transfer coefficient, but only contributes to a minor extent towards an increase of the pressure drop in the flow passage.

The fine structure of the plate 1b has a wavelength λ of between 2—5 mm, preferably 3 mm, and its shape is sinusoidal as shown in the figure. The shape may also be triangular or some interlying shape.

Shown in Fig. 3 is how a plurality of exchanger plates are combined into a heat exchanger package. The heat exchanger package is usually arranged so that the heat exchanger plates are disposed vertically. The heat exchanger body is inclined towards the horizontal plane to facilitate discharge of condensate water precipitated in the flow passage.

Fig. 4, 5a and 5b as well as 6 show in detail how a bottom heat exchanger plate according to the invention is connected at its end edge with a top heat exchanger plate. A necessity for the heat exchanger package to function properly is that the plates are joined effectively, both from a mechanical and a sealing point of view. A leakage between the separated flow passages should be avoided as far as possible and may in some applications prove definitely harmful. Fig. 6 shows how the heat exchanger plate terminating across the distance members at its two end sides 10a, b displays a lengthwise section of end zones 11a, b. Each contact plate also displays at its two end sides 20a, b terminating along the distance members, a lengthwise section 21a, b, in which a

folding edge 22a, b is arranged. At its edges the plate displays the notches 26. The edges 22a, b are intended to be joined with an adjacent plate in such a way that they will be folded around the adjacent edge zone area, by which a folded edge 23 is formed. In addition, the folding edge 22a, 22b displays a distance section 25 which by its size corresponds to the distance between the adjacent plates determined by the pleat height, and forms a seal of the side for the corresponding flow passages 3a, 3b at the ends of the plates. The folded edge 23 extends over the corresponding edge zone area and encloses this. The edge 23 and the enclosing material also display a lengthwise pleating 24 which extends along the whole width of the plate and is designed to achieve locking of the edge 23 and, if necessary, thus prevent the folding edge 22a, b from springing back. The fine structure in the pleating of the two plates is partly deformed owing to their being pressed together and forms an effective seal between the plates. In effect, the thickness resulting from the compression is not larger than the plate thickness T defined in Figure 2b.

An especially purposeful embodiment according to the invention is the arrangement of downfolding the distance member, as shown in Fig. 5a, and then covering from the underlying plate it by the edge 23. As a result, the fine structure of the plates stacked upon each other (including the folding edge 22a, b and the edge 23) has been deformed so that the common thickness, on the whole, still is enclosed in the plate thickness T, as defined in the Figure 2b. This condition can be accomplished also when both sides 5a, 5b of the distance members 2 are provided with a fine structure.

The pleating 24 displays according to the invention a wavelength Y and a waveheight y which are dimensioned so that they give rise to a stretching of the material that at least corresponds to the surface expansion ensuing from the deformation of the fine structure in the pleating. The wavelength Y of the pleating amounts to about 10 mm and its waveheight y to about 2 mm. The surface expansion of the fine structure amounts to between 1% and 10%, preferably 3%.

A very effective seal between the separate flow passages is achieved by this method. The stretching of the folded edge 23 brought about (effected) by the lengthwise pleating 24 smoothes out the fine structure of the edge 23 and renders a pleated, smooth and tight joint. Moreover, whenever applicable, the downfolded distance members 2 can be enclosed in thickness T of the plates thanks to the fine structure. By compressing the folded edge 23 together the function of the resultant fine structure may be ranked in the same category as the function of a packing.

The shown embodiment of the plate heat exchanger is intended in the first instance for application in comfort ventilation plants, but obviously the invention is not limited to this embodiment.

Claims

1. A plate heat exchanger designed for heat exchange between gaseous media which preferably consist of air and are kept separated from each other in the heat exchanger, the said heat exchanger consisting of a number of plates (1a—c) stacked upon each other and provided with distance members (2) lengthwise in the flow direction where every second plate is offset 90° in relation to the adjacent plate in order to form throughgoing flow passages (3a, b) whereby the plates (1a—c) between the lengthwise distance members (2) are provided with a friction pressure drop forming fine structure (4) in the form of corrugations, characterized in that each plate at its two end sides (10a, b) terminating across the distance members displays a lengthwise edge zone area (11a, b), that each plate at its two end sides (20a, b) terminating along the distance members displays a lengthwise part (21a, b) within which a folding edge (22a, b) is arranged, that said edges (22a, b) in order to be joined with an adjacent plate are folded around the edge zone area of the adjacent plate and thus form a folded edge (23), which extends over the corresponding edge zone area and encloses it, and that the folded edge (23) and the enclosing material display a lengthwise pleating (24) having a length and a height of wave and extends along the whole width of the plate in order to lock the folding edge (22a, b).

