Dec. 6, 1932. C. E. LUCKE 1,890,186

HEAT TRANSFER DEVICE

Filed March 17, 1931

Fig. 1

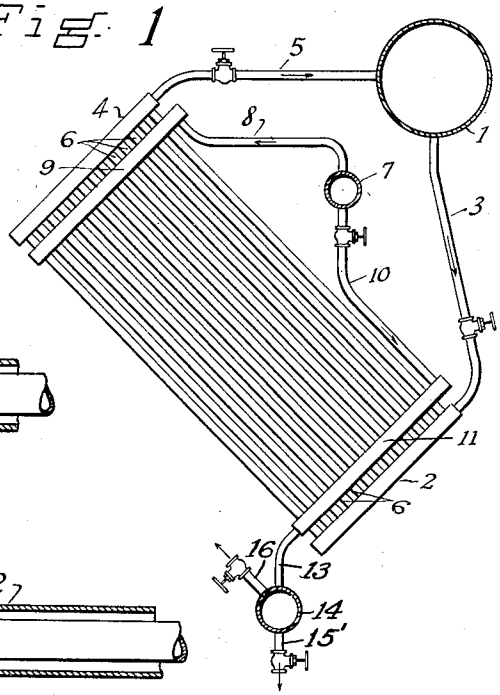


Fig. 2

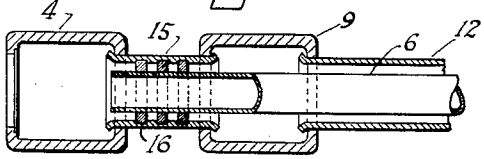


Fig. 3

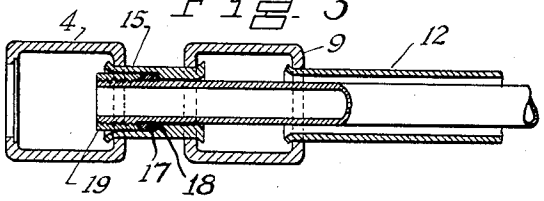


Fig. 4

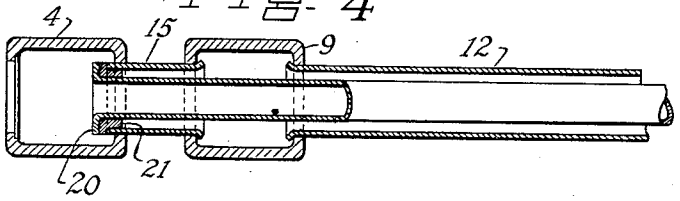


Fig. 5

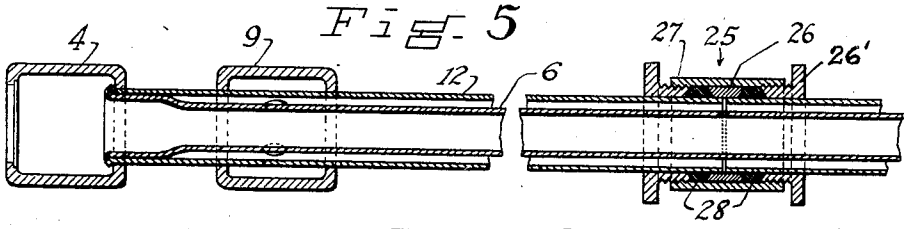


Fig. 6

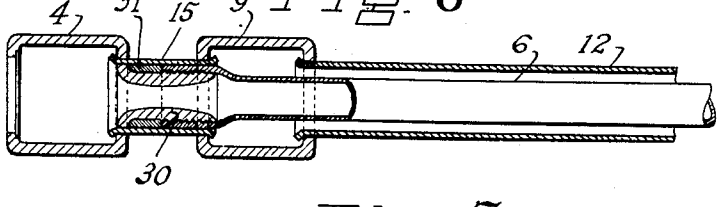
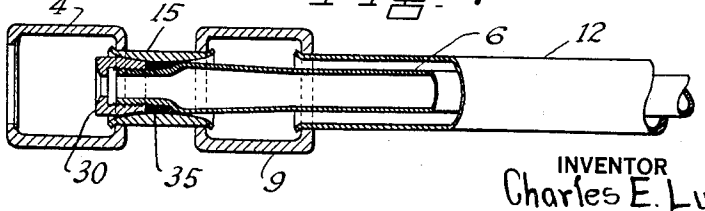


Fig. 7



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UNITED STATES PATENT OFFICE

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HEAT TRANSFER DEVICE

Application filed March 17, 1931. Serial No. 523,272.

