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TUBE SUPPORTING MEANS FOR FLUIDIZED HEAT EXCHANGE APPARATUS

Filed Oct. 28, 1957

3 Sheets-Sheet 1

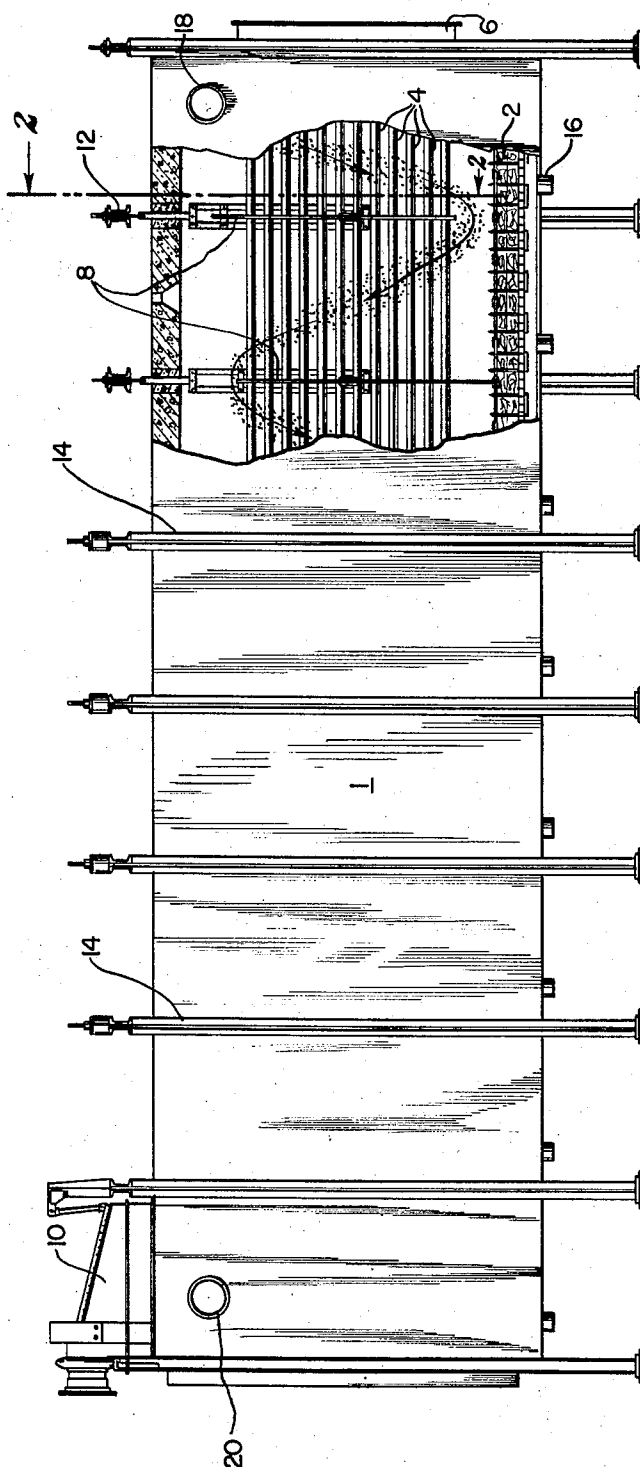


Fig. 1

