March 6, 1945. M. P. LAURENT 2,370,804

PLUG STRUCTURE

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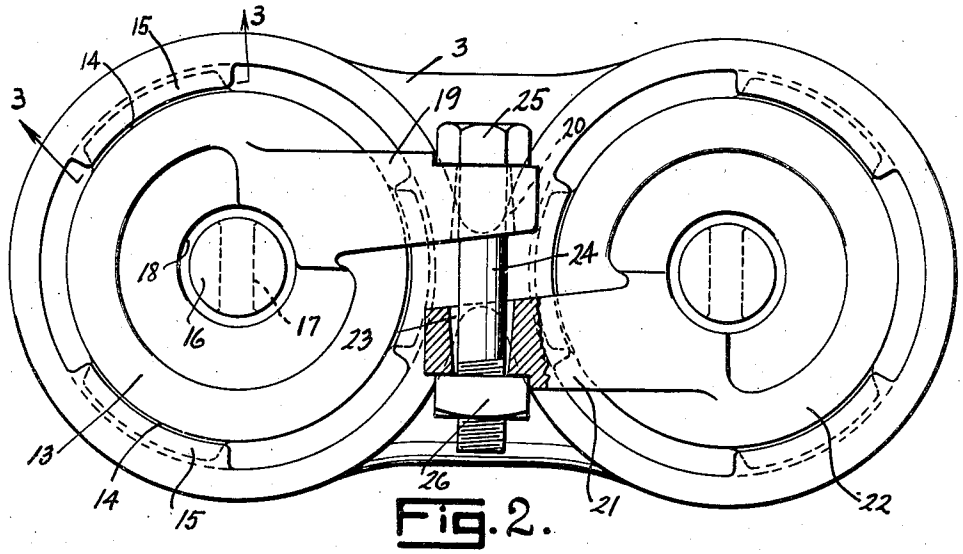

Fig. 2.

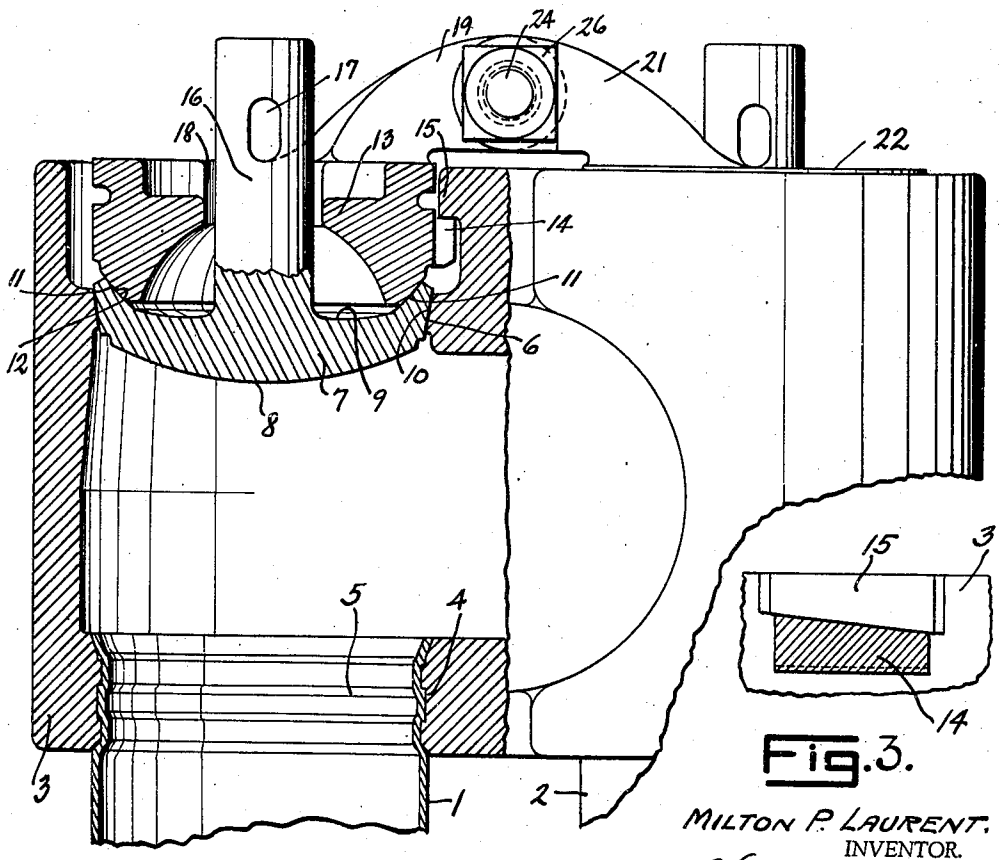

Fig. 1.

