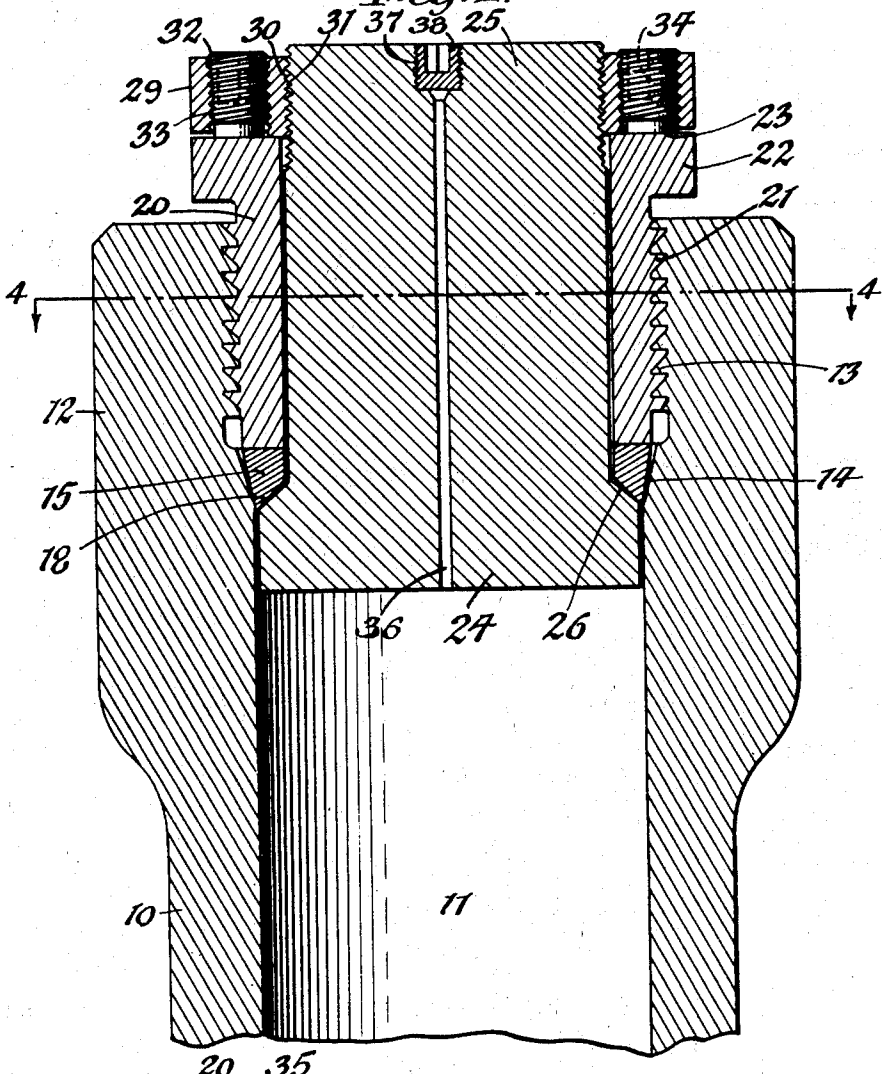
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CLOSURE FOR HIGH PRESSURE VESSELS

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Fig. 1.



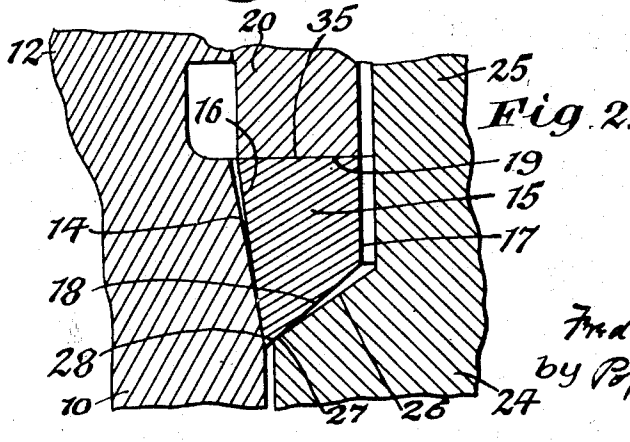


Fig. 2.

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Fig. 3.

