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(54) **FRAME PLATE AND/OR PRESSURE PLATE FOR A PLATE HEAT EXCHANGER.**

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## Description

This invention relates to plate heat exchangers, and more particularly to a plate heat exchanger frame plate and/or pressure plate having at least one through hole for heat exchange medium.

A plate heat exchanger comprises two end plates, namely a frame plate and a pressure plate, and a stack of heat exchanging plates positioned between the end plates. The plate package is clamped together by bolts.

Holes or ports are provided in at least the frame plate for connection to the pipe lines conducting the heat exchange media to and from the heat exchanger. There are as a rule four connections, namely an inlet port and an outlet port for each of two media.

When using frame plates and/or pressure plates in which the distances between the ports are small, problems have occurred at the connections of the pipe lines. These problems arise partly due to the fact that the flanges of the connections are too close to each other, or simply applied against each other, and partly due to the flanges of the connections being too near to the carrying bars and the guide bars.

Previously these problems have been solved partly by connecting pipes of different lengths being applied to the frame plate and/or the pressure plate, and partly by pipe bends being applied to the connecting pipes of the frame plate and/or the pressure plate. Since the connecting components are made of stainless steel, titanium or expensive alloys, their costs become high. Furthermore, projecting connecting components are subject to pressure vessel requirements, making the cost of applying them still higher.

The present invention provides a solution to these problems and provided in accordance with the invention is a plate heat exchanger frame plate and/or pressure plate having at least one through hole for heat exchange medium, the hole having a straight center line ($C_1$) and a circular opening at each side of the plate, characterised in that the center line ($C_1$) is at an angle other than 90° to the plane (P) of the plate, and the wall of the hole has a generating line which is inclined to the plane of the plate around at least part of the hole periphery.

There have sometimes been wishes from customers regarding connection port dimensions which are not in accordance with the standard for which the heat exchanger is designed, and which correspond to the dimensions of the port openings in the plates of the plate package. Such customer wishes can be for smaller or larger dimensions than normal. Such requirements are today in most cases met by expensive external distance pieces which are tapered in either direction and are placed between the frame plate or the pressure plate and the connecting pipeline flange. The present invention can also provide an alternative solution to the problem of meeting with these wishes by the holes in the frame plate or pressure plate having different sizes on opposite sides of the plate.

A better understanding of the invention will be had from the following detailed description of some embodiments, reference being made to the accompanying drawings, in which:-

Figure 1 shows a connection port of a frame plate or pressure plate with a pipe line connected to the plate by fastening elements;

Figure 2 shows an assembly similar to that of Figure 1, but with the connection port having a different liner;

Figure 3 shows a frame plate or a pressure plate according to the invention, and

Figure 4 shows another assembly similar to that of Figure 1 but not in accordance with the invention.

In Figure 1 there is shown a frame plate or pressure plate 1 to which are fastened a number of bolts 2 serving to connect a flange 3 against the plate 1. The purpose of the flange 3 is to hold a connecting pipe 4 having a flange 5 against the plate. Each bolt 2 cooperates with a nut 6.

The plate 1 has through holes 7 for conducting into and out of the heat exchanger respectively, at least one heat exchanging medium. The wall and the centre axis ($C_1$) of each hole 7 has an angle to the plane (P) of the plate other than 90°. Thus, as seen in Figure 1, the generating line at one longitudinal edge 8 of the hole 7 forms an acute angle with one longitudinal edge 10 at the inner side of the plate 1, while the generating line at the other longitudinal edge 9 of the hole 7 forms an acute angle with the other longitudinal edge 11 at the outer side of the plate. Due to this arrangement, the opening of the hole 7 on the outside of the plate 1 is located further outwards towards the periphery of the plate 1 than is the hole opening on the inside of the plate, whereby the distances between the connection holes 7 on the outer side 12 of the plate are larger than on the inner side 13 of the plate.

According to this embodiment the cross-section of the hole at the outer side 12 of the plate 1 is preferably circular and the same size as at the inner side 13 of the plate 1.

