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HEAT EXCHANGER CONSTRUCTION

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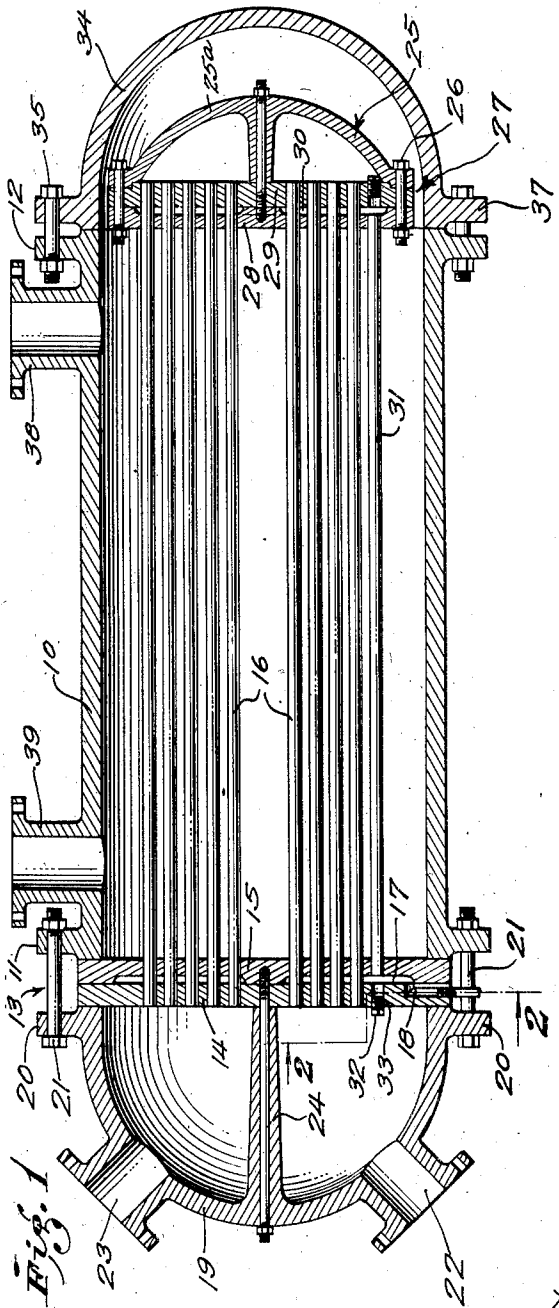


Fig. 1

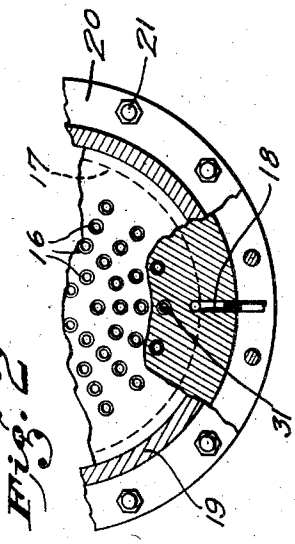


Fig. 2

INVENTOR

Lawrence I. Blennerhassett

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HEAT EXCHANGER CONSTRUCTION

Lawrence I. Blennerhassett, San Marino, Calif., assignor to C. F. Braun & Co., Inc., Alhambra, Calif.

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4 Claims. (Cl. 257—239)

This invention relates to a heat exchanger construction and particularly pertains to its tube nest.

In the use of tubular heat exchangers it is common practice to construct them with an outer shell which forms a conduit for a flowing fluid and within which shell a nest of tubes is mounted to accommodate another flowing fluid which has heat exchange relationship with the fluid confined within the shell. In view of the fact that the fluids within the tubes and within the shell may be physically and chemically incompatible it is imperative that the fluids be kept separate and that every precaution be taken to insure that in the event of leakage between the tubes and tube sheets there will not be an opportunity for the two fluids to commingle. It is the principal object of the present invention, therefore, to provide a tube sheet structure which will substantially prevent an opportunity for the fluids surrounding the tubes to communicate with the fluid passing through the tubes, and at the same time provide means whereby any leakage of fluid from around the tubes will be drawn off from the heat exchangers under control without having contact with the other fluid.

