SEALING DEVICE FOR PRESSURE CONTAINERS

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This invention relates to certain improvements in sealing devices for pressure containers, and the nature and objects of the invention will be readily understood by those skilled in the art in the light of the following explanation and detailed description of the accompanying drawing, illustrating what we at present consider to be the preferred embodiment or mechanical expression of our invention from among various other forms, arrangements, embodiments and designs thereof, of which our invention is capable within the spirit and scope thereof.

While it is to be understood that our invention provides a sealing and closing device adapted generally to various types of pressure containers, it is however, primarily designed and intended for use with and to meet the conditions encountered by so-called carbon dioxide “liquefiers” that are charged with solid carbon dioxide and then sealed for conversion of the solid to liquid by the pressures generated through gasification or sublimation of the carbon dioxide therein. With such a “liquefer”, the container thereof is charged with solid carbon dioxide and sealed by a removable closure, so that the solid carbon dioxide sublimes and gasifies under the action of heat transferred therein through the container walls. This conversion or sublimation of the solid to gas within the container finally builds up sufficiently high pressures in the container, of the order of 1000 pounds per square inch, to cause the gas to liquefy under proper temperature conditions. These so-called liquefiers are in use for various purposes and are designed to take the place of the familiar and generally used tanks or “cylinders” in which liquid carbon dioxide is charged and held under liquefying pressures, which tanks after charging are then shipped to the various points of use.

With such types of “liquefiers”, or analogous and equivalent containers, it is necessary to have some form of closure by which the pressure container can be opened for receiving its charge of solid carbon dioxide or other material and which can then be operated to tightly close and seal the container to withstand the high pressures therein without gas leakage and resulting pressure reduction and gas loss.

A main object of our invention is to provide a sealing and closure device for pressure containers, particularly those of the above referred to “liquefier” types, which device is so designed and arranged as to be readily applied to a container in closing and sealing position thereon, and which can be quickly released and bodily removed from the container to open the same, without requiring a plurality of manually and individually operable closure fastening members, such as bolts, screws, clamps and such like; and further without the necessity of rotating or turning the entire sealing and closing device in applying and removing the same.

A further object of our invention is to provide such a pressure container sealing and closure device, that is bodily removable from and insertible in container closing position, and is mechanically locked into closing and initial sealing position, and released from closing position for removal, by the manual actuation of a single operating member that controls the locking and sealing and its release.

Another object and feature of our invention is to provide in such a sealing and closure device for initial sealing of the container by the act of locking and securing the closure in position on the container, and then for automatic functioning of the closure under the action of the pressure in the container to increase the sealing action as the pressure within the container increases.

Another object of the invention is to so design and arrange the sealing and closing device that the locking operation is initiated and takes place prior to the preliminary sealing that results from the locking operation, and in releasing the closure device from locked position for removal from the container, the sealing by the device is eliminated prior to the release of the device from locked position.

A further object of the invention, is to provide a simple design of the container and of the sealing and closing device for cooperative relation and positioning of the device on the container for properly and accurately locating the locking and sealing mechanism by the insertion of the device in the container; and further to provide convenient means for grasping the device in applying and removing the same bodily to and from the container.

With the foregoing general objects and results in view, as well as certain others that will appear and be readily understood from the following explanation, our invention consists in certain novel features in construction and in combination and arrangements of elements, all as will be more fully and particularly referred to and specified hereinafter.

Referring to the accompanying drawing:

Fig. 1 is a transverse vertical section taken as on the line 1—1, of Fig. 2, disclosing a sealing and closure device mounted in operative position closing and sealing a high pressure con-
tainer, the upper end portion only of the container being shown. Fig. 2 is a view in top plan, with a portion thereof broken away and shown in horizontal section, of the closing device of Fig. 1, in mounted position locked in the end of and sealing the high pressure container.

An example of one possible embodiment and mechanical expression of which a sealing and closure device of our invention is capable is disclosed in the accompanying drawing, and is particularly designed and intended, although not so limited, for use on a high pressure container of the so-called liquefier type. Obviously the principles and several features of our invention can be mechanically expressed in a variety of other forms and embodiments, and our invention contemplates and includes all such other expressions thereof within its broad scope.

