

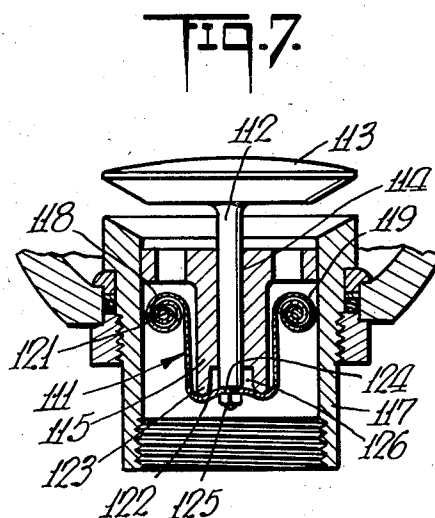
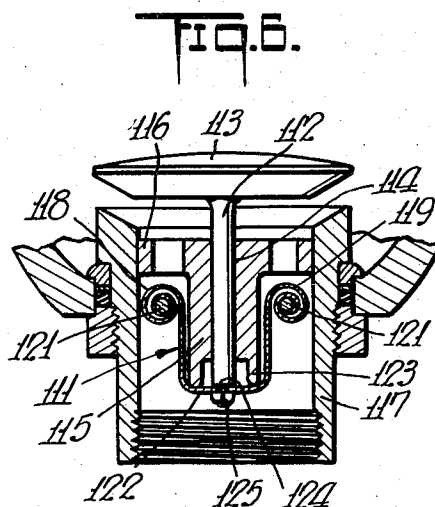
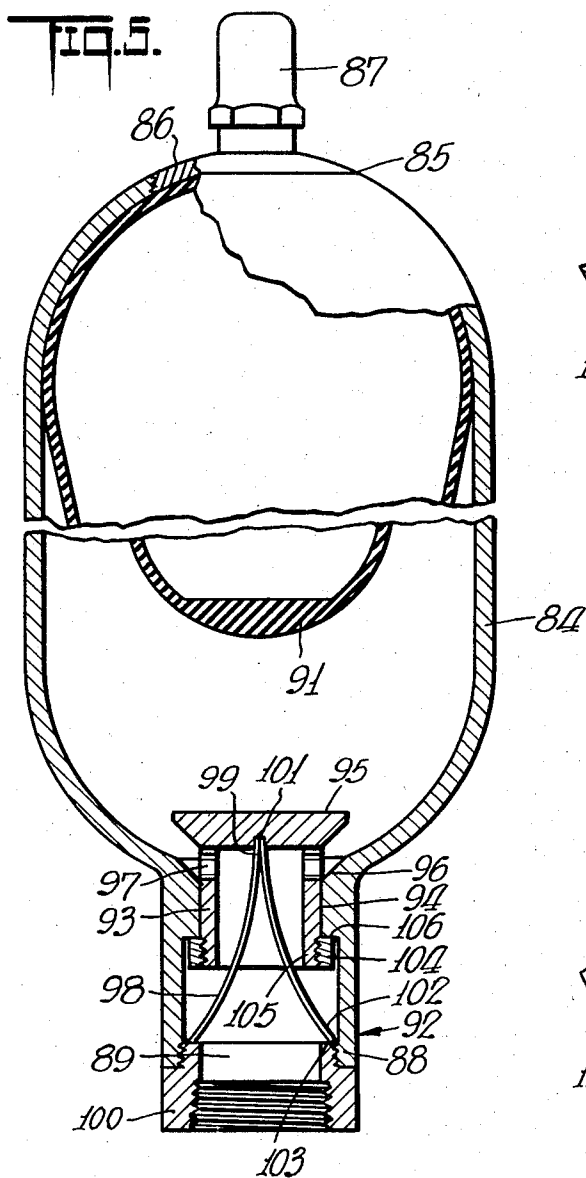
April 7, 1959

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CLOSURE VALVE FOR THE OUTLET PORT OF
A PRESSURE ACCUMULATOR

2,880,758

Filed Dec. 9, 1953

2 Sheets-Sheet 2



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2,880,758

CLOSURE VALVE FOR THE OUTLET PORT OF A PRESSURE ACCUMULATOR

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Application December 9, 1953, Serial No. 397,241

6 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 fluids, 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 open 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 ensure 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 liquid. 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 profuse and rapid discharge therefrom, yet will dependably close before the partition in the container can be extruded past such closure valve.

