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(54) Heat exchanger

Wärmetauscher

Echangeur de chaleur

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(56) References cited:

WO-A-83/01998	**WO-A-96/24020**
DE-A- 2 434 887	**FR-A- 1 567 831**
GB-A- 1 096 536	**US-A- 4 099 928**

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Description

[0001] The present invention relates to a plate heat exchanger of cross-flow type for heat exchange between different media of which at least one is a gas, wherein the plate heat exchanger comprises plates with elongated and in various alternating directions protruding corrugating ridges, wherein the plate heat exchanger has through-flow gaps for a first medium and through-flow gaps for a second medium, wherein the through-flow gaps extend crosswise relative to each other through the plate heat exchanger such that said first and second medium flow crosswise relative to each other through said plate heat exchanger, wherein each plate defines a partition wall between two different through-flow gaps for different media such that heat transfer between said media occurs through said plate, wherein the corrugating ridges are situated between two planes, wherein each plate has two edge portions which are provided in one plane and two other opposing edge portions which are provided in the other plane, wherein the corrugating ridges are located inclined or obliquely relative to said edge portions, wherein two adjacent plates are mounted relative to each other such that two edge portions of one of the plates and provided in one plane are joined together with two edge portions of the other plate located in the same plane, while two edge portions of said one plate and provided in another plane are situated at a distance from two edge portions of said other plate provided in said another plane, said two edge portions located at a distance from each other defining outlet and inlet gaps into and from a through--flow gap defined between the plates, said outlet and inlet gaps having substantially the same height as said through-flow gap, wherein two adjacent plates are also mounted such that the corrugating ridges inclined relative to the edge portions, cross each other in said through-flow gap, wherein each plate has four corner portions for sealing between the through-flow gaps at the corners of said plates, wherein each corner portion of a plate is by means of soldering joined closely together with a corresponding corner portion of an adjacent plate, and wherein the edge portions and corrugated ridges of two adjacent plates are joined together by means of soldering.

[0002] Plate heat exchangers of the abovementioned cross-flow type are previously known from e.g. US, A, 4 099 928. At these prior art plate heat exchangers, separate sealing means are required to provide sufficient sealing in the corners of said plate heat exchanger. Such separate sealing means must be exactly adapted to the plate heat exchanger to obtain the required sealing in its corners, assembly work is required to apply them and they must be held in position by means of corner rails in a frame structure.

[0003] The object of the present invention has been to provide, at a plate heat exchanger of the type defined above, a construction at which said separate sealing means can be deleted. This is arrived at according to the invention by providing the plate heat exchanger with the features of subsequent claim 1.

[0004] The plate heat exchanger according to the invention has, inter alia, the following advantages:

1) since the corrugating ridges cross each other and are inclined relative to the edge portions, a strong turbulence is generated in the through-flow gaps, which is advantageous,

2) since the inlet and outlet gaps, when the plates are assembled, have substantially the same height as the through-flow gaps, restriction of the flow at the inlets and outlets of the through-flow gaps is avoided,

3) since the plates have corner portions which are joined close to each other, the plate heat exchanger does not need to be provided with separate sealing means, but may instead only consist of plates of the same type and located at 90° relative to each other,

4) since the corner portions, the edge portions and the corrugating ridges are designed such that the plates simply can be stacked on top of each other arid since they are joined together through soldering, the plate heat exchanger can be manufactured in a quick and effective soldering process such that it will be gas-tight, and

5) since the corrugating ridges are also joined together through soldering, the plate heat exchanger is very rigid and durable and separate framworks for obtaining the required tightness and stability can be completely dispensed with.

[0005] The invention will be further described below with reference to the accompanying drawings, in which

fig. 1 is a perspective view of a plate heat exchanger according to the invention;

fig. 2 is a perspective view of two plates forming part of the plate heat exchanger of fig. 1 and facing each other in such first positions in which they can be attached to each other;

fig. 2a is a front view, partly in section, with the plates facing each other as in fig. 2;

fig. 2b shows the plates facing each other as in fig. 2a and attached to each other;

fig. 3 is a perspective view of two plates forming part of the plate heat exchanger of fig. 1 and facing each other in such other positions in which they also can be attached to each other;

fig. 3a is a front view, partly in section, of the plates facing each other as in fig. 3;

fig. 3b shows the plates facing each other as in fig. 3a and attached to each other;

fig. 3c is a plan view of a corner portion of a plate before it is bent;

fig. 3d is a plan view of the same corner portion of the plate after bending thereof;

fig. 3e is a view 3e of the corner portion of fig. 3d;

fig. 4 is a section along the line IV-IV through one of the plates of fig. 2;

fig. 5 illustrates schematically flows of medium through through-flow passages between two adjacent plates in the plate heat exchanger of fig. 1; and

fig. 6 is a plan view of a plate heat exchanger according to the invention wherein the plates have another shape than at the plate heat exchanger of figs. 1 and 5.

[0006] The plate heat exchanger illustrated in the drawings is of the cross-flow type for heat exchange between different media of which at least one is a gas. This plate heat exchanger comprises a stack 1 of plates under which there may be located a bottom plate 2 and on top of which there may be located a top plate 3. The stack 1 of plates includes plates 8a, 8b which in the drawings are square, but which alternatively can be rectangular. The plates are preferably made of a sheet material which is folded to form elongated, substantially in wave shape extending corrugating ridges 15.

[0007] Plates 8a, 8b define together through-flow gaps 9 and 10 of which every second through-flow gap 9 extends through the plate heat exchanger and is adapted to let through a first medium V, e.g. hot air. The remaining through-flow gaps 10 extend crosswise relative to the through-flow gaps 9 extending through the plate heat exchanger and are adapted to permit passage of a second medium K, e.g. cold air.

[0008] Each plate 8a and 8b respectively, defines a partition wall between the two different through-flow gaps 9, 10 so that heat transfer can occur from one medium, e.g. the hot air V, to the other medium, e.g. the cold air K, through said plate 8a and 8b respectively.

[0009] Adjacent plates 8a, 8b are provided such that their corrugating ridges 15 cross each other in a through-flow gap 9 or 10 defined between the plates 8a, 8b.

[0010] Of two adjacent plates 8a, 8b are the corrugating ridges 15 of one plate 8a in a through-flow gap 9 or 10 defined between the adjacent plates 8a, 8b directed preferably in a lateral direction relative to an inlet direction of a medium V or K flowing into the through-flow gap 9 or 10.

[0011] The corrugating ridges 15 of the other plate 8b of said adjacent plates 8a, 8b are in said through-flow gap 9 or 10 directed in another lateral direction relative to said inlet direction.

[0012] The plates 8a, 8b have opposing edge portions 11, 12 and 13, 14 respectively. These edge portions 11, 12 and 13, 14 respectively, are preferably straight or substantially straight and the corrugating ridges 15 are preferably inclined relative thereto. The corrugating ridges 15 extend e.g. at an angle of about 45° relative to said edge portions.

[0013] The corrugating ridges 15 of adjacent plates 8a, 8b engage each other pointwise in the through-flow gap 9 or 10 defined between said plates 8a, 8b and are joined together in the points of engagement.

[0014] A through-flow gap 9 or 10 defined by the adjacent plates 8a, 8b and inlet and outlet gaps 17, 18 defined by opposing edge portions 11, 12 or 13, 14 of the plates 8a, 8b for inlet and outlet flow of said media V, K into and from said through-flow gap 9 or 10, preferably have the same or substantially the same height H.

[0015] The plates 8a, 8b in the stack 1 thereof are also provided or mounted such that two opposing edge portions 13, 14 or 11, 12 of first and second plates 8a, 8b are joined closely together for closing through-flow gaps 9 or 10 defined between said plates 8a, 8b at two opposite sides, while two other opposing edge portions 11, 12 or 13, 14 of first and second plates 8a, 8b define between them inlet and outlet gaps 17, 18 into and from said through-flow gaps 9 or 10.

[0016] The two opposing edge portions 11 and 12 of each plate 8a and 8b respectively, lie preferably in the same first plane P1 and its two other opposing edge portions 13 and 14 preferably in the same second plane P2.

[0017] The corrugating ridges 15 of each plate 8a and 8b respectively, extend back and forth between said first and second planes P1 and P2 so that outer portions 15a of every second corrugating ridge 15 lie in the first plane P1 and outer portions 15a of corrugating ridges 15 therebetween lie in the second plane P2.