In this illustrated example, a sealing and closure device of our invention includes a locking ring or annular member 10 providing a supporting structure that carries and has mounted thereon a vertically disposed bolt 11, adapted thereto spaced intervals therearound the cylindrical locking members or bolts 11, that are disposed radially of and transversely through this locking ring 10. Each of the locking members or bolts 11 extends inwardly through the ring 10 and is provided with the reduced diameter inner end portion or shank 12 that is provided at its inner end with a socket or recess 14 in which a ball 15 is freely revolvably mounted and confined to form an anti-friction bearing to which the axial pressures or forces are applied in actuating these locking members.

The locking ring member 10 is provided with a spider or support frame 16, across its upper top side, which spider provides a central boss 17, having a vertical internally threaded bore there-through in axial alignment with the locking ring 10. A spindle 18, is externally threaded and extends downwardly through the threaded bore of the boss 17 in vertically disposed position axially aligned with the ring 10, and this vertical spindle 18 is formed at its lower or inner end with the outwardly flaring, conical head 19, forming the upwardly and inwardly inclined surface 20 there-around. This outwardly flared, conical head 19, is positioned for engagement of its inclined surface 20 at the balls 15 at the inner ends of the locking members or bolts 11, so that by raising the screw spindle 18 to raise the head 19 to the position of Fig. 1, with its portion of greatest diameter disposed between and engaged by balls 15, the locking members or bolts 11 are forced outwardly through the ring 10, to their outwardly projected locking positions, as shown in Figs. 1 and 2, of the drawing. At the upper end of the vertical spindle 18, there is fixed thereon a suitable hand wheel 21, by which the spindle is rotated manually or otherwise, to raise and lower the spindle and head 19, to and from position for projecting the locking members or bolts 11 to their locking position.

The locking members or bolts 11, are normally withdrawn and maintained in their retracted, unlocked positions by the contractile springs 22 (see Fig. 2, in particular). These springs are each connected between adjacent locking member or bolts 11, as by the eye members 23a threaded into the members 11, so as to continuously exert force on the members 11, tending to withdraw or retract these locking members to normal unlocked positions, with their outer ends disposed within the outer surface or face of the ring member 10.

With such arrangement, therefore, when the vertical spindle 18 is rotated to lower the conical head 19, the springs 23 act to withdraw and retract members 11 inwardly from their locking positions, with the balls 15 of the members 11, maintained in rolling contact and engagement with the upwardly and inwardly inclined surface 20 of the conical head 19. When the members 11 are in their retracted and unlocked position, they are forced outwardly to their projected positions against the forces exerted by the springs 22, by actuating the hand wheel 21, to raise the vertical spindle 18 and the conical head 19, to the position shown in Fig. 1, with the head 19, forcing the locking members or bolts 11, outwardly through ring 10, to their projected and locking positions.

The vertical spindle 18 and its locking member actuating conical head 19, is formed with an axial bore extending therethrough from end to end thereof, and a bolt 23, is mounted in and extends slidably and downwardly through the bore of the vertical spindle 18, with the head 24 of this bolt adapted to engage the outer end of the spindle 18, to limit downward movement of the bolt through the spindle. The bolt 23 is of a length to extend downwardly or inwardly beyond the head 19 of spindle 18, and through the ring 10 and a distance therebelow or inwardly therebelow. The lower or inner end of the bolt 23 is of reduced diameter and externally threaded to receive the sealing and closure plate or member 25.

This closure plate 25 is formed with an upwardly extended central projection or boss 25', having an internally threaded bore or socket to receive the threaded lower end of the bolt 23, with the closure plate thus secured to and carried by the lower end of bolt 23 in position below and at the under or inner side of the locking ring 10.

