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(54) **A plate heat exchanger with thermally drilled hole**

(57) The invention relates to a plate heat exchanger (1) including a plate package (P), which plate package includes a plurality of heat exchanger plates (A, B) of at least two configurations which are joined to each other and which alternate with each other to form a stack (2) of heat exchanger plates (A, B) forming plate interspaces (3, 4) between the heat exchanger plates. The plate inter-

spaces (3, 4) are arranged to receive at least two different fluids. At least one through hole (20) is arranged to extend between the exterior of the plate package (P) and a compartment (5) inside the plate package, the compartment (5) being at least partly formed by any of the plate interspaces (3, 4), wherein the at least one through hole (20) is formed by a thermal drilling.

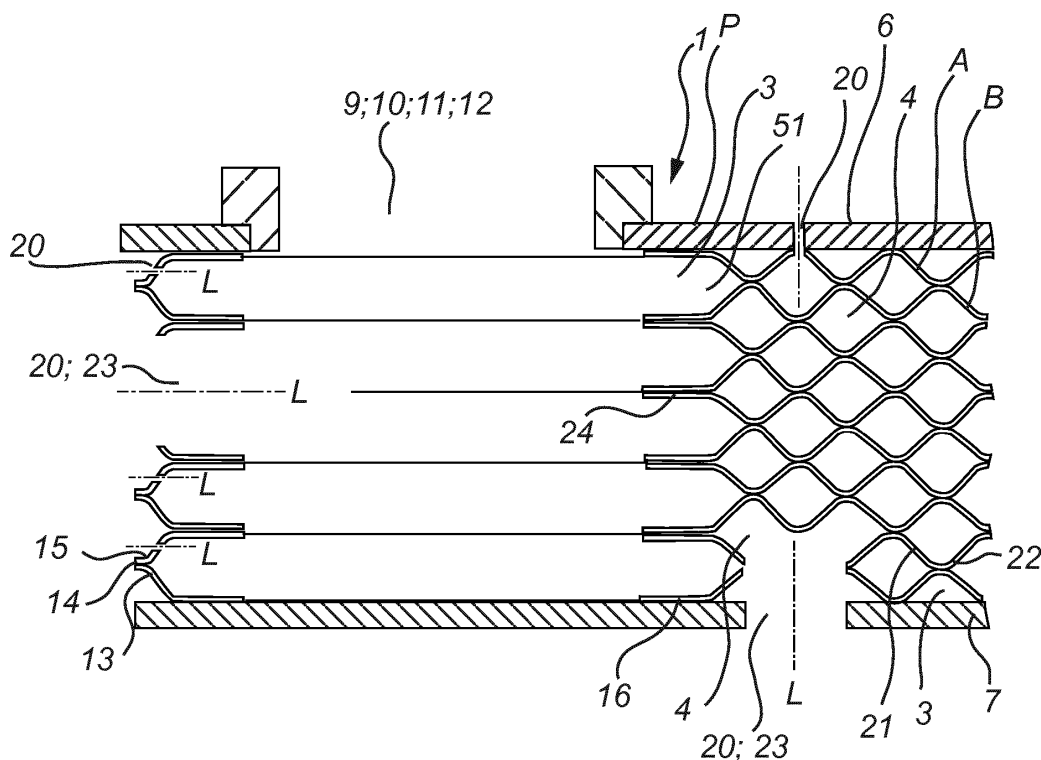


Fig. 6

Description

Technical field

[0001] The present invention refers generally to a plate heat exchanger having at least one through hole being formed by thermal drilling. The invention also relates to a method of arranging at least one through hole in a plate heat exchanger.

Background art

[0002] Heat exchangers and especially plate heat exchangers are examples of thin walled structures for the provision of an interior channel system for the guiding of one or several fluids between at least one inlet and at least one outlet.

[0003] A typical plate heat exchanger is formed by a plurality of thin heat exchangers plates arranged to form a plate package. The plate package is formed by a number of first and second heat exchanger plates. The heat exchanger plates may be permanently joined to each other and arranged side by side in such a way that a first plate interspace is formed between each pair of adjacent first and second heat exchanger plates and a second plate interspace is formed between each pair of adjacent second and first heat exchanger plates. The first plate interspaces and the second plate interspaces are separated from each other and provided side by side in an alternating order in the plate package. Substantially each heat exchanger plate has at least a first porthole and a second porthole, wherein the first portholes form a first inlet channel to the first plate interspaces and the second portholes form a first outlet channel from the first plate interspaces.

[0004] The permanently joining may be achieved by welding, brazing, bonding or adhesives. In such permanently joined plate heat exchanger the positions of inlets or outlets are depending on the first and second portholes. Also, any surface profile of the heat exchanger plates is depending on the position of the inlets and the outlets in order to optimize the flow through the panel interspaces and thereby the thermal efficiency. Generally, there is a constant struggle to reduce the size of the port holes to maximize the available heat transfer surface of the heat exchanger plates.

[0005] The thin walled lamellae like structure formed by the permanently joined plate heat exchanger makes it very complicated to add additional inlets or outlets, sensors or the like since the positioning thereof is limited to the port holes and the inlet or outlet channels formed thereof.

[0006] There are many problems relating to making a connection or an interface in a permanently joined plate heat exchanger. Just to mention a few of them: It is almost impossible to create a hole in a side thereof by preparing/pressing a pattern in the individual plates before joining the plates to form a plate package. If drilling or threading

holes in a plate package, chips will inevitable get into the plate package and contaminate it. Due to the highly complex cross section of a permanently joined plate heat exchanger, it is almost impossible to remove any chips.

5 There is also a risk of contamination of any devices to be arranged downstream thereof, such as a compressor. The thin goods in the sides, created by the flanks of the individual plates, is as such not thick enough to allow a threaded connection. The complex and irregular lamellae structure of a permanently joined plate heat exchanger results in an unreliable material for machining and the inner structures in the inlet or outlet ports may collapse. Generally it is hard to even create surfaces to seal against in a permanently joined plate heat exchanger. Further, 10 provided the permanent joining is achieved by brazing, it is difficult to solder or weld connections, such as weld bolts, without destroying the brazed structure. Additionally, it is very hard to make large holes covering one or several plate interspaces.