According to the invention, the closure valve includes resilient means against which the expanding partition will react, said resilient means being of the type such that over a predetermined range of its compression or stroke, or tension applied thereto caused by the force exerted

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by the partition in direction to close the valve, it provides a progressively increasing force opposing the force causing such compression and thereupon when such compression or stroke exceeds a predetermined amount it provides a progressively decreasing force opposing the force causing such compression.

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,

Figs. 2, 3, 4, 5 and 6 are fragmentary sectional views similar to Fig. 1 of other embodiments of the invention,

Fig. 7 is a view similar to Fig. 6 in a second position of operation, and

Fig. 8 is a graph illustrating the operation of the resilient means utilized in the closure valve.

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 cylindrical as desired and has a deformable partition 12 intervening between the gas inlet port 12 and the liquid outlet port 13 of the container. 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 tubular member 16 positioned in said port. Although any suitable means may be used to mount the tubular 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, tubular 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 tubular 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 tubular 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 tubular member 16 when a nut 24 is screwed on the externally threaded portion of tubular 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 tubular member 16 has a transverse wall 31 across its inner end, which wall has an axial bore 32 as well as a plurality of fluid passageways 33 therethrough.

The inner end of member 16 is desirably beveled as at 34 to form a seat for the corresponding beveled edge 35 of a valve head 36 which preferably has a rounded top surface 37. The valve head 36 has an axial stem 38 which is slidably mounted in bore 32 and extends therethrough, the lower end of the stem 38 having suitable means, such as a head 39 to limit the upward movement of stem 38 in bore 32.

Resilient means are provided normally to urge the valve

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stem 38 and valve head 36 into the container 11 so that the rim 35 of the valve head will be spaced from the valve seat 34 to provide communication between the interior of the container 11 and the bore 41 of tubular member 16.

Such resilient means comprises a spring of such type that it normally exerts considerable force against the stem 38 to retain the valve head in open position, but after it has been compressed or stressed a predetermined amount the force exerted by the spring will be greatly reduced.

In the embodiment shown in Fig. 1, the spring is a leaf 42 preferably of spring steel and a pair of such springs are desirably provided, the lower end 43 of each spring being positioned against an abutment illustratively a recess 44 in the wall of bore 41 on opposed sides thereof and the upper end 45 of each spring also being positioned against an abutment or recess 46 in the lower end of valve stem 38.

The embodiment shown in Fig. 2 is similar to that shown in Fig. 1 and corresponding parts have the same reference numerals primed.

In this embodiment, the bore 41' of tubular member 16' is of reduced diameter at its inner end as at 47 defining an annular shoulder 48. Slidably mounted in bore 47 is a sleeve 49 which has a laterally extending flange 51 at one end which may abut against shoulder 48. The other end of the sleeve which will extend beyond the preferably flat, inner end 52 of the tubular member 16' when flange 51 is against shoulder 48, is closed as at 53 and forms a valve head, and the sleeve 49 adjacent its closed end has at least one opening or passageway 54 therethrough. This passageway normally provides communication between the interior of container 11' and the bore 41' of tubular member 16'.

The sleeve 49 is urged inwardly to open position to expose passageway 54, by a leaf spring 42' similar to those shown in Fig. 1. The upper end 56 of leaf spring 42' is retained in a recess 57 in the bottom of the closed end 53 of the sleeve and the lower end 58 is retained in a recess 59 in a plug 61 screwed into the bore 41', said plug having a plurality of fluid passageways 62 therethrough.

The embodiment shown in Fig. 3 is in many respects also identical to that shown in Fig. 1 and corresponding parts have the same reference numerals doubled primed.

The stem 38'' of valve head 36'' in addition to passing through the bore 32'' of transverse wall 31'' also extends through the bore 63 of a second transverse wall 64 positioned in bore 41'' beneath wall 31''.

The valve head 36'' of the embodiment shown in Fig. 3 is normally retained off its seat 34'' by means of one or more "Belleville" washer springs 65 which encompass stem 38'' and are positioned between wall 31'' and valve head 36''. The springs 65 are desirably positioned in opposed relationship for addition of the force to be exerted by each spring.

The "Belleville" washer springs function like the leaf springs 42 and 42' in that they normally exert considerable force against the valve head 36'' to retain the latter in open position, but after they have been compressed or stressed a predetermined amount, the force exerted by the "Belleville" washer springs will be greatly reduced.