2. A plate heat exchanger as claimed in claim 1, characterized in that the fine structure of the two plates within the lengthwise pleating (24) is partly deformed by being pressed against each other and thus forms an effective seal between the plates.

3. A pleat heat exchanger as claimed in claim 1, characterized in that the fine structure (4) is essentially arranged at right angles to the distance members.

4. A plate heat exchanger as claimed in claim 1, characterized in that the distance members (2), including their sides (5a, b) display a fine structure (4).

5. A plate heat exchanger as claimed in claim 1, characterized in that the sides (5a, b) of the distance members (2) are being pressed against each other.

6. A plate heat exchanger as claimed in claim 1, characterized in that the distance members (2) within the edge zone areas (11a, b) display a folded part enclosed by the folded edge (23).

7. A plate heat exchanger as claimed in claim 1, characterized in that the pleating (24) displays a wavelength (Y) and a waveheight (y) which are so dimensioned that they render a stretching of the material that at least corresponds to the surface expansion effected by the deformation of the fine structure within the pleating.

8. A plate heat exchanger as claimed in claim 7, characterized in that the wavelength (Y) amounts to about 10 mm and the waveheight (y) to about 2 mm.

9. A plate heat exchanger as claimed in claim 1, characterized in that the surface expansion of the fine structure amounts to between 1% and 10%, preferably 3%.

10. A plate heat exchanger as claimed in claim 1, characterized in that the fine structure (4) displays a pleat height (S) that amounts to between 0.1 to 1 mm.

11. A plate heat exchanger as claimed in claim 1, characterized in that the flow passages (3a, 3b) formed have a width of between 10 and 50 mm, preferably 20—30 mm.

12. A plate heat exchanger as claimed in claim 1, characterized in that the material thickness of the plates (1a—c) is less than 0.1 mm.

13. A plate heat exchanger as claimed in claim 1, characterized in that the material thickness (t) of the plates (1a—c) is less than 0.1 mm and that the fine structure thickness (T) of the plates, defined as the total thickness of the parts of the plates with undeformed fine structure (4), i.e., S plus t, amounts to between 0.1 and 1 mm, preferably 0.5 mm.

14. A plate heat exchanger as claimed in claim 1, characterized in that the total thickness of the compressed plates at the pleating (24) essentially does not exceed the fine structure thickness (7).

Patentansprüche

1. Plattenwärmetauscher, der für den Wärmeaustausch zwischen gasförmigen Medien ausgelegt ist, die vorzugsweise Luft sind, und die in dem Wärmetauscher voneinander getrennt gehalten werden, wobei der Wärmetauscher besteht aus einer Anzahl von Platten (1a—c), die aufeinander gestapelt sind und die der Länge nach in Strömungsrichtung mit Abstandselementen (2) ausgestattet sind, wobei jede zweite Platte in Bezug auf die benachbarte Platte um 90° versetzt ist, um hindurchgehende Strömungsdurchlässe (3a, b) zu bilden, wobei die Platten (1a, c) zwischen den längsgerichteten Abstandselementen (2) mit einer einen Reibungsdruckabfall hervorrufenden Feinstruktur (4) in Form von Rillen ausgestattet sind, dadurch gekennzeichnet, daß jede Platte an ihren beiden Endseiten (10a, b) die quer zu den Abstandselementen enden, eine längliche Kantenzonenfläche (11a, b) zeigt, daß jede Platte an ihren zwei Endseiten (20a, b), die entlang den Abstandselementen enden, einen länglichen Teil (21a, b) zeigt, in dem eine zusammengefaltete Kante (22a, b) angeordnet ist, daß die Kanten (22a, b), um mit einer benachbarten Platte verbunden zu werden, um die Kantenzonenfläche der benachbarten Platte herumgebogen sind, und somit eine zusammengefaltete Kante (23) bilden, die sich über die entsprechende Kantenzonenfläche erstreckt und diese einschließt, und daß die zusammengefaltete Kante (23) und das eingeschlossene Material eine längsgerichtete Faltung (24) zeigt, die eine Länge und eine Höhe einer Welle besitzt, und sich entlang der gesamten Breite der Platte erstreckt, um die zusammengefaltete Kante (22a, b) festzuklemmen.