20 **[0007]** Following these examples of problems, it is very hard to mount connections of any additional inlets or outlets, sensors, probes, fastening means or the like to a plate heat exchanger, and especially to a permanently joined plate heat exchanger. This is especially the case in a high volume production.

Summary

30 **[0008]** The object of the present invention is to provide a plate heat exchanger having at least one through hole remedying the problems mentioned above.

[0009] Another object is to provide a method allowing an essentially arbitrary positioning of a through hole in a plate heat exchanger.

35 **[0010]** Further, the method should be applicable to high volume production where a high degree of reliability and repeatability is required.

40 **[0011]** This object is achieved by a plate heat exchanger including a plate package which plate package includes a plurality of heat exchanger plates of at least two configurations which are joined to each other and which alternate with each other to form a stack of heat exchanger plates forming plate interspaces between the heat exchanger plates, the plate interspaces being arranged to receive at least two different fluids. The plate heat exchanger is **characterized in that** at least one through 45 hole is arranged to extend between the exterior of the plate package and a compartment inside the plate package, the compartment being at least partly formed by any of the plate interspaces, wherein the at least one through hole is formed by a thermal drilling

50 **[0012]** Thermal drilling, also known as flow drilling, friction drilling or form drilling is a non-cutting method providing a plastic re-shaping of the material. The hole is formed by rotating a pin-like tool having a circular cross section with a diameter essentially corresponding to the hole to be formed. During rotation, the tool creates a hole by relying on the friction that results from the high rota-

tional speed. The generated heat makes the material malleable enough to be formed and perforated. As the tip of the tool penetrates the lower surface of the base material, the displaced material starts to flow in the direction of the tool feed. Some displaced material may form a collar around the upper surface of the work piece. The rest of the material may form a sleeve-like bushing in the lower surface. The formed sleeve is remarkably strong and may by way of example be threaded in a separate process.

[0013] Thermal drilling has surprisingly proven to be applicable to thin-walled, honeycomb-like structures such as plate heat exchangers. Further, thermal drilling is a non-cutting method leaving no contaminating chips which may cause uncontrolled throttling or blocking in the narrow passages in the interior of the plate heat exchanger. Also, there is no risk of chips being formed that might constitute problems for devices to be arranged downstream of a plate heat exchanger, such as a compressor. The combination of the honeycomb-like structure and the strict requirement of no chip formation has traditionally made hole making in joined plate heat exchangers very complicated and in fact something that has generally been avoided where possible. This is especially the case in high volume production.

[0014] By using thermal drilling, completely new possibilities concerning access to the interior of the plate package of a permanently joined plate heat exchanger are provided. This involves insertion of instruments such as sensors, cameras or the like to improve the monitoring and understanding of the operational conditions inside the plate heat exchanger. Also, it provides completely new possibilities regarding positioning of inlets or outlets for fluid supply or tubings used therefore. In fact, the thermal drilling allows an essentially arbitrary positioning of a through hole in a plate heat exchanger. Further, by thermal drilling it is made possible to make large holes providing access to more than one plate interspace.

[0015] The compartment may comprise a plurality of plate interspaces communicating with each other via a common channel, wherein the at least one through hole is arranged in a wall portion defining the common channel. Thus, the wall portion may be the circumferential envelope surface of the common channel or a longitudinal end surface thereof. The common channel may by way of example be an inlet or an outlet channel extending through or along the plate package.

[0016] The at least one through hole may be arranged to receive a component contained in the group consisting of sensors such as temperature sensors, pressure sensors and optic sensors, plugs, such as drainage plugs or inspection glasses and connectors for tubings. It is to be understood that these are not limiting examples of components possible to be applied.

[0017] The longitudinal axis of the at least one through hole may be arranged to extend essentially in parallel with a general plane of the longitudinal extension of the heat exchanger plates.

[0018] The at least one through hole may be arranged in a wall portion defining a circumferential side wall of the plate package, the side wall extending essentially perpendicular to a general plane of the longitudinal surface extension of the heat exchanger plates.

[0019] The at least one through hole may have a diameter providing access to more than one plate interspace.

[0020] The at least one through hole may be arranged in an upper or a lower end plate forming part of the plate package.

[0021] The heat exchanger plates in the plate package may be permanently joined to each other through brazing, welding, adhesive or bonding.

[0022] The at least one through hole may comprise a longitudinal envelope surface defining a sleeve having a longitudinal extension being coaxial with the longitudinal axis of the through hole, and the sleeve may have a free edge portion facing the interior of the compartment. The sleeve may be used for threading or for the receipt of a bushing, lining, connector or the like. The sleeve may also be used to provide a channel past one or several plate interspaces to thereby provide enhanced access to the interior structure of the plate package allowing insertion of e.g. a sensor.

[0023] The mouth of the at least one through hole facing away from the compartment may comprise a circumferential collar formed during the thermal drilling. Such circumferential collar may be used for connection of a component to be inserted into the through hole.

[0024] The at least one through hole may comprise a threaded portion.

[0025] The plate heat exchanger may further comprise a bracket arranged in or around the mouth of the at least one through hole. Such bracket may be used for mounting of a component to be inserted into the through hole.

[0026] The stack of the plate package may include a number of first heat exchanger plates and a number of second heat exchanger plates, which are joined to each other and arranged side by side in such a way that a first plate interspace is formed between each pair of adjacent first heat exchanger plates and second heat exchanger plates, and a second plate interspace is formed between each pair of adjacent second heat exchanger plates and first heat exchanger plates. The first plate interspaces and the second plate interspaces may be separated from each other and provided side by side in an alternating order in the at least one plate package.

[0027] According to another aspect, the invention may relate to a method of providing a through hole in a plate heat exchanger, the method comprising providing a plate heat exchanger comprising a plate package, which plate package includes a plurality of heat exchanger plates of at least two configurations which are joined to each other and which alternate with each other to form a stack of heat exchanger plates forming plate interspaces between the heat exchanger plates, the plate interspaces

being arranged to receive at least two different fluids; and arranging by thermal drilling at least one through hole extending between the exterior of the plate package and a compartment inside the plate package, the compartment being at least partly formed by any of the plate interspaces.

Brief description of the drawings

[0028] Embodiments of the invention will now be described, by way of example, with reference to the accompanying schematic drawings, in which

Fig. 1 discloses schematically a side view of a typical plate heat exchanger.