In some types of heat exchangers there is a material difference in temperature between the two fluids flowing through the heat exchanger which temperature makes it necessary for one end of the tube nest to float with relation to the shell of the heat exchanger in order to compensate for variations in length due to contraction and expansion of the various parts of the heat exchanger under different temperature condition. It is another object of the present invention therefore to provide means whereby leakage of fluid from within the tubes and headers may be drawn off from the heat exchanger without possibility of its contact with the fluid surrounding the tubes and without interference due to the relative expansion and contraction of the parts of the heat exchanger.

The present invention contemplates the provision of a heat exchanger having an outer shell closed at opposite ends by heads, in connection with one of which a fixed tube sheet is secured in position, the tube sheet structure being a part of a tube nest extending longitudinally of the shell and terminating at its opposite end in a floatinghead.

The invention is illustrated by way of example in the accompanying drawing in which:

Fig. 1 is a view in longitudinal section and elevation through a heat exchanger showing the details of the present invention.

Fig. 2 is a fragmentary view in transverse section through the lower portion of the fixed tube sheet unit showing the arrangement of the drain openings.

Referring more particularly to the drawing, 10 indicates the shell of a heat exchanger which shell is provided at its opposite ends with bolting flanges 11 and 12. Disposed externally of the end of the shell adjacent to bolting flanges 11, and lying flat against the end face is a fixed tube sheet unit 13, which comprises tube sheets 14 and 15. These tube sheets are of preferably equal diameter and may be of any desired thickness. The contiguous faces of these sheets lie flat against each other so that the outer ends of tubes 16 may be expanded into place through both of the sheets simultaneously. An annular recess 17 is formed in one of the contiguous faces of the sheets in the area occupied by the tubes, so that in the event there is leakage around the tubes 16 through the openings in either of the tube sheets 14 or 15, the leaking fluid may reach the intermediate space formed by the recess 17, and will drain off through a drain opening 18 formed at the lower edge of one of the tube sheets and extending through its periphery as indicated in Fig. 2 of the drawing. It will be evident that since the pressure of the fluids in the tubes and the shell are in excess of atmospheric pressure, any fluid which reaches the intermediate space 17 will drain therefrom through the opening 18 rather than commingle with the other fluid within its respective fluid compartment or conduit.

The tube sheet structure 13 is held in its position at the end of the shell 10 by a cap 19, which is provided with a bolting flange 20 receiving bolts 21. These bolts pass through the parallel flanges 20 and 11 of the cap 19 and the shell 10 respectively. As will be understood the cap provides an end closure for the tubes 16 and is supplied with fluid through an induction nozzle 22, after which the fluid passes lengthwise of a desired number of tubes 16, in the nest, and returns to the cap 19 to pass outwardly through an eduction nozzle 23, the in-flowing and outflowing streams of the tube fluid being separated by partition 24 in the cap 19. The fluid within the tubes when reaching the opposite end of the tube nest from tube sheet unit 13, passes through a floatinghead 25. This head is formed by securing a cover 25^a by bolts 26 to a floating tube sheet unit 27. The unit 27 comprises a pair of tube sheets 28 and 29 which are of an outside diameter

less than the inside diameter of the shell 10, so that the tube sheet may float within the shell and may be withdrawn longitudinally therefrom. A space 30 occurs between the contiguous faces of the tube sheets 28 and 29 to accommodate leaking fluids in the same manner as the space 17 between tube sheets 14 and 15 of the fixed tube sheet unit 13. However, it is not possible for the fluid leaking into the space 30 to be directly drawn off from the heat exchanger and for that reason a drain tube 31 is expanded into the tube sheet 28 with its end in communication with the leakage space 30. This tube 31 extends longitudinally of the tube nest and communicates with the space 17 formed within the fixed tube sheet unit 13. Any fluid drained through the pipe 31 from the floating tube sheet unit 27 will be finally drained from the tube sheet unit 13 through the opening 18. In order to make it possible to clean the drain tube 31 readily, removable plugs 32 are inserted in openings 33 of the outer tube sheets of each unit, these openings being in longitudinal alignment with the central axis of the drain tube 31. The end of the heat exchanger shell 10, adjacent to the floating head is fitted with the usual removable cap 34 secured to the shell by bolts 35 passing through bolting flanges 12 and 37.