2. Plattenwärmetauscher nach Anspruch 1,

dadurch gekennzeichnet, daß die Feinstruktur der zwei Platten in der längsgerichteten Faltung (24) teilweise deformiert wird, da sie gegeneinander gepreßt werden und somit eine wirksame Versiegelung zwischen den Platten bildet.

3. Plattenwärmetauscher nach Anspruch 1, dadurch gekennzeichnet, daß die Feinstruktur (4) im wesentlichen in rechten Winkeln zu den Abstandselementen angeordnet ist.

4. Plattenwärmetauscher nach Anspruch 1, dadurch gekennzeichnet, daß die Abstandselemente (2), deren Seiten (5a, b) eingeschlossen eine Feinstruktur (4) zeigen.

5. Plattenwärmetauscher nach Anspruch 1, dadurch gekennzeichnet, daß die Seiten (5a, b) der Abstandselemente (2) gegeneinander gepreßt sind.

6. Plattenwärmetauscher nach Anspruch 1, dadurch gekennzeichnet, daß die Abstandselemente (2) in den Kantenzonenflächen (11a, b) einen gefalteten Teil zeigen, der von der ungefalteten Kante (23) eingeschlossen ist.

7. Plattenwärmetauscher nach Anspruch 1, dadurch gekennzeichnet, daß die Faltung (24) eine Wellenlänge (Y) und eine Wellenhöhe (y) zeigt, die so bemessen sind, daß sie eine Dehnung des Materials hervorrufen, die zumindest mit der Oberflächendehnung korrespondiert, die durch die Verformung der Feinstruktur in der Faltung bewirkt wird.

8. Plattenwärmetauscher nach Anspruch 7, dadurch gekennzeichnet, daß die Wellenlänge (Y) ungefähr 10 mm und die Wellenhöhe (y) ungefähr 2 mm beträgt.

9. Plattenwärmetauscher nach Anspruch 1, dadurch gekennzeichnet, daß die Oberflächendehnung der Feinstruktur zwischen 1% und 10%, vorzugsweise 3% beträgt.

10. Plattenwärmetauscher nach Anspruch 1, dadurch gekennzeichnet, daß die Feinstruktur (4) eine Faltungshöhe (S) zeigt, die zwischen 0,1 und 1 mm beträgt.

11. Plattenwärmetauscher nach Anspruch 1, dadurch gekennzeichnet, daß die ausgebildeten Strömungsdurchlässe (3a, b) eine Weite von 10 bis 50 mm, vorzugsweise 20 bis 30 mm besitzen.

12. Plattenwärmetauscher nach Anspruch 1, dadurch gekennzeichnet, daß die Materialdicke der Platten (1a—c) weniger als 0,1 mm beträgt.

13. Plattenwärmetauscher nach Anspruch 1, dadurch gekennzeichnet, daß die Materialdicke (t) der Platten (1a—c) kleiner als 0,1 mm ist, und daß die Feinstrukturdicke (T) der Platten, die als Gesamtdicke der Teile der Platten mit unverformter Feinstruktur (4), d.h. als S plus t festgelegt ist, zwischen 0,1 und 1 mm, vorzugsweise 0,5 mm beträgt.

14. Plattenwärmetauscher nach Anspruch 1, dadurch gekennzeichnet, daß die Gesamtdicke der zusammengepreßten Platten an der Faltung (24) im wesentlichen nicht die Faltstrukturdicke (T) übersteigt.

Revendications

1. Echangeur de chaleur à plaques conçu pour un échange de chaleur entre des fluides gazeux qui sont de préférence constitués par de l'air et sont maintenus séparés l'un de l'autre dans l'échangeur de chaleur, ledit échangeur de chaleur consistant en un certain nombre de plaques (1a—c) empilées les unes sur les autres et munies d'organes (2) d'écartement placés longitudinalement dans la direction d'écoulement où une plaque sur deux est décalée de 90° par rapport à la plaque adjacente de façon à constituer des couloirs d'écoulement traversants (3a, b), les plaques (1a—c), entre les organes longitudinaux (2) d'écartement, étant pourvues d'une structure fine (4) se présentant sous forme d'ondulations, et entraînant une perte de charge par frottement, caractérisé en ce que chaque plaque présente, à ses deux côtés extrêmes (10a, b) qui se terminent en travers des organes d'écartement, une surface de zone marginale longitudinale (11a, b), en ce que chaque plaque présente, à ses deux côtés extrêmes (20a, b) qui se terminent le long des organes d'écartement, une partie longitudinale (21a, b) dans laquelle se trouve un bord pliable (22a, b), en ce que lesdits bords (22a, b), afin d'être joints à une plaque adjacente, sont pliés autour de la surface de zone marginale de la plaque adjacente et constituent ainsi un bord plié (23), qui s'étend au-dessus de la surface de zone marginale correspondante et qui l'entoure, et en ce que le bord plié (23) et le matériau d'enveloppement présentent un plissement longitudinal (24) ayant une longueur et une hauteur d'onde et s'étendant sur toute la largeur de la plaque afin de verrouiller le bord pliable (22a, b).

