

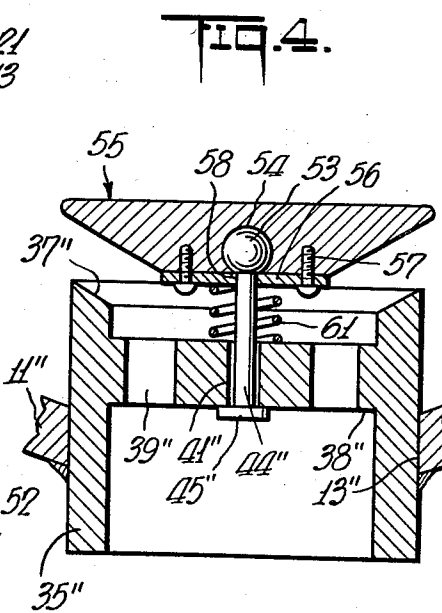
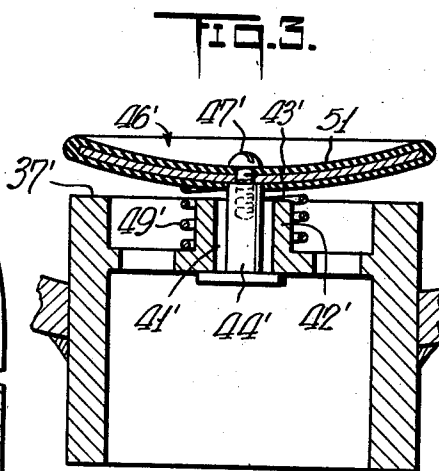
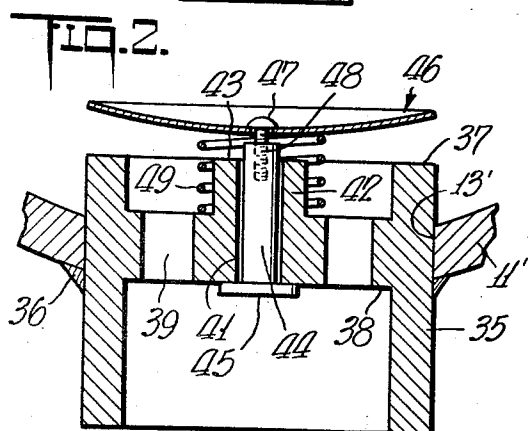
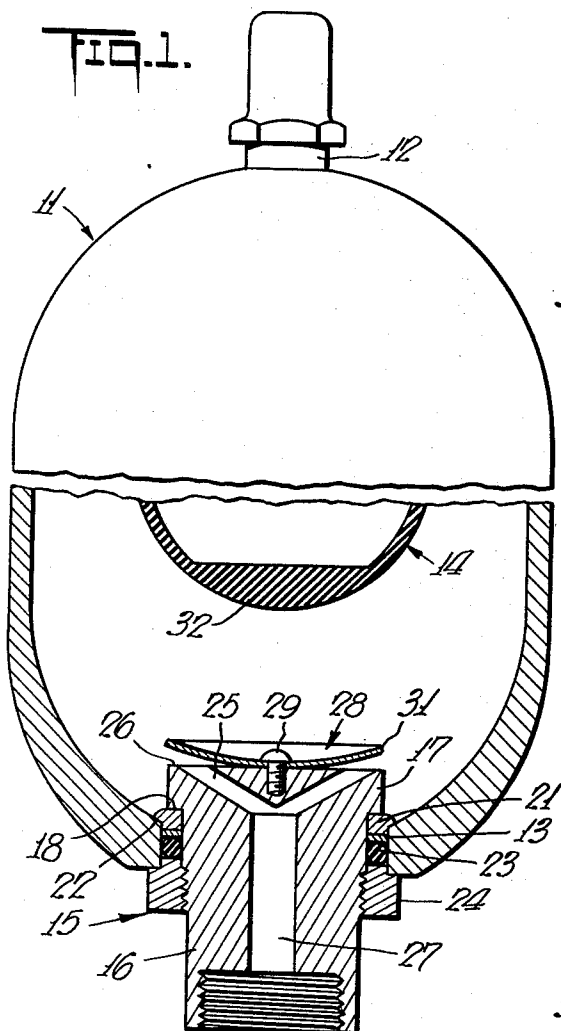
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CLOSURE VALVE FOR THE OUTLET PORT OF A PRESSURE ACCUMULATOR

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CLOSURE VALVE FOR THE OUTLET PORT OF A PRESSURE ACCUMULATOR

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15 Claims. (Cl. 138—30)

This invention relates to the closure for the outlet port of a container for fluid and more particularly to a closure valve for a pressure accumulator of the type having a rigid container to be filled with fluid, usually oil and air under pressure and having a deformable partition intervening between such fluids.