This invention relates to heat transfer devices in which a fluid is heated by another fluid of higher temperature.

An object of the invention is to provide tubes in fluid tight relation to each other in a heat transfer device in which the tubes are contacted by fluids of different temperatures, and contemplates a provision to compensate for unequal expansion and contraction of the tubes by permitting relative movement therebetween while maintaining them in fluid tight relation to each other.

A specific object of the invention is to provide a heat transfer device in which a fluid is heated by another fluid at higher temperature by means of jacketed tubular elements, and contemplates a manner for compensating for unequal expansion and contraction of the tubes and jackets contacted by the fluids of different temperatures by permitting relative movement therebetween while maintaining them in fluid tight relation to each other.

These and other objects will be apparent to those skilled in this particular art from the claims and the description in the specification in connection with the drawing in which—

Fig. 1 is a side view of a portion of a boiler utilizing the elements illustrative of this invention;

Figs. 2 to 7 are sectional fragmentary views of jacketed tubes connected to headers illustrative of the embodiments of the invention.

In the embodiments of the invention which have been chosen for purposes of illustration, in Fig. 1 is shown the fluid circulatory system of a boiler similar to the one illustrated in Fig. 1 of the patent application of Charles E. Lucke, filed July 14, 1928, Serial No. 292,638, and Figs. 2 to 7 illustrate forms of jacketed tubes especially adaptable for use in such a boiler.

In Fig. 1, a drum 1, that may serve as a steam and water drum when the device is operated as a steam boiler, is connected to the upper ends of a row of downtake headers 2 by means of valved tubes 3. The upper ends of a row of uptake headers 4 are connected to the drum 1 by means of valved tubes 5 that enter the drum some distance above the lower portion thereof. A bank of inclined tubes 6 connects the headers 2 to the headers 4, a row of these tubes being provided for each pair of headers.

A drum or manifold 7 is provided to receive a hot fluid, such as steam at high pressure or mercury vapor for example, from any convenient source. Pipes 8 lead from the upper portion of the drum 7 to headers 9 that are located between the headers 2 and 4, near the headers 4. Valved tubes 10 lead from the lower portion of the drum 7 to headers 11 corresponding to the headers 9 but located near the headers 2. The headers 9 and 11 may be parallel to the headers 2 and 4.

Tubes 12, corresponding in number to the tubes 6, connect the headers 9 and 11, the tubes 12 being larger than the tubes 6 and surrounding the same, to leave spaces between the tubes 6 and 12 adapted to contain a fluid. Pipes 13 lead from the headers 11 to a drum or manifold 14 to the bottom of which a valved condensate outlet pipe 15′ is connected, and to the upper portion of which a valved outlet pipe 16 for uncondensed gases is connected.

The operation will be described in connection with the generation of low pressure steam from high pressure steam. The water from which the low pressure steam is to be generated is introduced, preferably, into the drum 1 and passes downwardly through the tubes 3 into the headers; thence upwardly through the bank of tubes 6 where steam is generated.

The mixture of steam and water passes into the headers 4, and thence through the pipe 5 into the steam and water drum 1. The steam may be taken off through an outlet (not shown) at the upper portion of the drum 1 in the manner well known in water tube steam boilers. The scale that may be deposited from raw water on the inside of the tubes 6 by the evaporation of the water can be removed without interrupting the operation of the unit by closing the valves in the pipes 3 and 5, corresponding to one pair of headers, and the tubes cleaned mechanically through handholes that are provided in the headers by the devices well known in connection with water tube steam boilers.

The high pressure steam for heating the tubes 6 is introduced into the drum 7 and then passes through the pipes 8 and 10 into the headers 9 and 11, and thence through the spaces between the tubes 6 and 12, the condensate passing out through the pipes 13 into the drum 14 and thence out of the outlet 15' to a boiler, from which the stream is supplied to the drum 7. The steam can thus be kept clean so that no scale will form on the outside of the tubes 6. If the steam entering the drum 7 carries some air or other non-condensible gases mixed therewith, the valves in the pipes 10 can be closed periodically or permanently, thus causing the steam and air to pass through the pipes 8 into the headers 9, and so sweep the air downwardly into the drum 14 from which the air can be removed through the outlet 16. In the operation herein described, both the sensible heat and latent heat of the high temperature steam are utilized to generate steam in the tubes 6.

