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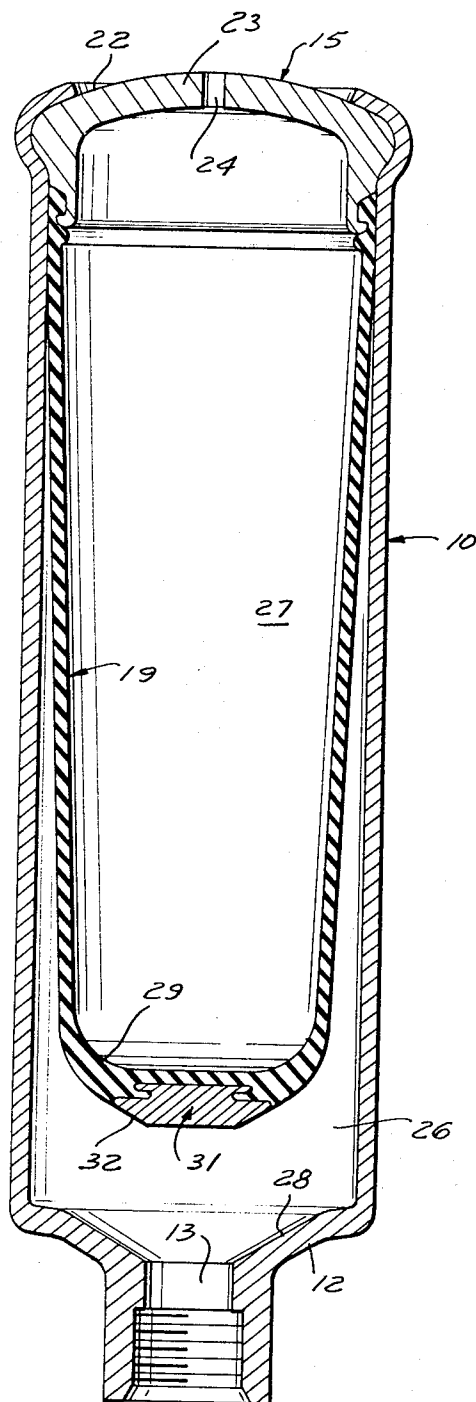
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3,408,731