When oil is pumped into the outlet port of the container on one side of the partition, it will deform the latter and compress the air previously charged into the container on the other side of the partition. In use of the accumulator, a control valve in the line between the outlet port and the hydraulic device to be operated, is opened and the partition in expanding will force such oil from the container through the closure valve.

Unless the closure valve remains open until substantially all the oil in the container is expelled, the trapped oil will not be available for useful purposes. Also, where the partition when expanding is forced against and extrudes past the closure valve, it is likely to become pinched or torn with resultant failure of the equipment.

Where, to retain the valve opened so that substantially all of the oil may be expelled from the container, a relatively strong spring is used to react against the valve head, if such spring also keeps the valve open even when the container is substantially empty, the partition may be extruded past the valve head with resultant injury thereto.

Where, to insure that the valve head will close before the partition can be extruded, a relatively weak spring is used, then the expanding partition, when it engages the valve head, will immediately overcome the force of the spring and close the valve while the container is still charged with a considerable quantity of oil. Furthermore, in the event a large rate of flow of liquid is desired during any short period of time, such as, for example, to operate a hydraulic brake, the flow of such fluid would result in a low pressure area beneath the valve head and a high pressure area in the container. As a result, the relatively weak spring would not be able to overcome the differential pressure on both sides of the valve head and the latter may close almost immediately after the flow of fluid begins, thereby to prevent proper functioning of the equipment to be operated.

It is accordingly among the objects of the invention to provide a closure valve for the outlet port of a pressure accumulator of the above type, which closure valve has but few sturdy parts that may readily be assembled and are not likely to become out of order and which valve will remain open until substantially all of the oil in the accumulator is expelled, even with rapid and profuse discharge therefrom, yet will dependably close before the partition in the container can be extruded past such closure valve.

Another object is to provide a valve for the liquid port of the accumulator, which upon initial engagement by the expanding partition will only partially close the liquid port to prevent extrusion of the partition and only when substantially all of the liquid has been expelled

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from the accumulator by the expanding partition will completely close the liquid port of said accumulator.

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

This application is a continuation-in-part of co-pending applications Serial No. 327,602, filed December 23, 1952, now Patent No. 2,773,511 and Serial No. 397,241, filed December 9, 1953, now Patent No. 2,880,758.

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 an accumulator having one embodiment of the invention incorporated therewith, and

Figs. 2, 3 and 4 are fragmentary sectional views similar to Fig. 1 of other embodiments of the invention.

Referring now to Fig. 1 of the drawings, the pressure accumulator desirably comprises a container or pressure vessel 11, preferably of strong rigid material such as steel, cast aluminum or the like, capable of withstanding high pressures. The container may be spherical or cylindro-spherical as desired, and has a deformable partition intervening between the gas inlet port 12 and the liquid outlet port 13 thereof. Preferably, the partition is a collapsible and expansible bag 14 which desirably is of resilient material such as rubber or synthetic plastic of like physical characteristics, which in distended but substantially unstretched condition is smaller than the cavity of the container and the inlet 12 leads into the rubber bag 14.

Means are provided to close the outlet port 13. Such means comprises an outlet closure assembly 15 which may include a cylindrical member 16 positioned in said port. Although any suitable means may be used to mount the cylindrical member 16, it is desirably so retained in port 13 that it may be removed therefrom without likelihood of injury to the mechanic disassembling the accumulator. To this end, the construction shown in Patent No. 2,469,171, dated May 3, 1949 is preferred.

