

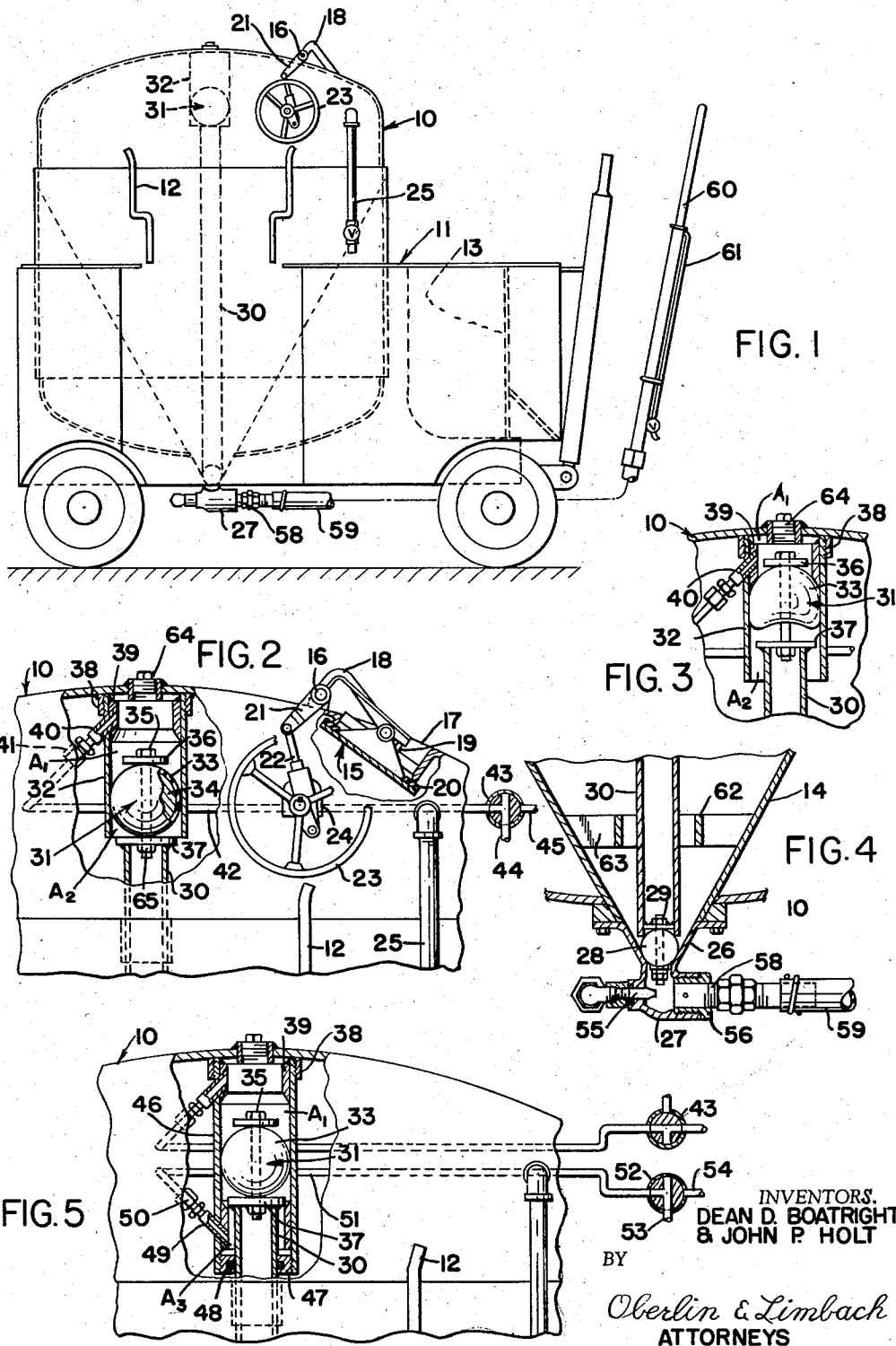
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APPARATUS FOR FEEDING GROUND MATERIAL

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APPARATUS FOR FEEDING GROUND MATERIAL

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The present invention relates to apparatus for feeding ground or pulverulent material under pressure and, more particularly, to a pressurized container having fluid-operated valve means to control the flow of such material.

In various industrial applications, it is often necessary or desirable to flow pulverulent or granular material to a point of use. For example, in one instance ground refractory material such as cementitious material, various aggregate mixtures, and the like are shot under pressure along walls of a furnace to replace or repair the linings thereof. An apparatus for effecting this deposition of ground material is shown and described in U.S. Patent No. 2,615,693 to Matirko. In this apparatus an outlet valve is opened and closed by a suitable linkage actuated by a hand operated lever located on the outside of the apparatus. Ordinarily, this arrangement for operating the outlet valve is preferred, since it avoids placing any mechanically-activated valve operators within the container where the pulverulent material abrades and rapidly wears away any valve operating device or closure structure designed to operate the outlet valve and its enclosing structure. Such abrasion on structures within the container is particularly severe upon discharging material therefrom in view of the pressurized atmosphere of the container which forces the particles of the material against such structures as well as pushing the particles from the container. As a result, malfunctioning develops rather quickly in any usual valve-operating means stationed within a pressurized container.

Although the pressurized container of Patent No. 2,615,693 operates well when the pressure is of the order of 40 p.s.i.g. or less, it has been found quite difficult to operate the container at higher pressures. The outlet valve is so tightly jammed against its seat by the higher pressures within the container that workmen are able to operate the valve only with difficulty.