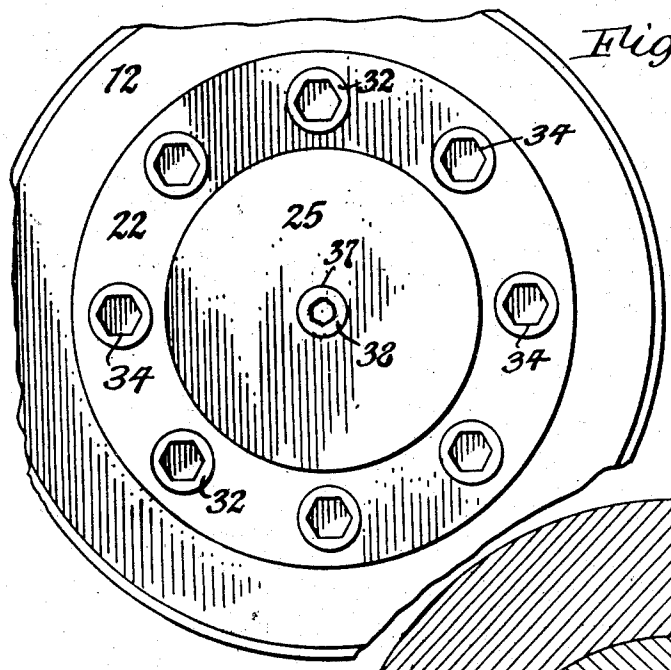


Fig. 4.

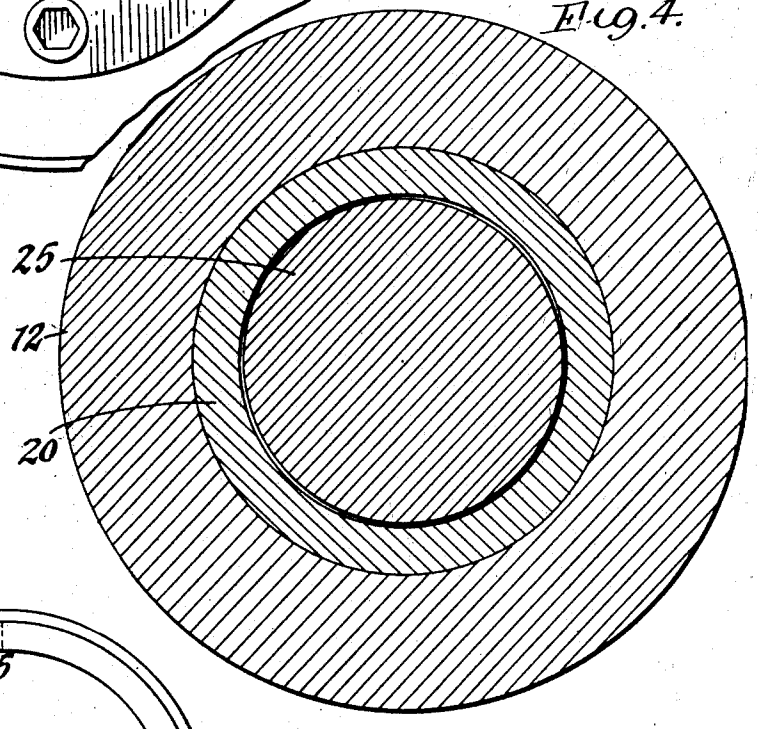
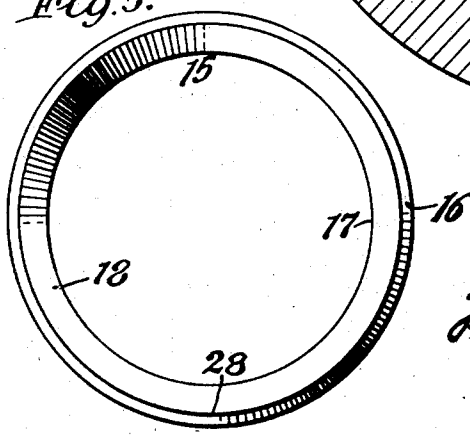


Fig. 5.



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UNITED STATES PATENT OFFICE

2,424,449

CLOSURE FOR HIGH-PRESSURE VESSELS

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Application November 2, 1945, Serial No. 626,324

2 Claims. (Cl. 220—46)

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This invention relates to a closure for high pressure vessels such as autoclaves which are subject to extremely high internal pressures when processing materials contained in the vessels. When using vessels of this character it is extremely important to make the joint between the body or container and the cover absolutely tight so as to prevent leakage under the maximum pressure within the vessel for the purpose of accurately controlling the process and also avoiding objectionable effects of leakages from the vessels.