As shown, cylindrical member 16 desirably has an external annular flange 17 at its inner end of smaller outside diameter than the diameter of port 13 and defining an annular shoulder 18. A locking member, illustratively a ring 21 of greater diameter than said port 13 and deformable to permit its insertion into said port, encompasses said cylindrical member 16 and is seated on the rim 22 of port 13, the inner diameter of said ring 21 being less than the outer diameter of flange 17 so that said shoulder 18 may seat on said ring. Encompassing said cylindrical member 16 and in juxtaposition to port 13 is a rubber gasket or seal ring 23 which serves effectively to prevent leakage between port 13 and the side wall of cylindrical member 16 when a nut 24 is screwed on the externally threaded portion of cylindrical member 16.

The construction thus far described is not per se claimed herein, as it is shown in the above-mentioned patent.

According to the illustrative embodiment of the invention shown in Fig. 1, the cylindrical member 16 desirably has a plurality of passageways 25 leading from its inner end 26 adjacent its periphery to an axial bore 27 therethrough. A concave valve member or disc 28 of flexible material, preferably of spring steel is affixed as by screw 29 to such inner end 26 so that the convex undersurface of the disc 22 adjacent its center is against the inner end 26, axially aligned with bore 27. The diameter of disc 28 is such that when any portion of the rim 31 thereof is engaged by the expanding bladder 14 and moved downwardly in the manner hereinafter described, the passageways 25 beneath the engaged portion

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of the rim 31 of disc 28 will be closed. Consequently, extrusion of the bladder through such passageways 25 will be prevented. Upon further expansion of the bladder, the thickened bottom 32 thereof will engage the remaining portion of the periphery of the disc 28 to press the latter downwardly against the inner wall 26 to seal all of the passageways 25.

As a result, regardless of the position of the bladder 14 in the container, when it engages the disc 28, the portion of the disc adjacent the passageway 25 closest to the bladder will seal such passageways to prevent extrusion of the bladder with resultant injury thereto.

The concave disc 28 has the characteristics of a "Belle-ville" washer, in that over a predetermined range of deformation thereof caused by the force exerted by the expanding bladder in direction to move the periphery of the disc downwardly it provides a progressively increasing force opposing the force causing such deformation and thereupon when such deformation exceeds a predetermined amount it provides a progressively decreasing force opposing the force causing such deformation so that the periphery of the disc will rapidly seat to seal the passageways 25. Thus, at least some of the passageways 25 will remain open until substantially all of the oil in the container is expelled and only then will the disc 28 seat to close all of the passageways 25 thereby preventing extrusion of the bladder and injury thereto.

In the embodiment shown in Fig. 2, the closure member comprises a tubular member 35 positioned in port 13 of a container 11' identical to that shown in Fig. 1 and also having a bladder therein, the tubular member 35 being affixed in port 13' as by welding at 36, the inner end 37 of member 35 defining a valve seat.

Tubular member 35 has a wall 38 extending transversely thereacross with a plurality of passageways 39 desirably arranged in a ring about an axial bore 41 through an axial hub 42 on the wall 38, the inner surface 43 of hub 42 desirably being aligned with the inner end 37 of the tubular member 35. Extending through the axial bore 41 is a pin 44 which has a diameter substantially equal to that of bore 41 so that it will slide therein with little transverse play. The pin desirably has a stop 45 at its outer end and its inner end mounts a valve member 46 illustratively a concave disc preferably of spring steel of diameter such that its periphery may seat on the inner end 37 of the tubular member 35 and having the characteristics of the disc 28 shown in Fig. 1 and previously described.

To mount the valve member or disc 46, a screw 47 extends through an axial opening therein and is secured in a threaded bore 48 in the pin 44. Clearance is desirably provided between the headed end of the screw and the end of the pin to permit tilting or pivoting movement of the disc with respect to said pin 44. The disc 46 is normally retained spaced from its seat 37 by a coil spring 49 encompassing hub 42 and compressed between the undersurface of the disc and the wall 38.

In the operation of the embodiment shown in Fig. 2, regardless of which portion of the periphery of the disc 46 is engaged by the thickened bottom of the expanding bladder, the disc will tilt so that such engaged portion will be moved downwardly against seat 37. Consequently, extrusion of the bladder at the engaged portion will be precluded. When the disc has been moved downwardly against the tension of coil spring 49 so that its convex undersurface rests against the inner surface 43 of the hub 42, the coil spring will have no further effect and at such time at least a portion of the periphery of the disc will be spaced from seat 37 to permit flow of fluid from the container. Thereafter, with continued expansion of the bladder, the periphery of the disc will rapidly move against the seat 37 to prevent extrusion of the bladder.