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3 Sheets-Sheet 2

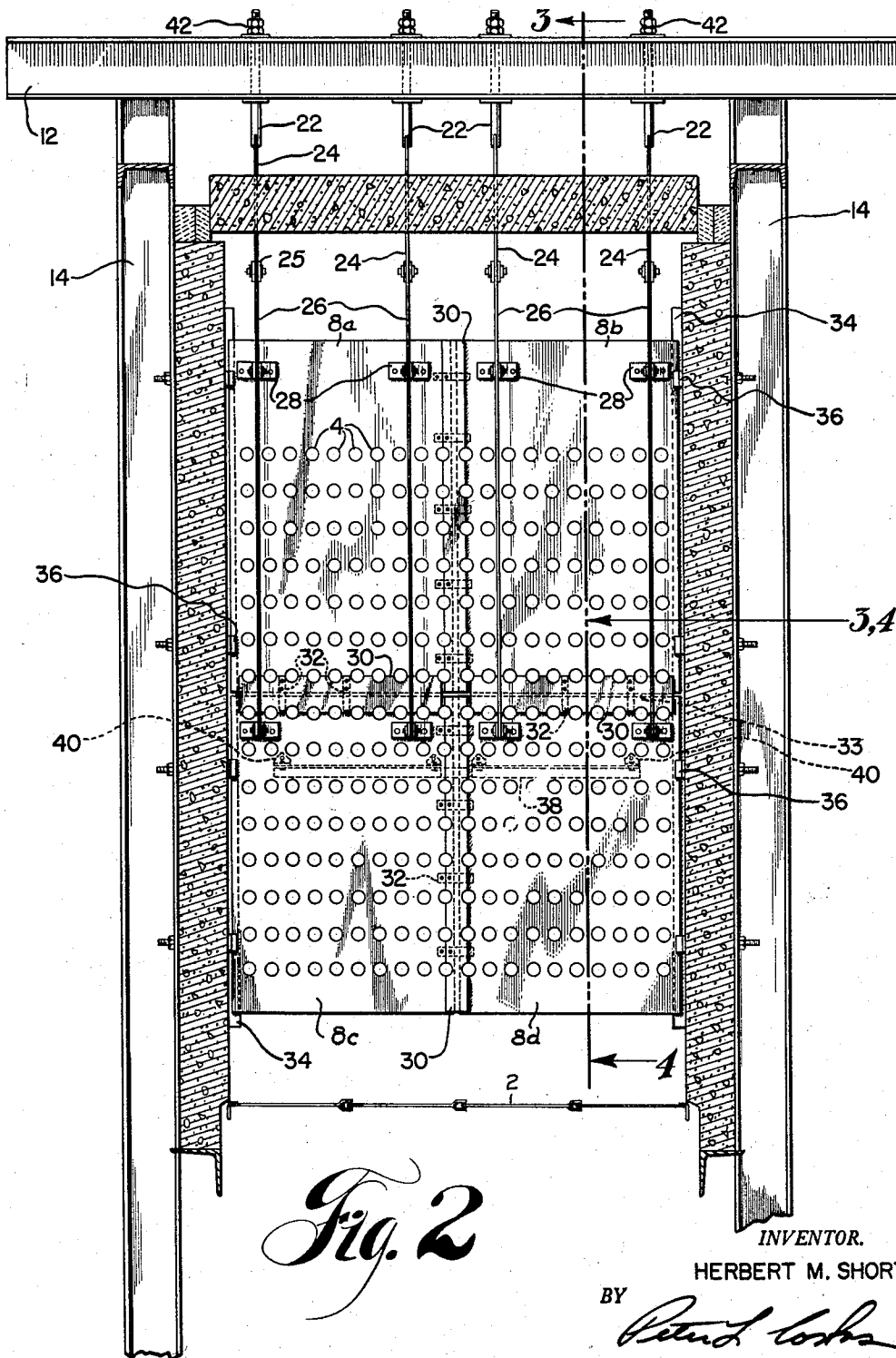


Fig. 2

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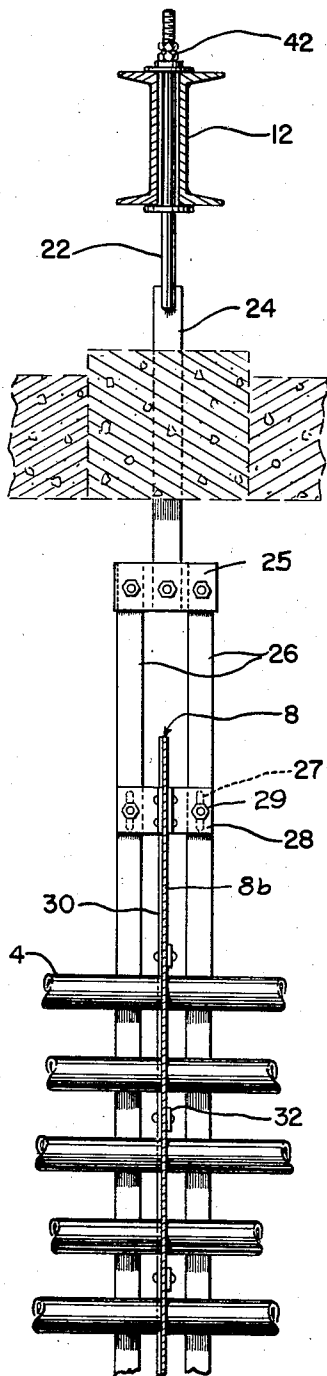
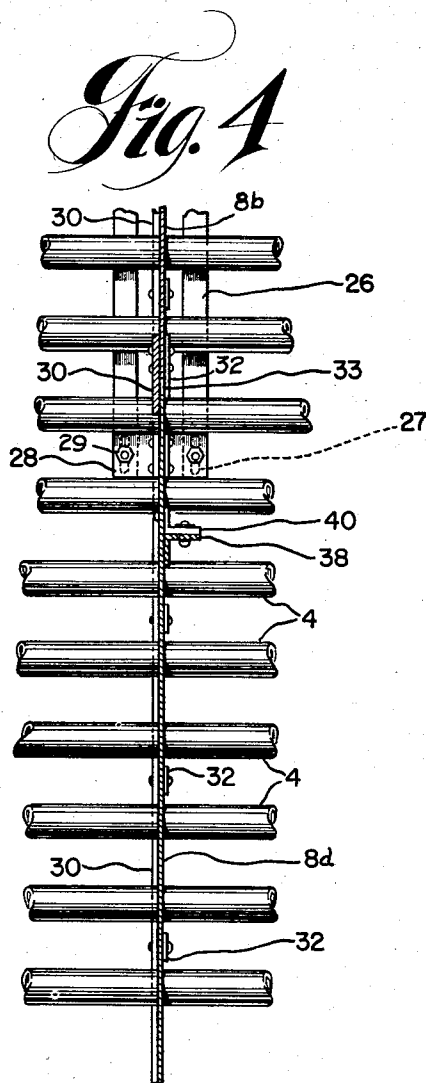