[0018] Adjacent plates 8a, 8b in the stack 1 thereof may be located in two different positions relative to each other, namely either the positions according to figs. 2 2a and 2b or the positions according to figs. 3, 3a and 3b. Common to these two different mutual positions is that the adjacent plates 8a, 8b are located relative to each other such that their corrugating ridges 15 extend crosswise relative to each other. Additionally, the two adjacent plates 8a, 8b are facing each other such that corrugating ridges 15 on one plate 8a are facing corrugating ridges 15 on the other plate 8b. The outer portions 15a of the corrugating ridges 15 facing each other of the two adjacent plates 8a, 8b engage each other.

[0019] The two adjacent plates 8a, 8b define between them a through-flow gap 9 or 10 the height H of which is somewhat less than the distance A1 between the two planes P1 and P2 of one plate 8a plus the distance A2 between the two planes P1 and P2 of the other plate 8b. Particularly, the height H is similar to the distances A1 + A2 minus the wall thickness of two plates 8a, 8b.

[0020] The plates 8a, 8b can be designed such that the distance A1 and A2 respectively, between the planes P1 and P2 of the respective plate 8a, 8b, is always the same, which means that the through-flow gap 9 or 10 is twice as high as the distance between the planes P1 and P2 of one plate. However, the plates 8a, 8b may alternatively be designed such that the distance between the planes P1, P2 of one plate 8a is less than the distance between corresponding planes P1, P2 of the other plate 8b. In this case, the height H of the through-flow gap 9 or 10 is less than the sum of the distances between the planes P1, P2 of said plates 8a, 8b.

[0021] Said two adjacent plates 8a, 8b may also have such mutual positions that two opposing edge portions 13, 14 and 11, 12 respectively, of one plate 8a engage and are joined together with two opposing edge portions 13, 14 of the other plate 8b. Two other opposing edge portions 11, 12 of one plate 8a and two other opposing edge portions 11, 12 of the other plate 8b define between them an inlet gap 17 into and an outlet gap 18 from 'the through-flow gap 9 or 10, the heights H of which correspond with or substantially correspond with the height H of the through-flow gap 9 or 10.

[0022] As mentioned above, the adjacent plates 8a, 8b may be located in two different positions relative to each other. When the plates are in the relative positions illustrated in figs. 2, 2a and 2b, opposing edge portions 13, 14 which on the plate 8a lie in the same second plane P2, engage and are joined together with opposing edge portions 13, 14 which on the other plate 8b also lie in said second plane P2.

[0023] The other opposing edge portions 11, 12 of the first plate 8a, lying in the same first plane P1, and the other opposing edge portions 11, 12 of said other or second plate 8b, define between them said inlet gap 17 and said outlet gap 18.

[0024] When the plates 8a, 8b instead are located in the positions relative to each other shown in figs. 3, 3a and 3b, opposing edge portions 11, 12 which on one plate 8b lie in the same first plane P1, engage and are joined together with opposing edge portions 13, 14 which on an adjacent plate 8a lie in said second plane P2.

[0025] The other opposing edge portions 13, 14 of the plate 8b which lie in said second plane P2 and other opposing edge portions 11, 12 of the plate 8a, define between them said inlet gap 17 and said outlet gap 18.

[0026] In order to seal the through-flow gaps 9, 10 at the corners of the stack 1 of plates and/or to hold the plates 8a, 8b together and/or to stiffen the stack 1 of plates, each plate 8a, 8b has four corner portions 20. When the plates 8a, 8b are placed in said stack 1 thereof, the inside of the corner portions 20 of a plate is joined together with the outside of corresponding corner portions 20 of an adjacent plate 8b or 8a.

[0027] In order to provide such a corner portion 20 at e.g. the plate 8b (see figs. 3c, 3d), a corner portion 20 of said plate extends obliquely from the edge portion 14 lying in the plane P1 to the edge portion 12 lying in the plane P2 of the plate. The corner portion 20 is bent downwards (or upwards) along a bending line 20b which, seen from above (fig. 3c), extends from the edge portion 14 to the edge portion 12. By bending the plate 8a and 8b respectively, downwards (or upwards) along this bending line 20b, the outer part of the edge portion 14 is bent downwards, the corner part 20a downwards along a part of the bending line 20b extending obliquely between the planes P1, P2 and the outer part of the edge portion 12 downwards. In order to hereby ensure that the corner portion 20 is directed straight or almost straight downwards although it partly emanates from a bending line 20a which extends obliquely between the planes P1, P2, the corner portion 20 is formed, preferably in connection with the bending, such that one side 20c thereof becomes longer than its other side 20d and this difference in length depends on the distance between the planes P1 and P2. The corner portion 20 of the plate 8a is provided in the same way.

[0028] The corner portions 20 are provided so close and/or durable to each other by soldering and/or have such rigidity that they replace separate sealing and/or holding and/or stiffening means at the corners of the stack 1 of plates.

[0029] When the plates 8a, 8b are joined together in said positions, through-flow gaps 9, 10 are defined which form a "through-flow labyrinth" for the media flows passing through said gaps. By forming this "through-flow labyrinth", undesired temperature zoning or layering at the outlet gaps 18 can be prevented or at least obstructed.

[0030] The angles α of the corrugating ridges relative to the inlet gaps 17 for hot medium V may e.g. be less than the angles β of the corrugating ridges 15 relative to inlet gaps 17 for cold medium K. In this example it is achieved that a greater flow resistance is generated for hot medium V in the plate heat exchanger than for cold medium K.

[0031] The angles α may be about 30° and the angles β consequently about 60°, but said angles α, β may vary in view of the desired flow resistance for each medium V and K.

[0032] The corrugating ridges 15 or a part thereof may form spaces 16 in one of two adjacent plates 8b, 8b, said spaces being directed from a first inlet gap 17 of the plate heat exchanger for a medium, preferably cold medium K, obliquely towards an inlet gap 17 of the plate heat excbanger for a second medium, preferably hot medium V. Hereby, said cold medium K can quickly cool such a part of the plate heat exchanger which is heated most by said hot medium V.

[0033] In order to further cool those parts of the plate heat exchanger which are heated most be hot medium

V, a separate through-flow passage 19 may be provided close to and extend along the inlet gap 17 for hot medium V. This separate through-flow passage 19 may lack corrugating ridges 15 such that cold medium K can flow therethrough with substantially less turbulence than the turbulence generated in cold medium K in the other through-flow gaps 10.

[0034] Said separate through-flow gap 19 can be rectilinear and it can be located immediately within the inlet gap 17 for hot medium V.

[0035] The plates 8a, 8b may have identical shape or substantially identical shape. As an example it can be noted that all plates 8a, 8b may have corner portions 20 bent in the same direction. Alternatively, every second plate 8a, 8b may have corner portions 20 bent in the opposite direction, but otherwise, the plates 8a, 8b may be identical.

[0036] The plates 8a, 8b are manufactured of a metallic material and they are mounted or attached to each other by soldering, e.g. vacuum soldering. The soldering can be carried through by applying a material suitable for soldering between the plates 8a, 8b (and eventually also between the members of the frame structure 4 and the plates), and then place the plate heat exchanger in a heating device in which the soldering material is melted. When the plate heat exchanger is removed from the heating device and the melted soldering material has cooled down, the solder is finished and the plate heat exchanger tight or leakproof.

[0037] By means of said soldering, the edge portions 11-14, the corrugating ridges 15 and the corner portions 20 are joined together in a stable and durable manner and it is possible to do without all types of frame structures located outside the stack 1 of plates for holding the plates together and/or provide sufficient stability to said stack 1 of plates.

[0038] Finally, it should be mentioned that the embodiments of the plate heat exchanger described above may vary within the scope of the following claims and that the plate heat exchanger can be used for two gaseous media or for one gaseous medium and one liquid medium.

