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FLOATING HEAD AND TEST RING

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Fig. 3.

Fig. 5.

Fig. 4.

Fig. 2.

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The invention forming the subject matter of this application relates to improvements in heat exchangers of the type in which a 
"bundle" or nest of tubes is mounted within a containing shell, and which are generally known in the art as "shell and tube" heat 
exchangers.

In the design of removable bundle heat exchangers, it is desirable to keep the space between the outside of the tube bundle and the 
inside of the shell as small as possible. If the floating head of this type of heat exchanger were fastened to the tube sheet by means of 
bolts passing directly through the sheet and head, the outside dimension of the tube sheet must be large enough to accommodate the 
bolts; and the shell itself must be made considerably larger than the tube bundle in order to provide clearance for the tube 
sheet when the bundle is being withdrawn from the shell.

To overcome this defect, and to lessen the diameter of the floating tube sheet, it has been customary to use a split ring somewhat as 
shown in United States patent to Price, No. 1,809,910, June 16, 1931. This split ring construction allows the floating tube to be made of 
smaller diameter than would be possible if it were directly bolted to the floating head.

Hooks have sometimes been used instead of split rings to secure the floating head to the tube sheet. The split ring and the hooks have 
a tendency to twist or spring when pressure is applied to the bolts for securing the floating head to the tube sheet; and this tendency 
makes it difficult to secure a tight joint between the tube sheet and floating head. The main difficulty with the hook bolt idea is that 
the bolt ordinarily is subject to deflection when pressure is applied to effect a tight joint between the floating head and tube sheet.

The main object of the present invention is to overcome these defects in the prior art by providing means for connecting the floating 
head to the tube sheet which will permit the tube sheet to be small in diameter in comparison with prior constructions.

Another object of the invention is to eliminate the use of split rings in heat exchangers of this character by providing hook bolts of 
a peculiar construction which are permanently attached to the floating head.

A further object of the invention is to provide a means for connecting a floating head to a tube sheet so that all the work of fastening 55 
the floating head to the tube sheet is effected from the outside of the sheet.

Still another object of the invention is to provide a fastening means of this character, so constructed as to indicate when the parts 60 
are properly arranged for fastening, and to prevent attachment of the shell cover unless and until the floating head and tube sheet 
are properly fastened to each other.

Other objects of the invention will become apparent as the detailed description thereof proceeds.

In the drawings:

Figure 1 is a fragmentary central vertical section taken through the floating head end of a heat exchanger of the character referred to;

Figure 2 is a fragmentary central vertical section through a heat exchanger of the type described, and having a test ring secured to 75 
the tube sheet and the shell enclosing the same;

Figure 3 is a fragmentary section, to an enlarged scale, of part of the floating head, and of a hook bolt forming an essential part 80 
of the present invention;

Figure 4 is a fragmentary end elevation of the hook bolt shown in Figure 3; and

Figure 5 is a perspective view of the afore-85 
said bolt.

The heat exchanger shown in Figure 1 of the drawings comprises the shell 1 provided with an inlet 2 and an outlet 3. One end of 
the shell has suitably secured thereto a flange 4 having bolt holes 5 suitably formed therein. The flange 4 is provided with a rabbet 90 
6 forming a shoulder 7 which is adapted to fit into a machined out recess 8 formed in the flange 9 of the shell cover 10. The usual gas-
det 11 is arranged between the flanges 4 and 9 and bolts 12 are used to secure the two flanges to each other.

The tube sheet 13 is provided with the usual tube apertures to receive the tubes 14 of the exchanger; and this tube sheet 13 is made
of such diameter that it will pass freely through the shell 1 when the entire nest of tubes is to be withdrawn for any purpose. The floating head 15 is enlarged at its periphery, which is shaped to form a flat annular surface 16 for the nuts 17 of the hook bolts 18. The periphery of the floating head is machined to form a flange 19, and bolt apertures 20 are bored through the flattened surfaces 16 so that these apertures have their cylindrical elements flush with the inner face of the flange 19.

The flange 19 is about the same depth as the thickness of the tube sheet 13 so that when the tube sheet is seated within the cap 15, the inner face of the sheet lies substantially flush with the end of the flange 19. The diameter of the tube sheet 13 is substantially the same as the inner diameter of the flange 19 so that the outer periphery of the tube sheet 13 fits snugly within the flange when the parts are properly assembled.

The bolts 18 have one end turned laterally to form a toe or hook 21 adapted to contact either with the inner face 22 of the tube sheet 13 or with the end 23 of the flange 19. The other end of the bolt 18 is screwed threaded to receive a nut 17 adapted to be rotated by the usual wrench or plier in drawing the floating head up to proper position on the tube sheet 13. This bolt 18 is intended to be permanently secured to the floating head 15; and is provided with an indicator member 25 suitably fixed to the screwed threaded end of the bolt 18. The indicator element 25 has its sides flattened so that a wrench may be applied thereto in order to prevent turning of the bolt 18 while the nut 24 is being rotated thereto.

When the head 15 is removed from the tube sheet the bolts 18 are turned so that their hook ends 21 and indicators 25 extend radially outwardly of the floating head. In this outward position, the nuts 24 are tightened up slightly to maintain the bolts 18 so positioned and keep the bolts from sliding loosely in the apertures 20. Before assembling the floating head on a tube sheet, it is necessary that all the bolts be arranged in this manner; that is, with their indicators and hook ends extending outward radially from the floating head. The circular arrangement of bolts 18 then presents a series of line contact elements adapted to facilitate the sliding movement of the head onto said tube sheet prior to the locking of the same together.

