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(54) BRAZED PLATE HEAT EXCHANGER

(57) A brazed plate heat exchanger (10) comprises a plurality of heat exchanger plates (12A, 12B) which are stacked onto one another. The heat exchanger plates (12A, 12B) are obtained by forming from respective metal sheets and are permanently joined to each other through brazing by means of a braze material, so as to form a plate package (30) provided with first plate interspaces for a first fluid and second plate interspaces for a second fluid. The plate package (30) comprises an alternation between a first heat exchanger plate (12A) and a second heat exchanger plate (12B). Each first heat exchanger plate (12A) and each second heat exchanger plate (12B) are provided with a plurality of portholes (P1, P2, P3, P4) and has a substantially rectangular shape, with two long side edges (26), two short side edges (28) and a longitudinal axis (X) extending parallel to the long side edges (26) and transversely to the short side edges (28). Each first heat exchanger plate (12A) and each second heat exchanger plate (12B) have a corrugation pattern which forms at least one heat transfer area (36, 38; 40), that extends along the longitudinal axis (X) and comprises mutually parallel ridges (32) and grooves (34) arranged in such a manner that the ridges (32) of one of the first heat exchanger plates (12A) abut the grooves (34) of an adjoining one of the second heat exchanger plates (12B), so as to form a plurality of joining areas. Each ridge (32) and each groove (34) of at least one first heat transfer area (36) of each first heat exchanger plate (12A) are inclined with respect of the longitudinal axis (X) by a first angle (α) comprised between 0° and 30°. Each ridge (32) and each groove (34) of at least one heat transfer area (40) of each second heat exchanger plate (12B) are inclined with respect of the longitudinal axis (X) by a second angle (β) comprised between 90° and 45°. At least part of the ridges (32) and at least part of the grooves (34) of at least a first heat transfer area (36) of each first heat exchanger plate (12A) extend without discontinuities between the opposite edges of the respective heat transfer area (36), wherein these opposite edges are parallel to the short side edges (28).

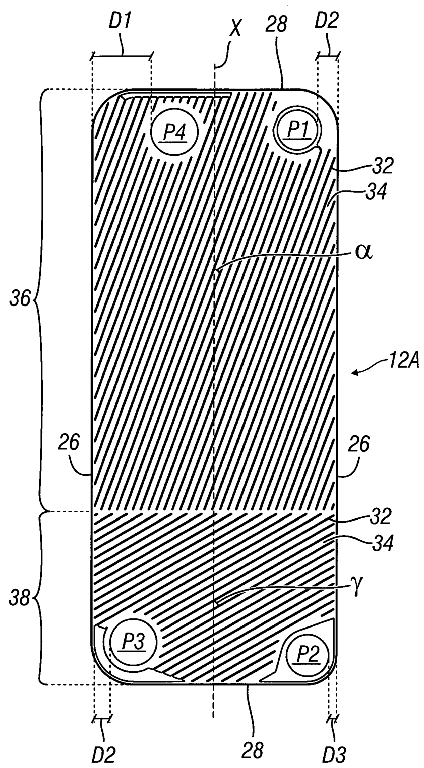

Fig. 3

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Description

Field of the invention

[0001] The present invention refers in general to a plate heat exchanger and, more specifically, to a brazed plate heat exchanger wherein the heat exchanger plates are provided with an improved corrugation pattern of ridges and grooves which facilitates the liquid condensate drainage.

Background of the invention

[0002] Heat exchangers are devices used to transfer heat between two or more fluids. A plate heat exchanger is a specific type of heat exchanger wherein metal plates are used to transfer heat between two fluids. Plate-type heat exchangers generally comprise a start plate, an end plate and a plurality of intermediate plates stacked onto one another, so as to form flow channels between them. In a plate-type heat exchanger, the two fluids at different temperatures (one of which is usually identified as the refrigerant fluid) respectively flow through plate channels obtained between opposite surfaces of pairs of adjacent heat exchanger plates: in this way the two fluids exchange their thermal content. These fluids can flow counter-current or co-current and their leak-free circulation is ensured by gaskets or by the junctions between the heat exchanger plates.

[0003] The flow channels between the heat exchanger plates are commonly obtained by providing both plate surfaces with a corrugated pattern. In other words, both plate surfaces are provided with a pressed pattern of ridges and grooves. When the heat exchanger plates are stacked onto one another, the ridges of a first heat exchanger plate contact the grooves of an adjacent heat exchanger plate and these plates are thus kept at a distance from each other through spacer elements. In this way the flow channels are formed.

[0004] A common way of manufacturing a plate-type heat exchanger is to braze the heat exchanger plates together. This way of manufacturing requires that the heat exchanger plates are provided with a brazing material. During manufacturing, the heat exchanger plates stacked onto one another and placed in a furnace having a temperature sufficiently hot to at least partially melt the brazing material. After the temperature of the furnace has been lowered, the brazing material will solidify, allowing the heat exchanger plates to become joined to one another to form a compact and strong heat exchanger.

[0005] Brazed plate heat exchangers, also known by the acronym "BHE", can be used as condensers in various applications (e.g., air conditioners, heat pumps, etc.). The condensing process usually occurs in vertical flow channels of the heat exchanger plates, with the refrigerant vapor generally flowing from the top to the bottom of the channels according to gravity. This facilitates the liquid condensate drainage by gravity, reducing the liquid film thickness on the surface of the plates, and its related thermal resistance.

[0006] Normally, BHE units used as condensers are installed in vertical position. This means that, since the heat exchanger plates usually have a substantially rectangular shape, the short sides of these plates are arranged horizontally, while the long sides of these plates are arranged vertically. Several corrugation patterns of BHE plates are known in the prior art. For example, a known corrugation pattern provides a plurality of channels in the shape of a single or multiple chevrons, with one or more vertical spines extending between the short sides of each heat exchanger plate. Further known corrugation patterns are disclosed, for example, in prior art documents WO 2021/154152, EP 3832243, US 7669643, US 2011/0083833, CN 102519281 and JP 11037677.

[0007] The Applicant found that, by tilting a BHE provided with plates having a known corrugation pattern at a predefined angle with respect to a vertical axis, the BHE condenser performances were improved for certain inclination angles (see attached figures 7 and 8). A possible explanation was that an inclined BHE unit, at certain angles related likely to the cross-corrugation angle and the direction of gravity, could make it easier for the liquid condensate to be drained to the bottom of the heat exchanger plates (where subcooled liquid is built up), thinning the liquid film and so reducing its thermal resistance, with a final improvement of the condensing process (lower condensing temperature or lower temperature approach). Therefore, there is a need to improve such prior art BHE units, since it is not convenient to install these BHE units in arrangements other than the vertical one.

Summary of the invention

[0008] One object of the present invention is therefore to provide a brazed plate heat exchanger which is capable of resolving the drawbacks of the prior art in a simple, inexpensive and particularly functional manner.

[0009] In detail, one object of the present invention is to provide a brazed plate heat exchanger wherein the liquid condensate can be drained to the bottom of the heat exchanger plates in a simpler and faster way with respect to brazed plate heat exchangers according to the prior art, assuring a good heat transfer by a proper special selection of the corrugation angles of the plates.

