

April 12, 1960

J. MERCIER
CLOSURE VALVE FOR THE OUTLET PORT OF
A PRESSURE ACCUMULATOR

2,932,320

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2 Sheets-Sheet 1

FIG. 1.

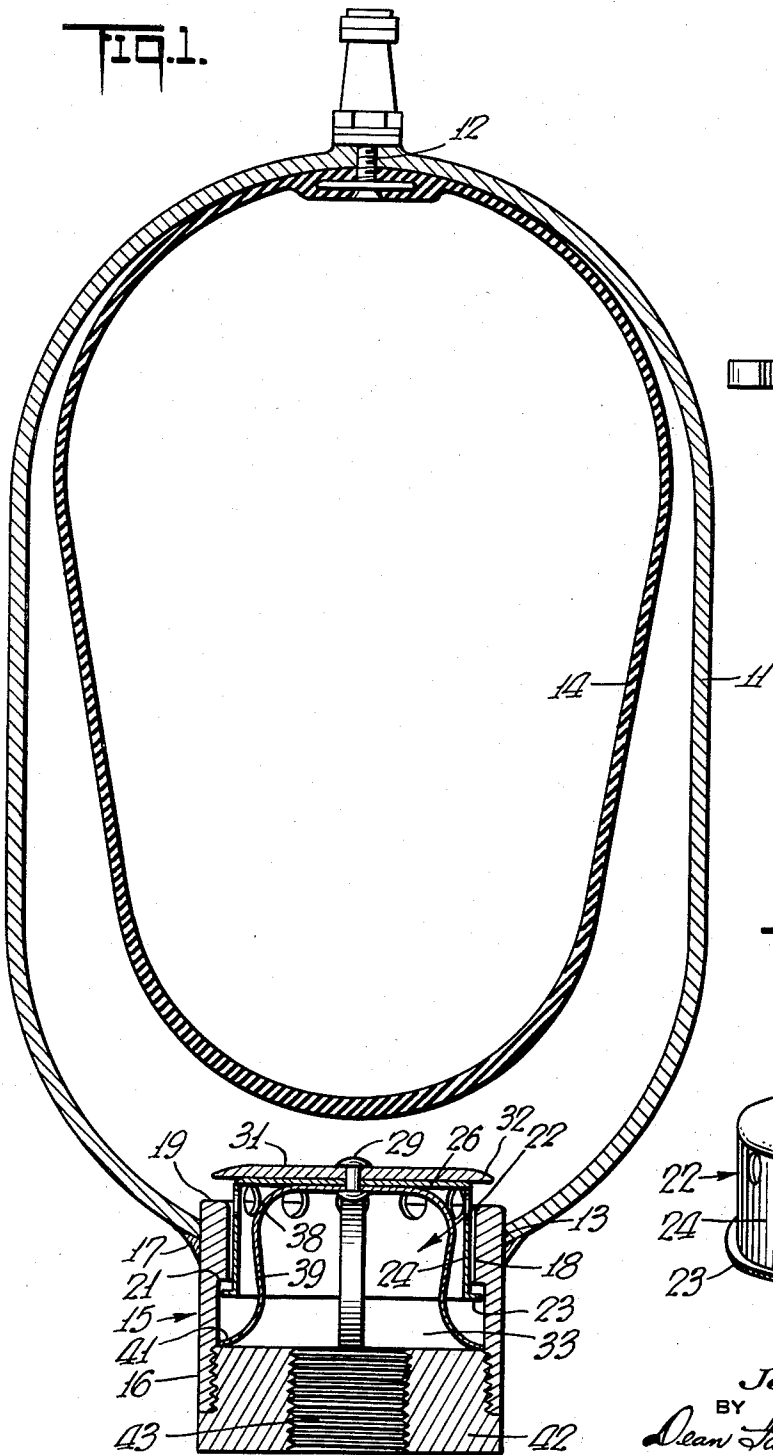


FIG. 2.

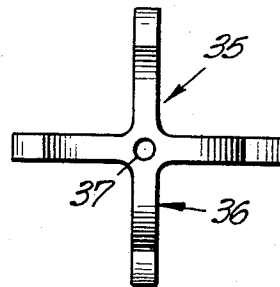
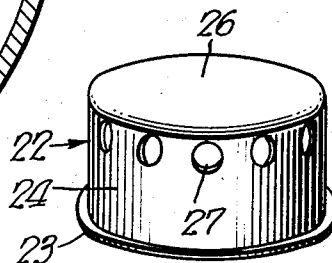


FIG. 3.



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2 Sheets-Sheet 2

FIG. 4.