The embodiment shown in Fig. 3 is substantially the same as that shown in Fig. 2 and corresponding elements have the same reference numerals primed. As shown in

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Fig. 3 the pin 44' is mounted in an axial bore 41' of considerably greater diameter than the pin so that the pin 44' may tilt in such bore. In addition, the disc 46' is rigidly affixed to the inner end of the pin by a screw 47' so that the disc and the pin will move in unison.

In the operation of the embodiment shown in Fig. 3 when the expanding bladder engages the disc, which may have a suitable elastomer or rubber coating 51 to prevent injury to the bladder, by reason of the freedom of movement of the pin 44' in bore 41' the disc will pivot so that the portion of the periphery of the disc engaged by the bladder will engage the seat 37' to prevent extrusion of the bladder at such region. Thereafter with continued expansion of the bladder when the disc has been moved downwardly so that its undersurface rests against the inner surface 43' of the hub 42, the spring 49' will have no further effect and thereafter action of the disc is similar to that described with respect to the embodiments shown in Figs. 1 and 2.

In the embodiment shown in Fig. 4, a tubular member 35'' is positioned in the port 13'' of a container 11' and affixed therein as by welding, the bevelled inner end 37'' of member 35'' defining a valve seat. Tubular member 35'' has a wall 38'' extending transversely thereacross with a plurality of passageways 39'' desirably arranged in a ring about an axial bore 41'' through which extends a pin 44''.

The pin 44'' desirably has a stop 45'' on the outer end thereof and has a ball conformation 53 at the inner end thereof positioned in a socket 54 in a valve head 55. The ball 53 is desirably retained in socket 54 by means of a plate 56 affixed to the undersurface of the valve head 55 as by screws 57 and having an opening 58 through which pin 44'' extends. The valve head 55 is desirably retained in its outermost position spaced from its seat 37'' by a coil spring 61 compressed between the undersurface of valve head 55 and wall 38''.

In the operation of the accumulator with the valve shown in Fig. 4, regardless of which portion of the periphery of the valve head 55 is engaged by the bottom of a bladder (not shown), in container 11'', the valve head 55 will pivot in the direction of the force applied thereagainst until a portion of the periphery of the valve head is against its seat 37''. As a result, extrusion of the bladder through openings 39'' adjacent the sealed portion of valve head 55 is prevented. Upon further expansion of the bladder and as pressure is applied against the entire valve head, the entire periphery of the latter will finally be seated against the tension of coil spring 61 to close the port 13.

By reason of the valve construction above described and shown in Fig. 4, regardless of the position of the bladder in the container 11'' when it engages the valve head 55, the portion of the valve head 55 adjacent the openings 39'' in wall 38'' closest to the bladder will seal such openings to prevent extrusion of the bladder.

With the constructions above described, a closure member is provided which will dependably retain the outlet port of a pressure accumulator open until substantially all of the oil is expelled therefrom regardless of the rate of flow of oil from the accumulator, yet with assurance that when substantially all of such oil is discharged, the outlet port will be closed without likelihood of an extrusion of the bladder.

As many changes could be made in the above constructions, 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. A pressure vessel comprising a rigid container hav-

ing an inlet and an outlet port, a deformable and expandable partition intervening between said ports, valve means for controlling flow of fluid from said outlet port, said valve means comprising a valve seat in said container axially aligned with said outlet port, a valve member in said container axially aligned with said valve seat and having its periphery normally spaced therefrom, the periphery of said valve member being movable against said seat by the force exerted by the expanding partition to seal the outlet port, and means mounting said valve member for oscillating movement thereof about its axis, whereby when the partition initially engages a portion of the periphery of the valve member when such periphery is spaced from the valve seat, such portion will move toward the valve seat to engage the latter only at the region of engagement of the valve member by the partition to prevent extrusion of the partition past the valve seat yet permitting flow of fluid.

2. The combination set forth in claim 1 in which resilient means react against said valve member to retain the latter spaced from its seat.