It is therefore the object of this invention to provide a closure for high pressure vessels whereby the joint between the cover and body of the same may be positively sealed against leakage under the maximum pressure likely to be used and to accomplish this by means which permit the vessel to be readily closed and opened and which are simple in construction and can be easily operated with a minimum of effort and by the use of common tools.

In the accompanying drawings:

Fig. 1 is a fragmentary longitudinal section of the upper part of an autoclave provided with a closure embodying this invention.

Fig. 2 is a similar view, on an enlarged and exaggerated scale, of a portion of the cooperating parts of the members whereby the joint between the body and cover of the container or vessel is sealed against leakage.

Fig. 3 is a top plan view of the autoclave having its closure equipped with this invention.

Fig. 4 is a horizontal section taken on line 4—4, Fig. 1.

Fig. 5 is a bottom plan view of the gasket or sealing ring forming a part of the means for sealing the closure of the autoclave.

In the following description similar characters of reference indicate like parts in the several figures of the drawings:

Referring more particularly to Figs. 1, 2 and 4, the numeral 10 represents the hollow body, shell or container of a vessel such as an autoclave in the cylindrical internal chamber 11 of which extremely high pressures are set up while processing materials therein. This vessel is provided at one or both of its ends with a neck 12 containing an opening or passage through which the material to be treated may be introduced into the vessel and removed therefrom after treatment. Each of these openings or passages is adapted to be covered and uncovered by a sealing closure which embodies this invention and which in its preferred form is constructed as follows:

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The numeral 13 represents an internal helical abutment screw thread formed in the outer part of the passage in the neck of the vessel, which thread is preferably of the buttress type. At the inner end of this thread the bore of this neck is provided with an annular seat or shoulder 14 which is of slightly tapering or conical form and flares outwardly.

The numeral 15 represents a sealing ring or gasket which is made of any deformable material best suited for use in connection with the material to be treated in the autoclave, such as ordinary steel, alloy steel, stainless steel, Monel metal, copper, brass, aluminum and the like. This sealing ring is provided on its periphery with a conical bearing face 16 which tapers inwardly and engages the shoulder or seat 14 of the vessel so as to form a leak-tight joint therewith. The bore 17 of this sealing ring is preferably of cylindrical form. The inner end of this ring is provided with an inwardly tapering or flaring conical seat or face 18 and its outer end is provided with a square thrust face 19 which is arranged horizontally or in a plane at right angles to the axis of the respective passage of the vessel.

The numeral 20 represents a pressure or thrust nut of tubular form which is provided on its periphery with an external screw thread 21 of a form corresponding to that of the abutment thread 13 and adapted to interengage therewith in the assembled position of the several parts of the closure. The inner end of the thrust nut is provided with a bearing face 35 which is square with or at right angles to the longitudinal axis of this nut and adapted to engage the square face 19 on the outer end of the sealing ring or gasket 15. At its upper or outer end this thrrust screw nut is provided with a laterally projecting annular flange 22 for increasing the area of the outwardly facing surface 23 on the same.

The removable cover for the passage of the body comprises an inner cylindrical head 24 and an outer cylindrical shank or stem 25 arranged concentrically with the head and projecting outwardly from the central part of the latter and formed integrally therewith. Between the head and shank of the cover the same is provided with an outwardly facing annular seat or shoulder 26 which is of conical form and tapers outwardly. In the assembled position of the parts the head of the cover is arranged within the treating chamber 11 so that its periphery which is machined fits the bore of the same, the shank of the cover is arranged within the bore of the tubular thrust nut, and the shoulder of the cover

operatively engages the seat or shoulder 18 of the sealing ring.