METHOD OF RETAINING COVER MEMBER ON PRESSURE VESSEL

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2 Sheets-Sheet 1



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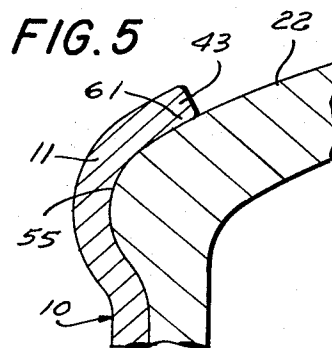
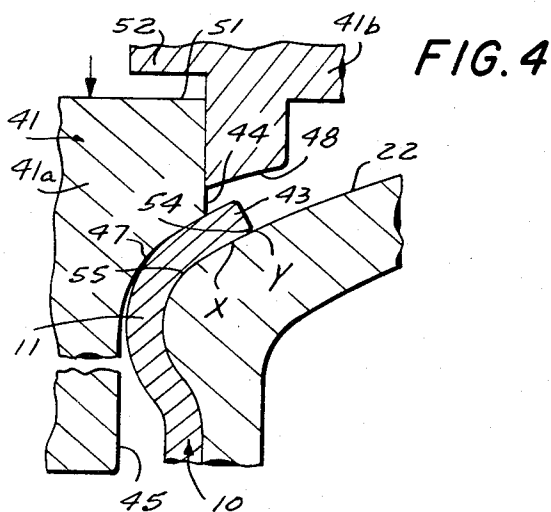
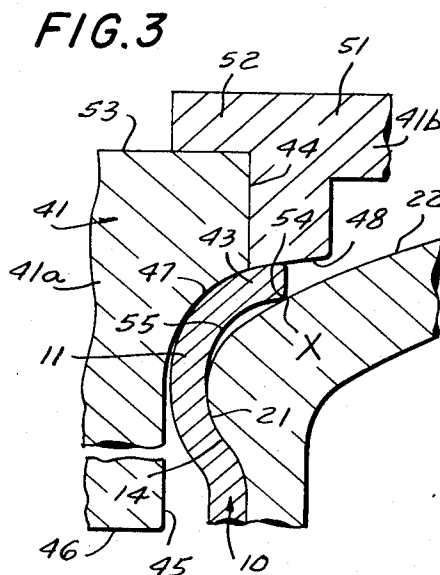
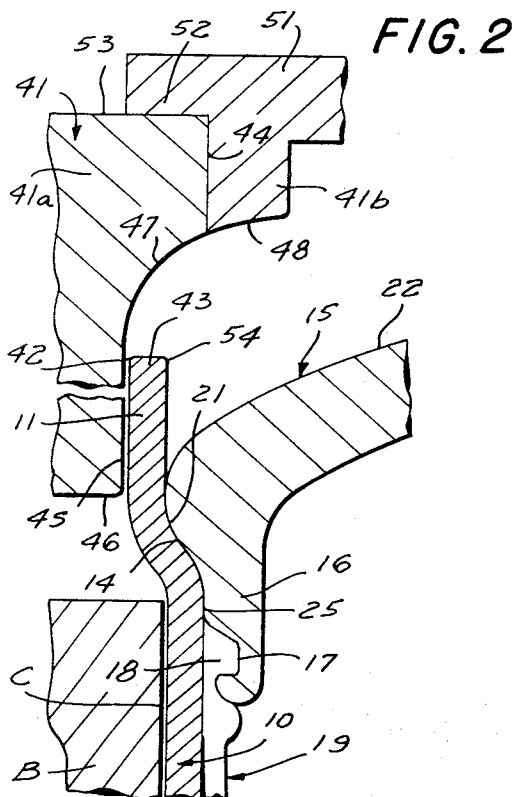
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METHOD OF RETAINING COVER MEMBER ON PRESSURE VESSEL

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2 Sheets-Sheet 2



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METHOD OF RETAINING COVER MEMBER ON PRESSURE VESSEL

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This invention relates to a method of retaining cover members on pressure vessels, more particularly to a method of retaining a cover member on a pressure vessel of the type having an enlarged mouth with a cover member positioned therein and retained in fixed position by bending over the periphery of such mouth.

As conducive to an understanding of the invention, it is to be noted that where pressure vessels of the above type utilize a deformable bladder, the mouth of which is secured between the cover member and the adjacent wall of the container and which defines two chambers in the container on opposed sides thereof which are in communication respectively with ports through which fluid may flow into and out of the pressure vessel, if the cover member should not be securely retained in fixed position, it is likely to reciprocate slightly during use of the container due to variations of pressure therein.

As a result of such slight movement or "breathing" of the cover member, there would be continuous frictional rubbing against the mouth of the bladder retained between the cover member and the wall of the container, with resultant wear of the bladder material and failure of the seal effected at such bladder mouth. Thus, with repeated use of the pressure vessel and gradually increased wear and fatigue of the seal defined at the mouth of the bladder as a result of the movement imparted thereto, the effectiveness of such seal would progressively decrease with consequent failure of the unit.

Furthermore, such breathing action causes a pumping to occur at the sealed mouth of the bladder so that the film of oil which is inherently present on the wall surface of the container will creep out of the container with resultant dripping and contamination of the room in which the equipment is used, which is especially serious when the equipment is used on dental chairs, in hospitals to control operating tables and the like or to control hospital beds.

Furthermore, such repeated breathing action will cause continuous stresses on the bent over periphery of the container adjacent its mouth with resultant cracking of such material thereby permitting blowout of the cover member due to the relatively high pressure in the container with the constant danger of injury to bystanders.

It is accordingly among the objects of the invention to provide a method for retaining in place the cover member of a pressure vessel of the above type, which method is relatively simple to perform, requiring a minimum of steps and a minimum of equipment and which will dependably retain the cover member in fixed position without likelihood of movement thereof.

According to the invention, these objects are accomplished by the arrangement and combination of elements hereinafter described and more particularly recited in the claims.

