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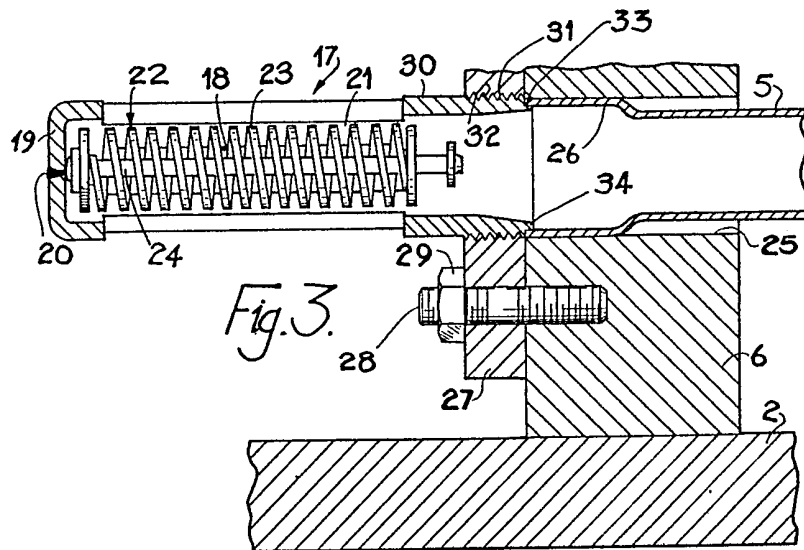
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(54) Heat exchanger with tube cleaning elements

(57) A heat exchanger has a plurality of fluid flow tubes 5 secured adjacent their ends by tube sheets 6(7). Cleaning elements 22 are adapted to shuttle back and forth in the tubes and are adapted to be captured by baskets 17. A basket retaining plate 27 is fixedly mounted, as by bolts 28 or the like, in facial contact with outer face of the tube sheet 6(7). The plate 27 and its mount co-operate with the tube sheet 6(7) to hold the baskets 27 in fixed position relative to the tube sheet 6(7) and tube ends 26. The outer capturing and holding portions of the baskets 17 extend outwardly from the retaining plate 27. The baskets 17 include portions which extend through openings in the plate 27 and which terminate within the tube sheet openings 25.



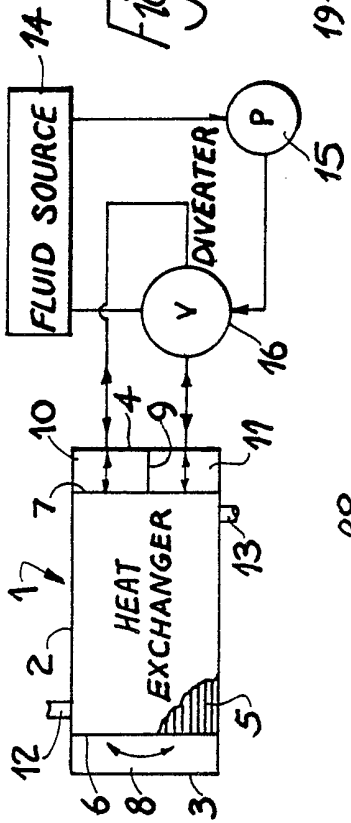


Fig. 1.