Into the hole 7 a lining 14 is inserted which in this case is made from a sheet of steel. Instead of being made of metal the lining can be made of rubber or plastics material. In the illustrated embodiment the lining 14 has a flange 15 located betwen the plate 1 and the flange 5 of the connecting pipe 4. On the inner side 13 of the plate 1 there is a recess 16 into which is fitted a steel ring 17 preferably of circular shape. Into this steel ring is fastened partly the lining 14 and partly a gasket 18 which functions as a seal between the plate 1 and the closest heat exchanging plate 19.

In Figure 2 there is shown an assembly which for the most part is the same as that in Figure 1, but which

incorporates a lining 20 of different design. The lining 20 is of one piece rubber construction and includes a part 21 which corresponds to the separately made steel ring 17 and a gasket 18 according to Figure 1. In order to prevent the rubber flange 22 being crushed between the plate 23 and the flange 24 of the connecting pipe 25 distance elements 26 are inserted in the flange 22, these elements preferably being made of steel.

The arrangement of the connection ports according to the invention can be used with different types of corrosion-protecting linings and also for plates with wholly unprotected ports.

In Figure 3 there is shown a frame plate or pressure plate 30 according to the invention. The plate 30 is provided with four connection holes 31, 32, 33, 34, each having a centre axis which forms an angle with the plane of the plate other than 90°.

When making the connection holes in the plate autogenous cutting is preferably used. The gas flame is directed with a certain angle to the plate and is moved to follow a circle. As a result circular hole openings are obtained at the outer surfaces 10 and 11 of the plate, while the cross-section perpendicular to the centre axis of the hole has (the shape of an ellipse.

Figure 4 is a schematic section through another assembly which as illustrated does not embody the invention. The frame plate or pressure plate 40 has a hole 41, and, as seen in the drawing the generating line at one longitudinal edge 42 of the hole 41 forms an acute angel with the longitudinal edge 43 at the inner side face of the plate 40, and the generating line at the opposite longitudinal edge 44 of the hole also forms an acute angle with the longitudinal edge 43 at the inner side face of the plate. Alternatively, the longitudinal edge 44 could form a right angle with the longitudinal edge of the plate, with the consequence that the axis $C_2$ of the hole would be inclined at an angle other than 90° to the plane of the plate.

Into the plate hole 41 is inserted a metal lining or a rubber lining 45

The construction described with reference to Figure 4 is particularly advantageous when wishing to comply with requirements concerning dimensioning of the connections and velocity of the heat exchanging media in connection pipes which deviate from those corresponding to the port dimensions of the plate package.

The form of the holes in the above described embodiment can be applied to one or only some of the ports in the frame plate and/or the pressure plate as well as all ports.

## Claims

1. A plate heat exchanger frame plate and/or pressure plate having at least one through hole (7) for heat exchange medium, the hole having a straight center line ($C_1$) and a circular opening at each side of the plate, characterised in that the center line ($C_1$) is at an angle other than 90° to the plane (P) of the plate, and the wall of the hole has a generating line (8, 9) which is inclined to the plane of the plate around at least part of the hole periphery.

2. A plate heat exchanger frame plate and/or pressure plate according to claim 1, wherein the opening of the hole (7) at the outer side of the plate is nearer to the periphery of the plate than is the opening of the hole at the inner side of the plate.

3. A plate heat exchanger frame plate and/or pressure plate according to claim 1 or 2, wherein over one part of the hole periphery the generating line (8) is at an acute angle with one side face (10) of the plate (1), and over another part of the hole periphery the generating line is at an acute angle to the other side face (11) of the plate (1).

4. A plate heat exchanger frame plate and/or pressure plate according to claim 1 or 2, wherein over one part of the periphery of the hole the generating line is at an acute angle with one side face of the plate, and over another part of the hole periphery opposite said one part the generating line is at a right angle with said one side face.

