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CONDENSER TUBE SEAL

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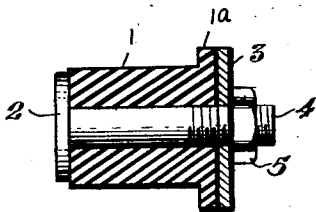


Fig. I.

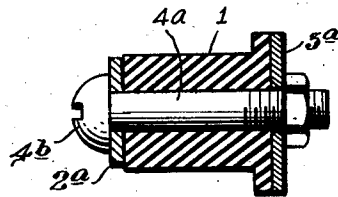


Fig. IV.

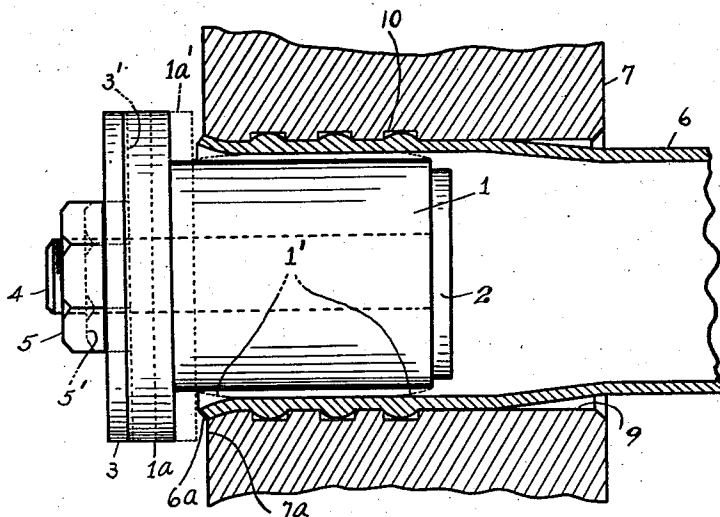


Fig. II.

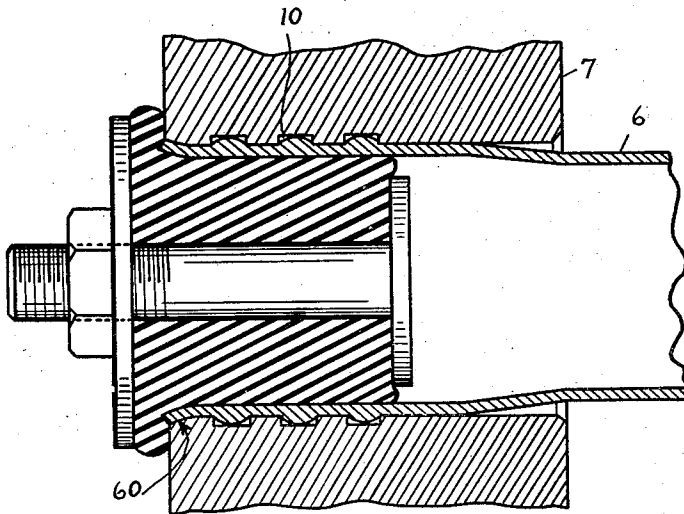


Fig. III.

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CONDENSER TUBE SEAL

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Application August 7, 1937, Serial No. 157,848

1 Claim. (Cl. 138—89)

My invention relates to steam condensers and other heat exchangers embodying a multiplicity of tubes, and consists in a device for sealing the ends of such tubes.

5 The usual steam condenser consists in a sealed chamber, usually a cylindrical chamber, including a group of tubes extending between its opposite ends. The tubes are sealed at their opposite ends in the walls or tube-sheets of the condenser, and cooling water is circulated through the tubes, while the steam to be condensed is introduced to the chamber externally of the tubes. An elaborate consideration of the construction and operation of condensers is unnecessary to an understanding of this invention. Suffice it to say, that the typical condenser of a steam turbine driving a 50,000 kva. generator includes as many as 9,840 tubes, and that in service the tubes tend to develop leaks, particularly in the regions of integration with the tube-sheets. The leaking tubes must be plugged, to prevent the cooling water from entering the steam chamber, and to guard against the infiltration of air from the outer atmosphere into the condenser. More particularly, the invention consists in means to such end.

15 In the accompanying drawing Fig. I is a view partly in axial section and partly in side elevation of a device embodying the invention; Fig. II is a fragmentary sectional view of an individual condenser tube, illustrating the sealing device in course of installation in one end of the tube; Fig. III is a view comparable with Fig. II, illustrating the device in completely installed position; and Fig. IV is a view comparable with Fig. I, illustrating a modification in the construction of the sealing device.

20 The device of my invention consists in a body of elastic material adapted to be, first, laterally expanded into sealed engagement with the internal wall of a condenser-tube, and, then, axially compressed into sealed position against the end of the tube and the adjacent surface of the tube-sheet. The body of elastic material is advantageously of substantially cylindrical form, arranged between two end members formed of relatively inelastic material; the end members are adjustable towards one another for compressing the elastic body and effecting the desired expansion laterally of the line of compression; and means are provided for adjusting such end members and securing them in adjusted position.