Fig. 3.

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PLUG STRUCTURE

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4 Claims. (Cl. 220—40)

This invention relates to plugs and has for its general object the provision of an improved plug for use in holding high pressure at high temperatures.

The plug to which this invention relates is of general application wherever a plug is required for closing an opening against relatively high pressures at elevated temperatures. Specifically the embodiment herein disclosed is designed for the particular purpose of providing closure members for the clean-out openings of headers and particularly box type headers such as are employed in connecting the adjacent ends of tubular members in a boiler or other heat exchange apparatus.

In the past these clean-out openings have been closed by means of tapered plugs held in place against tapered seats by any one of a number of well known holding devices. Prominent among these was a stirrup like yoke having parts extending from the exterior of the header on both sides of the opening in the header and having a cross member extending over the opening carrying a set screw adapted to bear against the plug and hold it in place. Difficulties have been encountered with this structure, however, in that when excessive pressure is applied to such a plug it tends to lift the plug from its seat and hence to produce a leak. When high pressures are combined with high temperatures this tendency is all the more prominent because of the fact that the material of the plug itself has less strength at high temperatures and is, therefore, more apt to take a permanent "set," which, of course, will mean that the plug will thereafter not provide a tight seal for the opening.

It is, therefore, an object of this invention to provide a plug structure and holding means therefor which will not loosen under high pressures and temperatures.

Furthermore, it is an object of this invention to provide such a structure in which the seal will actually become tighter and more perfect as the device is subjected to greater pressures and higher temperatures, this being true, of course, within the physical limits of the material of which the structure is made.

Another object of this invention is to provide a plug which will give greater strength per unit of its weight than would plugs of the previously used designs.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawing in which one embodiment of this invention is set forth by way of illustration and example.

In the drawing:

Fig. 1 is a view partly in longitudinal cross section and partly in side elevation illustrating a plug structure made in accordance with this invention.

Fig. 2 is an end elevation of the same structure with parts broken away and shown in cross section for purposes of illustration.

Fig. 3 is a fragmentary cross sectional view taken along the line 3—3 of Fig. 2.

Referring more in detail to the drawing, the numerals 1 and 2 indicate a pair of tubes or tubular members which are substantially parallel to each other and which are joined together at their adjacent ends by means of the header 3. The header 3 is provided with appropriate openings for receiving the ends of the tubes 1 and 2 and these tube ends are rolled into such openings and into circumferential corrugations 4 formed in such openings as indicated by the numeral 5. In order that access might be had to the interior of the opening in the header and of the tubular member fitting therein so that this rolling operation just referred to might be carried out and also so that access might be had to the interior of the tubular member and the header for clean-out purposes, the header is provided in alignment with the tubular member with an opening known as a clean-out opening having a tapered plug seat 6. Seated against this tapered plug seat 6 is the tapered peripheral surface of the closure or plug member 7. It is noted that this plug member 7 consists of a body portion of concavo-convex form having its convex surface 8 disposed toward the interior of the header and having its concave surface 9 disposed outwardly with respect to the header. On its outer edge the tapered seat 10 is provided for seating against the surface 6 within the opening in the header, these two seating surfaces being preferably ground together for the purpose of securing a perfect joint. As illustrated, these seating surfaces are conical although it is conceivable that they might be made spherical if desired.

The marginal portion of the plug member is preferably formed with an outwardly turned part or lip, and on the inner surface of this lip is provided a bearing or seating surface, this second surface being of spherical formation as shown at 11. Against this spherical surface 11 there is adapted to be seated a corresponding spherical surface 12 on a hold down nut 13. The purpose of providing the spherical surfaces 11 and 12 is so that the hold down member 13 might adjust itself with respect to the plug 7 without disturbing the seating of the plug 7 upon the seat 6.

The hold down member 13 is provided on its outer marginal portion with inclined ears or lugs 14 adapted to engage beneath correspondingly formed lugs 15 within the outer portion of the opening in the header. As will be seen by reference to Fig. 2 the lugs 14 and 15 are spaced apart circumferentially so that the lugs 14 may fit between the lugs 15 after which the member 13 may be rotated until the lugs 14 engage beneath the lugs 15 and serve to wedge the mem-

ber 13 against its seat on the plug 7 to hold the same in place.

It is further noted that the plug 7 has an upstanding stem 16 projecting outwardly from its central portion with an opening 17 formed in this stem thus providing a means whereby the plug 7 may be forcibly removed from its seat when desired. The hold down member 13 is provided with a central opening 18 loosely embracing the stem 16.

