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TUBE AND TUBE SHEET ASSEMBLY

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FIG. 1.

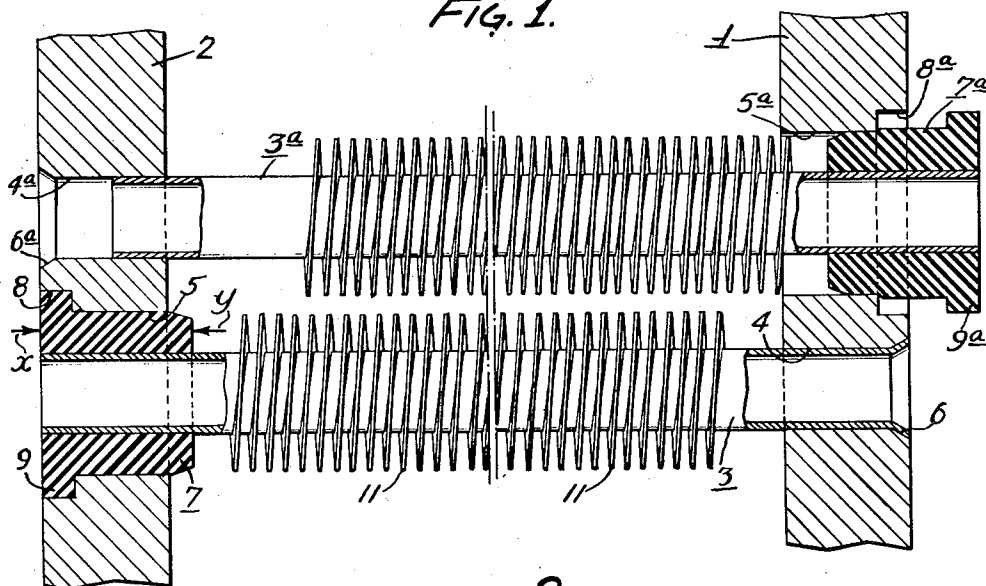
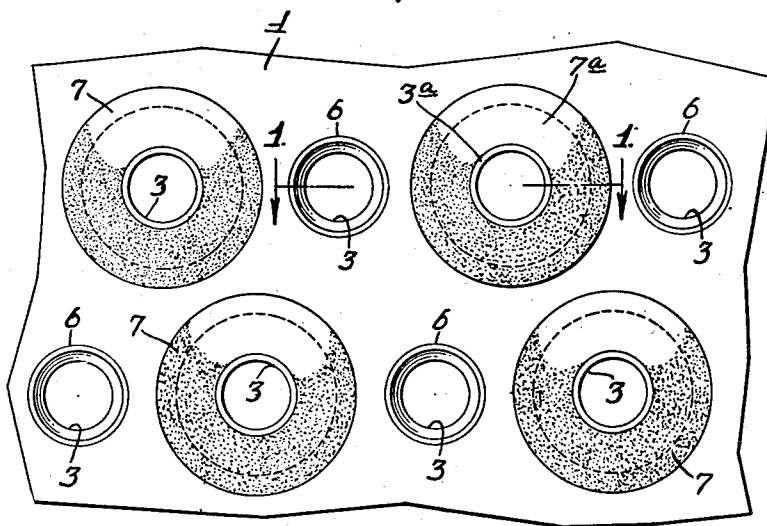


FIG. 2.



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TUBE AND TUBE SHEET ASSEMBLY

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2 Claims. (Cl. 257—236)

The present invention relates to an improvement in heat exchange apparatus of the type wherein tubes, with or without thermally conductive fins, are mounted in and extend between tube sheets constituting opposite walls of a casing or duct intersected by the tubes, the ends of the tubes being sealed in the sheets. Air and gas coolers are typical examples of apparatus of this type.

An object of the invention is to provide an improved means for compensating expansion and contraction of the tubes with respect to the tube sheets, and for eliminating in substantial degree the causes for induced stresses in the tube ends.

Another object is to provide novel means for facilitating assembly of the tubes in the tube sheets and removal of defective tubes requiring replacement.

In the attached drawings:

Fig. 1 is a fragmentary sectional view of a tube and tube sheet assembly in accordance with the invention, one of the tubes being shown in process of assembly in the sheets, and

Fig. 2 is a fragmentary external face view of the tube sheets.