In the embodiment shown in Fig. 4, the tubular member 71 is retained in the port 72 of the container, preferably by the same means as that shown in Figs. 1 to 3.

Member 71 has a plurality of passageways 73 leading from its inner end 74 adjacent its periphery to an axial bore 75 therethrough. A concave member or disc 76 preferably of spring steel, having the same characteristics as the leaf spring and "Belleville" washer springs of Figs. 1 to 3 is affixed as by a screw 77 to such inner end 74 so that the convex undersurface of the disc is

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against inner end 74. The diameter of disc 76 is such that when the rim 78 thereof is moved downwardly by the bladder, the passageways 73 will be closed.

In the embodiment shown in Fig. 5, the pressure accumulator comprises a container or pressure vessel 84 of steel, cast aluminum or the like which may be of any desired configuration and illustratively is cylindrospherical. The upper end of the container desirably has a relatively large opening 85 with a plug 86 affixed therein which has a gas inlet port 87.

The lower end of the container desirably has an elongated tubular portion 88, the bore 89 of which defines the liquid outlet port. A deformable partition, preferably a collapsible and expansible bag 91 of suitable resilient material intervenes between the ports 87 and 89 and the inlet 87 leads into the bag 91.

To close the outlet port 89, a closure assembly 92 is provided, which comprises a sleeve 93 slidably mounted in the reduced diameter portion 94 at the inner end of bore 89. The sleeve 93 has a valve head 95 at its inner end adapted to be moved against a seat 96 to seal the outlet port, and the sleeve 93 adjacent said head has at least one opening or passageway 97 therethrough. This passageway normally provides communication between the interior of container 84 and the bore 89.

The sleeve 93 is urged inwardly to open position to expose passageway 97 by leaf springs 98 similar to those shown in Fig. 1. The upper ends 99 of each spring are positioned in a recess or abutment 101 in the under-surface of valve head 95, and the lower ends 102 of the springs are positioned against an annular shoulder 103 formed by the upper end of a fitting 100 screwed in the lower end of tubular portion 88. The movement of the sleeve 93 into the container is desirably limited by a nut 104 screwed on the threaded end 105 of the sleeve and which may abut against shoulder 106.

The embodiment shown in Figs. 6 and 7 is substantially identical to that shown in Fig. 1 except that the leaf springs 42 are replaced by coil spring means 111 having the same characteristics. This spring means, which is known as a negative spring or "Negator," is described in detail in "Product Engineering" July 1949 issue and has the characteristics such that it will originally exert progressively increasing force when first stressed and after being stressed a predetermined amount will exert a progressively decreasing force.

As shown in Figs. 6 and 7, the stem 112 of valve head 113 is slidably mounted in and extends beyond the bore 114 of the axial tubular extension 115 of a perforated wall 116 positioned in tubular member 117. The coils 118 and 119 of the "Negator" 111 are mounted on pins 121 affixed in the tubular member 117 with the intervening run 122 of the spring 111 extending across the end 123 of tubular extension 115. The valve stem 112 is of reduced diameter at its free end 124 and extends through an opening in run 122, a nut 125 screwed on the threaded reduced end 124 retaining the stem and run 122 of the spring together.

The bore at the free end 123 of extension 115 is of enlarged diameter as at 126 so that when fluid under pressure is initially forced into the container and reacts against the valve head to move it inwardly, the run 122 of spring 11 will enter such bore portion 126 as shown in Fig. 7 to take up the initial impact against the valve head thereby preventing shearing of the thread of the nut or the threaded end 124 of the valve stem 112.

It is to be noted that the resilient members in all of the embodiments shown are normally under tension, so that they may function in desired manner.

The resilient members of the embodiments shown have the characteristics clearly illustrated by the graph shown in Fig. 8.

Thus when pressure is applied to the resilient members by the expanding bladder, as they are first compressed

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or stressed or placed under tension, over a predetermined range measured along the abscissa 81 of the graph to the point A, the force exerted by the resilient members to restrain closing of the valve will progressively increase an amount measured along the ordinate 82. Thereupon as the resilient members are further compressed or stressed or placed under tension, past the point A, the force exerted by the resilient members will progressively decrease.

The resilient members are desirably originally compressed or stressed or placed under tension to the position shown, for example, at B on the graph in Fig. 5. Thus, a considerable force will be available to retain the valve in open position.