The hold down member 13 is also provided with an outwardly and laterally extending arm 19 having an opening 20 adjacent its outer end. This arm 19 is adapted to extend toward and overlap the end of a similar arm 21 on an adjacent plug hold down member 22 on the same header, with the opening 23 in such arm 21 registering substantially with the opening 20 in the arm 19. Through these two openings 20 and 23 there is then placed a bolt 24 having a head 25 on one end and a nut 26 on the other, so that upon tightening this nut and bolt the two arms will be drawn toward each other to tighten the two hold down members 13 against their respective plugs.

From the foregoing it will be seen that the space between the seat 6 in the clean-out opening and the surface 12 on the hold down member 13 is an annular wedge-shaped space and that the marginal lip on the plug 7 forms a wedge-shaped member fitting such space. It will further be seen that since the hold down member 13 bears against the marginal portion of the plug and the plug is of concavo-convex formation with the convex side toward the pressure, any tendency of the plug to yield under pressure will cause a spreading of its marginal portions and thus cause the plug to bear more tightly against the seat 6. This effect will be accentuated by the fact that the marginal lip portion is being forced into a wedge-shaped space thus causing it to fit more and more tightly against both the surface 6 and the surface 12. Furthermore, it will be seen that the result just described will follow regardless of whether the deformation of the plug is due solely to pressure or is due to a yielding of the plug because of a weakening thereof under high temperature conditions.

In addition to the foregoing it will be noted that the plug being formed in a concavo-convex shape provides a dome support against the pressure within the header an thus provides great strength in the plug with a relatively small amount of material used therein. Thus the weight of the plug may be reduced for a given strength.

It will thus be seen that a means has been provided for carrying out and accomplishing all of the objects sought by this invention.

Having described my invention, I claim:

1. In a plug structure a concavo-convex disk like member having a seat about its outer edge to form a seal within an opening and being adapted to have its convex side exposed to high pressure, and means engageable with the marginal portions of said member on the concave side thereof to prevent bodily movement of said member under influence of such pressure, the surface of contact between said means and member being spherical whereby said means may adjust itself to bear at all times evenly against the marginal portions of said member and whereby pressure on the convex side of said member will tend to flatten it and cause said marginal portions to expand into tighter sealing engagement with the wall of an opening.

2. In a plug structure, in combination with a chamber having an opening in the wall thereof and an outwardly tapering seat in said opening, a concavo-convex disk like member having a tapered seat about its outer edge to seat upon said seat within the opening and form a seal therewith when its convex side is disposed toward the interior of said member, and means separate from said member and anchorable within the outer portion of said opening and having parts engageable with the marginal portions of said disk like member on the concave side thereof to prevent bodily movement of said disk like member away from its seat under influence of pressure on the convex side thereof, whereby pressure on the convex side of said disk like member will tend to flatten it and cause said marginal portions to expand into tighter sealing engagement with the seat on the wall of said opening.

3. In a plug structure, a member having an opening therein and having the walls of said opening formed with a seat for a plug for closing said opening, a plug member having a seat about its outer edge to engage and form a seal with the seat within said opening and being adapted to have one of its faces exposed to high pressure, and means separate from said member and engageable with the marginal portions of the opposite face of said member to prevent bodily movement thereof under the influence of such pressure, said last mentioned means having its portion which contacts with said plug member so shaped as to provide a wedge-shaped space between said portion which contacts the plug member and the seat within said opening, and the marginal portion of said plug member with which said means engages being in the form of a lip-like flange extending in the direction in which such pressure would tend to force said plug member, said lip-like flange having formed on its outermost surface the seat portion which is adapted to seat within said opening and on its inner surface a portion adapted to be engaged by said means engageable with the plug member, said lip-like flange between said portions being of wedge-like formation to fit within said wedge-shaped space, whereby pressure on the said plug member will tend to wedge said lip-like portions into said wedge-shaped space and into tighter sealing engagement with the seat in said opening.

4. In a plug structure, in combination with a chamber having an opening in the wall thereof and an outwardly tapering conical seat in said opening a concavo-convex disk like member having a tapered conical seat about its outer edge to seat upon said seat within the opening and form a seal therewith when its convex side is disposed toward the interior of said member, and means separate from said chamber and anchorable within the outer portion of said opening and having parts engageable with the marginal portions of said disk like member on the concave side thereof to prevent bodily movement of said disk like member away from its seat under the influence of pressure on the convex side thereof, whereby pressure on the convex side of said disk like member will tend to flatten it and cause said marginal portions to expand into tighter sealing engagement with the seat on the wall of said opening.

MILTON P. LAURENT.