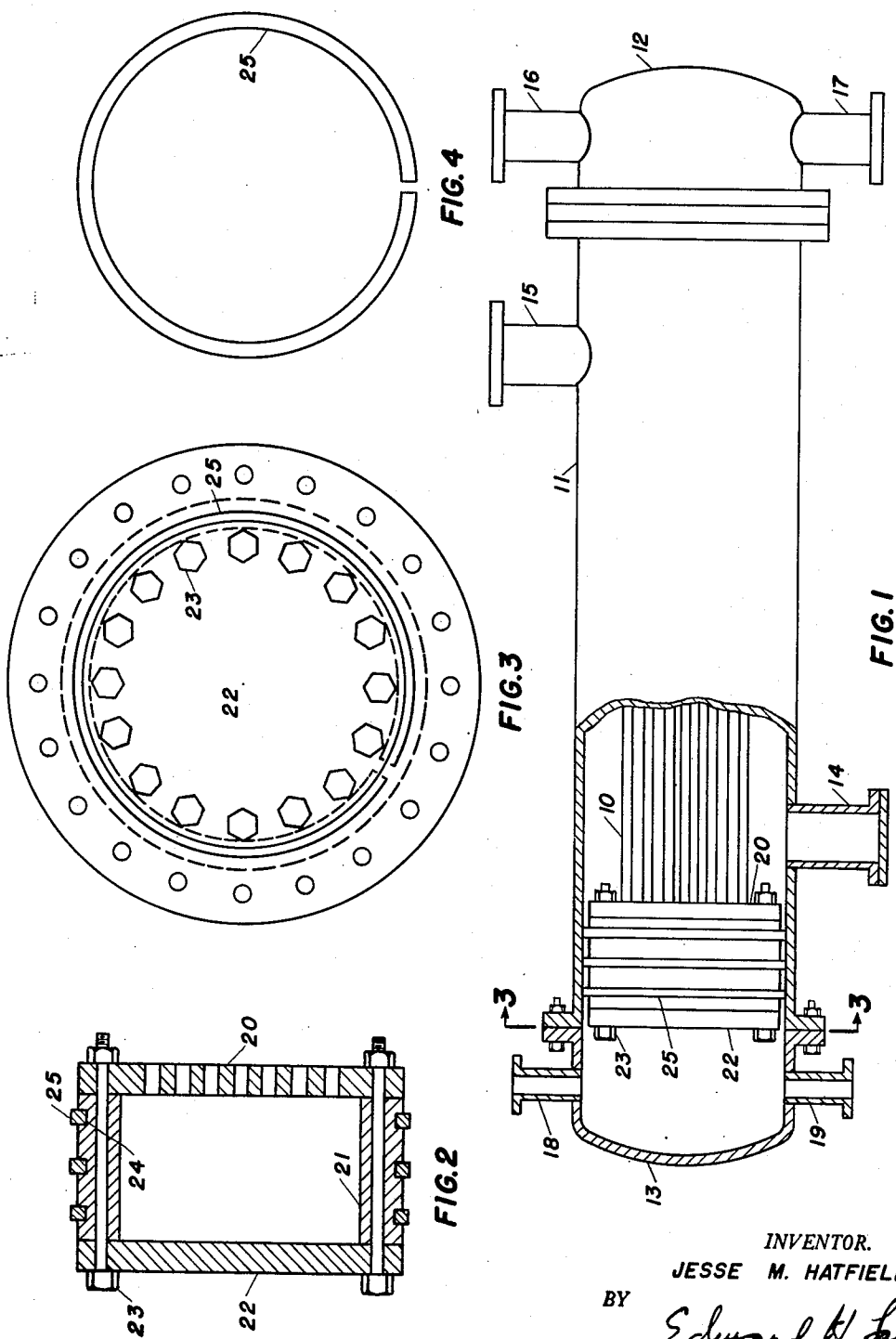


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FLOATING HEAD ASSEMBLY FOR SHELL AND
TUBE TYPE COOLERS OR HEAT EXCHANGERS
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FLOATING HEAD ASSEMBLY FOR SHELL
AND TUBE TYPE COOLERS OR HEAT
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1

This invention relates to industrial heat transfer equipment. It is more specifically related to an improvement in the design of shell and tube type equipment which facilitates the removal of tube bundles from the shell bodies of the equipment.

There are many types of heat transfer equipment available, however one of the most widely known types comprises a plurality of parallel tubes encased in a relatively close fitting tubular shell. Provisions are made whereby a fluid flows outside the tubes, called the shell-side fluid, and a fluid flows inside the tubes, called the tube-side fluid. Although this tubular type equipment is generally referred to as heat exchangers, depending upon the specific service in which it is employed this equipment may be variously designated as heat exchangers, overhead condensers, surface condensers and vaporizers, etc. In the following discussion and description of my invention I shall use the term heat exchanger to encompass all shell and tube type equipment regardless of its specific designation for a particular purpose.