5. A plate heat exchanger according to claim 1, 2, or 3, wherein the circular openings at the opposite sides of the plate have the same size.

## Patentansprüche

1. Plattenwärmetauscher-Rahmenplatte und-/oder -Druckplatte mit wenigstens einem Durchgangsloch (7) für Wärmetauschermedium, wobei das Loch eine gerade Mittellinie (C1) und eine kreisförmige Öffnung auf jeder Seite der Platte hat, dadurch gekennzeichnet, daß die Mittellinie (C1) einen von 90° abweichenden Winkel zur Ebene (P) der Platte einnimmt, und daß die Wandung des Loches eine erzeugende Linie (8, 9) hat, die gegenüber der Ebene der Platte auf wenigstens einem Teil der Peripherie des Loches geneigt ist.

2. Plattenwärmetauscher-Rahmenplatte und-/oder -Druckplatte nach Anspruch 1, bei der die Öffnung des Loches (7) auf der Außenseite der Platte näher an der Peripherie der Platte ist als die Öffnung des Loches auf der Innenseite der Platte.

3. Plattenwärmetauscher-Rahmenplatte und-/oder -Druckplatte nach Anspruch 1 oder 2, bei der die erzeugende Linie (8) auf einem Teil der Peripherie des Loches einen spitzen Winkel mit einer Seitenfläche (10) der Platte (1) einnimmt, und bei der die erzeugende Linie auf einem anderen Teil der Peripherie des Loches einen spitzen Winkel zu der anderen Seitenfläche (11) der Platte (1) einnimmt.

4. Plattenwärmetauscher-Rahmenplatte und-

/oder -Druckplatte nach Anspruch 1 oder 2, bei der die erzeugende Linie auf einem Teil der Peripherie des Loches einen spitzen Winkel mit einer Seitenfläche der Platte einnimmt, und bei der die erzeugende Linie auf einem anderen Teil der Peripherie des Loches gegenüber von dem einen Teil einen rechten Winkel mit der einen Seitenfläche einnimmt.

5. Plattenwärmetauscher nach Anspruch 1, 2 oder 3, bei der die kreisförmigen Öffnungen auf den gegenüberliegenden Seiten der Platte die gleiche Größe haben.

## Revendications

1. Plaque de châssis et/ou plaque de pression d'échangeur de chaleur à plaques comprenant au moins un trou traversant (7) pour un agent d'échange de chaleur, le trou avant un axe droit ($C_1$) et une ouverture circulaire de chaque côté de la plaque, caractérisée en ce que l'axe ($C_1$) forme un angle autre que 90° par rapport au plan (P) de la plaque et la paroi du trou présente une génératrice (8, 9) qui est inclinée par rapport au plan de la plaque autour d'au moins une partie de la périphérie du trou.

2. Plaque de châssis et/ou plaque de pression d'échangeur de chaleur selon la revendication 1, dans laquelle l'ouverture du trou (7) sur le côté extérieur de la plaque est plus proche de la périphérie de la plaque que ne l'est l'ouverture du trou sur le côté intérieur de la plaque.

3. Plaque de châssis et/ou plaque de pression d'échangeur de chaleur à plaques selon la revendication 1 ou 2, dans laquelle sur une partie de la périphérie du trou la génératrice forme un angle aigu avec une face latérale (10) de la plaque (1) et sur une autre partie de la périphérie du trou la génératrice forme un angle aigu par rapport à l'autre face latérale (11) de la plaque (1).

4. Plaque de châssis et/ou plaque de pression d'échangeur de chaleur à plaques selon la revendication 1 ou 2, dans laquelle sur une partie de la périphérie du trou la génératrice forme un angle aigu avec une face latérale de la plaque et sur une autre partie de la périphérie du trou qui est opposée à ladite première partie, la génératrice forme un angle droit avec ladite face latérale.

5. Echangeur de chaleur à plaques selon la revendication 1, 2 ou 3, dans lequel les ouvertures circulaires sur les côtés opposés de la plaque ont la même dimension.