Claims

1. Plate heat exchanger of cross-flow type for heat exchange between different media of which at least one is a gas,
wherein the plate heat exchanger comprises plates (8a, 8b) with elongated and in various alternating directions protruding corrugating ridges (15),
wherein the plate heat exchanger has through-flow gaps (9) for a first medium (V) and through-flow gaps (10) for a second medium (K),
wherein the through-flow gaps (9, 10) extend crosswise relative to each other through the plate heat exchanger such that said first and second medium (V, K) flow crosswise relative to each other through said plate heat exchanger,
wherein each plate (8a and 8b respectively) defines a partition wall between two different through-flow gaps (9, 10) for different media (V and K respectively) such that heat transfer between said media (V and K respectively) occurs through said plate (8a and. 8b respectively),
wherein the corrugating ridges (15) are situated between two planes (P1, P2),
wherein each plate (8a, 8b) has two edge portions (11, 12) which are provided in one plane (P1) and two other opposing edge portions (13, 14) which are provided in the other plane (P2),
wherein the corrugating ridges (15) are located inclined or obliquely relative to said edge portions (11-14),
wherein two adjacent plates (8a, 8b) are mounted relative to each other such that two edge portions (13, 14) of one of the plates (8a) and provided in one plane (P2) are joined together with two edge portions (13, 14) of the other plate (8b) located in the same plane (P2), while two edge portions (11, 12) of said one plate (8a) and provided in another plane (P1) are situated at a distance from two edge portions (11, 12) of said other plate (8b) provided in said another plane (P1), said two edge portions (11, 12) located at a distance from each other defining outlet and inlet gaps (17, 18) into and from a through-flow gap (9, 10) defined between the plates (8a, 8b), said outlet and inlet gaps (17, 18) having substantially the same height (H) as said through-flow gap (9 or 10),
wherein two adjacent plates (8a, 8b) are also mounted such that the corrugating ridges (15) inclined relative to the edge portions (11-14), cross each other in said through-flow gap (9 or 10),
wherein each plate (8a, 8b) has four corner portions (20) for sealing between the through-flow gaps (9, 10) at the corners of said plates (8a, 8b),
wherein each corner portion (20) of a plate (8a or 8b) is by means of soldering joined closely together with a corresponding corner portion (20) of an adjacent plate (8b or 8a), and
wherein the edge portions (11-14) and corrugating ridges (15) of two adjacent plates (8a, 8b) are joined together by-means of soldering
characterized in that each corner portion (20) is formed by bending of the plate (8a and 8b respectively) along a bending line (20b) such that said plate has outer parts of two edge portions (14, 12) located in different planes (P1, P2) and corner parts (20a) of the plate (8a and 8b respectively) located between said outer parts, said corner parts extending at said bending line (20b) obliquely between said planes (P1, P2) and that each corner portion (20) is directed perpendicular or substantially perpendicular to the plate (8a and 8b respectively).

2. Plate heat exchanger according to claim 1, **characterized in that** each corner portion (20) has two sides(20c, 20d) of different length.

3. Plate heat exchanger according to claim 1 or 2 **characterized in that** the plates (8a, 8b) are identical except for corner portions (20) which on every second plate (8a and 8b respectively) in the stack (1) thereof are turned relative to corner portions (20) of the other plates.

4. Plate heat exchanger according to any of claims 1 or 2, **characterized in that** the plates (8a, 8b) are identical and have corner portions (20) turned in the same direction.

5. Plate heat exchanger according to any preceding claim, **characterized in that** the angles (α) of the corrugating ridges (15) relative to edge portions at inlet gaps (17) for the medium (V) for which the heat transfer in the plate heat exchanger shall be maximized, are less than the angles (β) of the corrugating ridges (15) relative to edge portions at inlet gaps (17) for the medium (K) for which the resistance in the plate heat exchanger shall be minimized.

6. Plate heat exchanger according to any preceding claim, **characterized in that** the corrugating ridges (15) engaging each other pointwise, are joined together by soldering at the engagement or contact points.

7. Plate heat exchanger according to any preceding claim, **characterized in that** adjacent plates (8a, 8b) define a separate through-flow passage (19) for cold medium (K) without corrugating ridges (15), said separate through-flow passage (19) being provided close to and extending along an inlet gap (17) for hot medium (V) such that cold medium (K) flowing through said separate through-flow passage (19) cools the plate heat exchanger near said inlet gap (17) for hot medium (V).

8. Plate heat exchanger according to claim 7, **characterized in that** said separate through-flow passage (19) extends rectilinearly through the plate heat exchanger.

9. Plate heat exchanger according to claim 7 or 8, **characterized in that** said separate through-flow passage (19) is located immediately within an inlet gap (17) through which hot medium (V) flows into the plate heat exchanger.

Patentansprüche

1. Plattenwärmetauscher vom Querstromtyp zum Wärmeaustausch zwischen unterschiedlichen Medien, von denen wenigstens eines ein Gas ist,
wobei der Plattenwärmetauscher Platten (8a,8b) mit langgestreckten und in verschiedenen abwechselnden Richtungen vorstehenden Verstärkungsrippen (15) aufweist,
wobei der Plattenwärmetauscher Durchströmspalträume (9) für ein erstes Medium (V) und Durchströmspalträume (10) für ein zweites Medium (K) aufweist,
wobei die Durchströmspalträume (9,10) sich gegenseitig kreuzweise durch den Plattenwärmetauscher erstrecken, so dass das erste und zweite Medium (V,K) gegenseitig kreuzweise durch den Plattenwärmetauscher strömen,
wobei jede Platte (8a bzw.8b) eine Trennwand zwischen zwei unterschiedlichen Durchströmspalträumen (9,10) für unterschiedliche Medien (V bzw. K) bildet, so dass ein Wärmeaustausch zwischen den Medien (V bzw.K) durch die Platte (8a bzw. 8b) hindurch auftritt,
wobei die Verstärkungsrippen (15) zwischen zwei Ebenen (P1,P2) angeordnet sind,
wobei jede Platte (8a,8b) zwei Randteile (11,12), welche in einer Ebene (P1) vorgesehen sind, und zwei andere entgegengesetzte Randteile (13,14) aufweist, die in der anderen Ebene (P2) vorgesehen sind,
wobei die Verstärkungsrippen (15) bezüglich der Randteile (11-14) geneigt oder schräg angeordnet sind,
wobei zwei benachbarte Platten (8a,8b) relativ zueinander so angebracht sind, dass zwei Randteile (13,14) einer der Platten (8a), die in einer Ebene (P2) angeordnet sind, mit zwei Randteilen (13,14) der anderen Platte (8b) verbunden sind, die in der gleichen Ebene (P2) angeordnet sind, während zwei Randteile (11,12) der einen Platte (8a), die in einer anderen Ebene (P1) vorgesehen sind, in einem Abstand von zwei Randteilen (11,12) der anderen Platte (8b) angeordnet sind, die in der anderen Ebene (P1) vorgesehen sind, so dass zwei Randceile (11,12), die in einem Abstand voneinander angeordnet sind, Auslass- und Einlassspalte (17,18) in einen bzw. aus einem Durchströmspaltraum (9,10) bilden, die zwischen den Platten (8a, 8b) gebildet sind, wobei der Auslass- und der Einlassspalt (17,18) im Wesentlichen die gleiche Höhe (H) wie die Durchströmspalträume (9 oder 10) besitzen,
wobei zwei benachbarte Platten (8a,8b) ferner so angebracht sind, dass die Verstärkungsrippen (15), die bezüglich der Randteile (11-14) geneigt sind, in dem Durchströmspaltraum (9 oder 10) einander überkreuzen,
wobei jede Platte (8a,8b) vier Eckteile (20) zur Abdichtung zwischen den Durchströmspalträumen (9,10) an den Ecken der Platten (8a,8b) aufweist,

wobei jeder Eckteil (20) einer Platte (8a oder 8b) durch Verlöten mit einem entsprechenden Eckteil (20) einer benachbarten Platte (8b oder 8a) dicht verbunden ist, und
wobei die Randteile (11-14) und die Verstärkungsrippen (15) von zwei benachbarten Platten (8a,8b) durch Verlöten miteinander verbunden sind,
dadurch gekennzeichnet, dass jeder Eckteil (20) durch Biegen der Platte (8a bzw.8b) längs einer Biegelinie (20b) derart geformt ist, dass die Platte Außenteile der zwei Randteile (14,12), die in verschiedenen Ebenen (P1,P2) angeordnet sind, und Eckteile (20a) der Platte (8a bzw. 8b) aufweist, die zwischen den Außenteilen angeordnet sind, wobei die Eckteile sich an der Biegelinie (20b) schräg zwischen den Ebenen (P1,P2) erstrecken, und dass jeder Eckteil (20) senkrecht oder im Wesentlichen senkrecht zur Platte (8a bzw. 8b) ausgerichtet ist.

2. Plattenwärmetauscher nach Anspruch 1, **dadurch gekennzeichnet, dass** jeder Eckteil (20) zwei Seiten (20c,20d) unterschiedlicher Länge aufweist.

3. Plattenwärmetauscher nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Platten (8a,8b) mit Ausnahme der Eckteile (20) gleich sind, die an jeder zweiten Platte (8a bzw.8b) im Stapel (1) derselben bezüglich der Eckteile (20) der anderen Platten abgebogen sind.

4. Plattenwärmetauscher nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Platten (8a,8b) gleich sind und in der gleichen Richtung abgebogene Eckteile (20) aufweisen.

5. Plattenwärmetauscher nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** die Winkel (α) der Verstärkungsrippen (15) bezüglich der Randteile an den Einlassspalten (17) für das Medium (V), für welche der Wärmeübergang im Plattenwärmetauscher maximiert werden soll, kleiner sind als die Winkel (β) der Verstärkungsrippen (15) bezüglich der Randteile an Einlassspalten (17) für das Medium (K), für welche der Widerstand im Plattenwärmetauscher minimiert werden soll.