Fig. 3



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TUBE SUPPORTING MEANS FOR FLUIDIZED HEAT EXCHANGE APPARATUS

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Application October 28, 1957, Serial No. 692,700

4 Claims. (Cl. 248—58)

This invention relates to heat exchange between a fluidized pulverulent material and a heat transfer medium. More particularly, it relates to a novel construction for a tube-supporting baffle member in a fluidized heat exchange apparatus capable of accommodating great differentials in temperature.

Among the types of heat exchangers commonly employed in industry is the fluidized, indirect heat-transfer apparatus, which consists of a chamber having a plurality of tubes through which the heat-transfer medium flows. Pulverulent material, fluidized by gas rising through the chamber, flows through the chamber in contact with the aforesaid heat transfer tubes. The tubes, fixed at either end to tube sheets, are often supported by intermediate tube-supporting plates extending across the chamber transverse to the path of movement of the pulverulent material and which may further act as baffles to cause the pulverulent material to flow in a sinuous path through the chamber and about the heat transfer tubes.

At high temperatures, considerable relative movement between the hot tube sheet and the adjacent tube supporting plate may occur as the operating temperature changes, due to differential thermal expansion caused by variations in size and temperature between the hot tube sheet and the adjacent tube supporting plate. Such relative movement results in deflection of the tubes and may produce deflection in excess of the elastic limits of the tubes or stresses in excess of the strength of the tubes, particularly at the juncture to the hot tube sheet.

To minimize the aforesaid deflection and stresses under operating conditions, a flexibly mounted sectionalized tube-supporting plate has been devised, which will further provide a substantial support for the tubes under the weight of the unfluidized material.

Referring to the accompanying drawings,

Fig. 1 is a side elevational view of a fluidized cooler with a portion of the side wall broken away,

Fig. 2 is a transverse section through the apparatus on an enlarged scale, taken on the line 2—2 of Fig. 1,

Fig. 3 is a sectional view on a further enlarged scale of the upper portion of the baffle hanger assembly, taken on the line 3—3 of Fig. 2, and

Fig. 4 is a sectional view of the lower portion of the baffle hanger assembly taken on the line 4—4 of Fig. 2.

Referring in particular to Fig. 1, the heat exchange apparatus is shown as an elongated closed vessel 1 which is provided with a diffusion grid, designated generally as 2, throughout its bottom, through which air flows as hereinafter described to fluidize solids passing through the vessel. A plurality of heat transfer tubes 4 are anchored in a wall of the hot tube sheet and plenum chamber assembly 6 and extend the length of the vessel 1, supported intermediately by a plurality of suspended tube-supporting plates or baffles 8. At the left or cold end, the tubes 4 have a substantially 90° bend upward and are fixed to a wall of the cold tube sheet and plenum chamber assembly 10. The tube-supporting plates or baffles 8 are suspended in vertically staggered relation in

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vessel 1, as shown in Fig. 1, from horizontal cross-ties 12 which rest on the vertical buckstays 14. Fluidizing air is introduced through the air inlets 16 and diffuses through the grid 2. The hot pulverulent material entering at the inlet 18 is fluidized by the air diffusing through the grid 2 and is induced to flow in a sinuous path under and over the baffles 8 alternately until it exits at the discharge 20. The heat-transfer fluid, such as air, is introduced into the apparatus through the cold tube chamber assembly 10 and travels countercurrent to the material flow in the tubes 4 until discharged at the hot tube chamber assembly 6.