Fig.1

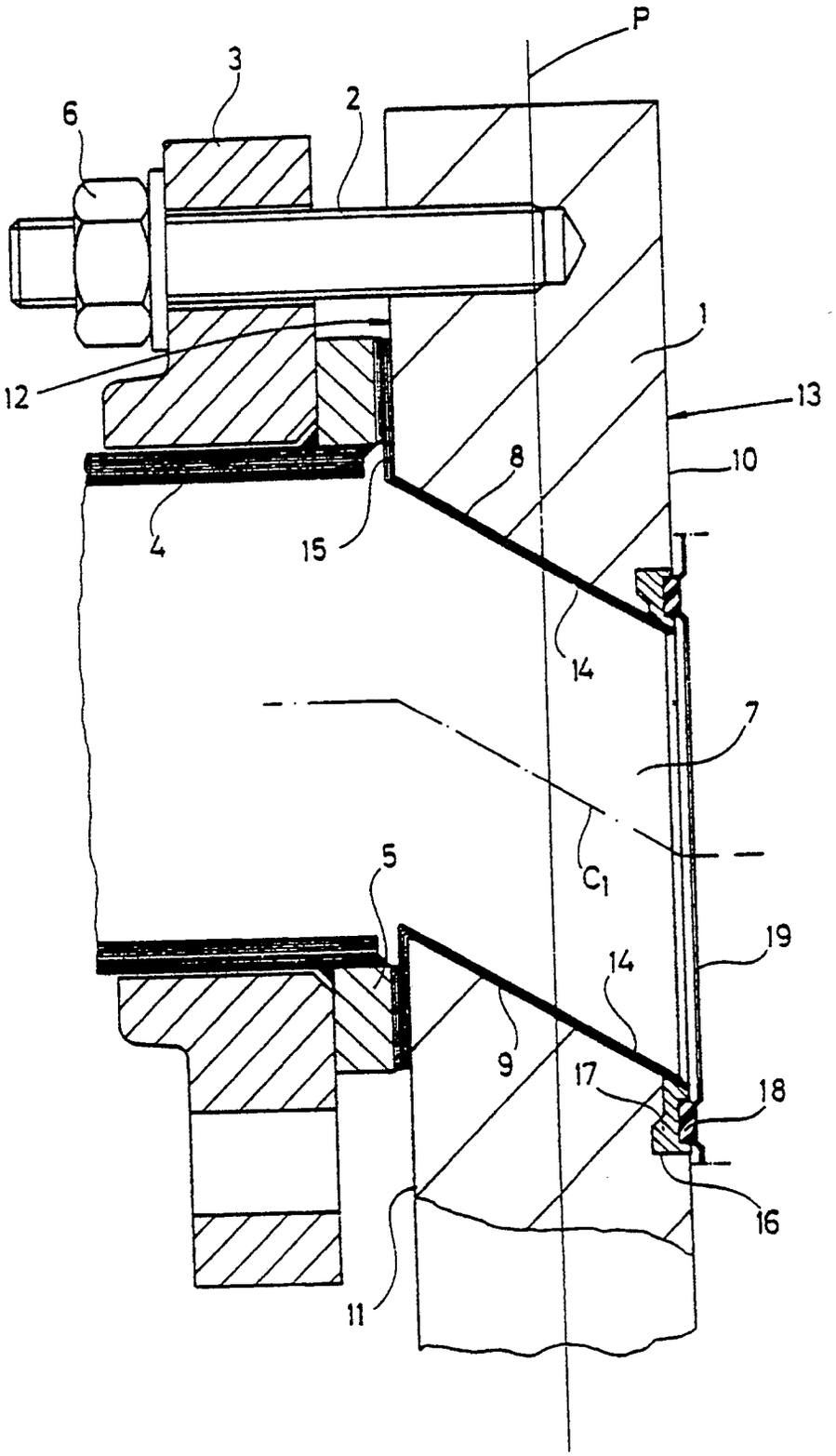