The angle of the tapering shoulder or seat 26 of the sealing ring is slightly greater than the angle of the shoulder or seat 18 of the cover so that the differential in the angularity between the faces of these seats produces an upwardly diverging gap which in the assembled position of the parts causes only the outer marginal part 27 of the annular cover seat 26 to engage in effect by a line contact with the lip or outer marginal part 28 of the annular ring seat 18, as shown in Figs. 1 and 2, and thus concentrate the pressure of the cover against the sealing ring or gasket and exert the maximum unit pressure on the lip 28 of the same, thereby producing a tighter joint between the same than would be possible if these seats 18 and 26 engaged each other over their entire areas. For this purpose an angle of 29 to 45 degrees for the ring seat 18 and an angle of 30 to 46 degrees for the cover seat 26 has been found satisfactory. The angle of the tapering face 14 of the neck is also slightly greater than the angle of the outer tapering face 16 on the sealing ring so that the difference between these angles produces an upwardly diverging or widening gap between these parts and causes only the lip 28 of the sealing ring to engage by a line contact with the face or shoulder 14, as shown to an exaggerated extent in Fig. 2, whereby a greater unit pressure is exerted by the sealing ring against the vessel and a tight joint between the same is assured. An angle of seven degrees for the face 14 and an angle of six and one-half degrees for the face 16 has been found satisfactory. The angles of the faces 14, 16, 18 and 26 are calculated on the longitudinal axis of the vessel and cover as a base.

The numeral 29 represents a locking screw nut whereby the cover, thrust nut and sealing ring are held in an assembled position preparatory to applying the closure to the vessel and also forms a support for the tightening means whereby the cover is caused to engage with the sealing ring with an extremely high pressure to ensure a firm engagement of the cover seat 26 with the sealing ring seat 18 and the latter with the vessel and positively prevent leakage through the joints between the sealing ring, vessel and cover from the interior of the vessel to the exterior of the same. This locking nut is provided in its bore with a screw thread 30 which engages with an external screw thread 31 on the outer part of the periphery of the cover shank. During the initial part of the operation of applying the closure to the vessel the inner side of the locking nut engages with the outer end of the thrust nut but when tightening means become effective the inner side of the locking nut is separated slightly from the outer end of the thrust nut.

The tightening means for producing high pressure engagement of the sealing ring with the cover and the vessel comprise a plurality of longitudinal set or tightening screws 32 working, respectively, in internally threaded openings 33 formed in an annular row in the locking screw nut around the axis thereof and each of these tightening screws engaging its inner end with the adjacent outer end part of the locking screw. The tightening screws are preferably headless and adapted to be turned by any suitable means, such as a wrench engaging with a non-circular socket 34 in the outer end of the respective tightening screw.

In utilizing this invention the procedure is as follows:

The cover, thrust unit, lock nut, set screws and sealing ring are first loosely assembled as a unit without, however, contacting the seats or shoulders 18, 26 of the sealing ring and cover under any pressure. While this unit is thus assembled the same is introduced into the neck of the vessel by passing the same with its head and sealing ring foremost into the passage of the neck and then screwing the thrust nut 20 into the threaded neck of the vessel body so as to bring the head of the cover within the bore of the body and the outer tapering face 16 of the sealing ring into engagement with the tapering seat 14 of the vessel body. The thrust nut is turned with comparatively little force so that its inner square face 35 upon engaging the outer square face 19 of the sealing ring will produce a contact between the peripheral tapering face 16 of the sealing ring and the tapering face or shoulder 14 of the vessel.

After the closure unit has been placed in the passage of the vessel and the sealing ring has been engaged with the shoulder 14 of the vessel the final sealing of the vessel is accomplished by tightening several set screws 32 so as to raise the lock nut 29 and the cover carried thereon, and thereby press the sealing face 26 of the cover firmly into engagement with the sealing face 18 on the inner side of the sealing ring and also pressing the latter against the face 14 of the vessel, thereby forming a contact therebetween which will prevent leakage under the maximum pressure to which the interior of the treating chamber may be subjected.

Heretofore the cover was drawn out by applying a spanner wrench to the locking nut, attaching a pipe extension to this wrench and applying sledge hammer blows to the pipe in order to obtain greater leverage for turning the lock nut and pressing the seat 26 of the cover against the seat 18 of the sealing ring. Even then it was very difficult to produce a sufficiently reliable joint. The ineffciency of this former method of tightening the closure is due to the great contact area between the relatively long cooperating threads 30 and 31 of the locking nut 20 and cover stem and the small helix angle of the same.

The cooperating threads of each of the set screws 32 and the opening 33 in the locking nut in which it turns, are comparatively short and small in diameter, resulting in a large helix angle and therefore higher efficiency.

By employing a plurality of set screws 32 of this character and operating them individually, the collective pressure of the several screws is much greater and the closure can be made leak-tight much easier than is possible by using a single screw member to draw the tapering shoulder 26 of the cover against the tapering bore 18 of the sealing ring as would be the case if the cover is moved outwardly against the sealing ring by turning the locking nut 29 while its inner side is in engagement with the outer end of the thrust nut 20.