[0010] Another object of the present invention is to provide a brazed plate heat exchanger wherein the corrugation pattern of the heat exchanger plates is easier to manufacture with respect to brazed plate heat exchangers according to the prior art.

[0011] These objects are achieved according to the present invention by providing a brazed plate heat exchanger as set forth in the attached claims.

[0012] Further features of the invention are underlined by the dependent claims, which are an integral part of the present description.

[0013] The brazed plate heat exchanger according to the present invention comprises a plurality of heat exchanger plates which are stacked onto one another. The heat exchanger plates are obtained by forming from respective metal sheets. The heat exchanger plates are permanently joined to each other through brazing by means of a braze material, so as to form a plate package provided with first plate interspaces for a first fluid and second plate interspaces for a second fluid. The plate package comprises an alternation between a first heat exchanger plate and a second heat exchanger plate. Each between the first heat exchanger plate and the second heat exchanger plate is provided with a plurality of portholes and has a substantially rectangular shape, with two long side edges, two short side edges and a longitudinal axis extending parallel to the two long side edges and transversely to the two short side edges. Each between the first heat exchanger plate and the second heat exchanger plate has a corrugation pattern which forms at least one heat transfer area that extends along the longitudinal axis. Each heat transfer area comprises mutually parallel ridges and grooves arranged in such a manner that the ridges of one of the first heat exchanger plates abut the grooves of an adjoining one of the second heat exchanger plates, so as to form a plurality of joining areas.

[0014] Each ridge and each groove of at least one first heat transfer area of each first heat exchanger plate are inclined with respect of the longitudinal axis by a first angle comprised between 0° and 30°. Additionally, each ridge and each groove of at least one heat transfer area of each second heat exchanger plate are inclined with respect of the longitudinal axis by a second angle comprised between 90° and 45°. Finally, at least part of the ridges and at least part of the grooves of at least a first heat transfer area of each first heat exchanger plate extend without discontinuities between the opposite edges of the respective heat transfer area, wherein these opposite edges are parallel to the short side edges.

[0015] Preferably, the first angle is of 20°, whereas the second angle is of 70°.

[0016] Also preferably, the amount of the ridges, and thus of the grooves, of the first heat transfer area of each first heat exchanger plate that extend without discontinuities between the opposite edges of the respective heat transfer area is equal to at least 30% of the total amount of the ridges, and thus of the grooves, of the first heat transfer area of each first heat exchanger plate.

[0017] According to a preferred aspect of the present invention, each of the first heat exchanger plates is provided with at least one second heat transfer area which is adjacent to the first heat transfer area. Each ridge and each groove of the second heat transfer area are preferably inclined with respect of the longitudinal axis by a third angle comprised between 45° and 90°. More preferably, this third angle is of 65°.

[0018] Also preferably, at least part of the ridges and at least part of the grooves of the second heat transfer area extend seamlessly, i.e., without discontinuities, between the opposite edges of the respective second heat transfer area, wherein these opposite edges are parallel to the short side edges. Still preferably, the second heat transfer area has a longitudinal extension, measured along the longitudinal axis, that is equal to about 1/3 of the longitudinal extension of the first heat transfer area.

[0019] Each ridge and each groove of each heat transfer area of both the first heat exchanger plates and the second heat exchanger plates are preferably straight and continuous along the respective heat transfer area. The longitudinal axis is preferably a vertical axis.

[0020] According to a preferred embodiment, each between the first heat exchanger plate and the second heat exchanger plate is provided with four portholes. Each porthole is then placed at a respective corner of the respective heat exchanger plate, that is, at the contact point between a long side edge and a short side edge of the respective heat exchanger plate.

[0021] Preferably, at least one of the portholes can be placed at a distance from its closest long side edge which is different from the distances from the respective closest long side edge of the remaining portholes. More preferably, said distance of the at least one porthole is greater than said distances of the remaining portholes. Still preferably, each corner of each heat exchanger plate is a rounded corner.

Brief description of the drawings

[0022] The features and advantages of a brazed plate heat exchanger according to the present invention will be clearer from the following exemplifying and nonlimiting description, with reference to the enclosed schematic drawings, in which:

Figure 1 is a side view of a generic embodiment of a brazed plate heat exchanger;
Figure 2 is a plan view of the brazed plate heat exchanger of Figure 1;
Figure 3 is a plan view of a heat exchanger plate provided with a first type of corrugation pattern of ridges and grooves according to the invention;
Figure 4 is a side view of the heat exchanger plate of figure 3;
Figure 5 is a plan view of a heat exchanger plate provided with a second type of corrugation pattern of ridges and grooves according to the invention;
Figure 6 is a side view of the heat exchanger plate of figure 5;
Figure 7 is a diagram showing the correlation between condensing temperature and inclination angle of the plates in a brazed plate heat exchanger according to the prior art;
Figure 8 is another diagram showing the correlation between condensing temperature and heat flux (measured in kW/m^2) of the plates in a brazed plate

heat exchanger according to the prior art;

Figure 9 is a schematic view showing the inclination angles of the plates in a brazed plate heat exchanger according to the prior art; and

Figure 10 is a schematic view showing the corrugation pattern of ridges and grooves of the plates in a brazed plate heat exchanger according to the invention.

Detailed description of the invention

[0023] With reference to Figures 1 and 2, a brazed plate heat exchanger 10 is shown. The heat exchanger 10 comprises, in a per se known manner, a plurality of heat exchanger plates 12A, 12B stacked onto one another. Typically, the heat exchanger plates 12A, 12B are stacked onto one another between a first end plate 14 and a second end plate 16 of the heat exchanger 10. Each heat exchanger plate 12A, 12B is obtained by forming from a respective metal sheet. The first end plate 14, the second end plate 16 and the heat exchanger plates 12A, 12B are permanently joined to each other through brazing by means of a braze material, so as to form a plate package 30. The plate package 30 is thus provided with first plate interspaces for a first fluid and second plate interspaces for a second fluid. The first fluid and the second fluid may be any suitable heat transfer fluid.

[0024] The plate package 30 of the heat exchanger 10 comprises an alternation between a first heat exchanger plate 12A and a second heat exchanger plate 12B. In other words, starting from the first end plate 14 and up to the second end plate 16, a first heat exchanger plate 12A is joined to a second heat exchanger plate 12B, while this second heat exchanger plate 12B is joined to another first heat exchanger plate 12A, and so on. Plate interspaces are thus obtained between heat exchanger plates 12A, 12B of different type, that is, a first heat exchanger plate 12A and a second heat exchanger plate 12B.

[0025] Each between the first heat exchanger plate 12A and the second heat exchanger plate 12B, as well as the first end plate 14 and the second end plate 16, is provided with a plurality of portholes, preferably four portholes P1, P2, P3 and P4. A first porthole P1 is connected to a first connection pipe 18 and communicates with the first plate interspaces. A second porthole P2 is connected to a second connection pipe 20 and communicates with the first plate interspaces. A third porthole P3 is connected to a third connection pipe 22 and communicates with the second plate interspaces. Finally, a fourth porthole P4 is connected to a fourth connection pipe 24 and communicates with the second plate interspaces. Connection pipes 18, 20, 22 and 24 may be provided extending from the first end plate 14, as shown in Figure 1, and/or from the second end plate 16.