Fig. 2 discloses schematically a front view of the plate heat exchanger of Fig. 1.

Fig. 3 discloses a highly schematic cross section along an inlet or outlet channel of a typical plate package of a plate heat exchanger

Figs. 4 and 5 disclose highly schematic examples of first and second heat exchanger plates of a plate heat exchanger.

Fig. 6 discloses a first embodiment of a highly schematic cross section of a plate package of a plate heat exchanger exemplifying different positions of through holes.

Fig. 7a-7d schematically discloses the formation of a through hole during thermal drilling and subsequent thermal tapping.

Fig. 8 discloses a schematic cross section of a through hole made by thermal drilling.

Detailed description

[0029] Figs. 1 to 3 disclose a typical example of a plate heat exchanger 1. The plate heat exchanger 1 includes a plate package P, which is formed by a number of compression molded heat exchanger plates A, B, which are provided side by side of each other to thereby form a stack 2. The heat exchanger plates included in the embodiment are two different heat exchanger plates, which in the following are called the first heat exchanger plates A, see Figs. 3, 4 and 6, and the second heat exchanger plate B, see Figs. 3, 5 and 6. The plate package P includes substantially the same number of first heat exchanger plates A and second heat exchanger plates B.

[0030] As is clear from Fig. 3, the heat exchanger plates A, B are provided side by side in such a way that a first plate interspace 3 is formed between each pair of adjacent first heat exchanger plates A and second heat exchanger plates B, and a second plate interspace 4 between each pair of adjacent second heat exchanger plates B and first heat exchanger plates A. Every second plate interspace thus forms a respective first plate interspace 3 and the remaining plate interspaces form a respective second plate interspace 4, i. e. the first and second plate interspaces 3 and 4 are provided in an alter-

nating order in the plate package P. Furthermore, the first and second plate interspaces 3 and 4 are substantially completely separated from each other.

[0031] A plurality of compartments 5 are thus formed inside the plate package P. By way of example, a first compartment 51 is formed at least partly by any of the first plate interspaces 3 and a second compartment 52 is formed at least partly by any of the second plate interspaces 4.

[0032] The plate package P also includes an upper end plate 6 and a lower end plate 7, which are provided on a respective side of the plate package P.

[0033] The plate heat exchanger 1 may advantageously be adapted to operate as an evaporator in a cooling agent circuit, not disclosed. In such an evaporator application, the first plate interspaces 3 may form passages for a first fluid, such as a cooling agent, whereas the second plate interspaces 4 may form passages for a second fluid, which is adapted to be cooled by the cooling agent.

[0034] In the embodiment disclosed in Fig. 1 and Fig. 3, the heat exchanger plates A, B and the upper and lower end plates 6, 7 are permanently connected to each other. Such a permanent connection may advantageously be performed through brazing, welding, adhesive or bonding.

[0035] As appears from especially Figs. 2, 4 and 5, substantially each heat exchanger plate A, B has four portholes 8, namely a first porthole 8, a second porthole 8, a third porthole 8 and a fourth porthole 8. The first portholes 8 form a first inlet channel 9 to the first plate interspaces 3, which extends through substantially the whole plate package P, i. e. all plates A, B and also the upper end plate 6. The second portholes 5 form a first outlet channel 10 from the first plate interspaces 3, which also extends through substantially the whole plate package P, i. e. all plates A, B and the upper end plate 6. The third portholes 5 form a second inlet channel 11 to the second plate interspaces 4, and the fourth portholes 5 form a second outlet channel 12 from the second plate interspaces 4. Also these two channels 11 and 12 extend through substantially the whole plate package P, i. e. all plates A, B and the upper end plate 6.

[0036] In the disclosed embodiment, the first inlet channel 9 being in communication with the first plate interspaces 3 may be seen as a part of the first compartment 51. The first outlet channel 10, being in communication with the first plate interspaces 3, may also be seen as forming part of the first compartment 51. Likewise in the disclosed embodiment, the second inlet channel 11 being in communication with the second plate interspaces 4 may be seen as a part of the second compartment 52. The second outlet channel 12, being in communication with the second plate interspaces 4, may also be seen as forming part of the second compartment 52.

[0037] In this type of prior art plate heat exchangers the first plate interspace 3 is accessed via the first inlet channel 9 or the first outlet channel 10, i.e. via the first

compartment 51. Likewise, the second plate interspace 4 is accessed via the second inlet channel 11 or the second outlet channel 12, i.e. via the second compartment 52.

[0038] In a prior art plate heat exchanger, any instruments, sensors or the like are inserted via one of these channels 9, 10, 11, 12, whereby they allow access along the longitudinal extension of one of these channels. However, this only allow access to a strict limited area of the interior of the plate heat exchanger, and especially, it allows no access to the heat transfer surface of an individual heat exchanger plate A, B. Access to such area is cumbersome and is for practical reasons not possible during normal use of a system produced in large scale.

[0039] Now, for better understanding of the invention, reference will be made to Fig. 6 disclosing a schematic cross section of an inlet channel 9; 11 or an outlet channel 10; 12 of a typical plate heat exchanger 1 describing one embodiment of the invention. Although the cross section is restricted to the area in and around an inlet or outlet channel 9; 10; 11; 12, the same principle is applicable to any exterior wall portion of the plate package P of a plate heat exchanger 1.

[0040] Fig. 6 discloses a plurality of first and second heat exchanger plates A, B provided side by side in such a way that a first plate interspace 3 is formed between each pair of adjacent first heat exchanger plates A and second heat exchanger plates B, and a second plate interspace 4 between each pair of adjacent second heat exchanger plates B and first heat exchanger plates A. Every second plate interspace thus forms a respective first plate interspace 3 and the remaining plate interspaces form a respective second plate interspace 4, i. e. the first and second plate interspaces 3 and 4 are provided in an alternating order in the plate package P. Furthermore, the first and second plate interspaces 3 and 4 are substantially completely separated from each other.

[0041] The circumferential side wall 13 of the plate package P comprises a plurality of outwardly extending flanges 14, each flange 14 being formed by the outer peripheral edge portion 15 of a pair of adjacent first heat exchanger plates A and second heat exchanger plates B. The circumferential side wall 13 extends essentially perpendicular to a general plane 16 of the first and the second heat exchanger plates A, B.