Fig.2

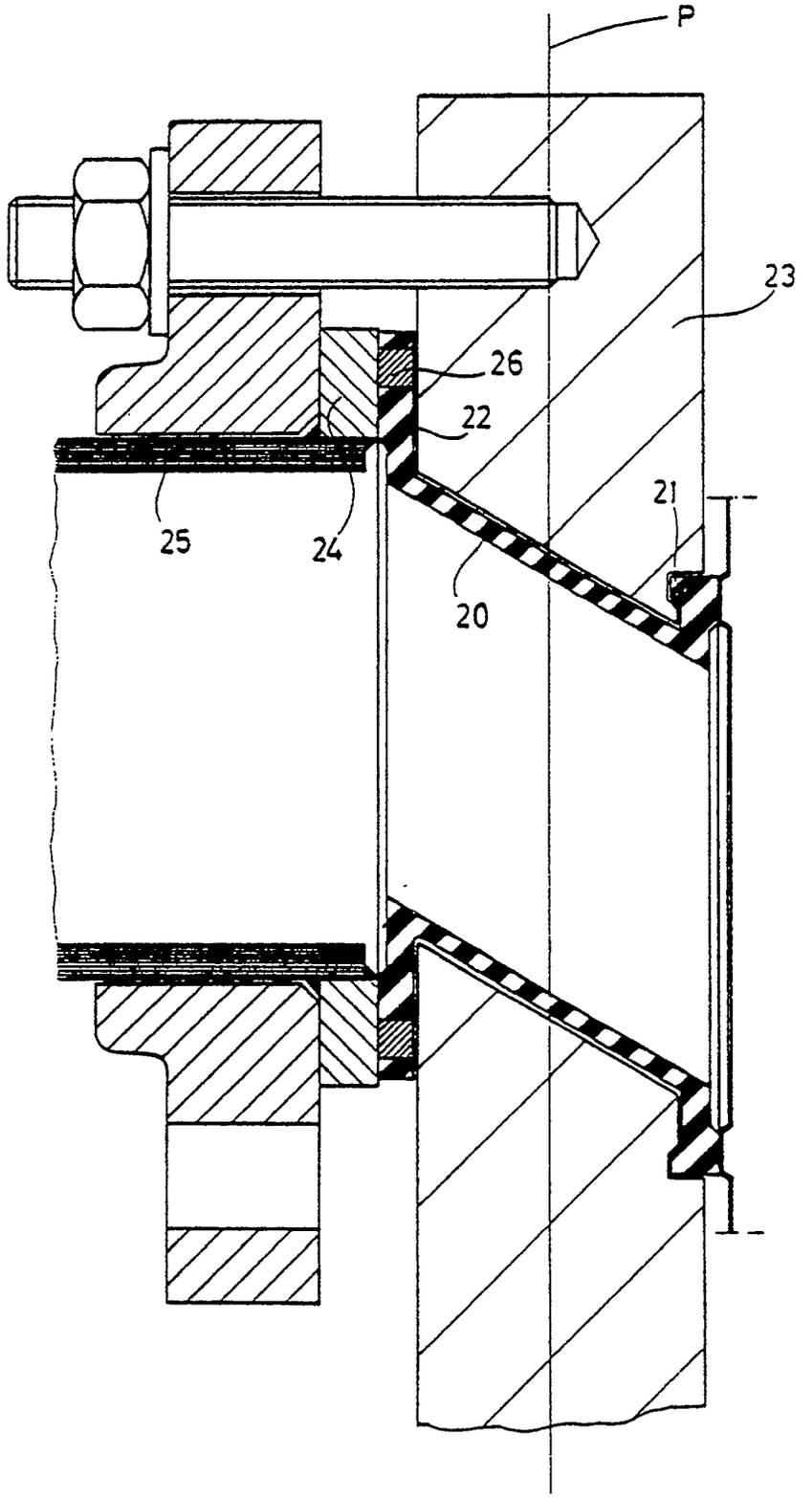