The locking ring or supporting structure 10 is provided at its lower or inner, outer edge with an annular groove or recess 27 that receives and engages an upwardly and outwardly inclined upper-face or wall 27a, and an annular sealing gasket or ring 28, of a suitable flexible or compressible material, is fitted and suitably confined in this recess 27 around the ring 10, with its under surface vertically aligned with and adapted to be engaged by the upper edge of the closure wall or flange 26, of closure 25, and its outer side or face exposed for sealing engagement with a container, as will be later referred to.

It is thus apparent that when the vertical spindle 18 is raised by the hand wheel 21, to position with the conical head 19 forcing the locking members or bolts 11 outwardly through ring 10, the bolt 23 will be raised by the engagement of its head 24 with the upper end of spindle 18, and the closure 25 will be raised by the engagement of its upper or outer edge of the vertical wall or flange 25 thereof in sealing engagement with the sealing gasket or ring 28. When the spindle 18 is lowered to lower head 19 and permit the springs 22 to withdraw the locking members 11, to their retracted and unlocked position, the closure plate 25 and the bolt 23, will drop or be lowered by gravity, due to the lowering of the upper end of spindle 18 that is engaged by the bolt head 24, so that the closure plate 25 will
move downwardly out of engagement with the sealing gasket 26, carried by the locking ring 10.

In order to limit the downward movement of the closure plate 25, a bolt 29 is inserted through the closure 25 and extends upwardly therefrom and slidably through a lug 30 that is formed extending inwardly from the upper portion of the ring 10. A stop pin 31 is extended transversely through the upper end of bolt 29 above lug 33 and thus engages this lug when the closure plate 25 is dropped or lowered, to thereby limit the distance that the closure plate can drop below the locking ring or supporting structure 12.

For the purpose of handling, that is, applying the sealing and closure device to and removing it from operative position on a high pressure container, we have in this instance provided the diametrically opposite handle and support members 32 that are attached and secured at one end to the upper edge of locking ring 10, extending a distance upwardly therefrom, and are then extended horizontally and outwardly a distance beyond and radially disposed from the locking ring or supporting structure 12.

We have disclosed in the accompanying drawing the upper end portion of a high pressure container 33, that is preferably of the so-called liquefied-gas type and which is open and is adapted to be closed sealed by a device of our invention. In accordance with our invention, the container 33 is provided with the diametrically opposite, vertical and open recesses 35 in the upper end or edge wall thereof, for the locating member 11 when these latter are projected therethrough.

In the operation and use of the sealing and closure device of our invention in the form hereinafter described and with the high pressure container 33 of a so-called liquefier, solid carbon dioxide, or other pressure generating material, is placed in the container and then the closure device is positioned in the open upper end of the container with the handle members 32 seated in the recesses 34 at the upper end of the container for supporting the device in proper position. The relative position and location of the recesses 33 with respect to the locking members 11, and the holes 35, in the container wall, is such that in mounted position of the device as shown in Fig. 1, the handles 32 support and position the locking ring 10 in the container with the locking members or bolts 11, in alignment with the bolt receiving holes 35. In this position and when the device is inserted in the open upper end of the container, the vertical spindle 18 and the conical head 19, are in their lowered positions with the locking bolts 11 recessed in the recesses 34 of the upper end, in the container, and the bolt receiving holes 35 in the upper portion, out of engagement with the sealing gasket 28. The locking ring or supporting structure 10 has an external diameter but slightly less than the internal diameter of the container and is freely inscribable and removable therefrom. By such relative diameter, the sealing gasket is placed in position for sealing engagement with the container wall when compressed by closure 25, or can be designed to make initial engagement as by a sliding fit with such wall.

After bodily inserting the device and positioning the same by placing the handles 32 in the container recesses 34, the hand wheel 21, is then rotated to raise the conical head 19, and force the locking bolts 11 outwardly into positions extending into and outwardly through the bolt receiving holes 35 in the container wall. In this way, the bolts 11, firmly and securely lock the device in position, within the open end of the container.