[0042] In the disclosed embodiment a plurality of through holes 20 are arranged in the circumferential side wall 13 of the plate package P. The through holes 20 are made by thermal drilling. Thermal drilling as a method will be described below. The longitudinal axis L of each through hole 20 is arranged to extend essentially in parallel with the general plane 16 of the first and the second heat exchanger plates A, B.

[0043] In the disclosed embodiment, each first plate interspace 3 comprises a through hole 20 extending from the exterior of the plate package P into the through channel being an inlet channel 9; 11 or an outlet channel 10; 12. It is to be understood that other hole patterns than

that illustrated may be used. Further, it is to be understood that by thermal drilling, the through hole 20 may be arranged in any arbitrary position along the circumferential side wall 13 of the plate package P.

[0044] In the disclosed embodiment, the through holes 20 are arranged with their longitudinal axis L somewhat displaced from the adjacent flanges 14, whereby the through holes 20 are essentially made through a portion of either of the first or the second heat exchanger plates A, B which together form a pair of heat exchanger plates A, B. It is to be understood that other positions are possible.

[0045] It is to be understood that the circumferential side wall 13 of the plate package P may be essentially smooth. This may be made e.g. by bending the plurality of outwardly extending flanges 14 to extend essentially in parallel with the circumferential wall portion 13 or by cutting off the flanges 14. It is also to be understood that the cross section depends on the surface pattern 21 of the heat exchanger plates A, B constituting the plate package P.

[0046] Further in Fig. 6, a through hole 20 is arranged in the upper end plate 6, whereby a communication is made possible from the exterior of the plate package P to the plate interspace 3; 4 closest to the upper end plate 6. In the disclosed embodiment, the through hole 20 extends into a first plate interspace 3, i.e. the first compartment 51. Any arbitrary position is possible depending on the intended use of the through hole 20. The same principle is applicable to the lower end plate 7.

[0047] Fig. 6 also discloses a through hole 20 arranged in the lower end plate 7. The through hole 20 extends past the plate interspace 3; 4 closest to the lower end plate 7 and into the second, subsequent plate interspace 3; 4. In the disclosed embodiment, the longitudinal axis L of the through hole 20 extends through a joint 22 between the two joined heat exchanger plates A, B. It is to be understood that other positions are possible.

[0048] Further, Fig. 6 discloses one embodiment of a through hole 20 having a diameter that provides access to more than one first or second plate interspace 3, 4. The through hole 23 is disclosed with an area extending across a plurality of heat exchanger plates A, B and thereby the partition walls 24 between two or several plate interspaces 3, 3; 4, 4, which partition walls 24 are formed by the heat exchanger plates A, B as such.

[0049] Thermal drilling, also known as flow drilling, friction drilling or form drilling is a non-cutting method used to form a hole. The hole may be a through hole or a blind hole. The process is illustrated in Figs. 7a-7c. The thermal drilling provides a plastic re-shaping of the material. The hole 20 is formed by rotating a pin-like tool 30 having a circular cross section with a diameter essentially corresponding to the hole to be formed, see Fig. 7a. The tool 30 has a cone shaped free end 31 engaging a base material 32 with a high rotational speed and with a relatively high axial pressure to thereby form a hole 20. The tool 30 may be made by way of example carbide, such as

Wolfram carbide. During rotation, the tool 30 creates a hole, see Fig. 9b by relying on the friction that results from the high rotational speed. The generated heat makes the base material 32 malleable enough to be formed and perforated. As the tool 30 advances in the axial direction a material displacement occurs, see Fig. 7c. Initially the displaced material flows upwards towards the tool. As the tip of the free end 31 of the tool 30 penetrates the lower surface 33 of the base material 32, the displaced material starts to flow in the direction of the tool feed. As the material softens, the axial force is reduced and the feed rate is increased. Some displaced material may form a collar 34 around the upper surface 35 of the base material 32. The rest of the material forms a sleeve 36 in the lower surface 33. The collar 34 and the sleeve 36 will be coaxial with the resulting through hole 20 and have a longitudinal extension L slightly exceeding the thickness of the base material 32. The degree of work hardening depends on the material. As a result, the formed sleeve 36 is remarkably strong and may by way of example be threaded in a separate process, see Fig. 7d. The threading may be made either internally or externally of the sleeve 36. It is to be understood that the threading 37 may be limited to a portion of the collar 34, the base material 32 and the sleeve 36.

[0050] Standard drilling, NC, and CNC machines are all suitable for thermal drilling. But the process depends on the speed and force with which the specialized tool 30 engages the base material 32. It is to be understood that parameters such as hole size, material, and thickness all influence the suitable rotational speed, feed rate, and axial force. For example, thin materials may bend or collapse under excessive pressure, necessitating adequate support to prevent deformation. Predrilled holes may reduce the required axial force and also leave a smooth finish in the sleeve's lower edge. However, due to chipformation, predrilling is normally not an option when applied to heat exchangers. By thermal drilling being a non-cutting method no chips are formed that might fall into and contaminate the plate heat exchanger, such as a permanently joined plate package, or any devices to be arranged downstream such plate heat exchanger. Thermal drilling has surprisingly proven to be excellent to when making large holes 23 having diameters straddling a plurality of plate interspaces 3, 3; 4, 4, like in a plate heat exchanger 1.

[0051] Provided the sleeve 36 is to be threaded, this may be made by using thermal tapping, basically using the same principle as with thermal drilling with the essential difference that the temperatures are much lower. Thermal tapping provides a plastic re-shaping of the material. The used tool 38, see Fig. 7d, has threads 38a and when inserted into the hole 20 during rotation, the material in the envelope surface of the hole flows into the thread depression and the crest 38a of the tool 38. Thus, the threads are cold formed leaving no chips. It is to be understood that the thread form, the depth and the strength is decided by the elected tool 38. It is also to

be understood that the treading may be made by a non-cutting conventional plastic cold forming.