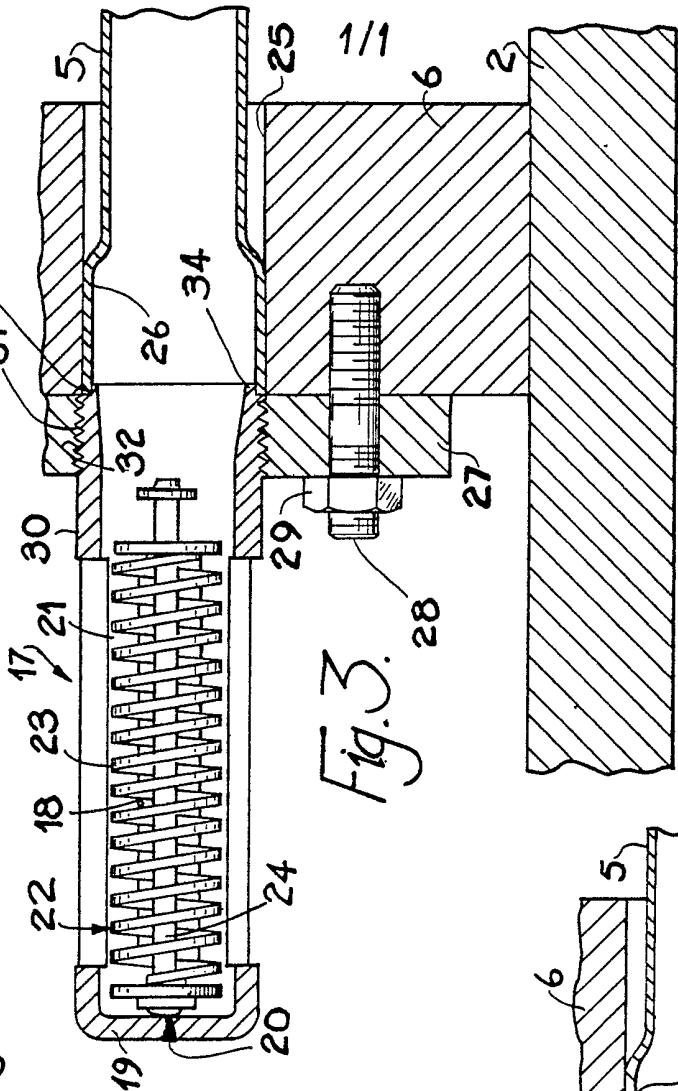


Fig. 3.

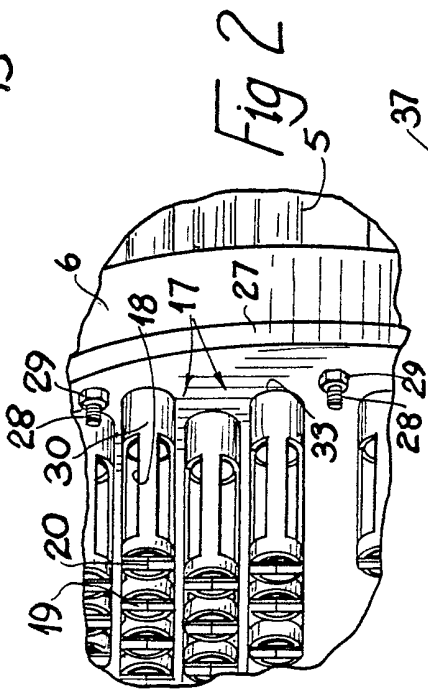


Fig 2

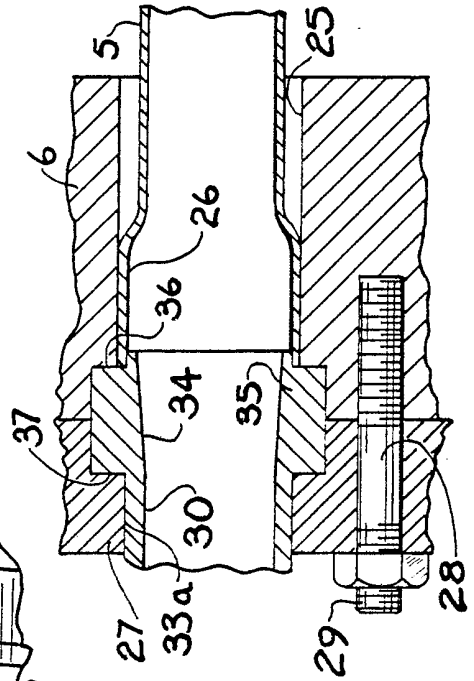


Fig. 4.

SPECIFICATION

Heat exchanger with tube cleaning elements

5 This invention relates to a heat exchanger having shuttle cleaning of the heat exchanger tubes.

It is known from U.S. Patents 3319710 and 4124065 to connect individual elongated cleaning element capturing cages or baskets to both ends of longitudinally extending tubes disposed in a heat exchanger housing. The tube ends are held in position at both ends by transverse tube sheets. The baskets are adapted to contain shutable cleaning elements, such as brushes. Fluid flowing in one direction through the tubes keeps the cleaning elements captured within their respective basket chambers, while the fluid discharges outwardly through slot-like openings in the basket walls. Upon reversal of fluid flow, the cleaning elements are forced out of their baskets and through the tubes to the baskets at the opposite tube ends to thereby perform a tube cleaning action.