[0026] Each between the first heat exchanger plate 12A and the second heat exchanger plate 12B, as well as the first end plate 14 and the second end plate 16, has a substantially rectangular shape, with two long side edges 26 and two short side edges 28, as shown in Figure 2. A longitudinal axis X extends parallel to the two long side edges 26 and transversely to the two short side edges 28.

[0027] Each between the first heat exchanger plate 12A and the second heat exchanger plate 12B has a corrugation pattern forming at least one heat transfer area 36, 38, 40 that extends along the longitudinal axis X. Each heat transfer area 36, 38, 40 comprises mutually parallel ridges 32 and grooves 34 arranged in such a manner that the ridges 32 of one of the first heat exchanger plates 12A abut the grooves 34 of an adjoining one of the second heat exchanger plates 12B, so as to form a plurality of small joining areas (called brazing joints).

[0028] According to the invention, each ridge 32, and thus each groove 34, of at least one first heat transfer area 36 of each first heat exchanger plate 12A are inclined with respect of the longitudinal axis X by a first angle α comprised between 0° and 30°, as shown in Figure 3. Each ridge 32, and thus each groove 34, of the heat transfer area 40 of each second heat exchanger plate 12B are instead inclined with respect of the longitudinal axis X by a second angle β comprised between 90° and 45°, as shown in Figure 5. Preferably, the first angle α is of 20°, while the second angle β is of 70°.

[0029] Additionally, at least part of the ridges 32, and thus at least part of the grooves 34, of the first heat transfer area 36 of each first heat exchanger plate 12A extend without discontinuities between the opposite edges of the respective heat transfer area 36, i.e., the opposite edges parallel to the short side edges 28 of the respective first heat exchanger plate 12A. In other words, since the longitudinal axis X is preferably a vertical axis, as shown in the figures, at least part of the ridges 32, and thus at least part of the grooves 34, of the first heat transfer area 36 of each first heat exchanger plate 12A extend seamlessly, i.e., without discontinuities, from top to bottom of the respective heat transfer area 36.

[0030] Preferably, the amount of the ridges 32, and thus of the grooves 34, of the first heat transfer area 36 of each first heat exchanger plate 12A that extend without discontinuities between the opposite edges of the respective heat transfer area 36 is equal to at least 30% of the total amount of the ridges 32, and thus of the grooves 34, of the first heat transfer area 36 of each first heat exchanger plate 12A. For example, the preferred first angle α of 20° of each first heat exchanger plate 12A ensures that at least 40% of the respective ridges 32, and thus the respective grooves 34, extend seamlessly from top to bottom of the first heat transfer area 36 of each first heat exchanger plate 12A.

[0031] The second angle β of the second heat exchanger plate 12B, which is comprised between 90° and 60° and is preferably equal to 70°, is selected in such a way to obtain good thermal exchange coefficients. In fact, in a heat exchanger plate according to the prior art, with a standard pattern, i.e., with small corrugation angles (e.g., 20°), two drawbacks arise on pairs of adjacent heat exchanger plates: low thermal exchange coefficients and incorrect distribution of fluids within the respective channels.

[0032] Preferably, as shown in Figure 3, each first heat exchanger plate 12A is provided with at least one second heat transfer area 38 which is adjacent to the first heat transfer area 36. More specifically, in case of the longitudinal axis X is a vertical axis, the second heat transfer area 38 is arranged below the first heat transfer area 36. Each ridge 32, and thus each groove 34, of this second heat transfer area 38 are inclined with respect of the longitudinal axis X by a third angle γ comprised between 45° and 90°. Preferably, the third angle γ is of 65°.

[0033] Similarly to the first heat transfer area 36, at least part of the ridges 32, and thus at least part of the grooves 34, of the second heat transfer area 38 preferably extend without discontinuities between the opposite edges of the respective second heat transfer area 38, i.e., the opposite edges parallel to the short side edges 28 of the respective first heat exchanger plate 12A. Preferably, as shown in figure 3, the second heat transfer area 38 of each first heat exchanger plate 12A has a longitudinal extension, measured along the longitudinal axis X, that is equal to about 1/3 of the longitudinal extension of the first heat transfer area 36 of the respective first heat exchanger plate 12A.

[0034] The corrugation pattern described above of both the first heat exchanger plates 12A and the second heat exchanger plates 12B is schematically shown in Figure 10. This corrugation pattern allows one of the fluids processed by the heat exchanger 10, for example the liquid condensate in the case of said heat exchanger 10 is used as a condenser, to move along almost vertical interspaces, so as to reach more easily the bottom zone of the heat exchanger plates 12A, 12B. Additionally, this advantageous feature is enhanced by the fact that each ridge 32 and each groove 34 of each heat transfer area 36, 38, 40 of both the first heat exchanger plates 12A and the second heat exchanger plates 12B are straight and continuous along the respective heat transfer area 36, 38, 40. In other words, the heat exchanger plates 12A, 12B are not provided with any vertical spine or other discontinuities in the respective heat transfer areas 36, 38, 40, thus improving the capability of the liquid condensate to reach more easily the bottom zone of the heat exchanger plates 12A, 12B.

[0035] Preferably, each of the four portholes P1, P2, P3, P4 of the heat exchanger plates 12A, 12B is placed at a respective corner of the respective heat exchanger plate 12A, 12B. In other words, as shown in the figures, each of the four portholes P1, P2, P3, P4 of the heat exchanger plates 12A, 12B is placed at the contact point between a long side edge 26 and a short side edge 28 of the respective heat exchanger plate 12A, 12B. More preferably, each corner of each heat exchanger plate 12A, 12B is a rounded corner.

[0036] According to a preferred aspect of the invention, at least one of the portholes P4 of each heat exchanger plate 12A, 12B, that is, the porthole P4 in the upper left in Figures 3 and 5, is placed at a distance D1 from its closest long side edge 26 which is different from the distances D2, D3 from the respective closest long side edge 26 of the remaining portholes P1, P2, P3. Preferably but not exclusively, the distance D1 of said at least one porthole P4 is greater than the distances D2, D3 of the remaining portholes P1, P2, P3. This preferred technical feature is due the fact that the specific and innovative combination of corrugation angles α and β requires an equally specific fluid port arrangement in order to have an even fluid distribution along the width of the heat exchanger plates 12A, 12B (so to maximize heat transfer).

[0037] It is thus seen that the brazed plate heat exchanger according to the present invention achieve the previously outlined objects.

[0038] The brazed plate heat exchanger of the present invention thus conceived is susceptible in any case of numerous modifications and variants, all falling within the same inventive concept; in addition, all the details can be substituted by technically equivalent elements. In practice, the materials used, as well as the shapes and size, can be of any type according to the technical requirements.

[0039] The scope of protection of the invention is therefore defined by the enclosed claims.

