

July 26, 1932.

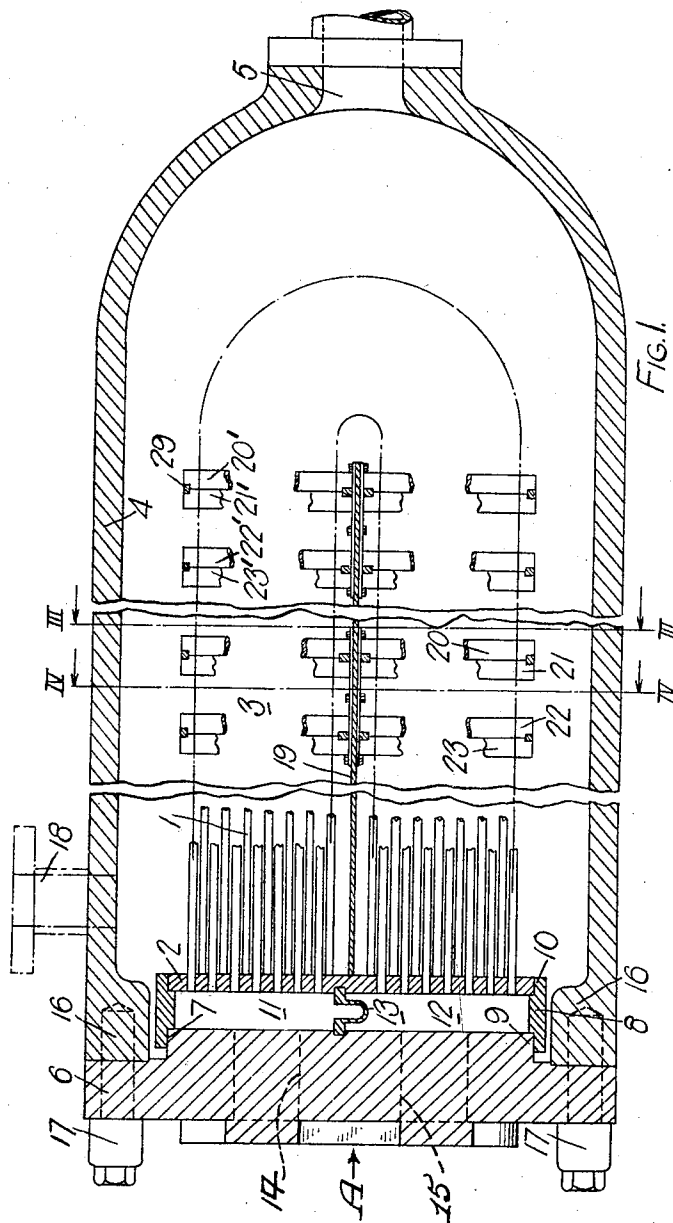
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1,869,236

EVAPORATOR FOR GENERATING HIGH PRESSURE STEAM

Filed Sept. 27, 1930

3 Sheets-Sheet 1



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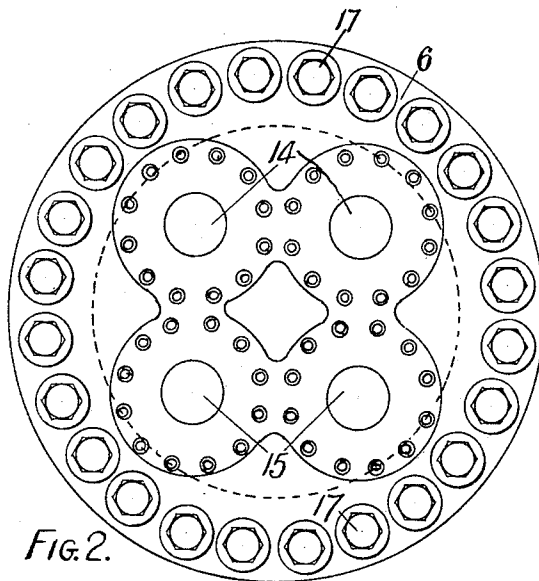
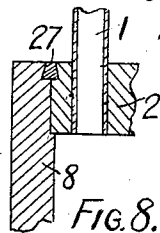
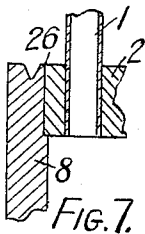
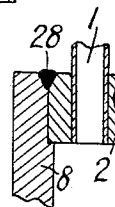
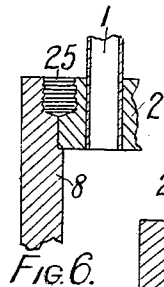
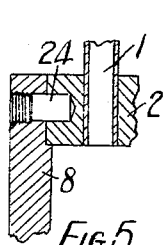


