Clips for plate heat exchanger gaskets

The gaskets in plate heat exchangers lie on the plate in a long, narrow groove resulting from the pressure on the plate. Two edges, the height of which are equal to the surface, run along the side of the groove. These gaskets move easily out of their place in the groove. When this occurs, not only do the gaskets not seal properly, but their presence outside the sealing groove disrupts the proper closing of the plates and causes significant leakage of the fluid between them.

In the past, the gasket would be glued into the groove to ensure that it remained in place. This solution is expensive, time-consuming, and makes ongoing maintenance of the heat exchanger difficult, as every time a gasket in the plate is replaced due to wear and tear, the glue must also be removed. To overcome the disadvantages of the gluing, methods were devised to hold the gasket in place using mechanical clips.

We mention here Prior Art rubber-gripping clips that form part of the gasket. These are a series of finger-like tabs that tightly grip onto specially-designed spaces at the edges of the plate tin, relying on the hardness of the rubber (which is generally insufficient) to hold the gasket in place. Rubber by its very nature is elastic, and when an undirected, moderate, random force is applied to the rubber clip, the grip is released, and the rubber gasket moves out of place.

Examples of such clips are those manufactured by Danfoss, Alfa Laval, and Oren.

This application details methods for creating a structure of mechanical locking clips that are easy to put in place in a locked grip, but difficult to remove from this position, to the extent that a device such as a screwdriver is required to release the lock. Alternatively, a lever could be built into the clip to release the lock, and thereby the gasket.

The locking clip described in this application is made of a specially-shaped bracket in the plate tin, produced during the pressing of the plate from a specially-shaped rubber cornice that is part of the gasket spine. It is produced together with the gasket during hot pressing of the rubber in the mold. Assembling the shaped gasket cornice within the shaped plate bracket creates the locking clip.

The plate heat exchanger is produced by cold pressing, usually with special imipressions consisting of two parts. The bottom part is made of shaped protrusions, the height of which equals the depth of the pressure (d), and of depressions formed between the protrusions, the depth of which is equal to the depth created by the pressure on the plate (d). The upper part of the impression is also made of protrusions and resulting depressions of the same height (d), created during the process of producing the plate. This occurs when the flat plate tin, with a thickness of (t), is placed between the upper and lower parts of the impression, and the upper part is lowered onto the lower part of the plate tin with thousands of tons of hydraulic force. The protrusions formed in the lower impression enter the spaces between the protrusions of the upper impression in such a way that a space of approximately 1.2t to about 2t wide (where t is the thickness of the plate) remains between the lower and upper protrusions. Similarly, the protrusions in the upper and lower impressions are rounded on the part close to the plate heat exchanger for the entire length of the geometric form, and the size of the pulling radii (r) range as follows: 3t <= r <= t. These two spaces and radii allow the tin to flow, stretch, and create the form of the protrusions above and below without damage or tearing.

In this application, the space between the lower and upper protrusions is reduced (to tolerance) to a very small space of just several hundredths of a mm, thereby either eliminating the rounding radius (r) that was described, leaving it, or changing it and adding a cutting shoulder under it as shown in Figure ( ). Reducing the space between the protrusions in the areas chosen by the designer and in the shape chosen as described in Figure ( ) causes the plate tin to be cut in these areas. This results in the creation of a shape that is either flat or in the form of a curved surface, as determined by the designer. Together with the pulling process (lowering of the upper part of the impression onto the lower part of the impression), the shape created in the tin transforms into a shaped window, parts of which (as determined by the designer) are pulled or bent either upward from below or downward from above, or are simply cut with a window between them. The maximum height of the window obtained from cutting only, without pulling or bending of the tin upward or downward, is the thickness of the plate (b) minus twice the thickness of the tin of the plate (t)

winhmax = (b-2t) = (d-t)

as shown in Figure ( ). The window created, with a height of winh, has either a flat-shaped contoured rim or the shape of a curved surface. In fact, its shape can be square, oblong, rhomboid, triangular, or any other shape, as shown in Figure ( ). The upper line can, but need not be, parallel to the surface of the plate. As a result, with respect to the rest of the lines of the window as shown in Figure ( ), the shape of the window either can be closed or can have an open section in one of its sections in any direction, as determined by the designer, as shown in Figure ( ).