List of references

[0040]

10:	heat exchanger;
12A:	first heat exchanger plates;
12B:	second heat exchanger plates;
14:	first end plate;
16:	second end plate;
18:	first connection pipe;
20:	second connection pipe;
22:	third connection pipe;
24:	fourth connection pipe;
26:	plate long side edges;
28:	plate short side edges;
30:	plate package;
32:	ridges;
34:	grooves;
36:	first heat transfer area of first heat exchanger plates;
38:	second heat transfer area of first heat exchanger plates;
40:	heat transfer area of second heat exchanger plates;
α:	first angle;
β:	second angle;
γ:	third angle;
P1:	first porthole;
P2:	second porthole;
P3:	third porthole;
P4:	fourth porthole;

D1: distance between fourth porthole and respective plate long side edge;
D2: distance between first and third porthole and respective plate long side edge;
D3: distance between second porthole and respective plate long side edge.

Claims

1. A brazed plate heat exchanger (10) comprising a plurality of heat exchanger plates (12A, 12B) which are stacked onto one another, wherein said heat exchanger plates (12A, 12B) are obtained by forming from respective metal sheets, wherein said heat exchanger plates (12A, 12B) are permanently joined to each other through brazing by means of a braze material, so as to form a plate package (30) provided with first plate interspaces for a first fluid and second plate interspaces for a second fluid, wherein said plate package (30) comprises an alternation between a first heat exchanger plate (12A) and a second heat exchanger plate (12B), wherein each between said first heat exchanger plate (12A) and said second heat exchanger plate (12B) is provided with a plurality of portholes (P1, P2, P3, P4) and has a substantially rectangular shape, with two long side edges (26), two short side edges (28) and a longitudinal axis (X) extending parallel to said two long side edges (26) and transversely to said two short side edges (28), wherein each between said first heat exchanger plate (12A) and said second heat exchanger plate (12B) has a corrugation pattern which forms at least one heat transfer area (36, 38; 40) that extends along said longitudinal axis (X), and wherein each heat transfer area (36, 38; 40) comprises mutually parallel ridges (32) and grooves (34) arranged in such a manner that the ridges (32) of one of the first heat exchanger plates (12A) abut the grooves (34) of an adjoining one of the second heat exchanger plates (12B), so as to form a plurality of joining areas, the heat exchanger (10) being **characterized in that:**

   - each ridge (32) and each groove (34) of at least one first heat transfer area (36) of said first heat exchanger plate (12A) are inclined with respect of said longitudinal axis (X) by a first angle (α) comprised between 0° and 30°;
   - each ridge (32) and each groove (34) of at least one heat transfer area (40) of said second heat exchanger plate (12B) are inclined with respect of said longitudinal axis (X) by a second angle (β) comprised between 90° and 45°;
   - at least part of the ridges (32) and at least part of the grooves (34) of at least a first heat transfer area (36) of said first heat exchanger plate (12A) extend without discontinuities between the opposite edges of the respective heat transfer area (36), wherein said opposite edges are parallel to said short side edges (28).

2. The brazed plate heat exchanger (10) according to claim 1, **characterized in that** said first angle (α) is of 20°.

3. The brazed plate heat exchanger (10) according to claim 1 or 2, **characterized in that** said second angle (β) is of 70°.

4. The brazed plate heat exchanger (10) according to anyone of claims 1 to 3, **characterized in that** the amount of the ridges (32), and thus of the grooves (34), of the first heat transfer area (36) of each first heat exchanger plate (12A) that extend without discontinuities between the opposite edges of the respective heat transfer area (36) is equal to at least 30% of the total amount of the ridges (32), and thus of the grooves (34), of the first heat transfer area (36) of said first heat exchanger plate (12A).

5. The brazed plate heat exchanger (10) according to anyone of claims 1 to 4, **characterized in that** each of said first heat exchanger plates (12A) is provided with at least one second heat transfer area (38) which is adjacent to said first heat transfer area (36).

6. The brazed plate heat exchanger (10) according to claim 5, **characterized in that** each ridge (32) and each groove (34) of said second heat transfer area (38) are inclined with respect of said longitudinal axis (X) by a third angle (γ) comprised between 45° and 90°.

7. The brazed plate heat exchanger (10) according to claim 6, **characterized in that** said third angle (γ) is of 65°.

8. The brazed plate heat exchanger (10) according to anyone of claims 5 to 7, **characterized in that** at least part of the ridges (32) and at least part of the grooves (34) of said second heat transfer area (38) extend seamlessly, i.e., without discontinuities, between the opposite edges of the respective second heat transfer area (38), wherein said opposite edges are parallel to said short side edges (28).

9. The brazed plate heat exchanger (10) according to anyone of claims 5 to 8, **characterized in that** said second heat transfer area (38) has a longitudinal extension, measured along said longitudinal axis (X), that is equal to about 1/3 of the longitudinal extension of said first heat transfer area (36).

10. The brazed plate heat exchanger (10) according to anyone of claims 1 to 9, **characterized in that** each

ridge (32) and each groove (34) of each heat transfer area (36, 38; 40) of both said first heat exchanger plate (12A) and said second heat exchanger plate (12B) are straight and continuous along the respective heat transfer area (36, 38; 40).

11. The brazed plate heat exchanger (10) according to anyone of claims 1 to 10, **characterized in that** said longitudinal axis (X) is a vertical axis.

12. The brazed plate heat exchanger (10) according to anyone of claims 1 to 11, **characterized in that** each between said first heat exchanger plate (12A) and said second heat exchanger plate (12B) is provided with four portholes (P1, P2, P3, P4), wherein each porthole (P1, P2, P3, P4) is placed at a respective corner of the respective heat exchanger plate (12A, 12B), that is, at the contact point between a long side edge (26) and a short side edge (28) of the respective heat exchanger plate (12A, 12B).

13. The brazed plate heat exchanger (10) according to anyone of claims 1 to 12, **characterized in that** at least one of said portholes (P4) is placed at a distance (D1) from its closest long side edge (26) which is different from the distances (D2, D3) from the respective closest long side edge (26) of the remaining portholes (P1, P2, P3).

14. The brazed plate heat exchanger (10) according to claim 13, **characterized in that** said distance (D1) of said at least one porthole (P4) is greater than said distances (D2, D3) of the remaining portholes (P1, P2, P3).

15. The brazed plate heat exchanger (10) according to anyone of claims 12 to 14, **characterized in** each corner of each heat exchanger plate (12A, 12B) is a rounded corner.