FIG. 2.



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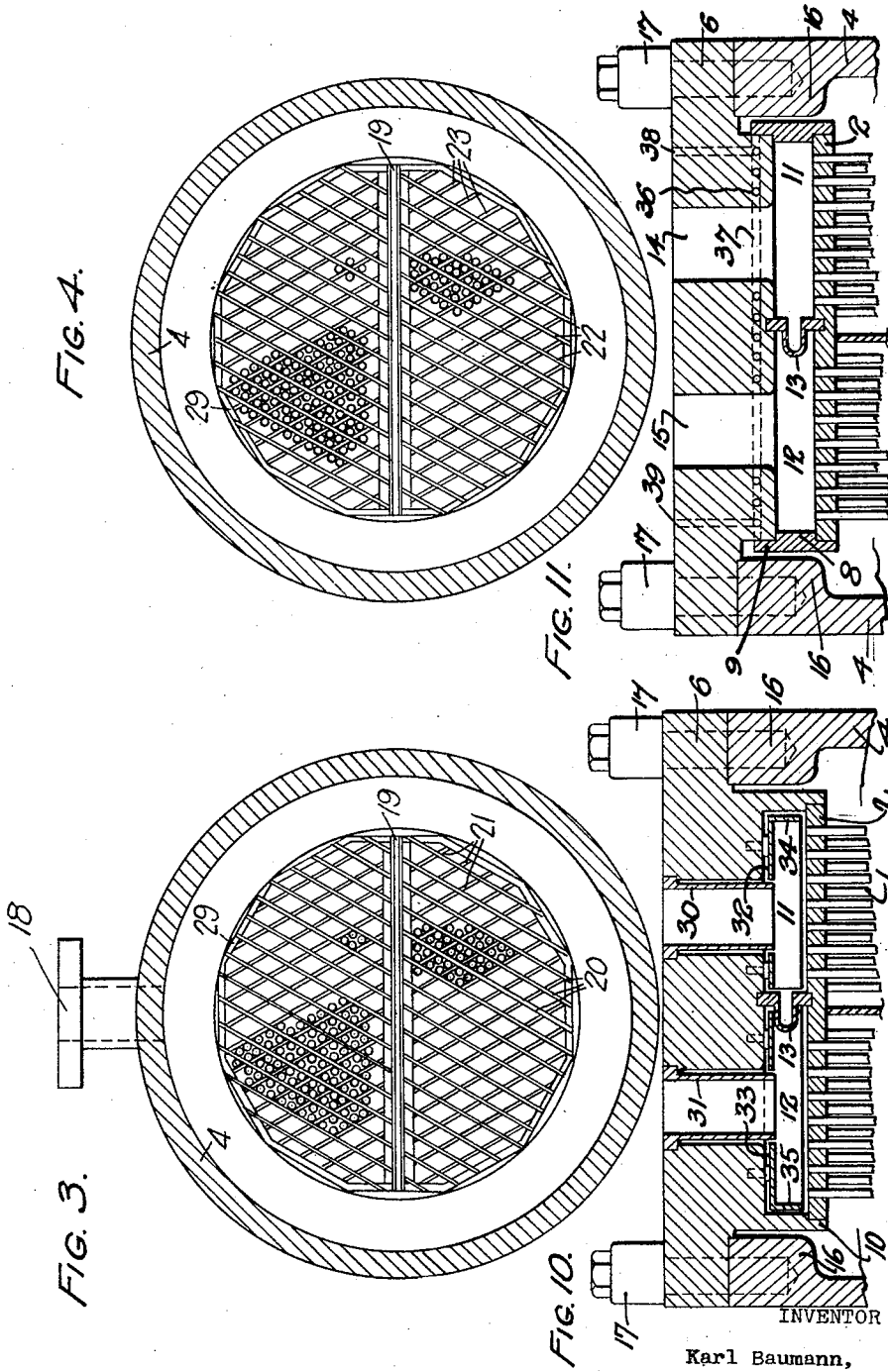
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EVAPORATOR FOR GENERATING HIGH PRESSURE STEAM