Fig.3

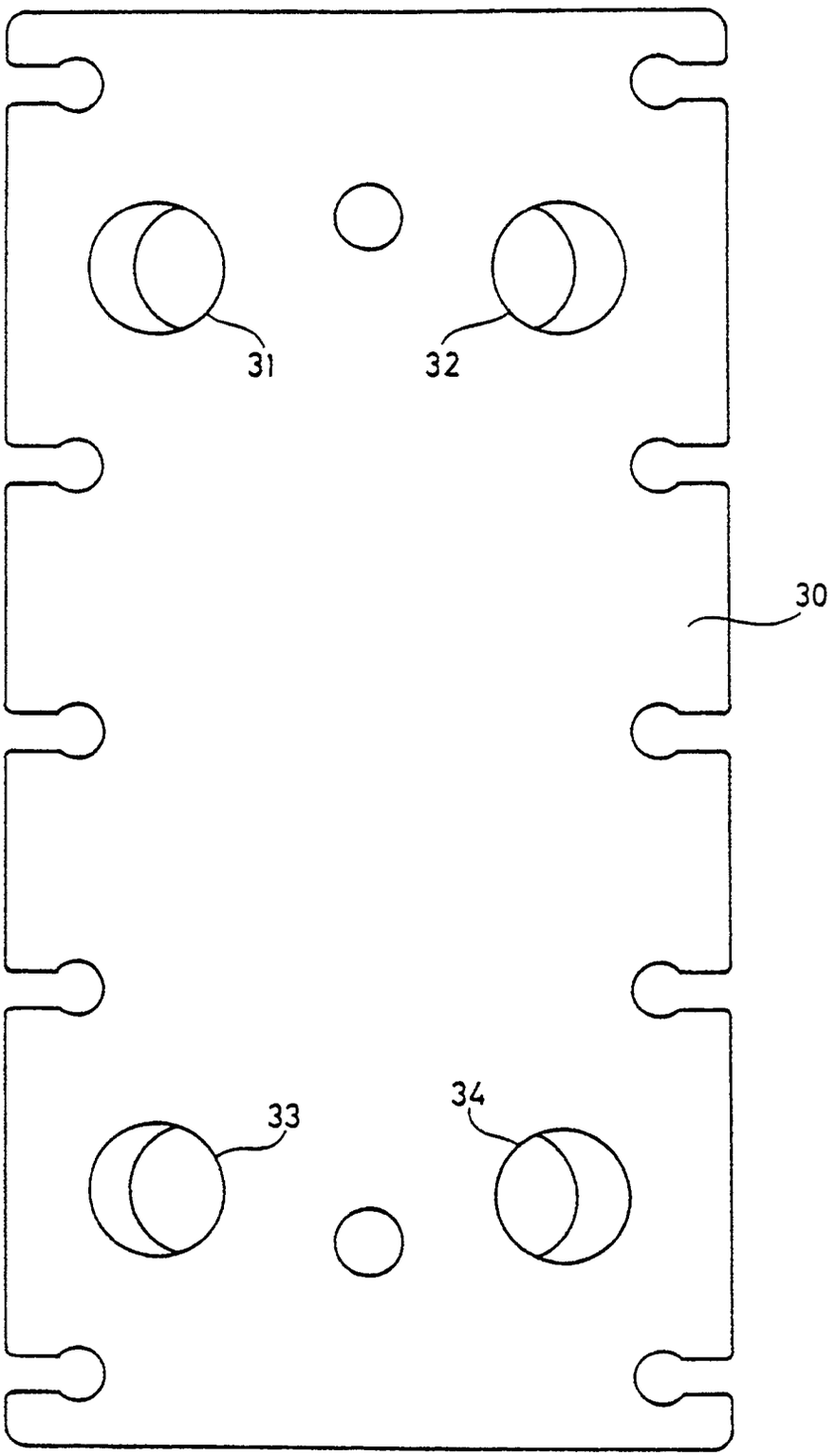

Fig.4