In the accompanying drawings in which are shown one or more of various possible embodiments of the several features of the invention.

FIG. 1 is a longitudinal sectional view of a pressure vessel according to the invention,

FIGS. 2, 3, and 4 are fragmentary sectional views illustrating the steps for securely retaining the cover member in fixed position according to the invention, and

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FIG. 5 is a fragmentary sectional view of the closed mouth of the pressure vessel.

Referring now to the drawings, in the embodiment shown in FIG. 1, the pressure vessel comprises a container 10 of strong rigid material such as aluminum, steel or the like, capable of withstanding high pressure.

The container 10 is cylindrical along the major portion of the body thereof and is closed at one end as at 12, said end having an axial port 13 therethrough defining the liquid port of the pressure vessel.

The cylindrical portion 11 of the container 10 at the mouth thereof is of larger diameter than the main body portion of the container defining a curved shoulder 14 to receive a cover member 15. The cover member 15 has a depending portion 16 which fits into the mouth of the container, said depending portion 16 being conformed adjacent its inner end with an annular groove 17 to receive the annular bead 18 at the mouth of a bladder 19 to retain the latter in fixed position in the container.

As is clearly shown, the cover member has a curved periphery 21 conformed to the curvature of the shoulder 14, and the portion 22 of the top surface of the cover member 15 adjacent the curved periphery 21 thereof illustratively is slightly curved. The central portion 23 of the cover member 15 is slightly arched and provided with an axial opening 24.

The depending portion 16 of the cover member has a cylindrical portion 25 which fits relatively snugly in the cylindrical portion of container 10 adjacent the curved shoulder 14 so that the cover member 16 will be accurately centered therein.

The bladder is of resilient material such as rubber or synthetic plastic of like physical characteristics and is expansible and deformable in order to provide its desired function.

The bladder 19 defines two chambers in the pressure vessel, i.e., illustratively an oil chamber 26 between the outer wall of the bladder and the inner surface of the container, which chamber is in communication with port 13 and a gas chamber 27 in the bladder 19 which is in communication with the axial opening or port 24 in the cover member, the latter illustratively having an air valve (not shown) positioned therein for charging the bladder 19.

As illustratively shown, the closed end 12 of the container is in the form of a fulcrum of a cone defining an inclined surface 28, the lower end of which surface defines the inner end of port 13.

In order to close the inner end of port 13, the free end 29 of the bladder 19 has a button 31 secured thereto and axially aligned with the longitudinal axis of the bladder 19. The button is of material harder than that of the bladder and may, for example, be of neoprene, aluminum or other suitable material.

As is clearly shown in the drawings, the outer surface 32 of the button 31 also has the form of a fulcrum of a cone. The angle of inclination of the outer surface 32 of the button 31 and the angle of inclination of the inclined surface 28 of the end 12 of the container are approximately the same. The tangent of each angle must be greater than the tangent of the angle of friction, which angle is dependent on the materials used, the finish of the materials as well as the fluid that is utilized in the container.

The cover member 15 is securely retained in position in the illustrative embodiment shown by inwardly bending the enlarged cylindrical portion or mouth 11 of the container. According to the invention, to accomplish the retention of the cover member 15, the pressure vessel preferably is assembled in the following manner.

The cover member 15 with the annular bead 18 of the bladder 19 positioned in the annular groove 17 is first positioned in the enlarged mouth 11 of the container so that the curved periphery 21 of the cover member 15 rests on the curved shoulder 14, the cylindrical portion 25 of the depending portion 16 of the cover member 15 accurately centering the cover member in the container.

The container with the cover member 15 positioned therein is then positioned in a corresponding cavity C in a suitable base member B which holds the container in upright position. Thereupon, a die 41 is moved against the outer periphery 42 of the rim 43 of the enlarged mouth portion 11 of the container to effect the retention of the cover member.