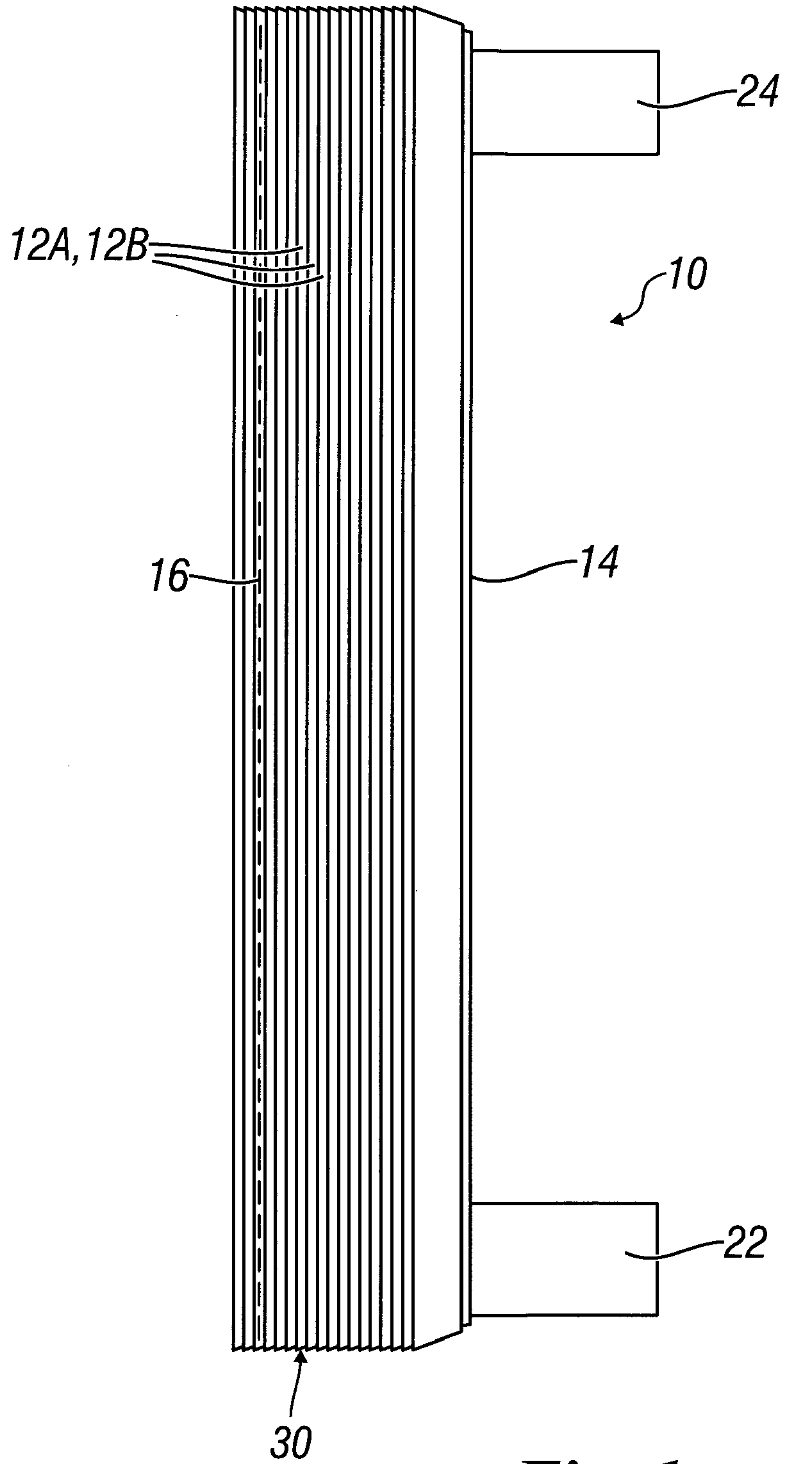

Fig. 1

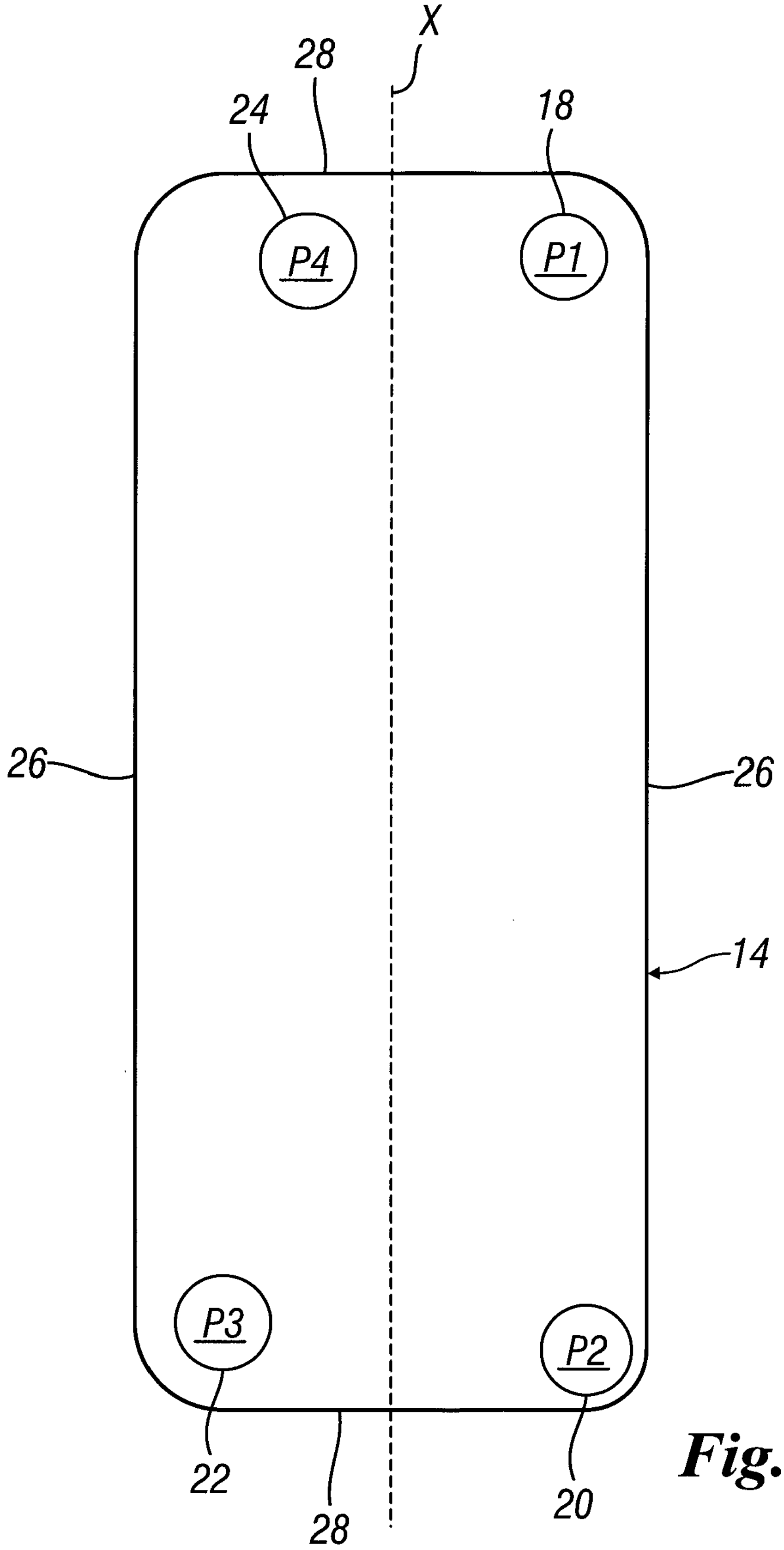

Fig. 2

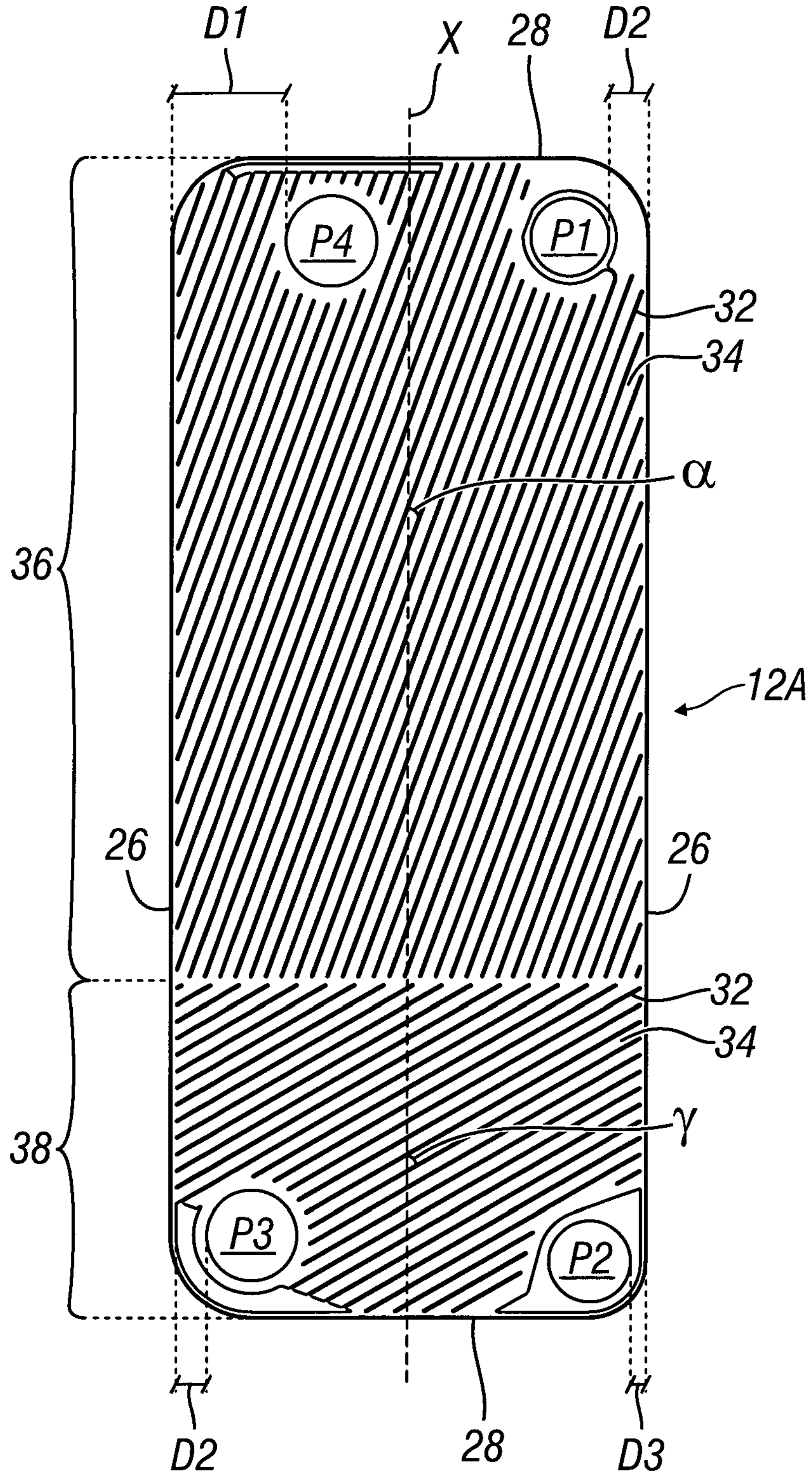