Another mode of operation is one in which superheated steam is used as the heating medium. In this mode of operation the steam is supplied to the headers 9 from the drum 7 through the pipes 8; the steam flows along the tubes 6 in the space between the tubes 6 and 12 to the headers 11, and is removed therefrom by the outlet 16 through the drum 14 and connections 13. In its passage along the tubes 6, counter to the flow of steam and water therein, most of the sensible heat of superheat will be given up and this heat generates the steam in the tubes.

In the specific jacketed tube arrangement illustrated in Fig. 2, the tube 12 is shown expanded in and open to the uptake header 9. The tube 6 extends through the tube 12 and through the header 9 to the uptake header 4 to which it is open. A nipple 15 is expanded in both the headers 4 and 9, and packing members 16, in the form of rings preferably of metal, are disposed between the nipple 15 and tubes 6, and thus form a closure between the tube 6 and the space formed between the inner surface of the tube 12 and the outer surface of the tube 6, while at the same time it is apparent that relative movement between the tubes 6 and 12 is permitted.

In the embodiment of the invention illustrated in Fig. 3, the tubes 12 and 6 are connected respectively to their headers 9 and 4, and the nipple 15 is expanded in these headers, as has just been described in connection with the embodiment of the invention illustrated in Fig. 2. In this modification, however, the outer end of the tube 6 is screw threaded, and packing 17, preferably soft, is inserted on the upper surface thereof beyond the screw threaded portion and held by a shoulder 18 on the nipple 15. A screw threaded member 19 is threaded on the threaded portion of the tube 6 and serves to hold the packing 17 securely in place. By virtue of this arrangement, it is apparent that limited relative movement is permitted between the tubes 12 and 6, while at the same time the packing 17 serves to form a fluid tight joint, so that the tube 12 is open only to the header 9 and the tube 6 is open only to the header 4 at this end.

In the jacketed tube arrangement illustrated in Fig. 4, the tubes 12 and 6 are connected respectively to their headers 9 and 4, and the nipple 15 connects these headers in a manner similar to the one just described in connection with Figs. 2 and 3. In this embodiment of the invention, however, the end of the tube 6 projects well within the header 4 and is up-set to form a flange 20. Packing material 21 is forced in place between the nipple 15 and flange 20. This arrangement of the tubes and packing leaves tube 6 open to the header 4 and the tube 12 open to the header 9, while the packing 21 forms a fluid tight bar between the two tubes, while permitting them to have limited relative movement.

In the embodiment of the invention illustrated in Fig. 5, the tubes 6 and 12 extend through the headers 4 and 9, both being expanded in the inner face of the header 4. In this connection, it is to be noted that the tube 6 is expanded against the inner surface of the tube 12 so that a fluid tight joint is formed therebetween, while at the same time the tube 6 is open to the header 4. The portion of the tube 12, extending through the header 9, has circumferentially arranged perforations therein so that the tube 12 is open to the header 9. To permit relative movement between the two tubes, to compensate for unequal expansion and contraction, the tube 12 is made in two parts and a stuffing box is provided at this point to make the junction of the two tubes fluid tight, at the same time permitting longitudinal movement. The stuffing box herein shown comprises a ring member 26 with a wedge shaped cross-section which is placed directly across the point of juncture of the two sections of the tubes 12.

A pair of flanged gland members 26' having screw threaded cylindrical portions and oppositely angled faces is assembled on opposite sides of the member 26. A cylindrical member 27 having screw threaded portions on its inner surface at its ends, engages the screw threaded portions of the gland, so that by turning the glands in the proper direction they are brought to bear on packing material 28 disposed between the wedge shaped member 26 and the opposite angled faces of the glands. In this manner, it is apparent that a fluid tight joint is provided at this junction point which will permit longitudinal movement of the two portions of the tube 12.

In the modification of the invention illustrated in Fig. 6, the tube 12 is connected with

the header in the manner described in connection with Figs. 2, 3 and 4, and the nipple 15 is similarly connected. In this modification of the invention, however, the tube 6 has a portion expanded against the inner surface of the nipple adjacent the header 9, although the fit is sufficiently loose to permit sliding movement therebetween. The inner surface of the expanded end of the tube 6 is screw threaded and is engaged by a member 30 which is screw threaded therein. By means of this member 30, the tube 6 is connected to the header 4, the member 30 forming in effect a Venturi throat for the tube. The portion of the member 30 adjacent the header 4 is bent up until it engages the nipple 15 and the space therebetween, which is measured in depth by the thickness of the tube 6 at this point, is filled with packing material 31 which may be packed any desired amount by the regulation of the number of turns on the screw threaded elements, and this packing material 31, in conjunction with the elements which bound it, form a steam tight joint, so that the tubes 6 and 12 are closed to each other by a fluid tight joint which at the same time permits relative sliding movement between them.