6. Plattenwärmetauscher nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** die Verstärkungsrippen (15), die einander punktweise berühren, durch Löten an den Angriffs- oder Kontaktpunkten miteinander verbunden sind.

7. Plattenwärmetauscher nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** benachbarte Platten (8a,8b) einen getrennten Durchströmkanal (19) für kaltes Medium (K) ohne Verstärkungsrippen (15) bilden, wobei der getrennte Durchströmkanal (19) nahe einem und längs eines Einlassspaltes (17) für heißes Medium (V) bilden, so dass kaltes Medium (K), welches durch den getrennten Durchströmkanal (19) strömt, den Plattenwärmetauscher nahe dem Einlassspalt (17) für heißes Medium (V) kühlt.

8. Plattenwärmetauscher nach Anspruch 7, **dadurch gekennzeichnet, dass** der getrennte Durchströmkanal (19) sich geradlinig durch den Plattenwärmetauscher erstreckt.

9. Plattenwärmetauscher nach Anspruch 7 oder 8, **dadurch gekennzeichnet, dass** der getrennte Durchströmkanal (19) unmittelbar innerhalb eines Einlassspaltes (17) angeordnet ist, durch welchen heißes Medium (V) in den Plattenwärmetauscher strömt.

Revendications

1. Échangeur de chaleur à plaques du type à courants croisés, pour l'échange de chaleur entre des milieux différents dont l'un au moins est un gaz,
dans lequel l'échangeur de chaleur à plaques comprend des plaques (8a, 8b) avec des nervures ondulées allongées (15) qui se projettent dans diverses directions alternées,
dans lequel l'échangeur de chaleur à plaques présente des intervalles traversants (9) pour l'écoulement d'un premier milieu (V) et des intervalles traversants (10) pour l'écoulement d'un second milieu (K),
dans lequel les intervalles traversants (9, 10) s'étendent de manière croisée les uns par rapport aux autres à travers l'échangeur de chaleur à plaques de telle manière que ledit premier milieu et ledit second milieu (V, K) s'écoulent de manière croisée l'un par rapport à l'autre à travers ledit échangeur de chaleur à plaques,
dans lequel chaque plaque (8a et 8b respectivement) définit une paroi de cloisonnement entre deux intervalles traversants différents (9,10) pour des milieux différents (V et K respectivement) de sorte qu'il se produit un transfert de chaleur entre lesdits milieux (V et K respectivement) à travers ladite plaque (8a et 8b respectivement),
dans lequel les nervures ondulées (15) sont situées entre deux plans (P1, P2),
dans lequel chaque plaque (8a, 8b) a deux parties de bordure (11, 12) qui sont prévues dans un plan (P1) et deux autres parties de bordure opposées (13, 14) qui sont prévues dans l'autre plan (P2),
dans lequel les nervures ondulées (15) sont situées inclinées ou en oblique par rapport auxdites parties de bordure (11-14),
dans lequel de plaques adjacentes (8a, 8b) sont montées l'une par rapport à l'autre de telle façon

que deux parties de bordure (13, 14) de l'une des plaques (8a) et prévues dans un plan (P2) sont réunies avec deux parties de bordure (13, 14) de l'autre plaque (8b) situées dans le même plan (P2), tandis que deux parties de bordure (11, 12) de ladite première plaque (8a) et prévues dans un autre plan (P1) sont situées à une distance depuis deux parties de bordure (11, 12) de ladite autre plaque (8b) prévues dans ledit autre plan (P1), lesdites deux parties de bordure (11, 12) situées à distance l'une de l'autre définissant des intervalles de sortie et des intervalles d'entrée (17, 18) sortant et entrant d'un intervalle traversant (9, 10) défini entre les plaques (8a, 8b), lesdits intervalles de sortie et lesdits intervalles d'entrée (17, 18) ayant sensiblement la même hauteur (H) que ledit intervalle traversant (9 ou 10),

dans lequel deux plaques adjacentes (8a, 8b) sont également montées de telle manière que les nervures ondulées (15) inclinées par rapport aux parties de bordure (11-14) se croisent les unes les autres dans ledit intervalle traversant (9 ou 10),

dans lequel chaque plaque (8a, 8b) a quatre parties de coin (20) pour assurer un étanchement entre les intervalles traversants (9, 10) aux coins desdites plaques (8a, 8b),

dans lequel chaque partie de coin (20) d'une plaque (8a ou 8b) est jointe intimement par soudure avec une partie de coin correspondante (20) d'une plaque adjacente (8b ou 8a), et

dans lequel les parties de bordure (11-14) et les nervures ondulées (15) de deux plaques adjacentes (8a, 8b) sont réunies ensemble par soudure,

caractérisé en ce que chaque partie de coin (20) est formée en cintrant la plaque (8a et 8b respectivement) le long d'une ligne de cintrage (20b) de telle manière que ladite plaque a des parties extérieures de deux parties de bordure (14, 12) situées dans des plans différents (P1, P2) et des parties de coin (20a) de la plaque (8a et 8b respectivement) situées entre lesdits parties extérieures, lesdites deux parties de coin s'étendant au niveau de ladite ligne de cintrage (20b) en oblique entre lesdits plans (P1, P2), et **en ce que** chaque partie de coin (20) est dirigée perpendiculairement ou sensiblement perpendiculairement à la plaque (8a et 8b respectivement).

2. Échangeur de chaleur à plaques selon la revendication 1, **caractérisé en ce que** chaque partie de coin (20) a deux côtés (20c, 20d) de longueurs différentes.

3. Échangeur de chaleur à plaques selon l'une ou l'autre des revendications 1 et 2, **caractérisé en ce que** les plaques (8a, 8b) sont identiques à l'exception de parties de coin (20) qui, sur une plaque sur deux (8a et 8b respectivement) dans l'empilage (1) de plaques, sont tournées par rapport à des parties de coin (20) des autres plaques.

4. Échangeur de chaleur à plaques selon l'une ou l'autre des revendications 1 et 2, **caractérisé en ce que** les plaques (8a, 8b) sont identiques et comportent des parties de coin (20) tournées dans la même direction.

5. Échangeur de chaleur à plaques selon l'une quelconque des revendications précédentes, **caractérisé en ce que** les angles (α) des nervures ondulées (15) par rapport aux parties de bordure au niveau des intervalles d'entrée (17) pour le milieu (V) pour lequel le transfert de chaleur dans l'échangeur de chaleur à plaques devrait être maximisé, sont inférieurs aux angles (β) des nervures ondulées (15) par rapport aux parties de bordure au niveau des intervalles d'entrée (17) pour le milieu (K) pour lequel la résistance dans l'échangeur de chaleur à plaques devrait être maximisée.

6. Échangeur de chaleur à plaques selon l'une quelconque des revendications précédentes, **caractérisé en ce que** les nervures ondulées (15) qui s'engagent mutuellement ponctuellement sont jointes ensemble par soudure au niveau des points d'engagement ou de contact.

7. Échangeur de chaleur à plaques selon l'une quelconque des revendications précédentes, **caractérisé en ce que** des plaques adjacentes (8a, 8b) définissent un passage traversant séparé (19) pour l'écoulement d'un milieu froid (K) dépourvu de nervures ondulées (15), ledit passage traversant séparé (19) étant prévu à proximité de et s'étendant le long d'un intervalle d'entrée (17) pour un milieu chaud (V) de sorte que le milieu froid (K) qui s'écoule à travers ledit passage traversant séparé (19) refroidit l'échangeur de chaleur à plaques à proximité dudit intervalle d'entrée (17) pour le milieu chaud (V).

8. Échangeur de chaleur à plaques selon la revendication 7, **caractérisé en ce que** ledit passage traversant séparé (19) s'étend de manière rectiligne à travers l'échangeur de chaleur à plaques.

9. Échangeur de chaleur à plaques selon l'une ou l'autre des revendications 7 et 8, **caractérisé en ce que** ledit passage traversant séparé (19) est situé immédiatement à l'intérieur d'un intervalle d'entrée (17) à travers lequel un milieu chaud (V) s'écoule en entrant dans l'échangeur de chaleur à plaques.