The indicators 25 are of such length that when they are turned radially outward they would contact with the shell cover 10 and prevent the cover from being secured to the flange 4 of the shell 1. Before this cover can be secured to the shell it is necessary, therefore, that all the bolts be properly turned with their indicators 25 pointing inwardly toward the center of the shell cover or tube sheet, thereby indicating that the hook ends 21 are properly turned for securing the floating head to the tube sheet.

The same hook-bolt arrangement and method of securing the floating head to the tube sheet can be applied also to securing a test ring 26 to the tube sheet and to the flange 4 of the shell 1. This test ring 26 has a flange 27 similar in every respect to the flange 9 of the shell cover 10 and adapted to be similarly secured by the same bolts 12. The test ring 26 is in the form of an annulus having a rabbit 23 formed to receive the hook bolts 18 and the tube sheet 13 in the same manner as the floating head receives the same tube sheet 13. By the use of this test ring pressure can be applied on the shell side of the exchanger, and the tube joints in the tube sheet may be then easily inspected for leakage, since the ends thereof are fully exposed. This test ring thus secured may also be used as a jig for rolling the tubes in place.

When it is desired to remove the floating head from the tube sheet, it is merely necessary to slacken the nuts slightly on the bolts, and then rotate the bolts about their axes until their hook ends lie over the end of the floating head flange. The nuts are then tightened sufficiently to hold the bolts in this position; and the head and bolts can be removed bodily from the tube sheet. It will be apparent that the head, in this condition, is ready to be applied to the tube sheet, without any necessity for handling a lot of loose bolts, and split rings in the manner common to the prior art. Obviously, this construction saves a great deal of time and labor during the handling of a floating head or test ring incident to assembly or removal of the several parts of the exchanger.

The indicator pointers 25 not only indicate the direction of the hook ends of the bolts, but also prevent the shell cover being applied to the shell until all the bolts are in proper securing position over the tube sheet. In the test ring, their radial positions indicate clearly on the outside of the tube sheet whether or not all the bolts are in or out of clamping position.

Another decided advantage of this construction resides in the fact that all the work of fastening the floating head or test ring to the tube sheet can be performed from the outside of the tube sheet. This is particularly important in the case of the test ring, which from its construction, prevents access to the inside of the tube sheet assembly.

While I have described my invention as embodied in concrete form and as operating in a specific manner in accordance with the provisions of the patent statutes, it should be understood that I do not limit my invention thereto, since various modifications thereof will suggest themselves to those skilled in the art without departing from the spirit of
my invention, the scope of which is set forth in the annexed claims.

What I claim is:

1. A heat exchanger comprising: a shell, a tube bundle, a tube sheet on the floating end of said bundle, and means for securing said tube sheet to the shell to form a test closure therefor.

2. A heat exchanger comprising: a shell, a tube bundle, a tube sheet on the floating end of said bundle, and means secured to said shell and tube sheet from the outside thereof to form a closure for the chamber between said shell and tube sheet.

3. A heat exchanger comprising: a shell, a tube bundle, a tube sheet on the floating end of said bundle, and an annular member secured to said shell and to close the space between the outside periphery of said shell and the inner periphery of said shell.

4. A disk, a member rabbed to form a shoulder seat for the disk and a flange extending around the periphery of the disk, said flange being substantially equal in depth to the thickness of the disk, L-head bolts extending through said member and said flange, means for rotating the bolts to move the laterally projecting part of the heads alternatively into contact with one face of said disk or the end of said flange, and means for locking the bolts in either of said positions.

5. A disk, a ring rabbed to form a shoulder seat for said disk and an annular flange concentric with said disk, said flange being substantially equal in depth to the thickness of said disk, a bolt having a head projecting radially therefrom, means for axially rotating said bolt to move said head alternatively into contact with one face of said sheet or the end of said flange, and means for locking said bolt with the head in either of said positions, the first named means forming an indicator to indicate the position of said head.

6. A bolt comprising a threaded shank, a head extending radially from one end of said shank, and an indicator extending radially from the other end of said shank and in the same direction as the head, and a nut rotatable on said shank.

7. A heat exchanger comprising: a shell, a tube bundle therein, a tube sheet on the floating end of said bundle, a floating head having a rabbet formed to receive said tube sheet, hook bolts permanently secured to said heads for clamping the head to said tube sheet, and means on said bolts for indicating when said bolts are in clamping position.

8. A heat exchanger comprising: a shell, a tube bundle therein, a tube sheet on the floating end of said bundle, a floating head having a rabbet formed to receive said tube sheet, and a flange substantially equal in depth to the thickness of said tube sheet, hook bolts permanently mounted in said head and rotatable into and out of clamping engagement with the said tube sheet, and means for axially rotating said bolts.

9. A heat exchanger comprising: a shell, a tube bundle therein, a tube sheet on the floating end of said bundle, a floating head having a rabbet formed to receive said tube sheet, and a flange substantially equal in depth to the thickness of said tube sheet, hook bolts permanently mounted in said head and rotatable into and out of clamping engagement with the said tube sheet, means for axially rotating said bolts, said means also indicating when the bolts are in position to clamp said tube sheet to the floating head.

10. A heat exchanger comprising: a shell, a tube bundle therein, a tube sheet on the floating end of said bundle, a member having an annular recess in which said sheet is seated, and means carried wholly by said member and operable from the outside of said shell and for detachably clamping said member to said tube sheet.

11. A heat exchanger comprising: a shell, a tube bundle therein, a tube sheet on the floating end of said bundle, a member having an annular recess in which said sheet is seated, and means attached to said member and rotatable thereon for detachably clamping said member to said tube sheet.

In testimony whereof I affix my signature.

MELVIN SACK.