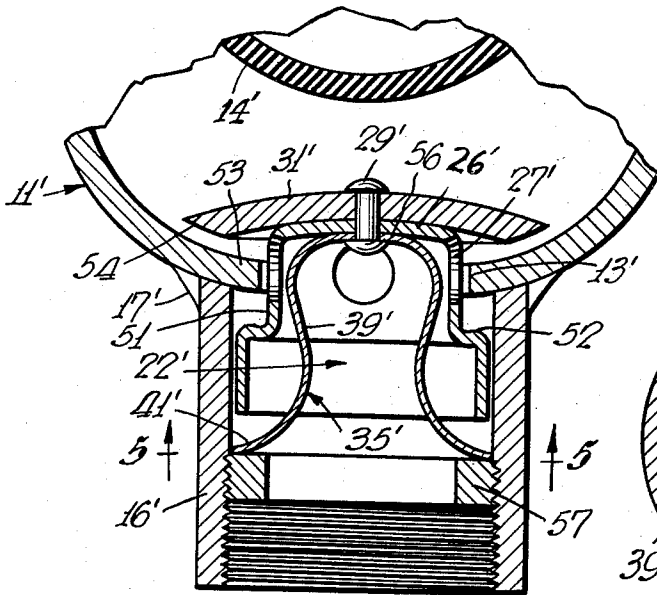


FIG. 5.

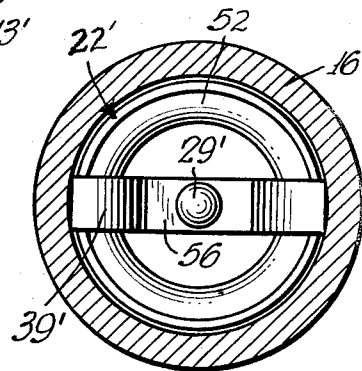
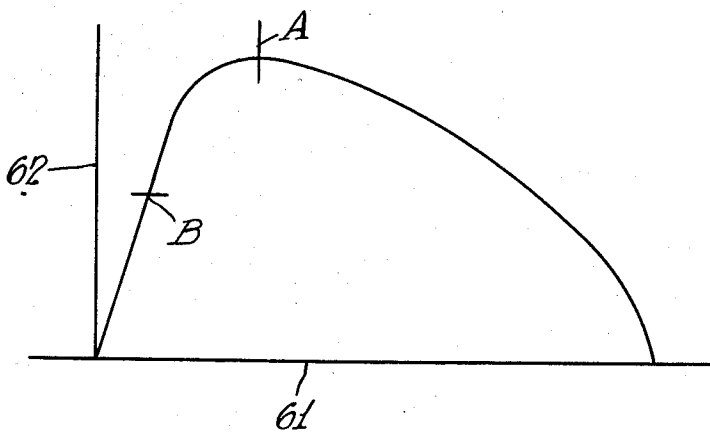


FIG. 6.



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1

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CLOSURE VALVE FOR THE OUTLET PORT OF A PRESSURE ACCUMULATOR

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Application February 23, 1956, Serial No. 567,330

11 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 at 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 deformation thereof or stress thereto caused by the force exerted by the par-

2

tion in direction to close the valve, it provides a progressively increasing force opposing the force causing such deformation or stress and thereupon when such deformation or stress exceeds a predetermined amount it provides a progressively decreasing force opposing the force causing such deformation or stress.

This application is a continuation in part of copending application Serial No. 397,241, filed December 9, 1953, now Patent No. 2,880,758, April 7, 1959.

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,

Fig. 2 is a top plan view of the resilient means for the closure valve of Fig. 1,

Fig. 3 is a perspective view of the valve head guide member,

Fig. 4 is a fragmentary sectional view of a closure valve according to another embodiment of the invention,

Fig. 5 is a transverse sectional view taken along line 5—5 of Fig. 4, and

Fig. 6 is a graph illustrating the operation of the resilient means utilized in the closure valves.

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 intervening between the gas inlet port 12 and the liquid outlet port 13 of the container. Preferably the partition is a collapsible and expansible bladder 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 bladder 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, in the illustrative embodiment shown it is affixed in said port as by welding as at 17.

The tubular member 16 is desirably of reduced diameter as at 18 near its inner end 19 defining an annular shoulder 21. A substantially cup-shaped guide member 22 is positioned in tubular member 16 and is of diameter such that it may readily slide in the reduced diameter portion 18 thereof with little transverse play. The mouth of the guide member has an outward extending lateral flange 23 adapted to abut against shoulder 21 to limit the inward movement of the guide member.

