

Dec. 20, 1960

J. W. BROWN, JR

2,965,360

HEAT EXCHANGERS

Filed Aug. 19, 1954

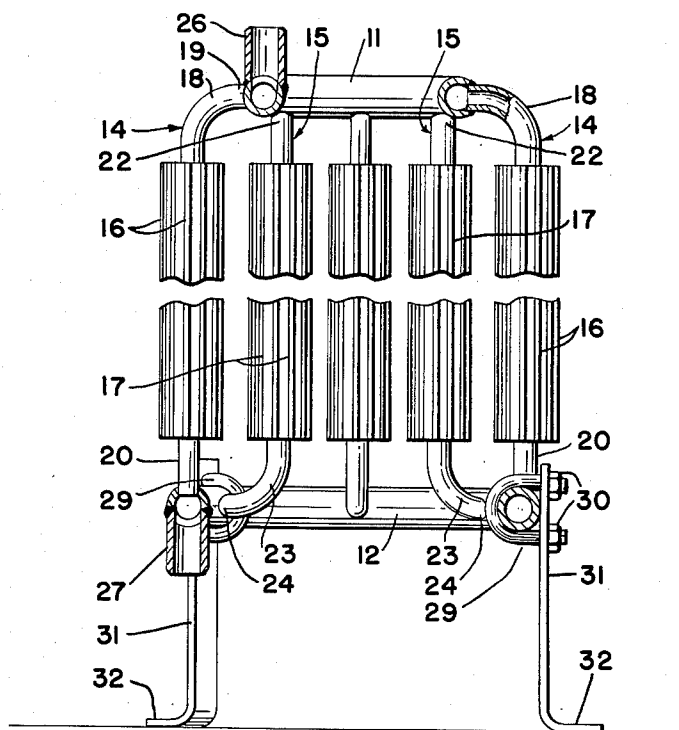


FIG. 1

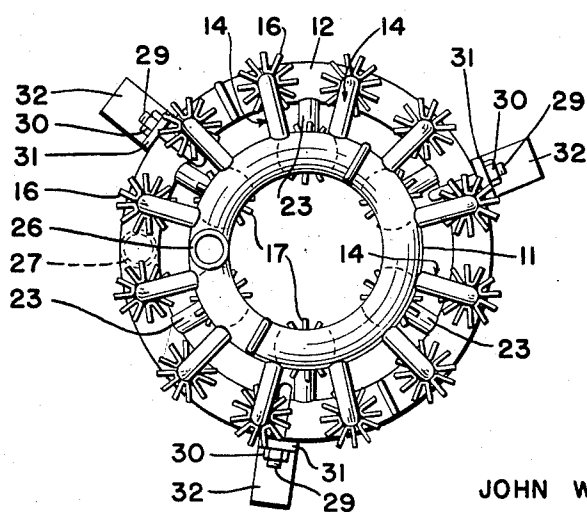


FIG. 2

INVENTOR.
JOHN W. BROWN, JR.

BY *Bosworth, Sessoms,*
Herrstrom & Williams

ATTORNEYS

1

2,965,360

HEAT EXCHANGERS

John W. Brown, Jr., Lakewood, Ohio, assignor to Brown Fintube Company, Elyria, Ohio, a corporation of Ohio

Filed Aug. 19, 1954, Ser. No. 450,880

2 Claims. (Cl. 257—248)

This invention relates to heat exchangers and, more particularly, to heat exchangers adapted to heat liquids within large tanks. The present invention may be considered as an improvement upon, or further development of, the heat exchanger disclosed and claimed in my prior Patent No. 2,640,686 patented June 2, 1953.

The heat exchanger of my said patent is extremely useful in connection with the heating of liquids in storage tanks in installations where it is necessary to heat the contents of the tanks to reduce the viscosity of the liquids to a point at which the liquids flow readily and can be pumped without difficulty. The heat exchanger of my said prior patent comprises, in a preferred form, a circular upper header and a circular lower header which are connected together by two concentric rows of vertically extended heat exchanger tubes. The heat exchanger tubes are preferably provided with longitudinally extending external fins in accordance with the teachings of my prior Patents No. 2,261,136 and 2,261,137. The fins give greatly extended surface area in contact with the liquid surrounding the tubes and because of their vertical arrangement the application of heat to the tubes creates an upward thermal flow of the liquid along the longitudinally extending fins; the upward flow along the fins creates a general circulation of the liquid in the tank. If the heaters are disposed around the outer portion of the tank as shown in my Patent No. 2,640,686, the circulation is upward near the outer wall of the tank in the zone of the heaters and downward in the center of the tank. The circulation greatly increases the efficiency of heat transfer of the vertical tubes and the vertical mounting of the tubes substantially eliminates deposition of sediment on the tubes and insures maintenance of the original efficiency of the heater for long periods of time.