2. Echangeur de chaleur à plaques selon la revendication 1, caractérisé en ce que la structure fine des deux plaques à l'intérieur du plissement longitudinal (24) est partiellement déformée par pressage d'une des plaques contre l'autre et constitue ainsi un joint étanche efficace entre les plaques.

3. Echangeur de chaleur à plaques selon la revendication 1, caractérisé en ce que la structure fine (4) est essentiellement disposée perpendiculairement aux organes d'écartement.

4. Echangeur de chaleur à plaques selon la revendication 1, caractérisé en ce que les organes (2) d'écartement, y compris leurs côtés (5a, b), présentent une structure fine (4).

5. Echangeur de chaleur à plaques selon la

revendication 1, caractérisé en ce que les côtés (5a, b) des organes (2) d'écartement sont pressés l'un contre l'autre.

6. Echangeur de chaleur à plaques selon la revendication 1, caractérisé en ce que les organes (2) d'écartement situés à l'intérieur des surfaces de zones marginales (11a, b) présentent une partie pliée entourée par le bord plié (23).

7. Echangeur de chaleur à plaques selon la revendication 1, caractérisé en ce que le plissement (24) présente une longueur d'onde (Y) et une hauteur d'onde (y) qui sont dimensionnées de telle façon qu'elles entraînent un allongement du matériau qui correspond au moins à la dilatation superficielle effectuée par la déformation de la structure fine située à l'intérieur du plissement.

8. Echangeur de chaleur à plaques selon la revendication 7, caractérisé en ce que la longueur d'onde (Y) s'élève à environ 10 mm et la hauteur d'onde (y) à environ 2 mm.

9. Echangeur de chaleur à plaques selon la revendication 1, caractérisé en ce que la dilatation superficielle de la structure fine s'élève à une valeur comprise entre 1% et 10%, de préférence égale à 3%.

10. Echangeur de chaleur à plaques selon la revendication 1, caractérisé en ce que la structure fine (4) présente une hauteur (S) de pli qui s'élève à une valeur comprise entre 0,1 et 1 mm.

11. Echangeur de chaleur à plaques selon la revendication 1, caractérisé en ce que les couloirs (3a, 3b) d'écoulement constitués ont une largeur comprise entre 10 et 50 mm, de préférence entre 20 et 30 mm.

12. Echangeur de chaleur à plaques selon la revendication 1, caractérisé en ce que l'épaisseur du matériau des plaques (1a—c) est inférieure à 0,1 mm.

13. Echangeur de chaleur à plaques selon la revendication 1, caractérisé en ce que l'épaisseur (t) du matériau des plaques (1a—c) est inférieure à 0,1 mm et en ce que l'épaisseur (T) de la structure fine des plaques, définie comme l'épaisseur totale des pièces des plaques avec une ministructure (4) non déformée, c'est-à-dire S plus t, s'élève à un montant entre 0,1 et 1 mm, de préférence 0,5 mm.

14. Echangeur de chaleur à plaques selon la revendication 1, caractérisé en ce que l'épaisseur totale des plaques comprimées à l'endroit du plissement (24) n'excède pratiquement pas l'épaisseur (T) de la structure fine.