In the drawings, reference numerals 1 and 2 indicate relatively spaced parallel and relatively fixed tube sheets, and 3 is a tube which extends between said plates, the ends of the tube being mounted in axially aligned apertures, 4 and 5 respectively, in the plates. The extremity of the tube which occupies the aperture 4 is expanded into the countersunk outer end 6 of the aperture, and the opposite end of the tube is confined in the aperture 5 by means of an interposed sleeve 7 of neoprene or similar resilient material. The outer end of the aperture 5 is countersunk, as indicated at 8, for reception of a terminal flange 9 on the sleeve 7.

The aperture 5 in the plate 2 is of greater diameter than the aperture 4 in the plate 1 to provide for reception of the resilient sleeve 7, and in the present instance the diameter of the aperture 5 is slightly greater than the diameter of the cylinder defined by the peripheral edge of a helical thermally conductive fin 11 forming a part of the tube 3. Also, the bore of the sleeve 7 within which the end of the tube 3 fits is of smaller diameter than the tube so that the sleeve will be expanded by and will bind securely on the tube, and the outer diameter of the sleeve 7 is greater than the diameter of the aperture 5 so that when inserted in this aperture, as hereinafter described, the resilient material of the sleeve 7 will be under a material compressive stress between the confronting surfaces of the tube and the aperture.

As shown in Figs. 1 and 2, each of the sheets 1 and 2 is provided with large and small apertures corresponding to the apertures 5 and 4, these apertures being arranged in the sheets in interspersed relation as illustrated in the aforesaid figures. By this means, the maximum number of tubes that can be assembled within a given surface area of the sheets is relatively great as compared with the number that would be possible if all of the apertures of small size were in one tube sheet and all of the apertures of larger size in the other.

The manner in which the tubes may be assembled in the sheets is illustrated in Fig. 1 wherein the tube 3a is

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shown in position for the assembly operation. The resilient sleeve 7a has been expanded over the end of the tube and the tube with its fins has been inserted through the aperture 5a in the tube sheet 1 so that the one end occupies the inner end of the aperture 4a in the sheet 2, and the inner beveled end of the sleeve 7a is engaged in the outer end of the aperture 5a. The tube with its sleeve 7a may now be driven as a unit into the aperture 5a until the flange 9a seats solidly within the countersunk recess 8a of the sheet 1, the sleeve forming a leak-proof joint between the tube and the sheet at that end. In operation, flange 9a seated solidly in recess 8a is under higher pressure from direction "x" than from direction "y" (see Fig. 1). This will tend to deform flange 9a and add to the sealing ability of the resilient sleeve 7. The other end of the tube is then expanded in conventional fashion into the countersunk recess 6a at the outer end of the aperture 4a in the tube sheet 2.

Expansion and contraction of the tubes with respect to the sheets 1 and 2 are compensated by corresponding flexure in the material of the resilient sleeve, and induced stresses in the tube ends from this or other causes are largely avoided. In the event that a tube become defective, it may be readily removed from the assembly by first drilling out the expanded end of the tube and by then employing a rod of suitable shape and size to exert pressure against the loosened end of the tube to displace the tube and the resilient sleeve from the opposite plate.

I claim:

1. In a tube and sheet assembly, a tube, confronting relatively spaced tube sheets having apertures for reception of the tube, the aperture of one of said sheets conforming in size and shape to the cross sectional form and size of the tube and having a countersunk recess at the outer end into which recess the proximate section of the tube is expanded to secure the tube in the aperture last named and to effectively seal the joint between the tube and sheet, the aperture in the other sheet being of larger size than the cross sectional size of the tube to afford a clearance space between the confronting surfaces of the tube and the wall defining the aperture last named, and a resilient sleeve seated in radially expanded condition on the tube prior to insertion of said tube and resilient sleeve into said clearance space but confined under compressive stress within said clearance space to secure the tube in the aperture last named and to seal the said clearance space when the tube and resilient sleeve are inserted into said clearance space, the said clearance space materially exceeding in its radial dimension the wall thickness of the tube, said resilient sleeve compensating for the expansion and contraction of the tube with respect to the sheets by flexure of the material of said resilient sleeve.

2. An assembly according to claim 1 wherein the tube is provided with projecting thermally conductive fins in the part thereof lying between said sheets, and wherein further the aperture in the one sheet which receives the resilient sleeve is sufficiently large to afford passage through the sheet of the finned portion of the tube.

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