[0052] Now turning to Fig. 8, a schematic cross section of a through hole 20 made by thermal drilling is disclosed. As a consequence of thermal drilling being a plastic re-shaping method in which the hole 30 is formed by displacing material instead of cutting material, the mouth 39 of the through hole 20 intended to face away from the plate interspace 3; 4 may comprise the circumferential collar 34 of displaced material. It is possible to shape the collar 34 by the tool 30 used during the thermal drilling to control the shape of the collar 34. Further, the through hole 20 comprises on its lower side a longitudinal envelope surface defining the sleeve 36 having a longitudinal extension being coaxial with the longitudinal axis L of the through hole 20. The sleeve 36 has a free edge portion 40. Also the sleeve 36 is the result of the thermal drilling being a plastic re-shaping method. The through hole 20 may be threaded. The threading may be made along the full interior envelope surface 41 of the through hole 20, i.e. from the outer edge of the collar 34 to the free edge portion 40 of the sleeve 36. Alternatively, only a portion of the envelope surface 41 be threaded. It is to be understood that the collar 34 may be used as connecting surface for any device, or for brackets or the like.

[0053] The through holes 20 may be used to receive or mount different types of sensors (not disclosed) such as temperature sensors, pressure sensors and optic sensors. The through holes 20 may also be used to mount plugs (not disclosed), such as drainage plugs or inspection glasses. Typical drainage plugs are drainage plugs for compressor oil and drainage plugs for system evacuation. The through holes 20 may also be used as separate inlets or outlets (not disclosed) for reversed cooling/heating duties.

[0054] The invention has generally been described based on a plate heat exchanger 1 having first and second plate interspaces 3; 4 and four port holes 8 allowing a flow of two fluids. It is to be understood that the invention is applicable also for plate heat exchangers having different configurations in terms of the number of plate interspaces, the number of port holes and the number of fluids to be handled. The invention is even applicable to plate heat exchangers wherein one or several inlet or outlet channels formed as through holes integrated in the heat exchanger plates are omitted. It is further to be understood that the invention is applicable no matter type of heat exchanger. It may by way of example be applied to heat exchangers of the tube and shell type or spiral heat exchangers.

[0055] The four portholes 8 are in the disclosed embodiment provided in the proximity of a respective corner of the substantially rectangular heat exchanger plates A, B. It is to be understood that other positions are possible, and the invention should not be limited to the illustrated and disclosed positions.

[0056] The invention is also applicable to plate heat exchangers (not disclosed) comprising pairwise perma-

nently joined heat exchanger plates, wherein each pair forms a cassette. In such solution, gaskets are arranged between each cassette. Also, in such embodiment, the heat exchanger plates forming each cassette may be permanently joined by welding. The invention is also applicable to plate heat exchangers (not disclosed) where the plate package is kept together by tie-bolts extending through the heat exchanger plates and the upper and lower end plates. In the latter case gaskets are used between the heat exchanger plates.

[0057] The invention is not limited to the embodiment disclosed but may be varied and modified within the scope of the following claims, which partly has been described above.

Claims

1. A plate heat exchanger (1) including a plate package (P), which plate package includes a plurality of heat exchanger plates (A, B) of at least two configurations which are joined to each other and which alternate with each other to form a stack (2) of heat exchanger plates (A, B) forming plate interspaces (3, 4) between the heat exchanger plates (A, B), the plate interspaces (3, 4) being arranged to receive at least two different fluids, **characterized in that** at least one through hole (20) is arranged to extend between the exterior of the plate package (P) and a compartment (5) inside the plate package (P), the compartment (5) being at least partly formed by any of the plate interspaces (3, 4), wherein the at least one through hole (20) is formed by a thermal drilling.
2. A plate heat exchanger according to claim 1, wherein the compartment (5) comprises a plurality of plate interspaces (3, 4) communicating with each other via a common channel (9; 10; 11; 12), wherein the at least one through hole (20) is arranged in a wall portion defining the common channel (9; 10; 11; 12).
3. A plate heat exchanger according to any of the preceding claims, wherein said at least one through hole (20) is arranged to receive a component contained in the group consisting of sensors such as temperature sensors, pressure sensors and optic sensors, plugs, such as drainage plugs or inspection glasses and connectors for tubings.
4. A plate heat exchanger according to any of the preceding claims, wherein the longitudinal axis (L) of the at least one through hole (20) is arranged to extend essentially in parallel with a general plane (16) of the longitudinal surface extension of the heat exchanger plates (A, B).
5. A plate heat exchanger according to any of the preceding claims, wherein the at least one through hole (20) is arranged in a wall portion defining a circumferential side wall (13) of the plate package (P), the side wall extending essentially perpendicular to a general plane (16) of the longitudinal surface extension of the heat exchanger plates (A, B).
6. A plate heat exchanger according to any of the preceding claims, wherein the at least one through hole (20) has a diameter providing access to more than one plate interspace (3, 4).
7. A plate heat exchanger according to any of claims 1-6, wherein the at least one through hole is arranged in an upper or a lower end plate (6, 7) forming part of the plate package (P).
8. A plate heat exchanger according to any of the preceding claims, wherein the heat exchanger plates (A, B) in the plate package (P) are permanently joined through brazing, welding, adhesive or bonding.
9. A plate heat exchanger according to any of the preceding claims, wherein the at least one through hole (20) comprises a longitudinal envelope surface (41) defining a sleeve (36) having a longitudinal extension being coaxial with the longitudinal axis (L) of the through hole (20) and the sleeve having a free edge portion (40) facing the interior of the compartment (5).
10. A plate heat exchanger according to any of the preceding claims, wherein the mouth (39) of the at least one through hole (20) facing away from the compartment (5) comprises a circumferential collar (34) formed during the thermal drilling.
11. A plate heat exchanger according to any of the preceding claims, wherein the at least one through hole (20) comprises a threaded portion (37).
12. A plate heat exchanger according to any of the preceding claims, further comprising a bracket arranged in or around the mouth of the at least one through hole.
13. A plate heat exchanger according to claim 1, wherein the stack (2) of the plate package (P) includes a number of first heat exchanger plates (A) and a number of second heat exchanger plates (B), which are joined to each other and arranged side by side in such a way that a first plate interspace (3) is formed between each pair of adjacent first heat exchanger plates (A) and second heat exchanger plates (B), and a second plate interspace (4) is formed between each pair of adjacent second heat exchanger plates (B) and first heat exchanger plates (A), wherein the first plate interspaces (3) and the second plate inter-

spaces (4) are separated from each other and provided side by side in an alternating order in the at least one plate package (P).