Elevation or outward movement of the spindle 18 to raise the conical head 19, simultaneously raises the closure plate 25 into initial and preliminary sealing position engaging the sealing gasket 28 around the lower edge of the locking ring 10. This engagement of the sealing gasket 28 by the upper edge of the closure flange 26, tends to force the gasket 28, aided by the inclined wall 28a of the recess 27, outwardly into sealing engagement with the inner surface of the container wall 33, as will be clear by reference to Fig. 1, of the drawing. Thus, the container 33, is closed and initially sealed by the closure plate 25 and the sealing engagement by the gasket 28 with this closure plate and with the inner surface of the container wall.

Due to the mounting of the closure plate 25 at the lowerje or inner end of the bolt 23, and the fact that this bolt is freely, upwardly slidably in and through the vertical spindle 18 independently of this spindle and of the locking ring or supporting structure 10, as the pressure generated in the initially sealed container 33 increases, this pressure will move the closure plate 24 upwardly against the sealing gasket 28 with increased force and thus increase the sealing between the gasket 28 and the container wall by more firmly and tightly forcing the gasket into sealing engagement with the container.

The sealing and closure device is readily and quickly bodily removed from the container 33 to unseal and open the same by manipulating the hand wheel 21 to lower the conical head 19 and project the springs 22 to withdraw the locking bolts 11 from the bolt receiving holes 35 in the container wall. As the spindle 18 is lowered in this unlocking operation, the bolt 23, with the closure plate 24, is lowered out of sealing engagement 30 with the gasket 28, so that the seal is broken and eliminated. The entire device can then be bodily lifted and raised from the container by the handles 32. In this connection, it is to be noted that in the locking of the device to the container by the bolts 11, the bolts reach locking engagement prior or in advance of the sealing engagement of the closure 25 with the sealing gasket 28; while in the operation of unlocking and removing the device from the container, the bolts are released from locking engagement only after the sealing engagement of the closure plate with the gasket 28 has been broken.

In applying the closure and sealing the container, the device is bodily inserted into the open upper end of the container and is automatically located at the proper height and conical position in the container, by the handles 32 seating in the container wall recesses 34, so that all it is necessary to do is to actuate the hand wheel 21, to force the bolts to locking position and raise the closure plate to sealing position in order to completely seal and close the container.

By the arrangement as shown, the locking action takes place prior to and in advance of the...
sealing of the container by the engagement of the closure plate with the gasket, it thereby being assured that the closure is securely locked in position on the gasket engage the container by the closure plate and under the action of the pressure within the container. Similarly, the locking action is maintained during the operation of releasing and removing the device until the sealing action has been broken and released, and then unlocking is effected and the entire device detached for removal bodily as a unit.

It is also evident that various changes, modifications, variations, substitutions, eliminations and additions might be resorted to without departing from the spirit and scope of our invention, and hence, we do not wish to limit ourselves in all respects to the exact and specific disclosures hereof.

What we claim is:

1. A sealing and closure device for pressure containers, embodying a structure for removable mounting at the open end of a container, radially disposed locking members on said structure for outward projection into locking engagement with a container, means for projecting and releasing said members to and from locking engagement, a sealing member carried at the inner end of and around said structure for sealing engagement with the container wall, a closure member carried by said structure at the inner end thereof and movable relative to the structure to and from sealing engagement with said sealing member, and an operative connection between said closure member and said locking member operating means for moving the closure member into sealing position when the locking members are projected and for movement of the closure from sealing position when the locking members are retracted.

2. A sealing and closure device for pressure containers, embodying a structure for removable insertion in the open end of a container, means on and removable with said structure as a unit for releasably locking said structure in a container, a sealing member around said structure for sealing engagement therewith and with the container wall to close and seal the open end of the container, a closure member carried by said structure and movable thereon to and from sealing engagement with said sealing member, said closure forced into sealing engagement with said member by pressure within the container.

3. A sealing and closure device for pressure containers, embodying a structure for bodily insertion in and removal from the open end of a container, means for removable supporting said structure in the container, locking members on said structure movable to and from locking engagement with the container, means for moving said members, a sealing member on said structure for sealing engagement with the container wall, a closure member carried by said structure at the inner end thereof within the container, said closure movable relative to said structure to and from locking engagement, and means for moving said locking member into engagement with the sealing member when the locking mechanism operating means for moving said member into engagement with the container.