The jacketed tube arrangement illustrated in Fig. 7 is similar in all details to the one shown and described in connection with Fig. 6 except that the end of the tube 6 is constricted after it has passed through the header 9, its outside surface is screw threaded, and the gland member 30 is secured on the outside portion thereof. In this modification, the ends of the member 30 adjacent the header 4 are bent downward and given such shape as to have the effect of a modified Venturi throat, and the face thereof, remote from the header 4, acts as a shoulder which presses against the packing 35 and serves to form a fluid tight joint permitting relative movement between the tubes 6 and 12.

In the description of the specific tube forms, only one end of the tube has been shown and described, but it is to be understood that the other end may be the same as the end shown, or they may be fused together by expanding, for example, as taught in the showing in Fig. 5. This last named construction is the cheaper and hence the more desirable, as the special structures at one end only will permit relative movement between the tubes and thus compensate for unequal expansion and contraction of the tubes even when one end is fixed.

A particular heat transfer device has been described in connection with several specific elements especially adapted for use therein, but it is to be understood that modifications, additions and omissions may be made therein within the spirit of the invention as defined by the appended claims.

What I claim is:

1. In a heat transfer device, a header adapted to receive a fluid at high temperature, a second header adapted to receive a fluid at lower temperature, a tube connected to said first named header, a second tube disposed within said first named tube connected to said second header, and packing means maintaining said tubes in fluid tight relationship with each other while permitting relative movement therebetween.

2. In a heat transfer device, a header adapted to receive a fluid at high temperature, a second header adapted to receive a fluid at lower temperature, a tube connected to said first named header, a second tube disposed within said first named tube connected to said second header, and packing means located between the two tubes and between the two headers permitting relative movement between the tubes while maintaining them in fluid tight relationship.

3. In a heat transfer device, a tube characterized by two abutting sections connected respectively to inlet and outlet headers, a second tube disposed within said first named tube in fluid tight relation therewith and connected to other inlet and outlet headers, and means associated with said first named tube at the junction of the two sections to maintain a fluid tight joint while permitting relative movement therebetween.

4. In a heat transfer device, a tube characterized by two abutting sections connected respectively to inlet and outlet headers, a second tube disposed within said first named tube in fluid tight relation therewith and connected to other inlet and outlet headers, a stuffing box associated with said first named tube at the junction of the two sections to maintain a fluid tight joint while permitting relative movement therebetween.

5. In a heat transfer device, a plurality of jacketed tubes each comprising complemental tubes connected to fluid supply sources, packing associated with said complemental tubes for maintaining them in fluid tight relationship with respect to each other while permitting relative movement to compensate for unequal expansion and contraction, and screw threaded means for compressing said packing.

6. In a heat transfer device, a plurality of jacketed tubes each comprising complemental tubes connected to fluid supply sources, packing associated with said complemental tubes for maintaining them in fluid tight relationship with respect to each other while permitting relative movement to compensate for unequal expansion and contraction, and screw threaded means forming a throat about one of said complemental tubes for compressing said packing.

7. In a heat transfer device, tubes one within the other and spaced from each other

and providing passages for heat transfer and recipient fluids, an end connection for each tube, and means connecting said end connections and maintaining the tubes in fluid tight relation with respect to communication between the passages.

8. In a heat transfer device a group of outer tubes and a group of inner tubes providing passages for heat transfer and recipient fluids, headers connecting the tubes of each group, and means connecting the headers and receiving the inner tubes in fluid tight relation with respect to communication between the passages of complementary inner and outer tubes.

9. In a heat transfer device, a header adapted to receive a fluid at high temperature, a second header adapted to receive a fluid at lower temperature, a distance nipple maintaining the headers in fixed relative association with each other, a tube connected to said first named header, a second tube within the first named tube and connected to said second header, similarly arranged headers at opposite tube ends from the aforesaid headers, and tube expansion and contraction compensating means preserving fluid tight relationship.

CHARLES E. LUCKE.