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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EVAPORATOR FOR GENERATING HIGH PRESSURE STEAM

Application filed September 27, 1930, Serial No. 484,908, and in Great Britain November 21, 1929.

This invention relates to evaporators, its primary object being to provide an improved construction for mounting the tubes, whereby the size of the evaporator casing or the aperture therein through which the nest of tubes is inserted may be reduced.

Usually in the construction of evaporators the tubes are first mounted in the tube plates and the assembled nest of tubes is then inserted into the drum-like casing and secured therein by the aid of flanges or laterally extending portions of the tube plates. The end covers are then applied, these being of box form or otherwise suitably adapted for the supply and withdrawal of the heating fluid to be passed through the tubes.

According to the present invention a tube plate is secured to an end cover of an evaporator drum by means of an annulus which is shrunk on the tube plate. The annulus may be integral with the cover, but is preferably formed separately therefrom and in the latter case takes the form of a shrink ring which is shrunk on to both the tube plate and the cover, the latter being of plug-like form.

A construction of evaporator according to the invention and particularly suitable for use in the generation of steam at high pressure, the heating fluid being highly superheated steam, is hereinafter described by way of illustration with reference to the accompanying drawings.

In the drawings Fig. 1 is a longitudinal sectional elevation of the evaporator, Fig. 2 is an end elevation looking in the direction of the arrow A on Fig. 1, Fig. 3 is a cross-section on the line III—III in Fig. 1, Fig. 4 is a cross-section on the line IV—IV in Fig. 1, Figs. 5, 6, 7, 8 and 9 show modifications of a constructional detail, and Figures 10 and 11 show two arrangements for protecting the body of the cover from the heat of the heating fluid. Fig. 10 also shows a modification in which the annulus is formed integrally with the cover.

Referring to the drawings, the tubes 1 are bent to hairpin form and their ends are secured by known methods in a tube plate 2. The latter is made of the smallest possible diameter permitted by the size of the tube nest

3 and the necessary thickness of the metal between the edge of the plate and the holes for the outermost tubes. The tube nest 3 is disposed in the casing 4 which is closed at one end with the exception of an aperture 5. The other end of the casing is closed by a cover 6 which is formed as a plug turned approximately to the same diameter as the tube plate 2 to receive a shrink ring 8. This shrink ring 8 consists of a relatively thin cylinder internally grooved at 9 and 10 to fit the plug of the cover 6 and the tube plate 2 which, when the ring is shrunk in position, are spaced apart to provide inlet and outlet chambers 11 and 12 for the heating fluid. In the modification shown in Fig. 10, an annulus 8 is formed integrally with the cover 6, the protruding end of which annulus is integrally grooved at 10 to fit the tube plate 2 on to which it is shrunk. The two chambers 11 and 12 are separated by a division plate 13 extending between the plug and the tube plate. The division plate 13 is preferably resilient so that it may accommodate itself to any variations that may take place in the spacing of the tube plate from the cover due to changes in temperature of the shrink ring, and in the particular example shown is of U-shaped cross-section. A slight clearance may further be provided between the shrink ring and the ends of the division plate to allow for possible differences of expansion.

The cover 6 is formed with bores 14 and 15 by which the heating fluid may be admitted to or withdrawn from the inlet and outlet chambers 11 and 12, the said bores being surrounded by bosses 14', 15' to which flanged fluid supply and withdrawal pipes may be directly bolted. The cover 6 may be provided internally with passages as shown in Fig. 11, formed by bores 36 in the cover interconnected by bores 37. These passages are connected to inlet and outlet passages 38 and 39 whereby cooling fluid may be circulated through the bores 36 and the temperature of the cover thus maintained within desired limits during operation. Preferably the temperature is the same as that of the remainder of the drum.