Because of their advantageous construction, heaters made according to my said Patent No. 2,640,686 are used widely to heat viscous fluids in storage tanks. However, in some installations, the heaters are subject to rather rapid changes in temperature and resulting thermal shock. In the heaters specifically disclosed in my said Patent No. 2,640,686, the upper and lower headers are of the same diameter and are connected by an outer circular row of straight tubes which extend from the bottom of the upper header to the top of the lower header and an inner, concentric, circular row of tubes which are bent at their ends so that they can be connected to the inner portions of the header, the bent ends of the tubes extending substantially horizontally where they are welded to the header.

In this type of construction, rapid temperature changes can set up severe stresses and, in some installations, difficulties have occurred at the welded connections between the finned heat exchange tubes and the headers; under severe operating conditions there have been failures of the welded connections between the heat exchange tubes and the circular headers.

2

According to the present invention, these difficulties are eliminated and heat exchangers are provided in which the thermal stresses likely to result from rapid changes in temperature, or heat shock, are minimized and in which such conditions do not result in the imposition of destructive forces upon and the consequent failure of the welded joints between the heat exchange tubes and the header. Furthermore, these results are obtained without any increase in the cost or size of the heaters and without loss of heat exchange efficiency.

A preferred form of heat exchanger embodying the invention is shown in the drawing in which:

Figure 1 is a vertical section illustrating a heater embodying my invention, and

Figure 2 is a plan view of the heater shown in Figure 1.

As illustrated in the drawings, a heater embodying my invention preferably comprises a circular upper header 11 and a circular lower header 12 of somewhat larger diameter than the header 11. Two concentric circular rows of vertically extending heat exchanger tubes extend between the headers 11 and 12. The tubes in the outer row are indicated by reference character 14 and the tubes in the inner row are indicated by reference character 15. As noted above, all of these tubes are preferably provided with a plurality of longitudinally extending external fins; the finned portions of tubes 14 are indicated by reference character 16 and the finned portions of tubes 15 by reference character 17. Preferably, the fins are constructed in accordance with the teachings of my said Patents No. 2,261,136 and No. 2,261,137. These longitudinally extending fins provide extended surface area and contribute greatly to the efficient heat transfer characteristics of my heaters.

The fins stop short of the ends of the tubes 14 and 15 as shown in order to provide for securing the tubes to the headers 11 and 12. The upper end portions 18 of the outer tubes 14 are bent inwardly so that when the extreme ends 19 are secured to the upper header 11 the vertical finned portions 16 of the tubes are offset outwardly from the header 11 and are directly over the header 12. Preferably, the tubes are bent through an angle of 90° as shown so that the extreme end portions 19 extend horizontally. The end portions 19 are welded into appropriate apertures in the outer surface of the header 11 as shown while the lower ends 20 of the tubes 14 preferably are straight and are welded into suitable apertures in the upper surface of the lower header 12 as shown.

The tubes 15 are substantially identical with the tubes 14 but their positions are reversed; tubes 15 are bent so that they are offset inwardly from the lower header 12 while their finned portions 17 are directly beneath header 11. The upper ends 22 of the tubes 15 are straight and are welded into appropriate apertures in the underneath surface of the header 11; the lower end portions 23 of the tubes 15 are bent, preferably at right angles as shown, to provide horizontal extreme end portions 24 that are welded into suitably spaced apertures in the inner surface of the lower header 12. The difference between the radii of the lower header 12 and the upper header 11 accommodates the offset in the ends of the tubes 14 and 15 which results from bending their end portions 18 and 23. When the tubes are welded to the headers 11 and 12, both sets of tubes are positioned so that their finned portions extend substantially perpendicular to the planes of the headers 11 and 12. Ordinarily, the headers 11 and 12 lie in horizontal planes and the finned portions of the tubes extend vertically, with the finned portions 16 of tubes 14 of the outer annular row preferably in alignment with the larger header 12 and the finned portions

17 of tubes 15 of the inner annular row preferably in alignment with smaller header 11.