Fig. 3

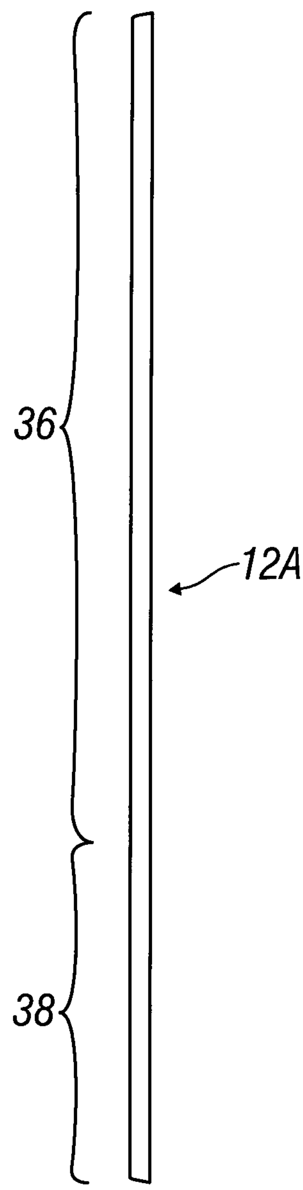

Fig. 4

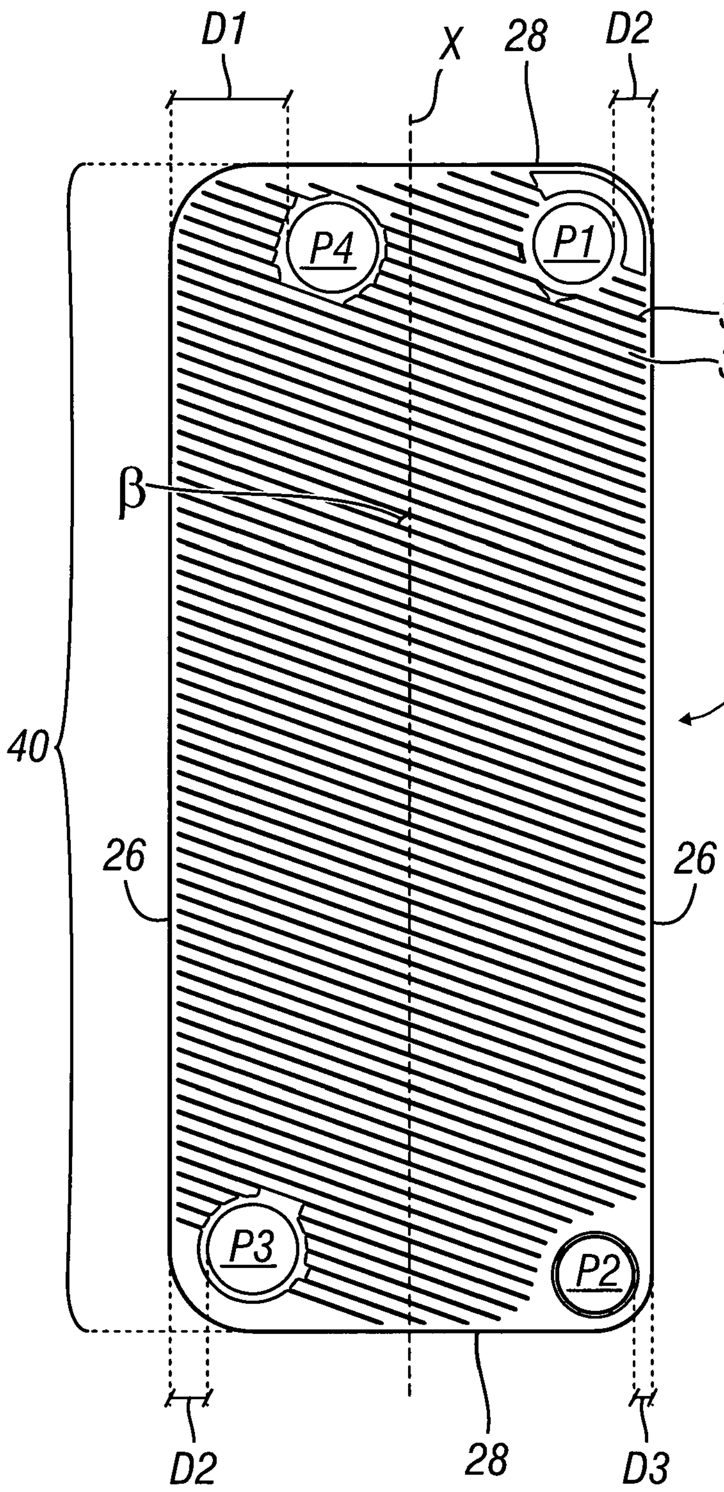