The side wall 24 of the guide member 22 is of width such that when the flange 23 abuts against the annular shoulder 21, the closed end or floor 26 of the guide member will extend past the inner end 19 of the tubular member 16, with the plurality of openings 27 in side wall 24 adjacent floor 26 exposed to permit flow of fluid into and out of container 11.

Affixed to the floor 26 as by an axial rivet 29 is a valve head 31, illustratively a flat disc, the periphery 32 of which may seat on the inner end 19 of the tubular member to close the liquid port 13, said valve head being guided by said guide member so that it will move substantially only in direction aligned with the axis of said tubular member 16.

Resilient means are provided normally to urge the guide member 22 and valve head 31 into the container 11 so that the periphery 32 of the valve head 31 will be spaced from the valve seat 19 and the openings 27 will be exposed.

to provide communication between the interior of the container 11 and the bore 33 of tubular member 16.

Such resilient means comprises a spring of such type that it normally exerts considerable force against the guide member 22 to retain the valve head 31 in open position, but after it has been deformed or stressed a predetermined amount the force exerted by the spring will be reduced.

In the embodiment of Fig. 1, the spring is a spider 35 preferably of spring steel having a plurality of legs 36 equidistantly spaced and extending radially from the hub 37 of the spider. The legs are curved as at 38 and extend at substantially right angles to the radially extending portions as at 39, said portions 39 defining leaf springs, the extremities 41 of which are bent outwardly slightly as shown.

The hub 37 of the spider 35 is affixed to the floor 26 as by the rivet 29 and the extremities 41 of the legs 36 abut against a plug 42 screwed into the threaded end of tubular member 16, the plug 42 having an axial bore 43 therethrough to provide a passage for fluid.

The embodiment shown in Fig. 4 is similar to that shown in Fig. 1 and corresponding parts have the same reference numerals primed.

In this embodiment the tubular member 16' is of larger diameter than the liquid outlet port 13' and is affixed to the container as by welding at 17' so that it is coaxial with said port 13'.

A substantially cup-shaped guide member 22' is positioned in tubular member 16' and is of diameter such that it may readily slide therein with little transverse play. The guide member 22' has a reduced diameter portion 51 adjacent its closed end or floor 26', which is slightly curved as shown, to define an annular shoulder 52 adapted to abut against the outer surface of the periphery 53 of port 13' of container 11' to limit the inward movement of the guide member.

The reduced diameter portion 51 of the guide member 22' is of width such that when the shoulder 52 abuts against the periphery 53 of port 13', the closed end or floor 26' of the guide member will extend into the container 11' past the inner surface of the periphery 53 of port 13' with the plurality of openings 27' in said portion 51 adjacent floor 26' exposed to permit flow of fluid into and out of container 11'.

Affixed to floor 26' as by an axial rivet 29' is a valve head 31' illustratively a disc curved to conform to the curvature of floor 26' and of diameter such that when in closed position its periphery 54, which is curved to conform to the curvature of the inner surface of container 11', will seat thereagainst to seal the oil port 13'. The valve head 31' is guided by said guide member 22' so that it will move substantially only in direction aligned with the axis of said tubular member 16'.

The guide member 22' and valve head 31' are urged inwardly by a resilient member or spring 35' which has the same characteristics as the resilient member 35 shown in Fig. 1.

The resilient member 35' desirably comprises a flat spring which is reversely bent to define a top portion 56 affixed by rivet 29' to the floor 26'. The spring is bent at right angles to the top portion 56 to define a pair of legs 39' each of which forms a leaf, and the extremities 41' of which are bent outwardly slightly as shown, said extremities abutting against a nut 57 screwed into the threaded end of tubular member 16'.

The resilient members of the embodiments shown have the characteristics clearly illustrated by the graph shown in Fig. 6.

Thus, when pressure is applied to the resilient members by the expanding bladder 14 or 14', as they are first deformed or stressed, over a predetermined range measured along the abscissa 61 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 62. Thereupon as the resilient mem-

bers are further deformed or stressed past the point A, the force exerted by the resilient members will progressively decrease and the valve head will move accordingly.

The resilient members are desirably originally deformed or stressed to the position shown, for example, at B on the graph in Fig. 6 so that a predetermined force will initially 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 opposed sides of the valve, the force of the pre-stressed resilient members 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 31, the latter will not be moved until the bladder has expanded sufficiently to exert enough force against the valve head 31 to overcome the counter-force exerted by the leg portions 39 of the pre-stressed spring 35. Thus, referring to Fig. 6, 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 slightly bending the leg portions 39 of spring 35 until they reach the point A on the graph. With further expansion of the bladder and bending of the leg portions 39, the counter-force exerted by the leg portions 39 against the force exerted by the bladder will start to decrease and the valve head 31 will move rapidly to seated position before the bladder can extrude therebeneath.