When heat exchangers are utilized under conditions wherein the temperature difference between the tube side and shell side fluids is large it is necessary that the heat exchanger design include means to allow for the difference in expansion of the tubes and of the shell. Various expedients may be employed to accommodate the expansion such as flexible sections built into the shell, U-shaped tubes, and others. Where an exchanger is used in a service which necessitates the removal of the tube bundle in order to clean the outside surfaces of the tubes a floating head construction is used which permits free expansion of the tube's heat yet permits the tube bundle to be removed readily for repairs and/or cleaning.

The removal of the tube bundle becomes necessary when a shell side fluid is used which is dirty or scale forming. The deposition of scale on the outside of the tubes interferes with effective heat transfer and must be removed in order to maintain maximum design efficiency. These scale deposits can be classified as hard, porous, or loose depending upon the nature of the materials forming the deposits. In some instances the scale may be removed by flushing operation or the use of various solvents which cleanse the equipment without the need for removing the tube bundle from the shell. More recalcitrant deposits such as hard deposits formed by water-deposited scale, corrosion products and so forth

2

and even porous deposits formed by mud and dirt, coke and carbon, asphalt and tars which resist the flushing and/or solvent cleaning operations demand the removal of the tube bundle from the exchanger shell in order that the external surfaces of the tubes may be made conveniently accessible for mechanical cleaning equipment. After removing the cover plates of the stationary head or the stationary head if the cover is integral therewith and the tube plate is positioned between the shell and head the entire tube bundle is withdrawn from the exchanger shell by connecting a suitable prime remover to the tube sheet and applying a force sufficient to remove the tube bundle. In the removal of the tube bundle care must be exercised to prevent injury to the tubes. When large bundles of tubes are badly fouled by scale deposits it is necessary to apply a considerable force to the stationary tube sheet. This resultant force may cause damages to the tube bundle. In addition large bundles of tubes which are not fouled may require a large force to overcome the inertia present and if the entire force necessary to remove the tube bundle is all applied at the tube sheet undesirable consequences may obtain.

Accordingly it is an object of my invention to overcome the disadvantages of the heat exchanger described in the prior art and to prevent the damages which may result in the removal of tube bundles from heat exchangers by providing a means for applying a supplementary force at the floating head to augment a force concomitantly applied at the stationary tube sheet for the removal of tube bundles from heat exchanger shells. This object is effected by fitting a section of the floating head with a plurality of springed packing rings peripherally mounted thereon whereby a tight fit is maintained against the inner wall of the heat exchanger shell. These rings provide a fluid-impervious barrier between the floating head and the inner wall of the exchanger shell yet allow the tube bundle to move to and fro within the heat exchanger shell.

This and other objects will be made more apparent from the following description and discussion of a non-limiting and illustrative example of my invention.

Referring to the drawing, Figure 1 illustrates a cutaway view of a two pass shell and tube heat exchanger which has a floating head construction embodying the features of my invention. Figure 2 shows an enlarge longitudinal cross-sectional elevation of a full floating head type construction employed in the exemplary two pass

heat exchanger. Figure 3 presents an enlarged cross-sectional view of the heat exchanger apparatus taken on line 3—3 of Figure 1. Figure 4 illustrates a type of packing ring that may be employed as a packing ring element in my invention.

In Figure 1 a two pass, on the tube side, shell and tube heat exchanger is shown. A tube bundle 10 comprises a plurality of tubes enclosed in a tubular shell 11 of generally cylindrical shape. The shell 11 is covered by a head section 12 positioned at the stationary end of the tube bundle 10 and an end cover 13 at the floating head. In the instance of the stationary head 12 the cover thereof may be integral therewith or removably fastened thereto. Similarly the cover plate 13 may be made integral with the shell 11 or removably affixed as shown. The shell is fitted with suitable nozzles 14 and 15 for allowing the passage of fluids through the exchanger shell outside the tubes. To provide for the passage of the tube-size fluid, inlet and outlet nozzles 16 and 17 are combined with the stationary head 12. The end cover 13 is also provided with a pair of nozzles 18 and 19 which are also provided for admitting a fluid to and draining the fluid from the chamber enclosed by the end cover 13. The floating head construction shown in the drawing which embodies the features of the instant invention is intended to be illustrative and non-limiting as any suitable floating head construction can be employed to complement my invention. The floating head described in the illustrative Figure 2 example shown in the drawing comprises a perforated circular tube plate 20 attached to one side of a header 21 the other side of which is covered by plate 22. These elements are joined together by means of suitable fasteners such as nuts and bolts 23. The header wall is sufficiently thick as to permit the placing of longitudinal bolt holes therein which register with corresponding bolt holes placed in the tube plate 20 and cover 22. The header 21 may be prepared in integral combination with either the tube sheet element or cover plate element if it is so desired, the desired construction being effected by welding, casting, etc. The outer wall of header 21 contains a plurality of parallel spaced, circumferential grooves 24. The grooves 24 are disposed in the header section 21 in planes perpendicular to the longitudinal axis of the exchanger shell although obliquely positioned grooves could be employed. Fitted within these grooves 24 are a corresponding number of sprung, packing rings 25 such as are illustrated in Figure 4. These rings 25 surround the header section 21 and maintain a tight fit between the surface of the rings 25 and the inner wall of the exchanger shell 11 thereby sealing the gap clearance between the floating head section and the exchanger shell wall. The packing rings 25 are usually made of cast iron but any other suitable material may be employed. The rings are split to facilitate installation and may be constructed as one piece, two piece or even three piece types. Butt, bevel, lap or other type joints may be employed. The grooves 24 of the header section 21 in which the packing rings 25 are fitted should be slightly wider than the ring, however, the rings should fit free without side play.