Fig. 5

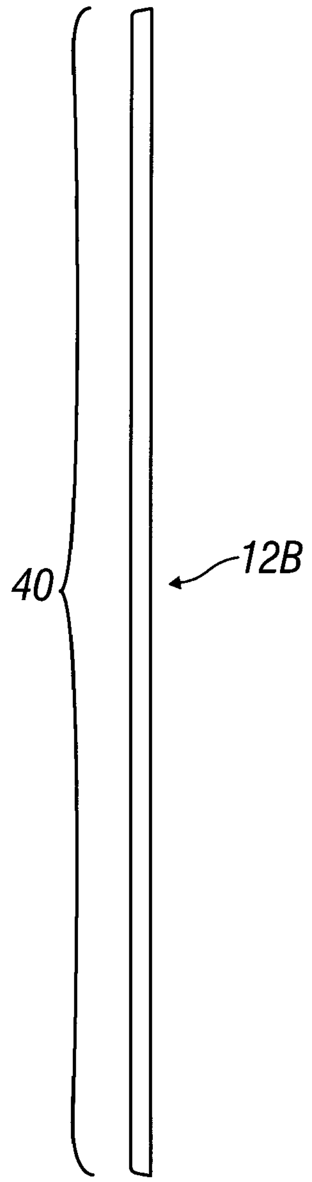

Fig. 6

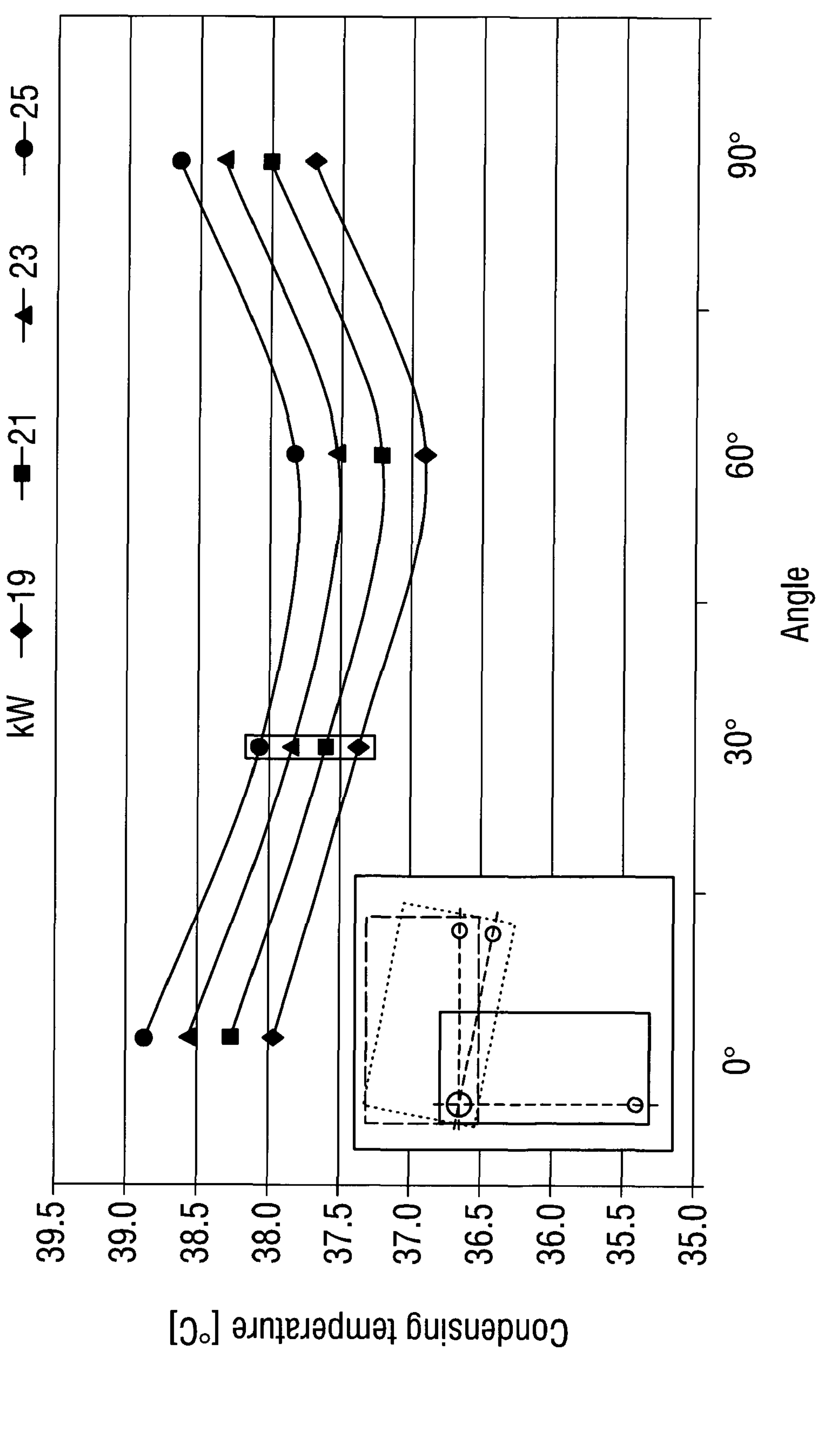

Fig. 7 (Prior art)