Fig.1

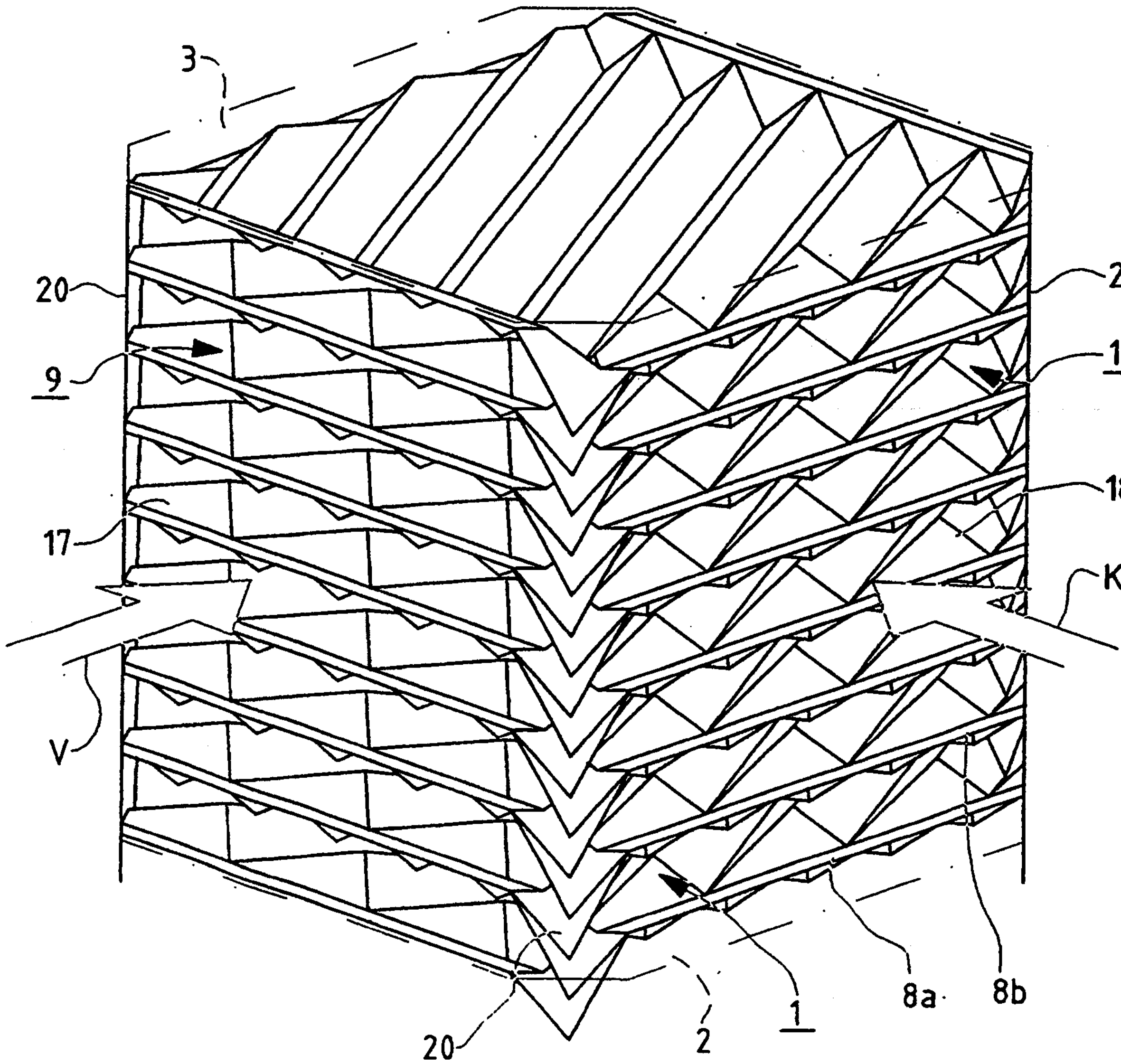
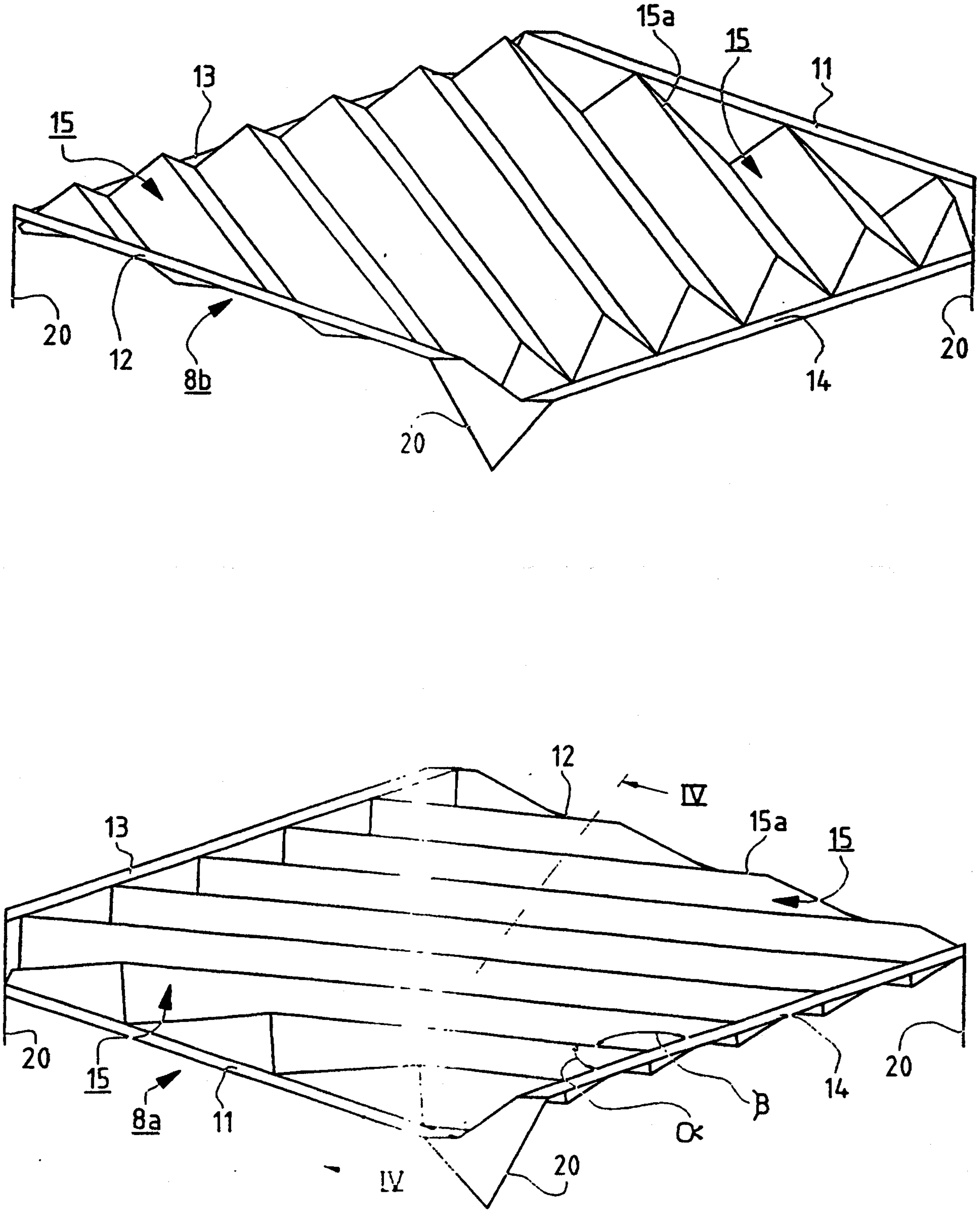
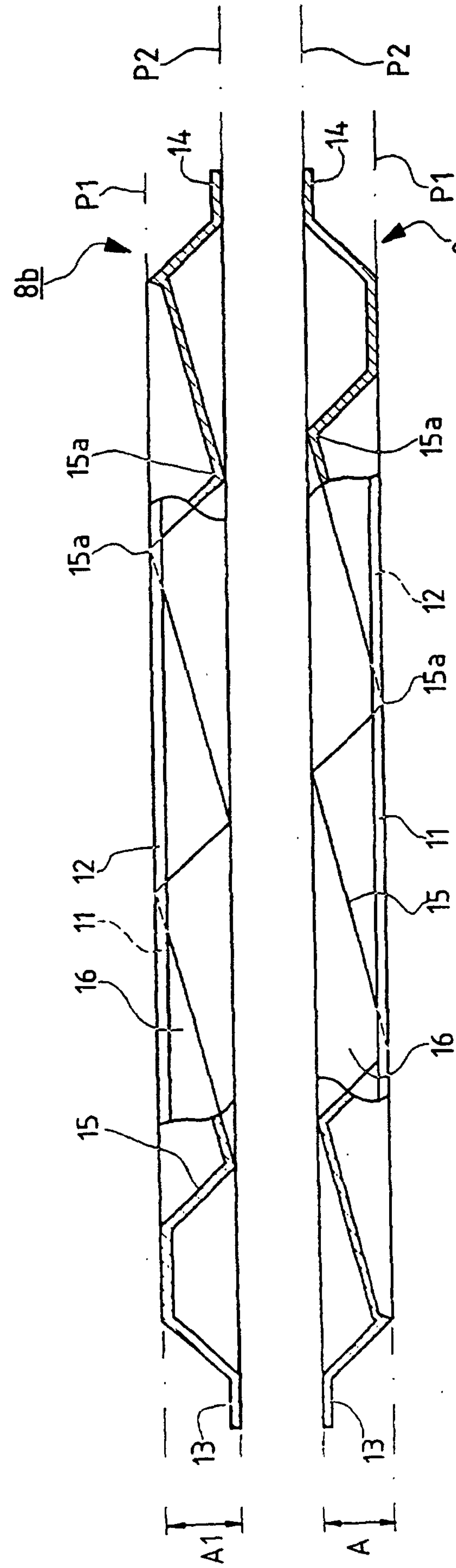