In order to circulate heating fluid through the heater, the upper header 11 is provided with a connecting pipe 26 and the lower header 14 is provided with a connecting pipe 27. One of these connecting pipes constitutes the inlet for the heating fluid, such as steam, and the other connecting pipe constitutes the outlet for the heating fluid, or condensate if steam is used as the heating fluid. These pipes may be connected to external conduits by fittings or connections of any conventional or suitable type.

In order to support the heaters within a tank or in any other desired location, U-bolts 29, preferably three in number, are disposed on the lower header 12 as shown and are secured as by nuts 30 to legs 31 which extend downwardly from the lower header. The legs 31 terminate in horizontally extending foot portions 32 which may rest upon, or be secured to, any appropriate support.

From the foregoing description of a preferred form of my invention, it will be evident that I have provided a simple and effective heat exchanger which is particularly adapted to the heating of fluids in large tanks. Heat exchangers embodying the invention can be manufactured at reasonable cost because the arrangement of the tubes with respect to the headers makes it possible to weld the heat exchanger tubes to the headers expeditiously. Inasmuch as the heat exchanger tubes in the inner and outer rows are substantially identical and are subjected to similar thermal conditions, they expand and contract substantially equally under changing temperature conditions. Hence, severe thermal stresses are not developed in the heat exchanger tubes or in the joints connecting them to the headers. Furthermore, the bent portions of the heat exchanger tubes act in the manner of expansion joints, giving some flexibility to the entire assembly and further reducing the stresses that may be applied to the joints by the tubes and the headers consequent upon changes in temperature of the heat exchangers.

Those skilled in the art will appreciate that various changes and modifications can be made in my invention without departing from the scope and spirit thereof. The essential characteristics of the invention are set forth in the appended claims.

I claim:

1. A heat exchanger comprising an upper annular header and a lower annular header separate from said upper header, one of said headers being larger than the other, said headers being disposed on the same axis and lying in spaced parallel planes, an outer annular row of heat exchanger tubes and an inner annular row of heat ex-

changer tubes extending between said headers, said heat exchanger tubes being substantially identical and each tube consisting essentially of a straight portion and one end portion bent substantially at right angles to the straight portion thereof, the straight portions of the tubes being provided with longitudinally extending external fins, the straight portions of the tubes in the outer row being aligned with the larger header and being joined directly to the surface of the larger header facing toward the smaller header, the bent ends of said tubes in the outer row extending inwardly and being joined directly to the outer surface of said smaller header, the straight portions of the tubes in the inner row being aligned with the smaller header and being joined directly to the surface thereof facing toward the larger header and the bent ends of said tubes in the inner row extending outwardly and being joined directly to the inner surface of said larger header.

2. A heat exchanger comprising an upper annular header and a lower annular header separate from said upper header, one of said headers being larger than the other, said headers lying in spaced parallel planes, an outer annular row of heat exchanger tubes and an inner annular row of heat exchanger tubes extending between said headers, said heat exchanger tubes being substantially identical and each tube consisting essentially of a straight portion and one end portion bent at a substantial angle to the straight portion thereof, the straight portions of the tubes in the outer row being aligned with the larger header and being joined directly to the surface of the larger header facing toward the smaller header, the bent ends of said tubes in the outer row extending inwardly and being joined directly to said smaller header, the straight portions of the tubes in the inner row being aligned with the smaller header and being joined directly to the surface thereof facing toward the larger header and the bent ends of said tubes in the inner row extending outwardly and being joined directly to said larger header.

References Cited in the file of this patent

UNITED STATES PATENTS

1,437,039	Bingay	Nov. 28, 1922
1,884,778	Lucke et al.	Oct. 25, 1932
2,640,686	Brown	June 2, 1953

FOREIGN PATENTS

721,873	France	Mar. 9, 1932
144,857	Germany	Oct. 6, 1903