14. A method of providing a through hole (20) in a plate heat exchanger (1), the method comprising providing a plate heat exchanger (1) comprising a plate package (P), which plate package includes a plurality of heat exchanger plates (A, B) of at least two configurations which are joined to each other and which alternate with each other to form a stack (2) of heat exchanger plates forming plate interspaces (3, 4) between the heat exchanger plates (A, B), the plate interspaces (3, 4) being arranged to receive at least two different fluids, and arranging by thermal drilling at least one through hole (20) extending between the exterior of the plate package (P) and a compartment (5) inside the plate package (P), the compartment (5) being at least partly formed by any of the plate interspaces (3, 4).

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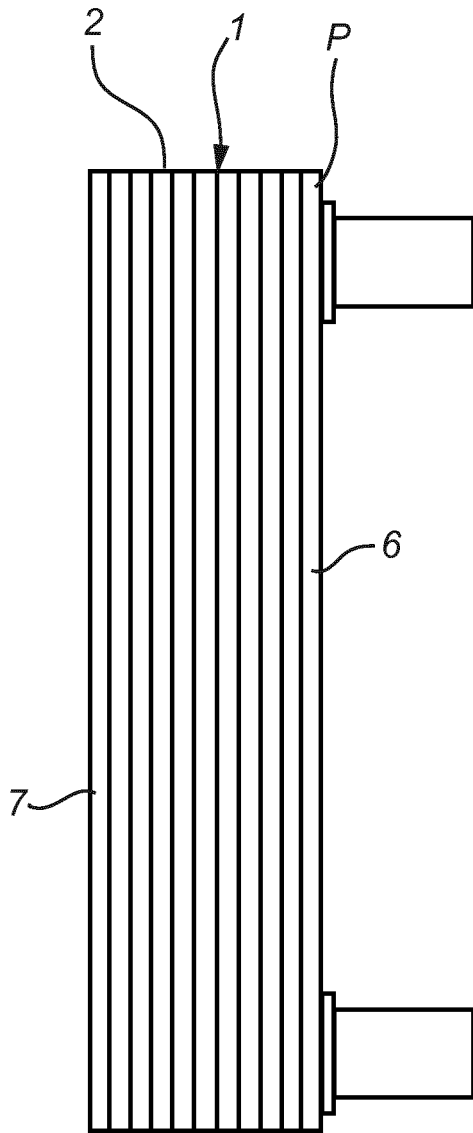