Fig.2


15a
15
11
13
15
20
12
8b
20
14
20
12
IV
13
15a
15
20
15
8a
11
α
β
14
20
20
IV


P2
P2
P1
P1
14
14
8b
8a
15a
15a
15a
15a
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12
11
11
16
16
15
15
13
13
A1
A

Fig.2a

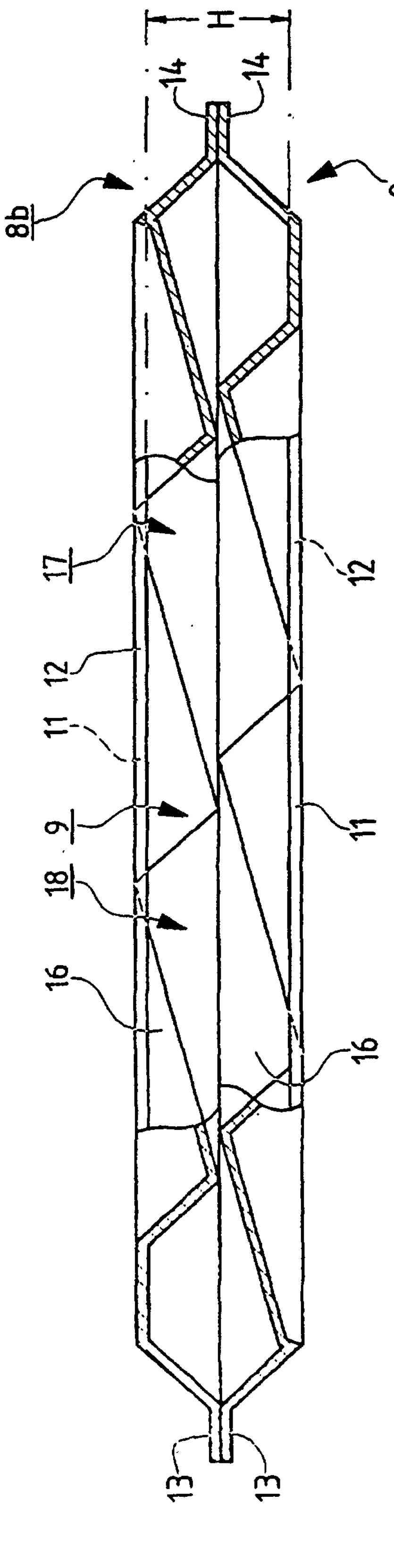


Fig.2b

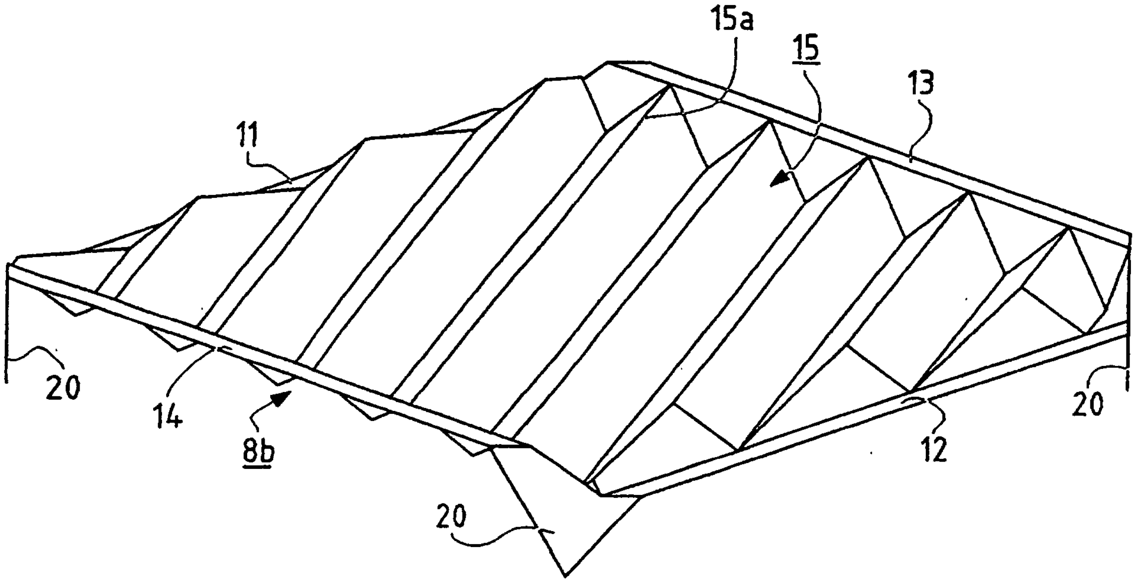
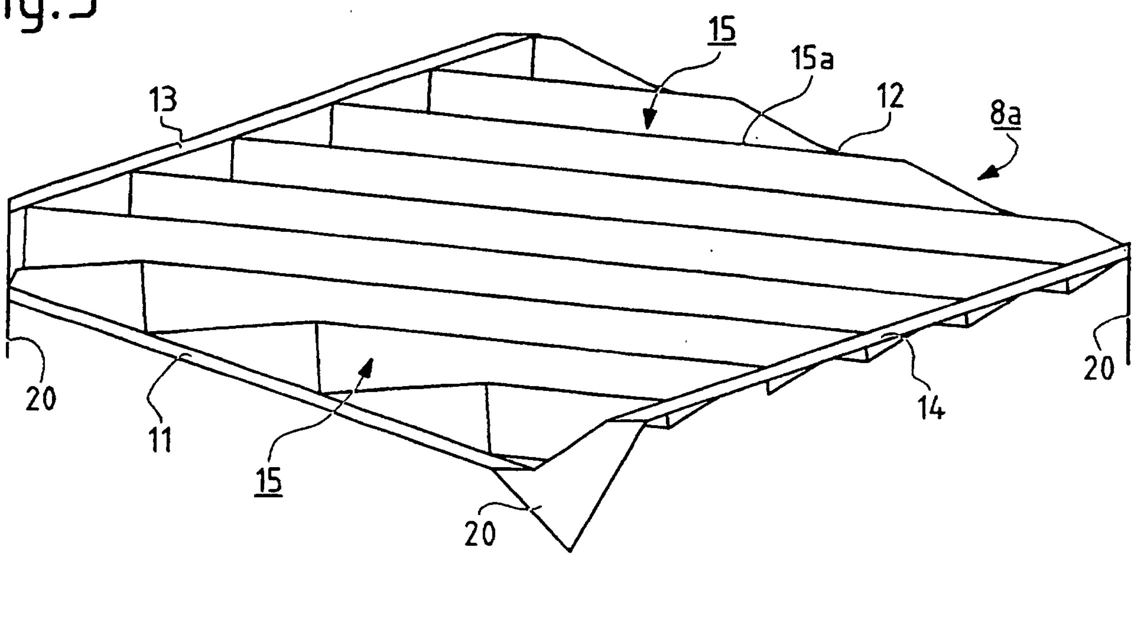