55

60

65

6

Fig. 1

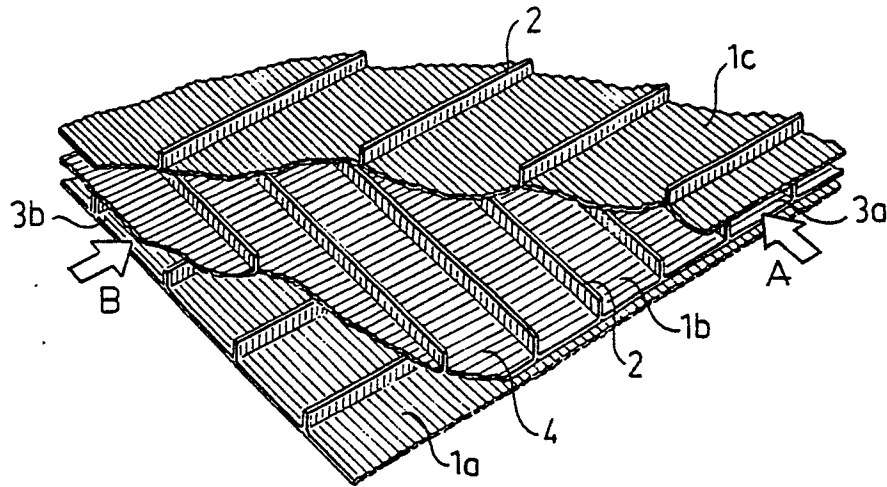


Fig. 2a

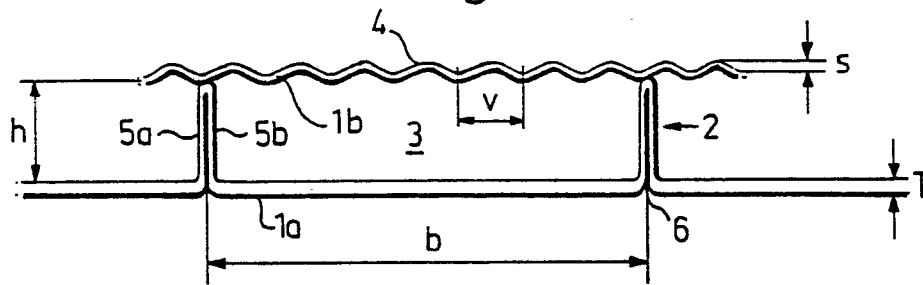


Fig. 2b

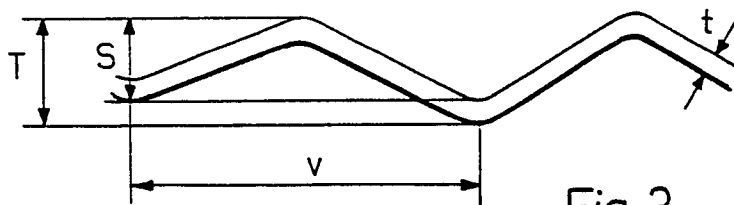


Fig. 3

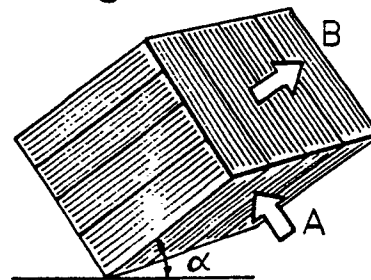


Fig.4

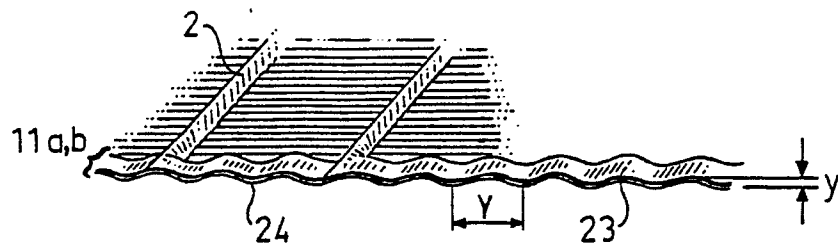


Fig.5a

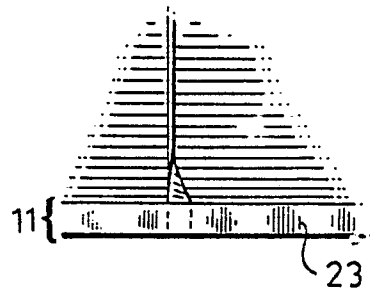


Fig.5b

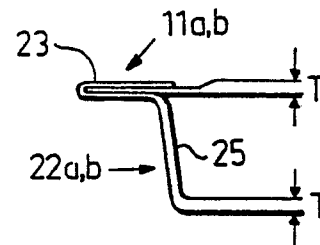


Fig. 6