The body of the cover 6, which preferably

consists of a steel forging, may be further protected from the heat of the heating fluid by means of thin tubes 30 and 31, and plates 32 and 33, as shown in Figure 10, which provide an inner shell or lining for the bores 14 and 15 and the inner surface of the cover 6. The tubes are flanged at their outer ends as shown, the flanges being adapted to fit corresponding grooves in the bores 14 and 15, and thus secure the tubes in position leaving a narrow space between them and the bores so that no appreciable flow of heating fluid takes place behind the tubes. The plates are secured in position by means of screws or studs with the interposition of distance pieces so as to leave a narrow space between them and the cover which also does not allow any appreciable flow of heating fluid to take place behind them. The shrink ring 8 is similarly protected by upstanding flanges 34 and 35 on the plates 32 and 33 which form in effect an inner shell of the ring. The aperture of the casing 4, through which the tube nest 3 is inserted and which is closed by the plug-shaped cover 6, is only slightly greater in diameter than the shrink ring 8. The walls of the casing 4 are thickened around the aperture as shown at 16 to receive heavy studs 17 which pass through the flange of the cover 6 and serve to hold it in place.

The aperture 5 at the other end of the casing is of small dimensions and serves for the inlet of the water to be evaporated. The steam evaporated in the casing may be removed by means of one or more pipes 18 introduced into the upper walls of the casing 4. Alternatively if the evaporator is arranged vertically, the pipes 18 may serve for the inlet of the water, the steam being drawn off through the aperture 5.

The tubes 1 are supported intermediately by rows of transversely disposed plates 20, 21, 22 and 23, welded or otherwise mounted on a longitudinal stay plate 19 which is secured to the tube plate 2. The plates in the rows 20 and 22 are parallel to one another and uniformly spaced, and the plates in the rows 21 and 23 are similarly spaced parallel to one another, but are disposed at an angle to the plates in the rows 20 and 22 to form two lattice units spaced close together longitudinally. The plates in the row 20 are displaced transversely with respect to the plates in the row 22 by a distance equal to half the distance between adjacent plates of a row, and the plates in the row 21 are similarly displaced transversely with respect to the plates in the row 23.

The tubes 1 are also supported adjacent their bends by two closely spaced lattice units comprising similar rows of transversely disposed plates 20', 21', 22', and 23'.

Figs. 5, 6, 7 and 8 show alternative means of additionally securing the tube plate to the shrink ring. As shown in Fig. 5 a grub

screw or screws 24 are inserted radially through the shrink ring 8 into the tube plate 2. Alternatively pins may be inserted in place of the grub screws. Fig. 6 shows an alternative method of fixing the shrink ring in which grub screws 25 are inserted endwise between the shrink ring 8 and the tube plate 2. An alternative method of providing an additional securing of the shrink ring as shown in Fig. 7 where the ring 8 is rolled or otherwise forced over the edge of the tube plate as shown at 26. This method of securing may be used in addition to the other methods described if desired. Fig. 8 shows an alternative method to Fig. 7, 27 being a caulking strip which is inserted between the ring 27 and the tube plate 2. Alternatively the tube plate may be welded to the shrink ring as shown at 28 in Fig. 9.

Certain of these methods may also be applied to secure the shrink ring to the end cover 6 if the ring 8 is not formed integral therewith. It is preferable however to employ a separate shrink ring so that in case it is necessary to dismantle the tube nest the ring can be cut and replaced at relatively small cost.

It will be evident that the invention enables evaporator drums of great strength to be constructed for use in the generation of steam at high temperature and pressure, the necessary weakening of the drum by the aperture through which the heating tubes are inserted being reduced to a minimum. The construction also substantially minimizes the stress upon the cover and therefore facilitates the maintenance of a tight joint between the cover and the drum.