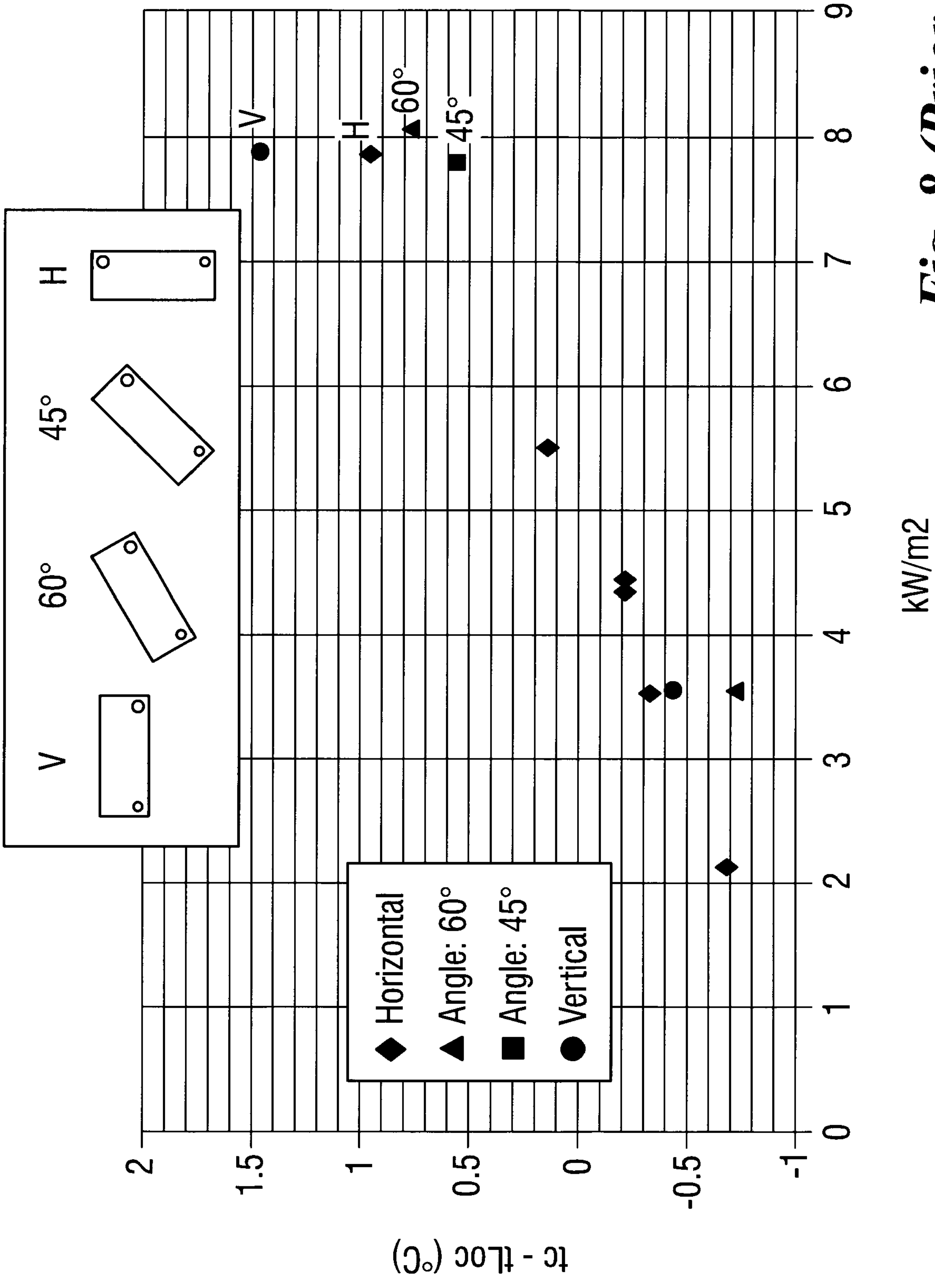

Fig. 8 (Prior art)

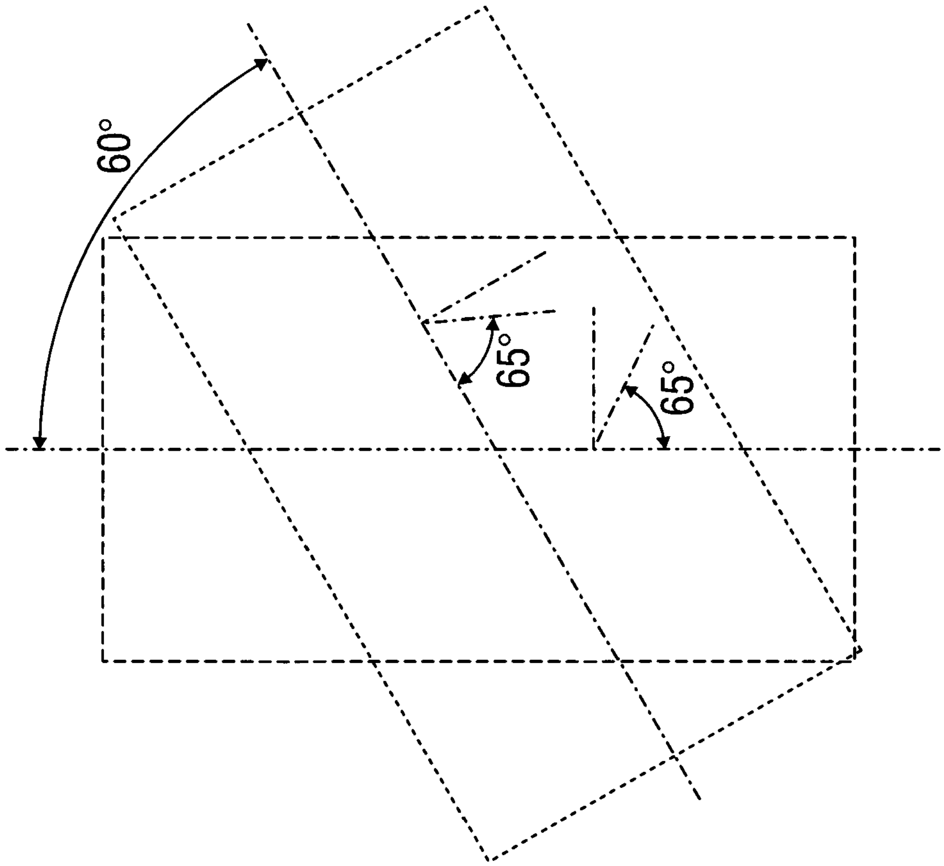

Fig. 9 (Prior art)

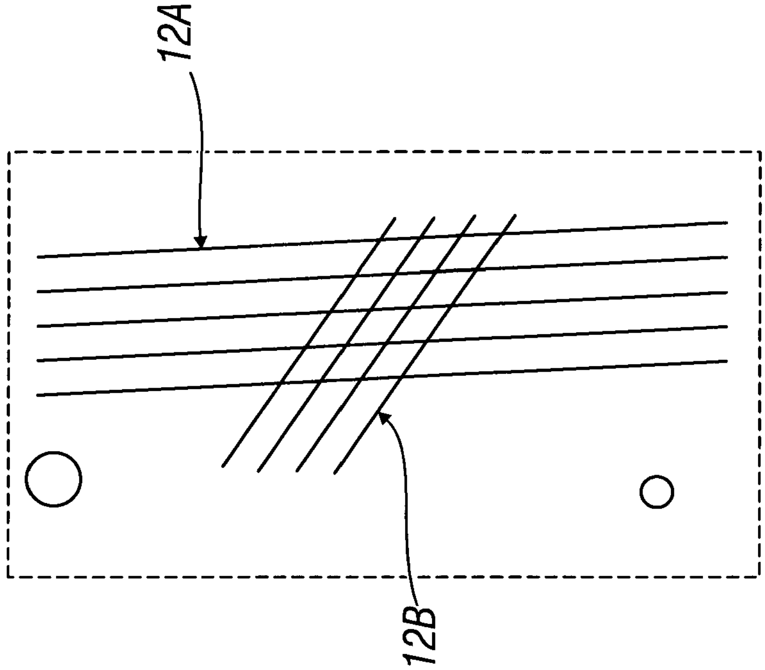

Fig. 10

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Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 January 2023	Jessen, Flemming

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