In view of the above explanation, the operation of the embodiments shown in Fig. 4 is readily apparent.

If desired, the valve head shown in the embodiments of Figs. 1 and 4 may be of a flexible material such as sheet steel, plastic, hard rubber or the like. In such case, to prevent excessive bending of said valve heads, the side wall of the associated guide member is of length such that it will abut against plug 42 or nut 57 when the periphery of the valve member is in closed position.

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 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 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 accumulator of the type having a rigid container with a gas port and a liquid port and a deformable partition intervening between said gas and liquid ports, valve means for controlling the flow of fluid from the liquid port, said valve means comprising a tubular member coaxially positioned with respect to said liquid port, a valve seat in said container coaxial with said liquid port, a valve head in said container adapted to be engaged by said partition upon expansion of the latter to be moved against said seat to seal the latter, a member in said tubular member to guide said valve head for movement thereof in direction aligned with the axis of said tubular member, and leaf spring means in said tubular member effectively reacting against said guide member normally urging said valve head away from said seat, said leaf spring being of the type that over a pre-

5

determined range of stress applied thereto, provides a progressively increasing force opposing the force exerted by the expanding partition against said valve head and thereupon when such stress exceeds a predetermined amount, provides a progressively decreasing force opposing the force exerted by the expanding partition against the valve head.

2. The combination set forth in claim 1 in which said tubular member extends through said liquid port into said container, the inner end of said tubular member defining said valve seat.

3. The combination set forth in claim 1 in which said tubular member is of diameter greater than that of the liquid port and is affixed to the outer surface of said container, the surface of the periphery of said liquid port inside said container defining said valve seat.

4. The combination set forth in claim 1 in which said guide member is slidably mounted in said tubular member and has a transverse portion to which said valve head is affixed, said leaf spring means reacts against said guide member to urge the latter inwardly and means are provided to limit such inward movement.

5. The combination set forth in claim 4 in which said leaf spring means comprises a spider having a hub with a plurality of legs radiating therefrom, said legs being bent at substantially right angles to the radially extending portions to define leaf springs and means are provided in said tubular member against which the extremities of said legs abut, said valve head being affixed to said hub.

6. The combination set forth in claim 4 in which said leaf spring means comprises a flat spring reversely bent to define a top portion to which said valve head is affixed, and a pair of legs defining leaf springs and means are provided in said tubular member against which the extremities of said legs abut.

7. The combination set forth in claim 1 in which said guide member is slidably mounted in said tubular member and is substantially cup-shaped having a floor at the inner end thereof, said valve head is affixed to said floor and said leaf spring means reacts against the floor of said guide member.

8. The combination set forth in claim 1 in which said guide member is slidably mounted in said tubular member and is substantially cup-shaped having a floor at the inner end thereof, said valve head is affixed to said floor, said leaf spring means reacts against the floor of said guide member to urge the latter inwardly and means are provided to limit such inward movement.

9. The combination set forth in claim 1 in which said guide member is slidably mounted in said tubular member and is substantially cup-shaped having a floor at the inner end thereof, the side wall of said guide member adjacent said floor having an opening therethrough, said

6

valve head is affixed to said floor, said leaf spring means reacts against the floor of said guide member to urge the latter inwardly and means are provided to limit such inward movement.

10. The combination set forth in claim 1 in which said guide member is substantially cup-shaped, the diameter of said guide member being slightly less than that of said tubular member so that it will slide therein with substantially no transverse play, said guide member having a floor at the inner end thereof and an outwardly extending lateral flange at the mouth thereof, said tubular member having an internal shoulder against which said flange may abut to limit the inward movement of said guide member, the side wall of said guide member adjacent said floor having an opening therethrough, said valve head is affixed to said floor and said leaf spring means reacts against the floor of said guide member to urge the latter inwardly.

11. The combination set forth in claim 1 in which said tubular member is of diameter greater than that of the liquid port and is affixed to the outer surface of said container, the surface of the periphery of said liquid port inside the container defining said valve seat, said guide member is substantially cup-shaped having a floor at the inner end thereof, the diameter of said guide member being slightly less than that of said tubular member so that it will slide therein with substantially no transverse play, the guide member being of reduced diameter at the portion thereof adjacent said floor to define a shoulder adapted to abut against the surface of the periphery of said liquid port outside the container to limit the inward movement of said guide member, the side wall of said guide member adjacent said floor having an opening therethrough, said valve head is affixed to said floor and said leaf spring means reacts against the floor of said guide member to urge the latter inwardly.

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