In operation of the present invention a heat exchanger is assembled as here shown care having been taken to expand the walls of the tubes 16 into the openings through the various tube sheets of each unit in a manner to prevent leakage of fluid around the tubes and through the openings when a fluid circulates through the tubes 16 from the induction nozzle 22 to the eduction nozzle 23 and another fluid circulates through the shell, as for example, from the induction connection 38 to the eduction connection 39. It may occur that a tube will become loosened in the tube sheet units. If the loosening takes place in the outer tube sheets 14 and 29 respectively, the fluid which is intended to flow through the tubes will leak into the spaces 17 and 30 of the two tube sheet units. If the tubes become loosened in the tube sheets 15 and 28, the fluid from the shell will leak into the spaces 17 and 30. If the drain openings 18 are sufficiently large to prevent the creation of back pressure within the spaces 17 and 30, the fluids will readily drain from the tube sheet units without reaching the main streams of either fluid. If these fluids are corrosive or create some other undesirable physical or chemical reaction when mixed the action will be confined to the spaces 17 and 30 of the two units and will insure that the remaining parts of the heat exchanger will be protected from such an action. In case there is leakage into the space 30 of the floating tube sheet unit 27, the leaking fluid will be drained back to the fixed tube sheet unit 13 through the pipe 31 and will then drain from the heat exchanger through the drain opening 18.

It will thus be seen that the heat exchanger structure here shown may be of conventional type and design while incorporating the desirable features of this invention and without necessitating any material changes in the dimensions or the various parts and no change in the operation of the heat exchanger and that at the same time the structure will insure that leakage of fluid around the tubes at the tube sheets will not result in any detrimental effect upon the heat exchanger or damage to the plant in which it is used.

While I have shown the preferred form of my invention as now known to me it will be understood that various changes might be made in the combination, construction, and arrangement of parts by those skilled in the art without departing from the spirit of the invention as claimed.

Having thus described my invention, what I claim, and desire to secure by Letters Patent is:

1. In a heat exchanger construction a tube nest comprising a fixed tube sheet structure, a floating tube sheet structure, and a plurality of tubes extending from one of said tube sheet structures to the other, each of the tube sheet structures being formed of two tube sheets through which sheets the ends of the tubes extend and with which they are fixed, a drain space formed between the sheets of each structure, and through which the tubes pass, and means for draining fluid from said spaces.

2. In a heat exchanger construction a tube nest comprising a fixed tube sheet structure, a floating tube sheet structure, and a plurality of tubes extending from one of said tube sheet structures to the other, each of the tube sheet structures being formed of two tube sheets through which sheets the ends of the tubes extend and with which they are fixed, a drain space formed between the sheets of each structure, and through which the tubes pass, means for draining the fluid from the floating tube sheet structure to the fixed tube sheet structure and means for draining fluid from the space in the fixed tube sheet to the exterior of the shell.

3. A tube nest for heat exchangers and the like comprising a set of tubes, a fixed tube sheet at one end thereof, through which said tubes extend, a floating tube sheet unit at the opposite end thereof, through which the tubes extend, a cover secured to said floating tube sheet unit to form a heading with which the tubes are in communication, a shell enclosing the tube nest, said floating tube sheet unit being formed with a central transverse passageway, through which the tubes extend, and at the opposite sides of which the tubes form tight joints with the tube sheet and means communicating with said passageway for draining off fluid leakage therefrom, and conducting said leakage away from the heat exchanger.

4. In a heat exchanger construction a tube nest comprising a fixed tube sheet structure, a floating tube sheet structure, a plurality of tubes extending from one of said tube sheet structures to the other, said floating tube sheet structure being formed of two tube sheets and through which sheets the ends of the tubes extend and with which the tubes form a tight joint, a drain space formed between the contiguous faces of the tube sheets of the floating tube sheet structure and through which space the tubes pass and means extending from said space to the fixed tube sheet and leading therefrom whereby fluid may be drained from the space to the fixed tube sheet and then to the exterior of the shell.

LAWRENCE I. BLENNERHASSETT.