Fig.3



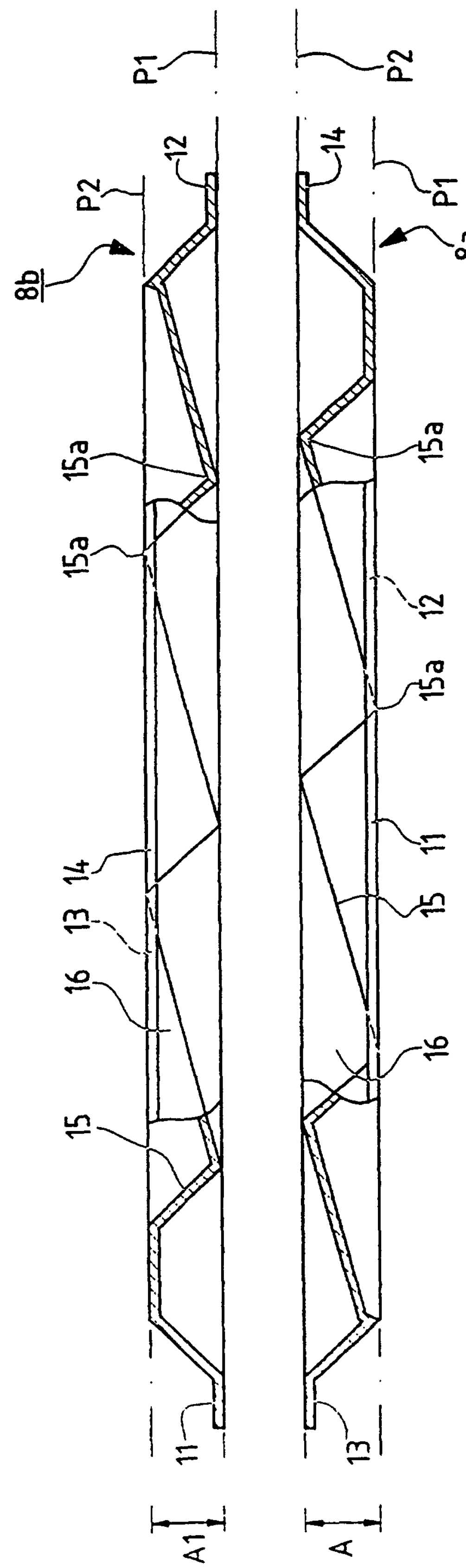

P1
P2
P2
P1
12
14
8b
8a
15a
15a
15a
15a
12
14
13
16
11
15
15
16
11
13
A1
A

Fig.3a

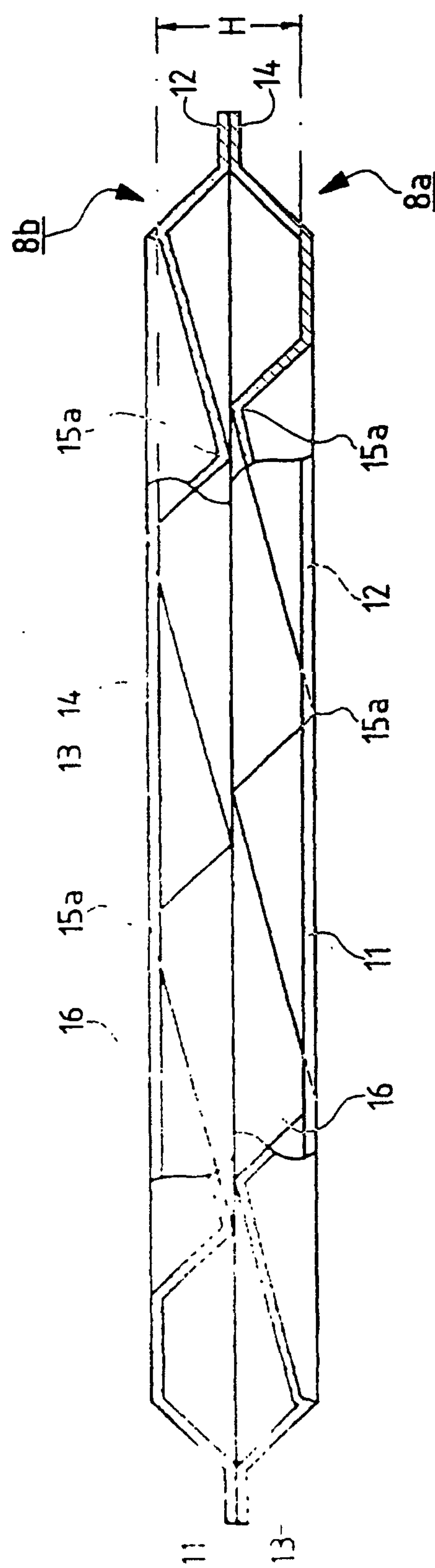


Fig.3b

Fig.3c

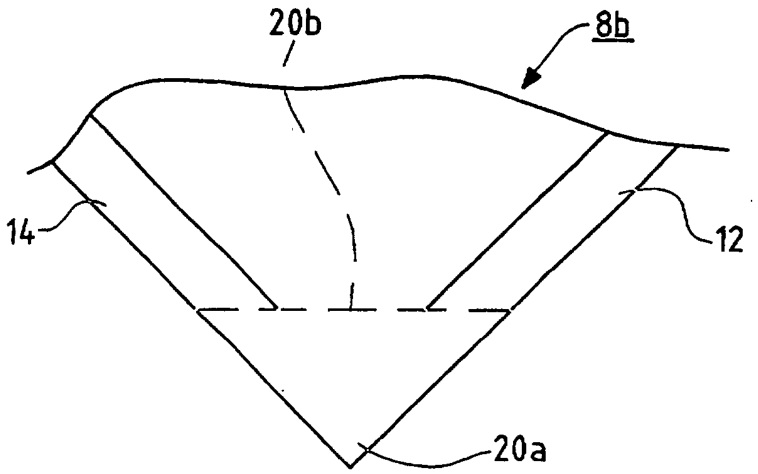


Fig.3d

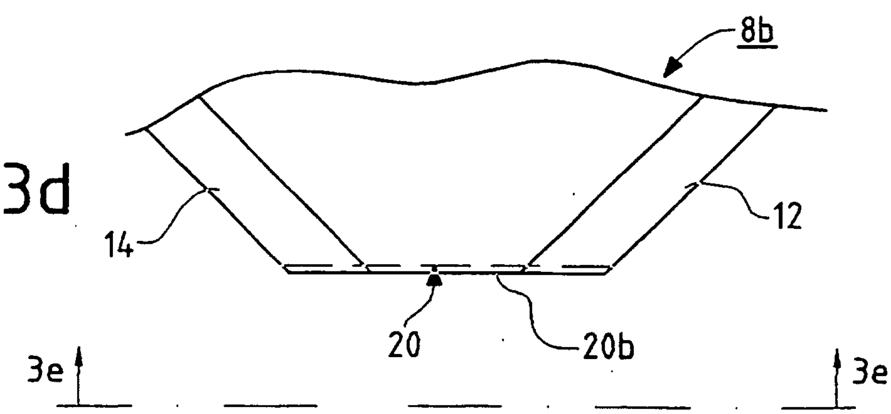
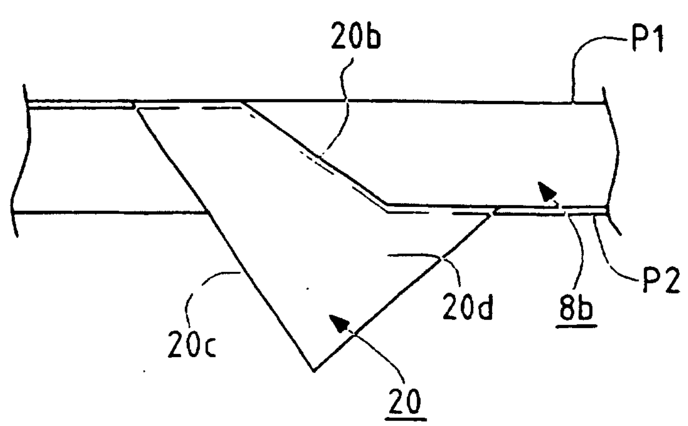