3. The combination set forth in claim 1 in which said valve member is a disc of the type that over a predetermined range of deformation thereof caused by the force exerted thereagainst by the expanding partition provides a progressively increasing force opposing such deformation and thereupon when such deformation exceeds a predetermined amount it provides a progressively decreasing force opposing the force exerted thereagainst by the expanding partition.

4. The combination set forth in claim 3 in which said disc has a resilient coating thereon.

5. The combination set forth in claim 1 in which said valve member is a disc of the type that over a predetermined range of deformation thereof caused by the force exerted thereagainst by the expanding partition provides a progressively increasing force opposing such deformation and thereupon when such deformation exceeds a predetermined amount it provides a progressively decreasing force opposing the force exerted thereagainst by the expanding partition and resilient means are provided reacting against said disc also to urge the latter away from its seat.

6. The combination set forth in claim 1 in which said valve member is in the form of a disc of flexible material, means axially mounting said disc so that it is axially aligned with said seat with its periphery normally spaced therefrom and with its concave undersurface in juxtaposition thereto, said axial mount for said disc affording oscillating movement thereof about its axis.

7. The combination set forth in claim 6 in which a cylindrical member is positioned in such outlet port having its inner end in the container, said member having passageways therethrough and defining the valve seat at its inner end and said disc is mounted on the inner end of the cylindrical member.

8. The combination set forth in claim 6 in which a cylindrical member is positioned in such outlet having its inner end in the container, said cylindrical member having a wall at its inner end with passageways leading from the rim thereof to an axial bore therethrough, the periphery of said wall defining the valve seat, said disc is mounted on said wall and is axially aligned with the cylindrical member, said disc having a diameter substantially equal to that of said wall.

9. The combination set forth in claim 1 in which a slidably mounted pin is axially aligned with said port, said valve member is a concave valve disc of flexible

material mounted at its axis to the inner end of said pin with its concave undersurface in juxtaposition thereto, said disc being of the type that over a predetermined range of deformation thereof caused by the force exerted by the expanding bladder provides a progressively increasing force opposing such deformation and thereupon when such deformation exceeds a predetermined amount it provides a progressively decreasing force opposing the force exerted thereagainst by the expanding bladder, means to limit the outward movement of said disc adjacent its axis, the periphery of said disc when the axial portion is against said limiting means being spaced from said valve seat and resilient means normally retaining the undersurface of said disc adjacent its axis spaced from said limiting means.

10. The combination set forth in claim 9 in which the mount for the disc to the inner end of the pin permits relative movement between said pin and said disc at its axial portion.

11. The combination set forth in claim 9 in which a headed fastening member of greater length than the thickness of the disc mounts the disc to the inner end of the pin to permit relative movement between said pin and said disc at its axial portion.

12. The combination set forth in claim 9 in which said resilient means reacts against the undersurface of said disc adjacent its axial portion.

13. The combination set forth in claim 9 in which a tubular member is mounted in said outlet port, the inner end of said tubular member defining the valve seat, said tubular member having an axial portion with its inner end lying in substantially the same plane as the valve seat and defining the disc limiting means, said axial portion having an axial bore through which the pin extends with substantially no transverse play.

14. The combination set forth in claim 9 in which a tubular member is mounted in said outlet port, the inner end of said tubular member defining the valve seat, said tubular member having an axial portion with its inner end lying in substantially the same plane as the valve seat and defining the disc limiting means, said axial portion having an axial bore of greater diameter than the diameter of said pin to permit pivotal movement of said pin and the disc thereon for movement of a portion of the periphery of said disc against said seat.

15. The combination set forth in claim 1 in which said valve means comprises a plug affixed in said outlet port, said plug having a neck extending into said shell and a longitudinal bore with a wall extending transversely thereacross spaced from said neck and having a plurality of openings therethrough, said neck having a bevelled inner edge defining a seat, a pin slidably mounted in said wall and extending therethrough, a stop at the outer end of said pin, a ball conformation at the inner end of said pin, said valve member comprising a valve head having a socket in the undersurface thereof, means to retain the ball conformation in said socket and a coil spring compressed between said wall and said valve head normally to retain the latter off said seat, whereby upon expansion of said partition and engagement of the valve head thereby the latter will be moved against said seat to close the openings in said wall.

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