Several ways have been suggested to mount the baskets in fluid flow communication with the tubes, which enter openings in the tube sheets. The inner basket ends have been press fit into the openings or into the tube ends themselves.

The present inventors' co-pending U.S. Patent Application S.N. 350288, filed 18th February 1982 and entitled "Mounting For Heat Exchanger Tube Cleaner Capturing Devices" discloses another arrangement where the inner basket ends are provided with a collar which hangs from a flared lip on the tube end which is disposed beyond the outer tube sheet face.

In some instances, the above-mentioned basket mounting arrangements may be undesirable. For example, in high temperature heat exchanger applications, a sole press fit connection may not hold due to large temperature fluctuations to which the joint is subjected. In other instances, the specifications for the particular heat exchanger may call for unthreaded tube sheet openings or unflared tube ends, or other structure incompatible with previous mounts.

It is a task of the present invention to provide a mounting means for the cleaning element capturing baskets which does not depend solely on the aforementioned methods of connection but which nevertheless holds the baskets securely in place.

In accordance with the various aspects of the invention, a basket retaining plate is fixedly mounted, as by bolts or the like, in contact with the outer tube sheet face. The plate and its mount co-operate with the tube sheet to hold the baskets in fixed position relative to the tube sheet and tube ends, regardless of temperature changes. The capturing and holding portions of the baskets extend outwardly from the retaining plate. The baskets include further portions which extend through openings in the plate and which terminate within the tube sheet openings. The baskets are fixedly secured against transverse shifting by a two-part support, one at the inner basket ends and one intermediate their ends. To hold the baskets in longitudinally fixed

position, and in one embodiment, the basket intermediate portions are threaded to the retaining plate. In another embodiment, shoulders adjacent the inner basket ends engage the plate and the tube sheet.

The accompanying drawings illustrate the best mode presently contemplated by the inventors for carrying out the invention.

In the drawings:-

75 *Figure 1* is a schematic showing of a heat exchanger and fluid flow controls therefor;

Figure 2 is a fragmentary perspective view of a portion of the interior of heat exchanger in accordance with one example of the present invention and showing the tube sheet and retaining plate;

80 *Figure 3* is a longitudinal section showing one embodiment of basket mount; and

Figure 4 is a longitudinal section showing another embodiment of basket mount.

85 The present invention is directed to tube-type heat exchangers. A schematic showing of such an exchanger and its fluid flow controls is shown in *Figure 1*. The exchanger 1 comprises a cylindrical housing 2 having end closure heads 3 and 4, and a plurality of longitudinally extending tubes 5 therein. The exposed open ends of tubes 5 are connected to circular transverse tube sheets 6 and 7 which are spaced from the respective end heads 3 and 4. Head 3 and tube sheet 6 form one fluid flow chamber 8, while a partition 9 separates the space between head 4 and tube sheet 7 into a pair of fluid flow chambers 10 and 11. Heat exchanging fluid is introduced through an inlet 12 to the area around tubes 5 and discharges through an outlet 13.

100 Heat exchanger 1 is also connected to a fluid source 14, a pump 15 and a fluid diverter valve 16 by various conduits in the conventional manner. Fluid is directed through tubes 5 via chambers 10, 8 and 11, in that order or in reverse order, depending on the position of valve 16.

105 Heat exchanger 1 is provided with tube cleaning means. For this purpose, the ends of each tube 5 are connected to a capturing device which in the present embodiment comprises a longitudinally extending elongated slotted basket 17 which is co-axial with the tube and made of metal or other suitable material. The basket is slotted at 18. The inside diameters of tube 5 and basket 17 are about the same. The outer end of each basket 17 is provided with a pair of narrow tabs 19 which are folded over and joined, as by a weld 20, to form an abutment.

110 Each basket forms a capturing chamber 21 for holding a tube cleaning device 22 which is adapted to shuttle back and forth between end baskets within its respective tube 5 upon reversal of fluid flow by valve 16. Device 22 may be of any desired type, that shown having a coil spring 23 shiftable along a central rod 24.