4. A sealing and closure device for bodily insertion in and removal from the open end of a pressure container, embodying in combination, a supporting structure for insertion in the container and having a sealing member therearound for sealing engagement with a container wall, locking means on the supporting structure for releasably securing the same in position in the container, and a closure member carried from the supporting structure at the inner end thereof and movable relative to said structure to and from sealing engagement with said sealing member.

5. A sealing and closure device for pressure containers, embodying in combination, a supporting structure for mounting in the open end of a container and having a sealing member therearound for sealing engagement with a container wall, locking means on the supporting structure for releasably securing the same in position in the container, and a closure member carried from the supporting structure at the inner end thereof and movable relative to said structure to and from sealing engagement with said sealing member.

6. A sealing and closure device for pressure containers, embodying in combination, a supporting structure for mounting in the open end of a container and having a sealing member therearound for sealing engagement with and around the container wall, locking mechanism on said supporting structure for operation to and from locking engagement with the container, means for operating said mechanism, a closure member carried by the supporting structure at the inner end thereof within the container and movable relative to such structure to and from sealing engagement with said sealing member, and means operatively associating said closure member with the locking mechanism operating means for moving the closure member into sealing engagement with said sealing member when the locking mechanism is actuated to locking position.

7. In a sealing and closure device for pressure containers, in combination, a supporting structure for mounting in the open end of a container and having a sealing member therearound for sealing engagement with and around the inner surface of the container wall, mechanism on said structure for releasably locking said member to said structure in position in the container, means for operating said mechanism to and from locking position, a closure member for the container carried by the supporting structure at the inner end thereof within the container and movable relative to the structure to and from sealing engagement with said member, and coupling said locking mechanism operating means with said closure member for moving said member into engagement with the sealing member when the locking mechanism is actuated to unhooking position.
8. In a sealing and closure device for pressure containers, in combination, a ring member for insertion in the open end of a pressure container, means for supporting the ring member in position from the upper end of the container, a plurality of radially disposed locking bolts on and around said ring member for projection into locking position with the container wall, a vertically disposed spindle on and extending through said ring member, said spindle provided at its inner end with an outwardly flaring conical head for engaging and forcing said locking bolts into projected locking position when the ring member is inserted into said container, said ring member for moving said spindle and head inwardly and outwardly to actuate the locking bolt, spring means normally forcing said bolts to retracted unlocked position, said spindle and head forming with an axial bore therethrough, a sealing member on and around the inner side edge portion of said ring member for sealing engagement with and around the inner surface of the container wall, a headed bolt member slidably extending through said spindle bore and a distance inwardly beyond said ring member, a closure for the container carried by said sealing member movable therewith relative to the ring and from sealing engagement with said sealing member, and said closure member moved to sealing position by the bolt member when said spindle is moved outwardly to project the locking bolts into locking position, said closure member in sealing position movable outwardly independently of said ring and spindle to exert increased sealing pressure on said sealing member under the action of pressure within the container.

In combination, with a pressure container having an open end with a series of locking bolts receiving holes through the side wall thereof adjacent the open end and diametrically opposite recesses formed in the edge of the container wall at the open end, a sealing and closure device for bodily insertion and removal to and from position in the container open end, embodying a supporting structure having opposite radially disposed handle members for fitting in said container recesses to support the structure in position within the open end of the container, a plurality of radially disposed locking bolts on said structure for projection to locking position in said container side wall holes, means for projecting and retracting said bolts to and from locking position, a sealing member around the inner end of said supporting structure for sealing engagement with and around the inner surface of the container wall, a closure member carried by said structure at the inner end thereof within the container and movable relative to the container to and from sealing engagement with said sealing member, and said closure member operatively associated with the means for projecting and retracting the locking bolts for movement by said means to sealing position when the bolts are projected and for release for movement out of sealing engagement when the bolts are retracted.