Referring now to Figs. 2, 3 and 4, the baffle 8 is a segmented structure consisting of four rectilinear segments 8a, 8b, 8c, and 8d, and is suspended from the horizontal cross-ties 12 by means of suspension devices spaced along the cross-tie 12, each device comprising a rod 22 joined at its lower end to a bar 24, a pair of hangers 26 fixed to the lower end of the bar 24 by the fastening plates or yokes 25 and extending down opposite sides of the baffle 8, and the baffle angles 28 fixedly mounted to the segments of the baffle 8 and slidably carried by the hangers 26 by means of engaging pins or bolts 29 which are fixed to the angles 28 and ride in the vertical slots 27 of the hangers 26. In this manner, the baffle segments are secured by the pins or bolts 29, but the slots 27 permit the individual segments to slide vertically, thereby providing a lost-motion connection between the hangers 26 and the sections of the plate which are suspended therefrom.

The space between adjoining segment edges of the baffle 8 is overlapped by cover plates 30 to prevent material flow between the segments, and the cover plates 30 together with the baffle clips 32 are fixed to opposite sides of one adjoining segment edge so as to provide a receiving groove 33 for the other adjoining or cooperating edge and to maintain the segments in a common plane, as more clearly illustrated in Fig. 4. Clearance is provided between the sides of the baffle 8 and the cooler wall to accommodate expansion. Angle members 34 and angle clips 36 bolted through the side wall restrain the baffle 8 from movement longitudinal of the cooler 1, and prevent material flow around the sides of the baffle 8. Lending mechanical strength to the lower baffle segments is a stiffener angle member 38, slidably retained by the stiffener clips 40 by bolts or pins passing through horizontal slots in the stiffener member 38 and permitting lateral movement of the plates relative to each other. The baffle-hanger assembly is adjustably retained in position by the lock nut assembly 42.

In the operation of the apparatus illustrated, hot pulverulent material introduced through the inlet 18 causes a considerable increase in temperature of the baffle 8 and the hot tube sheet and plenum chamber assembly 6, thus causing them to expand. By reason of variation in temperature and size of the baffle 8 and the hot tube assembly 6, considerably differential expansion may take place. Since the tubes 4 are fixed to a wall of the hot tube assembly 6 which can expand upwards and sideways, misalignment between the tube sheet and the tube-carrying openings in the baffle must be compensated by bending or deflection of the tube 4. To prevent undesirable stress so close to the hot tube assembly 6, each individual segment of the baffle 8 may slide upward with these deflecting tubes by reason of the vertical slots 27 of the hangers 26, its weight being borne by one or more rows of deflecting tubes 4. Misalignment between segments, and differential expansion of the segments, are accommodated in the receiving groove 33 provided between the segments. In this manner, deflection can take place over a greater distance and excessive stress can be prevented, thus eliminating rupture of the juncture of the tubes to the fixed

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tube sheet. When, however, the fluidization is stopped, the unaerated material becomes a heavy load on the tubes 4 and baffles 8, and the individual segments of baffle 8 slide downward by reason of the vertical slots 27 in the baffle hangers 26 which then provide a support for the segments of the baffle 8 and the tubes 4.

The openings in the baffle 8 for the tubes 4 are preferably oversize so as to provide a clearance for facility in assembling and to permit the tubes to slide freely and prevent buckling.

The cover plates 30 and the angle members 34 prevent material from flowing through the clearances provided between adjoining or cooperating edges of the segments and between the segments and the side walls. However, if particles of material do enter into these spaces, they are free to fall out through the openings on the opposite sides where only clips 32 and 36 are used.

This type of segmented baffle is desirably employed closest to the hot tube sheet assembly; in the balance of the heat exchanger, other types of baffles may be employed, such as those described in co-pending application of Kirtland Marsh, Serial No. 692,701, filed October 28, 1957, wherein further details of construction of such an apparatus may also be found.

Although a specific embodiment has been shown and described herein, it will be understood that details of construction may be varied without departing from the spirit of the invention.

Having thus described the invention, I claim:

1. In a heat exchange apparatus, a tube-supporting plate comprising a pair of sections having heat transfer tubes extending therethrough, the two sections being dis-

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posed one above the other in a common plane and being attached to at least one common support, each of the sections having a lost motion connection to the said support, whereby the said sections are vertically movable relative to each other.

2. In a heat exchange apparatus, a tube-supporting plate comprising a plurality of pairs of separate sections having heat-transfer tubes extending therethrough, the two sections of each pair being disposed one above the other in a common plane and being attached to at least one common support, each of the sections of each pair of sections having a lost-motion connection with the common support for that pair, whereby the sections in each pair are vertically movable relative to each other, the adjoining edges of the sections of each pair overlapping each other.

3. Apparatus in accordance with claim 1, in which a plate is affixed to one of the adjoining edges of the said sections and overlaps the cooperating adjoining edge of the other section.

4. Apparatus in accordance with claim 2, in which the said pairs of sections are in a common plane and are spaced laterally from each other, and in which a plate is affixed to one of each pair of cooperating adjoining edges of the said sections and overlaps the cooperating adjoining edge of the other section.

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