Fig. 1

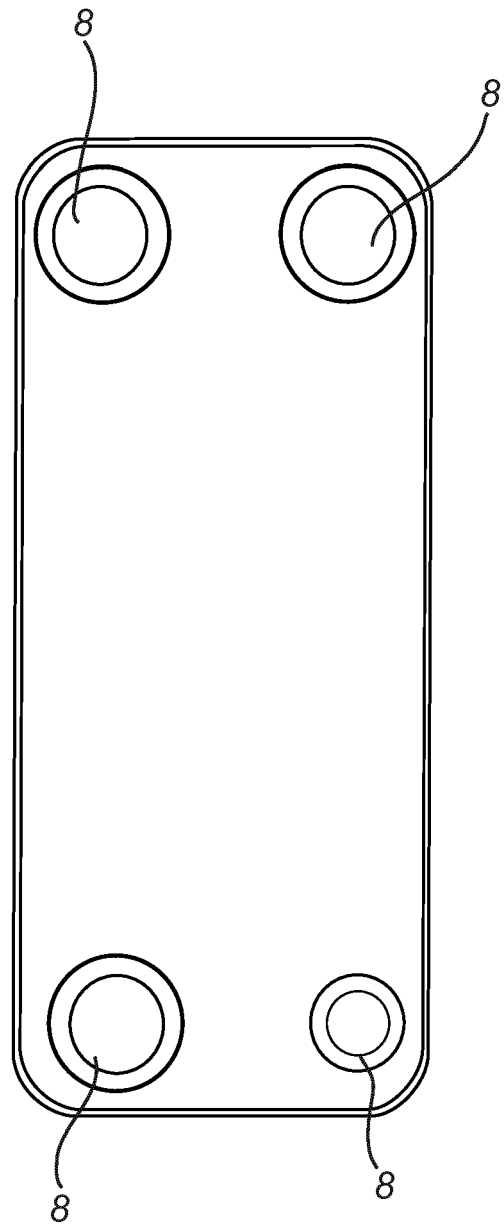


Fig. 2

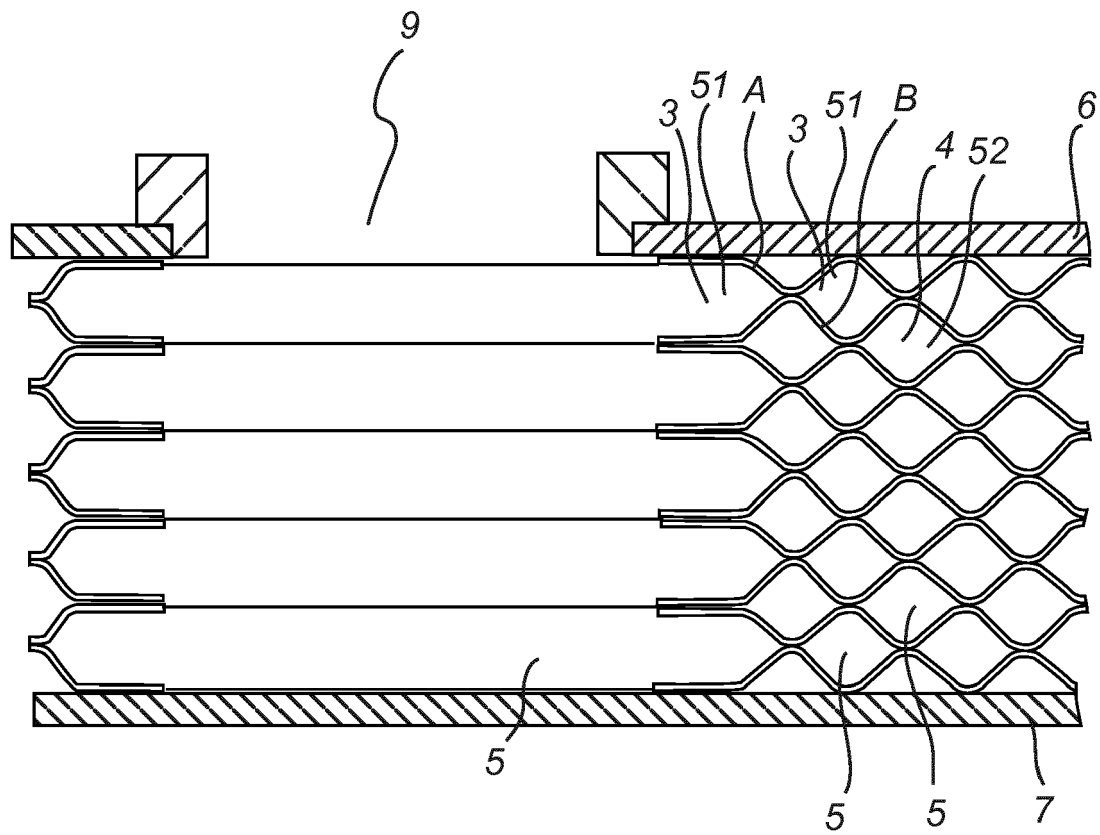


Fig. 3

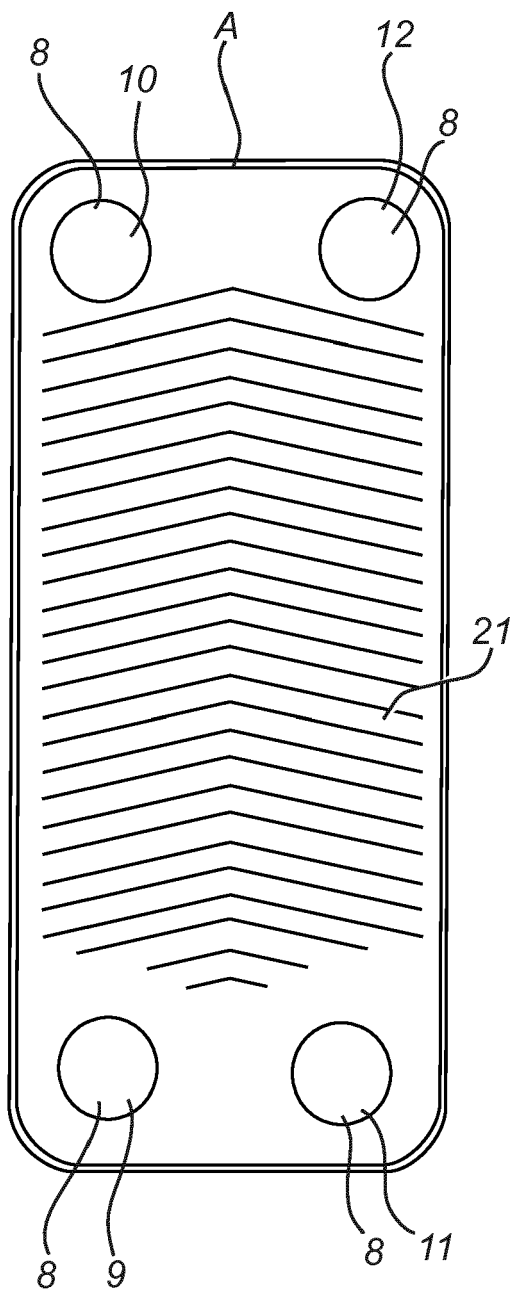


Fig. 4

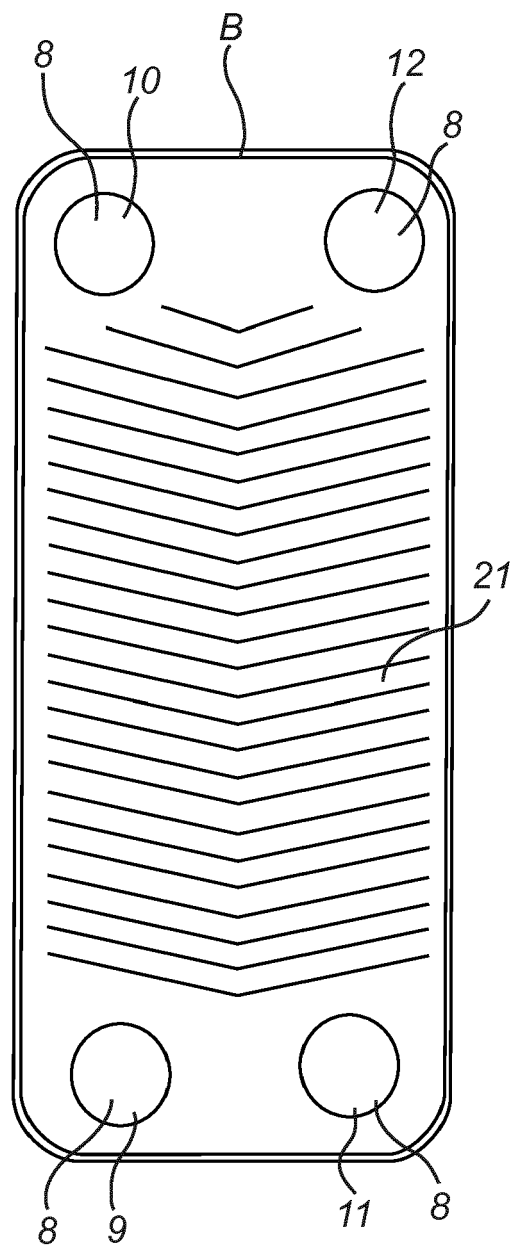


Fig. 5

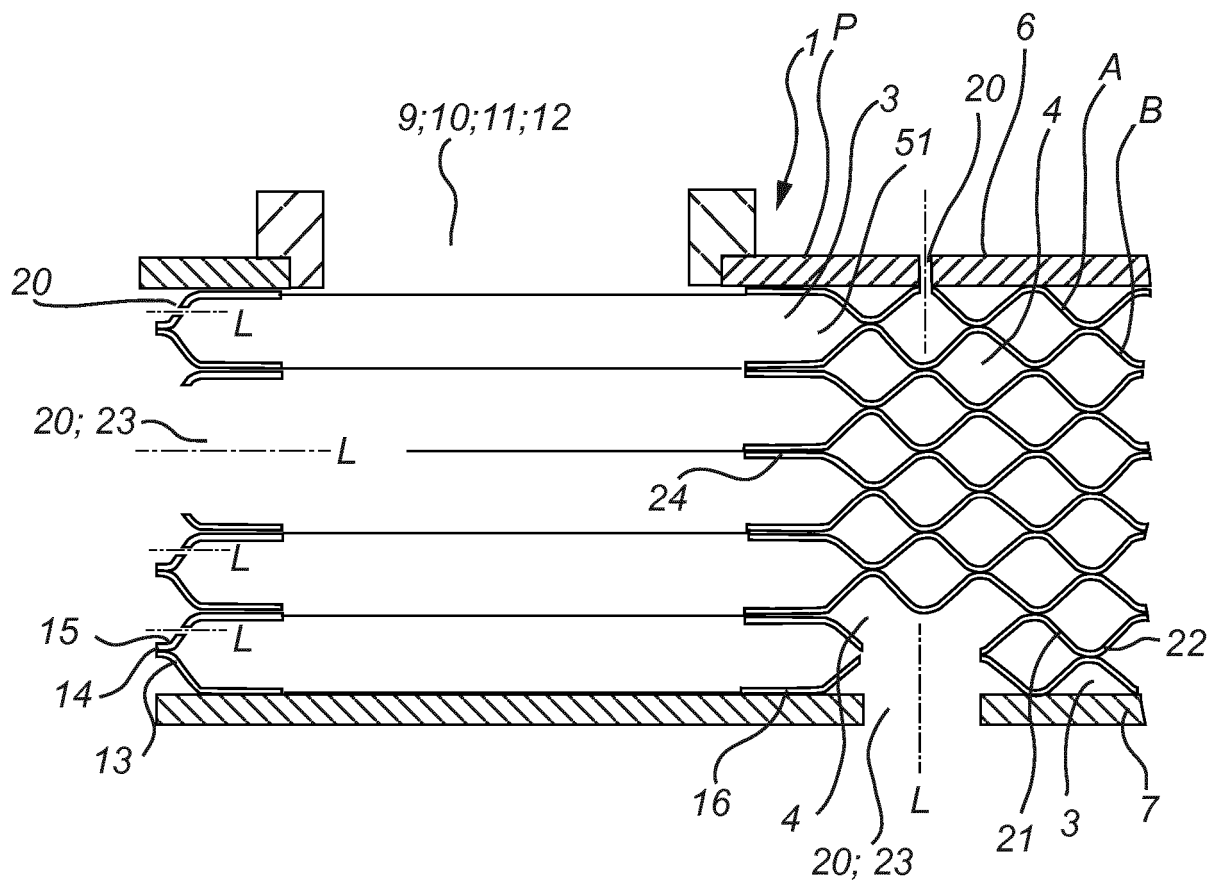


Fig. 6

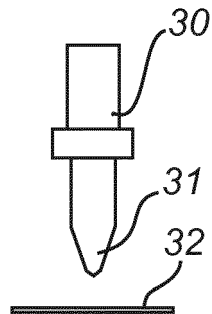


Fig. 7a

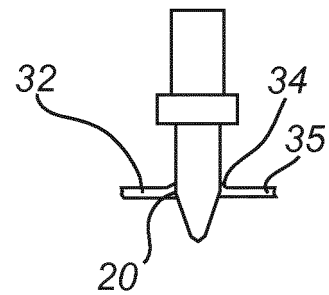


Fig. 7b