10. In combination, in a sealing and closure device for pressure containers, a supporting structure for the container, a locking member carried by said structure in the outer surface of the container wall, a sealing member around said structure for sealing engagement with and around the inner surface of the container wall, a closure for the container carried by said structure, means for supporting the ring member in position from the upper end of the container, a plurality of radially disposed locking bolts on and around said ring member for projection into locking position with the container wall, a vertically disposed spindle on and extending through said ring member, said spindle provided at its inner end with an outwardly flaring conical head for engaging and forcing said locking bolts into projected locking position when the ring member is inserted into said container, said ring member for moving said spindle and head inwardly and outwardly to actuate the locking bolt, spring means normally forcing said bolts to retracted unlocked position, said spindle and head formed with an axial bore therethrough, a sealing member on and around the inner side edge portion of said ring member for sealing engagement with and around the inner surface of the container wall, a headed bolt member slidably extending through said spindle bore and a distance inwardly beyond said ring member, a closure for the container carried by said sealing member movable therewith relative to the ring and from sealing engagement with said sealing member, and said closure member moved to sealing position by the bolt member when said spindle is moved outwardly to project the locking bolts into locking position, said closure member in sealing position movable outwardly independently of said ring and spindle to exert increased sealing pressure on said sealing member under the action of pressure within the container.

11. A sealing and closure device for pressure containers, including, a supporting structure for removable mounting in the open end of a pressure container, means for releasably locking said structure in position on the container, a closure member for the container carried by said structure at the inner end thereof within the container, a sealing member interposed between and around said closure and the inner end of said structure for sealing engagement with and around the container wall, said closure movable relative to the supporting structure to and from sealing engagement with said sealing member and to force the latter into sealing engagement with the container wall, and means operatively associating the locking means with the closure member for moving the latter into and from locking engagement with the sealing member by actuation of the locking means to lock and unlock said supporting structure to the container.

12. In combination with a pressure container having an open end and opposite recesses in the open end wall thereof, a sealing and closure device for insertion in and removal from the open end of the container as a unit, said device including a supporting structure having opposite outwardly extended handle members received in the container end wall recesses to support and position the structure in the open end of the container, means for releasably locking said structure in position in the container against outward displacement, a closure member for the container carried from said structure at the inner end thereof within the container, a sealing member between and around the inner end of said structure and the closure member for sealing engagement therewith and with and around the inner wall of the container, said closure member movable relative to the supporting structure to and from sealing engagement with the sealing member by actuation of the locking means to lock and unlock said supporting structure.

13. In combination, a pressure container having an open end and opposite recesses in the end wall opening through the outer edge of the wall, said container wall also being provided with locking-member-receiving bores therethrough, adjacent the open end thereof, a sealing and closure device for bodily mounting in and removal from the open end of the container as a unit, said device including a supporting structure having opposite laterally projecting members received in said end wall recesses to support and position the structure in mounted position relative to the locking member bores in the container wall, lock and unlock said structure aligned with said wall bores, respectively, and projectable into said bores to lock said structure in the container against outward displacement, means for projecting and retracting said locking members to and from locking position, a sealing member at and around the inner end of said structure for sealing engagement
with and around the adjacent inner wall of the container, and a closure member carried from said structure at the inner end thereof and movable relative thereto toward and from said sealing member, said closure member held in sealing engagement against and tending to force the sealing member into engagement with the container wall, by pressure within the container.

In combination in a removable closure unit for pressure containers, locking means for releasably securing said unit in position in the open end of a container, and means operatively associated with said locking means for sealing the unit in closing relation with the container, said sealing means actuated to sealing position by operation of the locking means after said means initially reaches unit securing position, and actuated to unsealed position by operation of the locking means to release the unit from secured position but prior to such release.

15. A removable closure unit for pressure containers, including in combination, a pressure resisting closure member adapted to fit in the open mouth of a pressure container, an open locking ring adapted to fit in the container mouth above the closure member and having retaining means adapted to engage with the container and allow for ready attachment and detachment of the locking ring; the ring having in its lower peripheral portion an annular bevel- edged groove therearound, a gasket positioned in the ring groove, and means supportable on and bearing upon the container for tightening the closure member against the locking ring through the interposed gasket to wedge the gasket outwardly against the walls of the container and form a tight seal therewith.

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