115 In the present embodiment, each tube 5 is shown as entering an opening 25 in tube sheet 6 and having an enlarged end portion 26 which fits tightly within the outer end of the opening.

120 In accordance with the various aspects of the invention, and referring to *Figures 2* and *3*, a generally circular transverse retaining plate 27 is

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disposed parallel to and in facial contact with tube sheet 6 within chamber 8. Means are provided to fixedly secure retaining plate 27 relative to tube sheet 6. For this purpose, and in the present

5 embodiment, a plurality of circumferentially spaced bolts 28 threadably extended through plate 27 and into threaded engagement within tube sheet 6. Nuts 29 on the outer threaded bolt ends serve to lock plate 27 in position.

10 The mounted plate 27 co-operates with tube sheet 6 to hold each basket 17 in position relative to tube sheet 6 and the end of tube 5. As shown, basket 17 has a generally cylindrical wall 30 with the outer cleaning element holding portion thereof containing

15 slots 18 and extending outwardly beyond retaining plate 27. The intermediate basket wall portion is provided with external threads 31 which threadably engage internal threads 32 on an opening 33 in retaining plate 27. The short inner basket wall

20 portion extends inwardly from plate 27 and terminates within tube sheet opening 25. This inner wall portion is shown as being tapered, as at 34. In the present instance, the inner basket end telescopes slightly into and engages enlarged tube portion 26 in

25 a press fit.

Basket 17 is fixedly secured against transverse shifting by virtue of its two-part support, i.e. the tube sheet 6 and tube 5 at its inner end, and retaining plate 27 intermediate its ends.

30 Basket 17 is also fixedly secured against longitudinal shifting by virtue of the threaded connections by bolts 28 of tube sheet 6 and plate 27, and in the embodiment of Figure 3, by the threaded passage of basket 17 through plate 27.

35 Figure 4 discloses another form of means to prevent longitudinal shifting of the basket. In this instance, there is no threaded connection between basket 17 and the opening 33a in retaining plate 27, the basket merely being slidable therethrough. In-

40 stead, the inner end portion of wall 30 is provided with an annular flange 35 thereon which is received in enlarged regions of the openings 25 and 33a, the inner and outer shoulders 36 and 37 of the flange 35 engage respective shoulders of the openings 25, 33a

45 of the tube sheet 6 and plate 27 respectively when bolts 28 are tightened up.

It is, of course, clear that there will be a plurality of openings 33, 33a in retaining plate 27 and which are disposed in axial alignment with openings 25 in tube

50 sheet 6.

Although the drawings illustrate the aspects of the invention as applied to tube sheet 6, it is contemplated that the same construction would normally be utilized in connection with tube sheet 7.

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CLAIMS

1. A heat exchanger having a housing, and having a plurality of longitudinally extending fluid

60 flow tubes disposed within said housing, tube sheets disposed within said housing, said tube sheets having openings in communication with the ends of said tubes, longitudinally extending baskets for receiving shuttling tube cleaning elements, a retain-

65 ing plate secured in contact with the outer face of a

said tube sheet, and means, including said retaining plate, mounting each said basket in fixed relationship to said tube sheet and to an end of a respective tube.

70 2. A heat exchanger as claimed in claim 1 in which said basket mounting means includes means securing said basket against transverse shifting.

3. A heat exchanger as claimed in claim 2 in which said basket has a portion extending into

75 telescoping connection with said tube sheet opening, said plate includes an opening receiving said basket therein and said securing means comprising a two-part basket support utilizing said telescoping connection and said plate opening.

80 4. A heat exchanger as claimed in any one of claims 1 to 3, in which said basket mounting means includes means securing said basket in longitudinally fixed position.

5. A heat exchanger as claimed in claim 4, in

85 which the longitudinal securing means comprises a threaded connection between said plate and each basket.

6. A heat exchanger as claimed in claim 4 in which said longitudinal securing means comprises a

90 flange disposed on said basket and trapped between said tube sheet and said plate.

7. A heat exchanger as claimed in any one of the preceding claims in which each basket has a tube cleaning element holding portion disposed longitu-

95 dinally outwardly of said retaining plate.