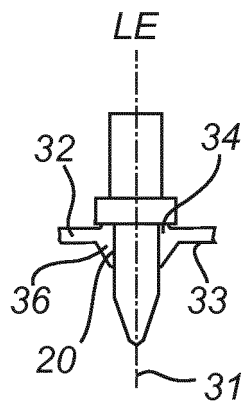


Fig. 7c

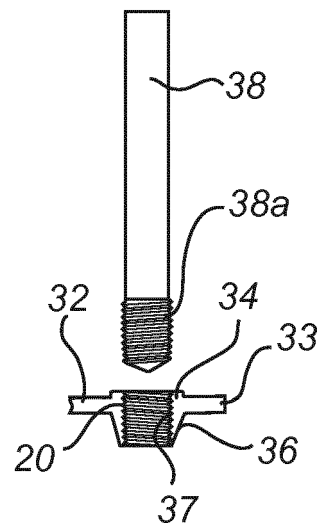


Fig. 7d

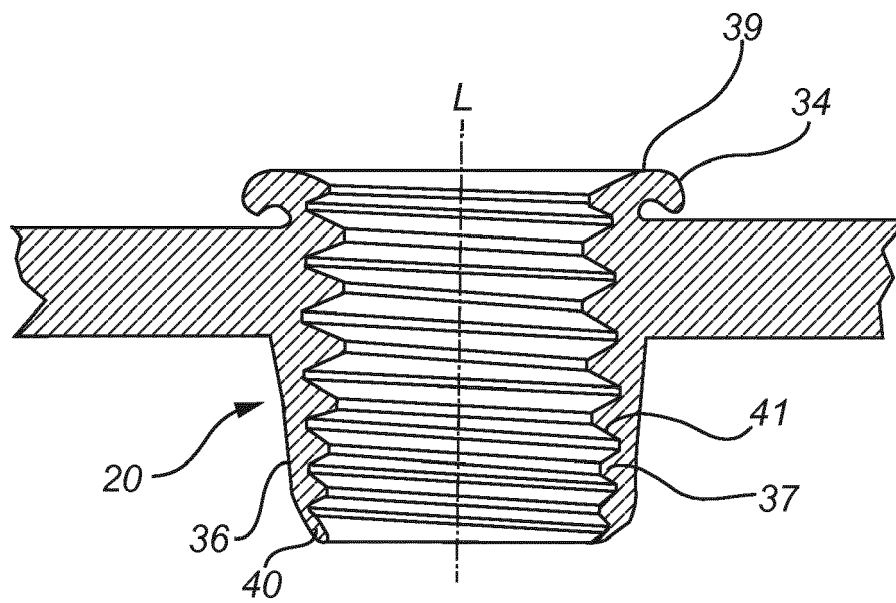


Fig. 8



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Place of search Munich		Date of completion of the search 21 November 2012	Examiner Leclaire, Thomas
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