Window rim surfaces are created around the contour of the window in the plate, toward the top, bottom and the sides. These are roughly parallel to the surface of the window, and continue outwards from it. They are called continuous rim surfaces (to the window). Perpendicular to the continuous rim surfaces are rim surfaces called the perpendicular upper and lower and side surfaces, where the contoured window described above appears on the connecting line between the continuous rim surfaces and the perpendicular rim surfaces.

For the sake of simplicity, we describe the window cut without pulling, and at the maximum height described in Figure ( ). However, this explanation also applies to cut and pulled windows. Only the upper and lower surfaces of the windows are described, but the explanation and specifications also include the lateral surfaces on the sides of the window. The continuous and perpendicular upper and lower rim surfaces shown with solid arrows in Figure ( ), and the parallel surfaces above and below the perpendicular surfaces indicated in Figure ( ) with dotted arrows, are the possible locking surfaces that the cut (and pulled) window structure or the windows provide as support and locking surfaces for the gasket wedge, on which the confinement surfaces for creating the locking clip between them are located.

To achieve optimal confinement and clip locking, it is possible to use some or all of the surfaces, as determined by the designing engineer.

A gasket wedge can extend and connect to one window or several windows in the plate.

Windows can be perpendicular to the plate surface, or can present at an angle in any direction from it, and at any angle with respect to the main axes of the plate.

The gasket wedge with its confinement surfaces, when combined with the locking surfaces of the plate windows, creates a stable and strong gasket/plate locking clip that does not open easily when handled in an unskilled manner by someone not fully trained in servicing the unit. This increases the reliability of the heat exchangers, and enables untrained personnel to perform some of the routine maintenance on them, including replacing gaskets, or opening and closing them for testing, without fear of malfunction, as often happens now.

-------------------------------------------

Claims

1. A plate of a plate heat exchanger in which a gasket groove surrounds the two lubricated openings of the first flow and its heat transfer area continuously and completely; the two circular gasket grooves (shaped like o-rings) surrounding the two openings around the second flow and in areas between the gasket buffer and the protruding rims; and the gasket groove of the inlet openings produced at the time of the pressing action of the plate or from a separate action, when sealing and pulling a single window to each clip. Each window is a flat structure or a curved surface, with a contoured line, parallel or not to the surface of the plate, closed or open in at least one specific section, from which the contoured line, leading further down to the surface of the window, are continued surfaces of the window. These are termed the continuous window rims, upper continuous rim, lower continuous rim, right continuous rim, and left continuous rim.

Perpendicular to the window surface, a contoured line protrudes from the upper, lower, right, and left perpendicular rim surfaces, all creating stability and strength on the support rim plate. There is a geometric structure of the gasket spine directly or (wedge) arms protruding from it which is a mirror image of the supporting rims of the plate.

When the gasket spine or the clip arm extending from it is pushed down with moderate force, it moves along the sliding surfaces in the gasket while changing shape upon reaching the locking space in the plate, where it opens and locks into place. Removing the locking clip requires the use of force or a tool (screwdriver) or a release tab on the gasket, the function of which is to release the lock.

2. The spine or arms (wedges) of the gasket for grip locking of the plate. These include: continuous and perpendicular confinement rims; sliding surfaces which enable the gasket or its clip arm to be pushed to the location in the plate where it eases into its place; and the confinement rims of the gasket which are opposite the locking rims of the plate when in the locking mode. Removing the locking grip requires use of force or a tool (screwdriver) or a release tab on the gasket, the function of which is to release the lock.

3. Support structures in the plate as described in Section 1, but instead of a single window with rim surfaces for the clip, there are two parallel windows in every clip. The double structure strengthens the grip.

4. The gasket as described in Section 2, but instead of support and locking by one window, the gasket is supported and locked by two or more parallel windows to increase the locking power.

5. Support structures in the plate as described in Section 3, but instead of a structure with two parallel support windows, there are two windows for each of the clips, with an angle between them.

6. The gasket as described in Section 4, but instead of the support of two parallel windows, there is support of two windows with an angle between them.