Clips for plate heat exchanger gaskets

The gaskets in plate heat exchangers lay on the plate in a long, narrow groove, the depth of which is as deep as pressure on the plate. On its side are two shoulders, the height of the surface of the peaks. These gaskets easily move out of their place in the groove. When this happens, 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 it remained in place. This solution is expensive, time-consuming, and makes maintenance of the heat exchanger difficult later on, 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 invented to hold the gasket in place using mechanical clips.

We mention here as Prior Art rubber-gripping clips that form part of the gasket, 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.

In this application, we describe methods to create a structure of mechanical locking clips that are easy to put into place in a locked grip, but difficult to remove from this position; to the point 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, and 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 dies that have two parts: the bottom one is made of shaped protrusions of the height of the depth of the pressure (d), and of valleys between the protrusions, whose depth is also (d), like the depth of the pressure on the plate. The upper part of the die is also made of protrusions and formed valleys at the same height (d), where during the process of pulling the plate, the flat plate tin whose thickness is (t) is placed between the upper and lower parts of the die, and the upper die part is lowered onto the tin toward the lower die part with thousands of tons of hydraulic force. The shaped protrusions in the lower die enter the spaces between the protrusions of the upper die such that between the lower and upper protrusions, a space remains that is about 1.2t to about 2t wide (where t is the thickness of the plate.) Similarly, the protrusions in the upper and lower die 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 radius (r) ranges as follows: 3t <= r <= t. These two spaces and radiuses allow the tin to flow, stretch, and obtain the form of the protrusions above and below without damage or tearing.

In this application, we reduce the space between the protrusions above and below (to tolerance) to a close space of just several hundredths of a mm, and eliminate the rounding radius (r) that was described, or leave it, or change it and add 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 he chooses as described in Figure ( ) causes cutting of the plate tin in these areas and obtaining a shape that is flat, or in the form of some curved surface as desired by the designer; and together with the pulling process (lowering of the upper part of the die into the lower part of the die), the shape created in the tin turns into a shaped window, parts of which (as desired by the designer) are pulled (bent) from below upward, or from the top downward, or are just 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 respectively 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 obtained whose height is winh has a flat-shaped contoured rim or is in the shape of some curved surface, and its shape can be square, oblong, rhomboid, triangular, or any other shape, as shown in Figure ( ). The upper line can be either parallel to the surface of the plate or not, and thus for the rest of the lines of the window as shown in Figure ( ), the shape of the window can be closed or can have an open section in one of its sections in any direction, as desired by the designer, as shown in Figure ( ).

Around the contour of the window in the plate, window rim surfaces are created toward the top, bottom and to the sides that are roughly parallel to the surface of the window, and continue it outwards. They are called continuous rim surfaces (to the window). Perpendicular to the continuous rim surfaces are rim surfaces perpendicular to them, called the perpendicular upper and lower and side surfaces, where the contoured window that was described is on the connecting line between the continuous rim surfaces and the perpendicular rim surfaces.

For the purposes of simplicity, we describe the window cut without pulling, and at the maximum height described in Figure ( ), but the explanations also apply to cut and pulled windows. Only the upper and lower surfaces of the windows are described, but the explanation and claims 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 are the confinement surfaces for creating the locking clip between them.

To achieve optimal confinement and clip locking, it is possible to use some or all of the surfaces, according to the decision of 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 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 touched in an unskilled manner by someone who is not fully trained in servicing the unit. This increases the reliability of the heat exchangers, and enables unspecialized personnel to perform some of the routine maintenance on them, including replacing gaskets, or opening and closing for testing, without fear of malfunction as currently takes place.

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Claims

1. A plate of a plate heat exchanger in which a gasket groove surrounds the two lubricated openings of the first fluid, its heat transfer area continuously and completely, and two rounded gasket grooves (shaped like o-rings) surrounding the two openings all around the second fluid, and in areas between the gasket buffer and the rims that \_\_\_\_ out; and the gasket groove of the inlet openings preparing?? at the time of the pressing action of the plate or from a separate action, in sealing and pulling a single window to each clip, with each window in a flat structure or a curved surface, with contoured line parallel or not to the surface of the plate, closed or open in at least one specific section, where from the contoured line and further down to the surface of the window are continued surfaces of the window called the continuous window rims, upper continuous rim, lower continuous rim, right continuous rim, and left continuous rim.

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

And when the gasket spine or the clip arm that extends from it push down with moderate force, they move on the sliding surfaces in the gasket while changing their shape when they arrive at the locking space in the plate, where there they open and lock in place. Removing the locking clip requires use of force or a tool (screwdriver) or a release tab on the gasket, whose function is to release the lock.

2. The spine or arms (wedges) of the gasket for grip locking of the plate, which include continuous and perpendicular confinement rims, and in addition sliding surfaces, which enable pushing the gasket or its clip arm to the place in the plate where it eases into its place and the confinement rims of the gasket are opposite the locking rims of the plate in locking mode. To open the locking requires force or tools or an opening tab in the gasket.

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

4. Gasket as described in Section 2 but instead of support and locking of 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 are as described in Section 3, but instead of a structure with two parallel support windows, there are two windows for each for each clip, at some angle between them.

6. Gasket as described in Section 4 but instead of the support of two parallel windows, there is support of two windows at some angle.