Fig.3e



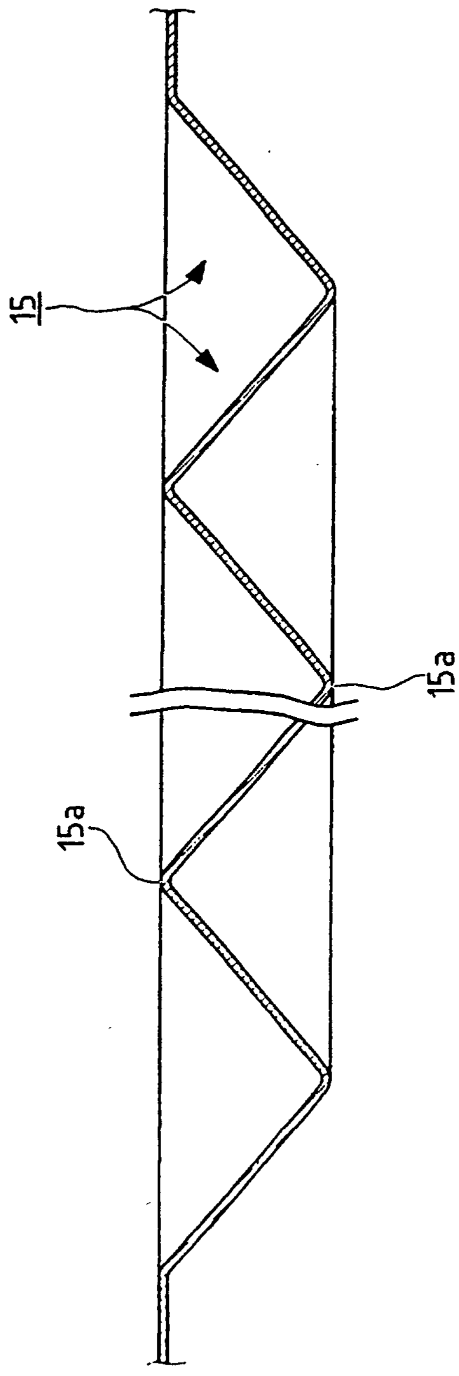


Fig.4

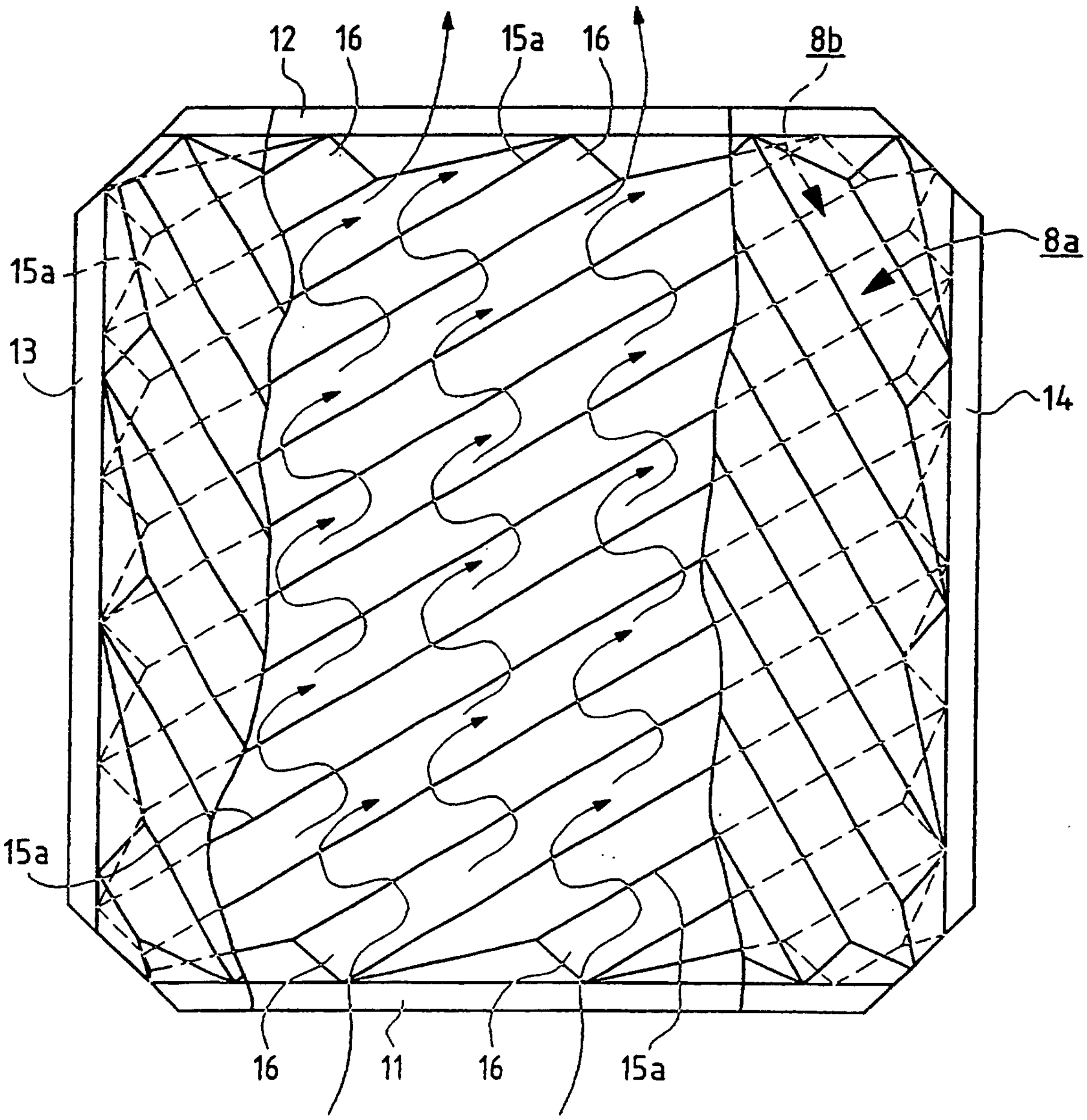


Fig.5

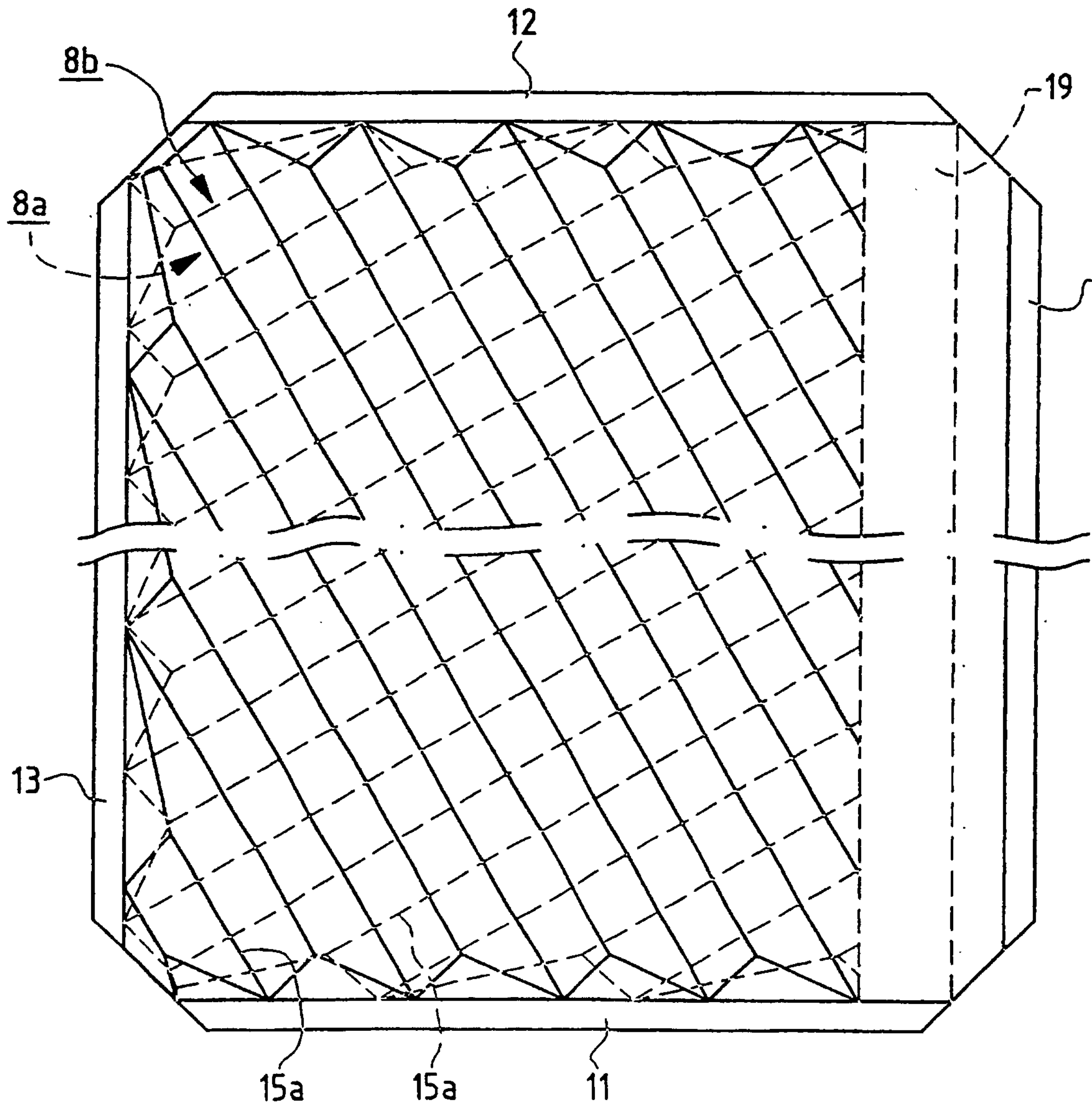


Fig.6