Even if the rate of flow through the tubular members of any of the embodiments shown should be great, with resultant high differential between the pressures on opposing sides of the valve, the force of the tensed resilient member will be sufficient to overcome such differential and retain the valve open.

Referring specifically to Fig. 1, as the bladder progressively expands and engages the valve head 36, the latter will not be moved until the bladder has expanded sufficiently to exert enough force against the valve head 36 to overcome the counter force exerted by leaf springs 42. Thus, referring to Fig. 8, not until the force exerted by the bladder has reached the point B' will the valve head move.

At this time substantially all of the oil has been discharged from the container 11 and with slight additional expansion of the bladder and further increase of the force exerted thereby, the valve head will move downwardly compressing the springs 42 until they reach the point A on the graph. With further expansion of the bladder and compression of the springs 42 the counter force exerted by the springs 42 against the force exerted by the bladder will start to decrease. Consequently, the greater force exerted by the bladder will quickly overcome the force exerted by the springs 42 and the valve head 36 will seat almost immediately before the bladder can extrude therebeneath.

In view of the above explanation, the operation of the embodiments shown in Figs. 2, 3, 4, 5 and 6 is readily apparent.

With the construction 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 the 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 extrusion of the bladder.

As many changes could be made in the above 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. In a pressure accumulator of the type having a rigid container and a deformable partition intervening between the inlet port and the outlet port; the combination therewith of a closure member comprising a valve seat, a valve head slidably mounted with respect to said seat, the inner end of said valve head being adapted to be positioned in such container to be engaged by such partition upon expansion thereof, and a leaf spring reacting against said valve head normally to retain the latter spaced from said seat, said leaf spring being of the type that over a predetermined range of tension applied thereto provides a progressively increasing force opposing the force exerted by the expanding partition against said

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valve head and thereupon when such tension exceeds a predetermined amount, provides a progressively decreasing force opposing the force exerted by the expanding partition against the valve head.

2. In a pressure accumulator of the type having a rigid container with an inlet port and a deformable partition intervening between said inlet and outlet ports; the combination therewith of valve means comprising a tubular member coaxial with said outlet port and having a valve seat at one end, a valve head adapted to be engaged by such partition upon expansion of the latter to be moved against said seat to seal the latter, and a leaf spring forming part of said valve means reacting against said valve head normally to retain the latter spaced from said seat, said leaf spring being of the type that over a predetermined range of tension applied thereto provides a progressively increasing force opposing the force exerted by the expanding partition against said valve head and thereupon when such tension exceeds a predetermined amount, provides a progressively decreasing force opposing the force exerted by the expanding partition against the valve head.

3. The combination set forth in claim 2 in which said valve head has a stem extending into said tubular member, said leaf spring has one end engaging said stem and fixed with respect thereto and its other end engaging said tubular member and fixed with respect thereto.

4. The combination recited in claim 3 in which said stem has an abutment at its lower end and said tubular member has an abutment in its wall located at a point longitudinally spaced from the position of the lower end of said stem when said valve head is seated and the ends of the leaf spring are positioned against the respective abutments.

5. The combination set forth in claim 2 in which said valve seat is at the inner end of said tubular member, the latter having a wall adjacent said seat with an axial bore and with fluid passageways therethrough, said valve head having a stem slidably mounted in said axial bore and extending through the latter, said stem having an abutment at its lower end and said tubular member having abutments on opposed sides of the bore thereof longitudinally spaced from the position of the lower end of the valve stem when the valve head is seated, and a pair of leaf springs are provided each having one end positioned against the abutment on the valve stem and their other ends positioned respectively against the abutments on said tubular member.

6. The combination set forth in claim 2 in which said tubular member has a reduced bore diameter at its inner end defining a shoulder, a sleeve is slidably mounted in said reduced diameter bore, the inner end of the sleeve being closed and defining the valve head, the other end of the sleeve having a lateral protrusion adapted to engage said shoulder, the closed end of said sleeve extending beyond the inner end of said tubular member when said protrusion engages said shoulder and having a transverse opening in said extending end to provide communication between the interior of the container and the bore of said sleeve, the inner end of the bore of said tubular member defining the valve seat, said leaf spring reacting against the closed inner end of said sleeve normally to retain said transverse opening beyond the valve seat.

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