25 Turning to Fig. I of the drawing, the elastic body of the device is shown as comprising a cylindrical, thick-walled tube 1 of rubber, the rubber

being of such composition and so vulcanized as to provide a body of relatively great strength and elasticity. The relatively inelastic members, between which the elastic body 1 is arranged, consist in discs 2 and 3 of metal, steel in this case, and the means for compressing the body 1 and securing the end members 2 and 3 in adjusted position comprise a screw-threaded stem 4 and a nut 5. As shown, the stem 4 extends through and snugly engages the tubular wall of the elastic body 1; the disc 2 is integrally formed as a head on one end of the threaded stem, while the opposite disc 3 comprises an ordinary steel washer interposed between the nut 5 and the adjacent end of body 1. Adjacent to one end of the body 1 is a compressible or elastic gasket 1a which, as will presently appear, is adapted to seal, or to assist in sealing, the end of a condenser tube. While the gasket 1a may comprise a rubber washer interposed between the end of body 1 and the head member 3, I ordinarily form it integrally with the body portion 1 of the device. It will be perceived that the gasket or gasket portion 1a extends radially outward the side surface of body portion 1, and that the head member 3 is of greater effective area than the member 2—the advantages of which will be manifest in the following description.

30 A typical condenser tube 6 is illustrated on large scale in Fig. II, and it will be understood that the header or tube-sheet 7 comprises one of a pair of spaced-apart headers or tube-sheets between which the tube extends. In accordance with known practice, the opposite ends of the tube are secured in openings 9 provided therefor in the tube-sheets.

Typically, the ends of the tubes are radially expanded and swedged into secure positions in the openings in the tube-sheets, and, as usual, a plurality of grooves 10 are formed in the bodies of the tube-sheets, to receive radially displaced body material of the tubes and so to improve the unions.

35 When in service it becomes necessary to close either or both ends of a tube 6, a sealing device is inserted, as shown in full lines in Fig. II, and it will be noted that, while the body portion 1 extends a substantial interval into the bore of the tube, the gasket portion 1a is positioned an interval from the end edge of the tube and the adjacent face of the tube-sheet 7. While holding the device in such position, the nut 5 is screwed inward, axially compressing the elastic body portion 1 and thereby causing it laterally to expand into secure, sealed engagement with 45

the wall of the tube. In such manner the body portion 1 is frictionally anchored within the bore of the tube, and the gasket portion 1a is axially shifted to a position relatively close to, if not to a position of contact with, the end edge 3a of the tube and the adjacent surface 1a of the tube-sheet. (Note the positions of the parts illustrated by the dotted lines 1', 1a', 3', 5'.)

When the sealing device has thus been firmly anchored in place, the nut 5 is turned further inward, with the consequence and effect that the gasket portion 1a is axially shifted into contact with, and compressed against both the end edge of the tube and the body or surface of the tube-sheet encircling such edge. The completed installation is illustrated in Fig. III. Thus, not only is my device effective to seal the bore of the tube 6, but it is additionally instrumental in hermetically sealing the joint or seam 60 between the outer surface of the tube and the body of the tube-sheet. And thus it is that any of the conditions of leakage which develop in a condenser in service may be quickly and effectively remedied by means of my sealing device.

Sometimes one end (or both ends) of a condenser-tube is secured in the tube-sheet by means of a packing and a packing gland or ferrule of well-known sort, and it will be manifest to those skilled in the art that my device may be installed substantially in the manner already described, to stop leakage which may develop in such packed joints or unions.

In Fig. II, I have illustrated that the body portion 1 of the sealing device is initially of less diameter than the bore of the tube, but it is to be understood that before inserting the sealing device, the nut 5 may be adjusted in such position that the body portion 1 is expanded to slightly larger diameter than the bore of the tube. Thus, when the device is initially inserted, the body 1 frictionally engages the wall of the tube. This engagement of the body 1 with the tube, together with the tight engage-

ment of the stem 4 and head 2 with such body 1, serves to prevent rotation of the device while the nut 5 is being turned.

In Fig. IV, I illustrate that the screw-threaded means for axially compressing the elastic body portion 1 may comprise a standard bolt 4a, to whose head 4b an ordinary washer 2a may be soldered or welded, to provide one of the two inelastic end members between which the elastic body is compressed, and it will be noted that in each form of my device the outer end member, 3 or 3a, is of larger effective area—larger area cross-sectionally of the assembly—than the inner end member, 2 or 2a.

This specification, together with the drawing and appended claim, comprises a continuation in part of application for Patent Serial No. 125,262, filed by me on February 11, 1937.

I claim as my invention:

In combination with a condenser tube having an end secured in an opening in a tube-sheet, a sealing device including a cylindrical body of rubber of relatively great elasticity extending into the bore of said tube and a rubber flange extending outward at the mouth of the tube radially beyond the seam between the outer surface of the tube and the tube-sheet, a member of relatively inelastic material arranged at each of the opposite ends of the flanged cylinder of rubber, such two members being of unequal diameters and severally commensurate with the diameters of the ends of the cylinder against which they are positioned, a screw-threaded shank extending through said rubber cylinder and flange and the larger of said members, and a nut screwed tight on said shank, with said cylindrical body of rubber radially expanded in secure engagement with the internal wall of the tube and said flange compressed axially of the assembly against both the peripheral edge of the tube and the outer wall of the tube-sheet adjacent thereto.

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