Cleaning the outside surface of the tubes contained in the tube bundle of a shell and tube type heat exchanger is facilitated by removing the tube bundle from the heat exchanger shell.

To effect this removal the tube sheet at the stationary end of the tube bundle is provided with tapped holes for jack screws or eye bolts. Integral lifting lugs, slings and hoists should also be provided for supporting the tube bundle during its removal. After disengaging and removing the stationary head 12 the adjacent tube sheet is exposed. An axially applied force is employed at the tube sheet by means of jack screws or a prime mover suitably connected to the eye bolts. When the shell side of the tube bundle is fouled up with scale deposits withdrawal of the tube bundle is hindered and the deposits create such a resistance that the removal of the tube bundle becomes almost impossible without damage to the tube sheet and the tubes mounted thereon. My invention however provides a means which enables the application of an assisting force against the floating head to augment the force utilized at the stationary tube sheet. To effect the application of this supplementary force nozzles 14 and 19 are closed by means of a valve or they may be blanked off by blind flange plates. Nozzle 18 is connected to a source of hydraulic pressure such as a hydraulic pump and a pressure is exerted by this means against cover plate 22. The packing rings 25 fitted in the header section 21 prevent the bypass of this pressure and permit it to be applied with maximum effectiveness against the cover plate 22 to augment that force which is simultaneously being applied at the tube sheet at the stationary end of the tube bundle.

My invention has particular application in heat exchanger installation where space limitations prevent the removal of the cover plate at the floating head which would permit the application of an external force to assist in the removal of the tube bundle. By employing my invention an assisting force can be applied which otherwise would not be available for use.

It is to be understood that the application of my invention is not limited to the type of shell and tube heat exchanger shown by the drawing. Transverse baffles may be installed in the heat exchanger equipment and by adding suitable partitions inside the headers 12 and 21 the tube side fluid can be made to make as many passes as may be desired.

I claim:

1. In combination with a multi-pass shell and tube heat exchanger which comprises a cylindrical shell having inlet and outlet nozzles, a removable, longitudinally baffled stationary head, said head being fitted with inlet and outlet nozzles, a plurality of parallel, tubular elements mounted in spaced relationship by a pair of spaced tube sheets affixed to the tubular elements adjacent their terminal ends, one of said tube sheets being held stationary by interposition between the said shell and said stationary head section, a floating head assembly employed to provide for differences in the expansion of said tubular elements and of the said shell, said floating head comprising the other tube sheet and a header and closure therefor, said closure providing a pressure receiving surface, said header having a plurality of parallel spaced peripheral grooves, a corresponding number of split, yielding annular metallic rings positioned in said grooves, said rings having an inside diameter substantially the same as the diameter of said groove and an outside diameter substantially the same as the diameter of said cylindrical shell, and a chambered closure enclosing the shell ex-

5

tremity adjacent to the floating head, said closure having inlet and outlet nozzles.

2. A shell and tube heat exchanger comprising a shell having inlet and outlet nozzles, cover plates for enclosing the ends of said shell, a close fitting tube bundle contained within said shell, said tube bundle having inlet and outlet openings and including a plurality of tubular elements held stationary at one end by means of a tube sheet interposed between said shell and a stationary head, the free end of said tube bundle terminating in a floating head assembly which reciprocates longitudinally during expansion and contraction of said tubular elements, said floating head assembly comprising a second tube sheet, a header and a closure therefor, said closure providing a pressure receiving end for said floating head, said header containing a plurality of peripheral grooves, said grooves having fitted therein a corresponding number of sprung metallic packing rings which provide a fluid-tight seal for the annular space between said header section and the inner wall of the heat exchanger shell, and means for applying fluid pressure directly to said closure.

3. A shell and tube heat exchanger comprising a shell having inlet and outlet nozzles, cover plates for enclosing the ends of said shell, a close fitting tube bundle contained within said shell, said tube bundle having inlet and outlet openings and including a plurality of tubular elements held stationary at one end by means of a tube

6

sheet interposed between said shell and a stationary head, the free end of said tube bundle terminating in a floating head assembly which reciprocates longitudinally during expansion and contraction of said tubular elements, said floating head assembly comprising a second tube sheet, a header and a closure therefor, said closure providing a pressure receiving end for said floating head, said header containing a plurality of peripheral grooves, said grooves having fitted therein a corresponding number of spaced packing rings which provide a fluid-tight seal for the annular space between said header section and the inner wall of the heat exchanger shell, and means for applying fluid pressure directly to said closure.

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