I claim:—

1. An evaporator comprising in combination a casing adapted to contain the liquid to be evaporated, a nest of tubes in said casing through which heating fluid may flow, a tube plate in which the nest of tubes is mounted, a cover of plug form for the casing and a shrink ring shrunk on to both the tube plate and the cover.

2. In an evaporator vessel for generating steam at high pressure, a casing to contain the liquid to be evaporated, said casing having one end open, a cover for the open end of said casing and having a plug-like protrusion on the inner side thereof, an annulus comprising a shrink ring shrunk on at one end on to the plug-like protrusion of the cover, means for additionally securing said annulus to said cover, a tube plate on which the other end of said annulus is shrunk and a nest of tubes mounted in said tube plate through which tubes heating fluid may flow.

3. In an evaporator, a casing having an opening, a cover for said opening, a tube plate disposed within the casing, a nest of tubes disposed in said tube plate, an annulus shrunk on to said tube plate and on said

cover and means comprising grub screws extending radially of said annulus for additionally securing said annulus to the tube plate.

4. An evaporator according to claim 1, including means for additionally securing the shrink ring to the tube plate.

5. An evaporator, comprising a casing having an opening, a cover for said opening, a nest of tubes disposed in said casing, a tube plate for said nest of tubes and a shrink ring having one end shrunk on said cover and its other end shrunk on said tube plate, the edge of the latter end of said shrink ring being turned over the edge of the tube plate.

6. An evaporator, comprising a casing having an opening, a cover for said opening, a nest of tubes in said casing, a tube plate for said nest of tubes, an annulus shrunk on to said cover and on to said tube plate and a resilient division plate between said cover and said tube plate forming inlet and outlet chambers for the nest of tubes.

7. An evaporator, comprising a casing having an opening, a cover for said opening having an upstanding annulus integrally formed thereon, a nest of tubes in said casing, and a tube plate for said nest of tubes, on which tube plate said annulus is shrunk.

8. An evaporator comprising a casing having an opening, a cover for said opening provided with internal passages for the circulation therethrough of cooling fluid, a nest of tubes in said casing, a tube plate for said nest of tubes, and an annulus having one end secured to said tube plate and its other end shrunk on to said cover.

9. An evaporator, comprising a casing having an opening, a nest of tubes in said casing, a tube plate for said nest of tubes, an annulus shrunk at one end on the said tube plate and shrunk at the other end on to a cover for the opening of said casing and thin metal liners secured in spaced relation to said cover to protect said cover from the heat of the heating fluid.

10. An evaporator, comprising a casing having an opening, a cover for said opening, a nest of tubes in said casing, a tube plate for said nest of tubes, an annulus shrunk at one end on to said tube plate and at the other end on to said cover, and an inner shell for said annulus to protect it from the heat of the heating fluid.

11. An evaporator, comprising a casing having an opening, a cover for said opening, a tube plate, an annulus shrunk at one end on to said tube plate and at the other end on to said cover, a nest of tubes terminating in said tube plate, a stay plate extending longitudinally of said casing and attached to said tube plate, and supporting plates for said nest of tubes extending transversely of said casing and secured to said stay plate.

12. An evaporator, comprising a casing

having an opening, a cover for said opening, a tube plate, an annulus shrunk at one end on to said tube plate and shrunk at the other end on to said cover, a nest of tubes terminating in said tube plate, a stay plate extending longitudinally of said casing and attached to said tube plate, two units of lattice stay plates arranged in close proximity for supporting the tubes and secured to said longitudinal stay plate, the stays of one unit of lattice stay plates being displaced transversely with respect to the stays in the other unit.

13. An evaporator comprising a casing having an opening, a cover for said opening, a nest of tubes in said casing, a tube plate for said nest of tubes, an annulus shrunk at one end on to said tube plate and at its other end on to said cover stay plate extending longitudinally of said casing and secured to said tube plate, tube supporting plates extending transversely of said casing and secured to said longitudinal stay plate, and a resilient division plate between said cover and said tube plate and forming inlet and outlet chambers for said nest of tubes.

In testimony whereof I have hereunto subscribed my name this twelfth day of September 1930.

KARL BAUMANN.