As is clearly shown in FIG. 2, for example, the die 41 illustratively has two separate and distinct elements 41a and 41b. The element 41a has a central opening 44 slidably to receive the element 41b. The element 41a of the die 41 has a substantially cylindrical wall surface 45 extending upwardly from its lower edge 46 for a distance greater than the length of the enlarged mouth portion 11 of the container 10 above the curved shoulder 14 thereof. Thereupon, the wall surface 45 has a curvature 47 which corresponds to the curvature of the periphery 21 of the cover member 15. The element 41b has a curved annular pressing surface 48 which has an inclination less with respect to the horizontal than the inclination of the slightly curved portion 22 of the cover member 15 and as illustratively shown, such curved pressing surface 48 is a continuation of the curvature of the portion 47 of the element 41a.

The element 41b has a head 51 of diameter greater than that of opening 44 in element 41a so that the periphery 52 of head 51 may move against the top surface 53 of the die element 41a.

In the operation of the die 41, pressure is exerted by a suitable press against the head portion 51 of the die element 41b to move both die elements 41a and 41b downwardly.

As a result of such movement, as soon as the outer periphery 42 of the rim 43 of the container is engaged by the curved surface 47 of the die element 41a, the rim 43 of the container will be forced inwardly following the curvature of the curved portions 47, 48 of die elements 41a, 41b until the rim 43 reaches the position shown in FIG. 3. At this time further downward movement of the rim 43 of the container will be prevented as its inner periphery 54 abuts against the top surface 22 of the cover member 15 as at X. Thereupon, pressure is now exerted by the press against the outer die element 41a only, the inner die element 41b being released.

As a result, since the curvature of the surface 47 of the outer die element 41a corresponds to the curvature of the curved portion 21 of the cover member 15, the outer die element will be moved downwardly until the inner surface 55 of the enlarged mouth portion 11 of the container presses snugly against the curved periphery 21 of the cover member 15, as shown in FIG. 4. As the result of such pressure, there will be further inward movement of the rim 43 of the container so that the inner periphery 54 of such rim will move from the position shown at X in FIGS. 3 and 4 to the position shown at Y in FIG. 4.

Due to such inward movement which causes the inner periphery 54 of the rim of the container to ride up the slightly inclined surface 22 of the cover member, the rim 43 will be stressed. As a result, such rim 43 will exert a permanent relatively great downward force against the cover member 15 along its undersurface 61.

Thereupon, the outer die element 41a is removed. Due

to the relatively great force exerted by the undersurface 61 of rim 43 against the cover member, such rim 43 will remain in substantially its pressed position, thereby dependably retaining the curved periphery 21 of the cover member 15 against the curved shoulder 14 of the container 10 with great force. The material from which the container 10 is formed and the dimensions of the container, such as its wall thickness, are selected so that the force retaining the cover member 15 in fixed position exceeds the opposed force exerted by the cover member 15 against the inwardly bent rim 43 resulting from the maximum working pressure of the pressure vessel to prevent movement of the cover member during operation.

As many changes could be made in the above method and equipment, and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. The method of retaining a cover member having an upwardly inclined top surface and a curved periphery in fixed position in a cylindrical pressure vessel having an enlarged diameter cylindrical mouth defining a curved shoulder to restrain axial movement of the cover member in use of the pressure vessel, due to variation of pressure therein, which comprises the steps of inserting the cover member into the mouth of the pressure vessel so that the curved periphery of the cover member seats on such curved shoulder, applying force against the outer periphery of the rim of the mouth of the pressure vessel as well as the adjacent portion thereof which extends beyond said curved shoulder in direction to move such rim inwardly until the inner periphery of such rim is substantially against the upwardly inclined top surface of the cover member and the adjacent inner surface of the enlarged diameter mouth is slightly spaced from said inclined top surface, and thereupon applying force in a substantially inward direction against the outer surface of the enlarged diameter mouth of the pressure vessel in direction to move the inner periphery of such rim radially inwardly along the upwardly inclined top surface of the cover member and to move said spaced inner surface of the enlarged diameter mouth into intimate contact with said inclined top surface for exertion of substantial force by said inner periphery against the cover member to retain the latter in fixed position in the container.

2. The method set forth in claim 1 in which after the inner periphery of said rim substantially engages the upwardly inclined surface of the cover member, the force thereupon applied is applied to the outer periphery of the mouth of the pressure vessel from a region spaced from the outer periphery of the rim thereof.

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