The sealing effect between the cover and sealing ring is further increased by constructing the faces 18 and 26 of different angularity so that the same diverge outwardy and only produce a circular line contact between the outer marginal part 27 of the cover seat and the outer marginal lip 28 of the sealing ring whereby the outward pressure on the cover is concentrated on a small area of the sealing ring and thus ensures a tighter

joint between these members than would be possible if the same contacted each other over their entire cooperating faces.

In like manner the sealing effect between the sealing ring and the vessel is further increased by constructing the faces 14 and 16 of different angles so that they diverge outwardly and cause the lip 18 of the sealing ring to engage the face or shoulder 14 of the vessel by a circular line contact and thus concentrate the pressure unit on this line.

As the pressure in the vessel rises while processing the material under treatment the cover is moved outwardly and the outer marginal part of its sealing face 26 deforms the sealing lip 28 and gradually increases the area of contact between the sealing ring and the cover and vessel from the lip 28 inwardly toward the axis of the sealing ring, thereby further increasing the sealing effect.

During this outward movement of the cover due to the internal pressure within the treating chamber, the set screws 32 do not take any load but are merely lifted slightly from the outer end of the lock nut but are again tightened preparatory to processing the next batch of material. During each processing operation the sealing ring is deformed increasingly adjacent to its lip 28 due to the unit pressure which is concentrated on the line contacts between the outer and inner sides of the sealing ring and the adjacent faces 26 and 15 of the cover and the vessel and after his sealing ring has reached the limit of its deformation capacity the same is replaced by a new ring.

Instead of introducing the material to be treated into the vessel and removing the same therefrom after being treated while the cover is detached from the vessel it is a common practice to leave the cover in place on the vessel and provide the same with a filling opening 36 which extends lengthwise through the same from the outer to the inner side thereof and through which the vessel may be charged with the material to be treated and the resultant product removed. At its outer end this filling opening 36 is provided with an enlarged internally screw threaded counterbore 37 forming part of the means whereby the material to be treated may be charged into the vessel and the finished material withdrawn therefrom. The filling opening may also be closed during the operation of processing the material within the vessel by any suitable means, such as a screw plug 38 fitting tightly in the bore 35.

The means of this invention for tightening the cover and the formation of the cooperating surfaces between the cover and the sealing ring permit of effectively closing the treating vessel against leakage under the highest pressures likely to be encountered in actual practice.

Moreover, these tightening and sealing means are exceedingly simple in construction, they can be easily operated without the use of special tools and the same permit of quickly opening and closing the vessels without undue effort.

I claim as my invention:

1. A closure for a high pressure vessel having a tubular neck provided in its inner part with an annular shoulder and in its outer part with an internal screw thread, comprising a sealing ring engaging its periphery with said shoulder and provided on its inner side with an outwardly tapering conical seat, a tubular thrust nut having an external screw thread engaging with the internal thread of said neck and engaging its inner end with the outer side of said sealing ring, a cover having an inner head arranged within said neck below said sealing ring, an outer shank projecting outwardly from said head through said tubular thrust nut and provided at its outer end with an external screw thread and an outwardly tapering annular seat which engages the conical seat of said sealing ring, a locking nut arranged above said thrust nut and having an internal screw thread engaging with the screw thread of said shank, and a plurality of set screws working in threaded openings in said locking nut and bearing against the outer end of said thrust nut.

2. A closure for a high pressure vessel having a tubular neck provided in its inner part with an annular shoulder and in its outer part with an internal screw thread, comprising a sealing ring engaging its periphery with said shoulder and provided on its inner side with an outwardly tapering conical seat, a tubular thrust nut having an external screw thread engaging with the internal thread of said neck and engaging its inner end with the outside of said sealing ring, a cover having an inner head arranged within said neck below said sealing ring, an outer shank projecting outwardly from said head through said tubular thrust nut and provided at its outer end with an external screw thread and an outwardly tapering annular seat which engages the conical seat of said sealing ring, the angularity of the seat on said sealing ring being greater than the angularity of the seat on said cover so that these seats diverge outwardly relative to each other and are engaged with each other by a circular line contact, a locking nut arranged above said thrust nut and having an internal screw thread engaging with the screw thread of said shank, and a plurality of set screws working in threaded openings in said locking nut and bearing against the outer end of said thrust nut.

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