The present apparatus is capable of easy operation even though pressures within the apparatus substantially exceed 40 p.s.i.g. We use a fluid-operated piston and cylinder structure to actuate the outlet valve of our container. This structure is easily operated even after extended use and does not develop leaks under exposure to the abrading action of pressurized particles. The piston of our structure is deformable in response to pressure to form a tight seal of extended area with the cylinder to prevent any escape of pressure or material from the apparatus through the piston and cylinder construction. Moreover, major wear of the piston or cylinder may be compensated for by a simple adjustment and without disassembling the cylinder structure from the apparatus.

It is, therefore, a principal object of the present invention to provide improved apparatus for feeding ground material under pressure.

Another object is to provide a pressurized container having outlet means actuated by a fluid-operated control.

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A further object is to provide a pressurized container for feeding granular material having outlet valve means operated by a piston and cylinder structure in which the piston is pressure-deformable.

A still further object is to provide a pressurized container for feeding pulverulent material having an outlet valve operated by a cylinder and pressure-sensitive piston, in which any major wear on the cylinder and piston may be easily compensated for by an adjustment.

Other objects will become apparent as the description proceeds.

To the accomplishment of the foregoing and related ends, the invention consists of the features hereinafter fully described and particularly pointed out in the claims, the annexed drawing and following disclosure describing in detail the invention, such drawing and disclosure illustrating, however, but one or more of the various ways in which the invention may be practiced.

In said annexed drawing:

Figure 1 is a side view of the pressurized container embodying our invention.

Figure 2 is an enlarged fragmentary view of Figure 1 showing a piston at one end of the cylinder.

Figure 3 is an enlarged fragmentary view similar to Figure 2 illustrating the piston at the opposite end of the cylinder and deformed against its seat.

Figure 4 is an enlarged fragmentary view of the outlet means of the container of Figure 1, and

Figure 5 is an enlarged fragmentary view similar to Figure 2 showing a modification.

Referring to the drawing, the embodiment shown includes a container or vessel 10 supported on a carriage or wagon 11 by which the container 10 is transported from station to station. Brackets 12 may be used to support hose. Suitable valves and other controls are located at the forward end of the carriage 11 as at 13 to effect the operation of the container.

The container 10 is generally of cylindrical construction externally and has a conical or funnel shaped section 14 (Figures 1 and 4) which extends at the small end from the bottom of the container 10 to define an outlet and terminates at the large end by the walls of the container 10. The container is air tight and the inlet and outlet valves thereof are preferably made to seat tightly.

The container may be used to eject under pressure either fluids or solids, but it is best suited for pulverulent or granular material. The latter may be added to the container 10 through a closure 15 which opens inwardly. Pivoted at 16 in a convenient location near an inlet opening 17 is an arm 18 which carries the closure 15, being loosely pivoted so as to allow some freedom of independent swinging movement on the part of the closure element and thereby assure accurate seating against the opening when the closure is swung into place. The amount of independent swinging motion by the closure 15 with respect to the arm 18 is limited by a stop 19 and by a double taper drilling in the hub of closure 15. A packing gasket 20, which may be secured to the closure 15, provides an air tight seal when the closure is in place. Also in relation to the pivot mounting 16 and to the arm 18 is an extension 21 which, being rigid with the arm 18, is connected by a link 22 to a toggle operating means embodying a hand wheel 23 mounted in a suitable bracket 24 on the container 10. The container is pressurized through the valved inlet pipe 25.

Within the container or vessel 10, there is fluid-operated means to control the flow of material therefrom. A conical section 26 is secured to the conical section 14 (Figure 4) to form a continuation and define a valve seat. The section 26 terminates in a valve body or ejector chamber 27 hereinafter described. A ball valve 28 engages the seat defined by section 26, and a bolt 29

fixes the ball to an end plate of a valve rod 30 as shown in Figure 4. At the other end of the rod 30, a pressure-sensitive or deformable piston generally shown at 31 slidably engages a cylinder 32. The pressure-deformable piston 31 includes a resilient jacket or covering 33 such as rubber enclosing a deformable metal 34 such as lead. The lead or similar metal may either be solid or in a milled or articulate form or impregnated in rubber to support yieldingly the cover 33. The normal lateral expansion of the piston 31 may be regulated by a threaded bolt 35 which extends through the piston and plates 36 and 37 on opposite sides axially of the piston 31, plate 37 being fixed as by welding to the end of the valve rod 30.

Cylinder 32 is screwed into an enclosing collar 38 substantially opposite to the valve seat provided by the conical section 26 and is reinforced by the enclosing collar 38, which is fixed to the container or vessel 10. A tube 39 beveled at the lower end is secured to the cylinder 32 and forms a seat for the deformable piston 31. It will be noted that in the embodiment of Figures 2 and 3, the piston defines one space A_1 within the cylinder 32 which is closed to the atmosphere of the vessel 10 and a second space A_2 which is open to such atmosphere. A tube 40 communicates with the space A_1 and connects by a coupling 41 to a conduit 42 which extends externally of the vessel 10 to a three way valve 43. The latter is open to the outside atmosphere through the conduit 44 and joined to a source of air pressure through the conduit 45. Tube 39 with a tapered seat for piston 31 serves two functions. The seat itself stops the upward travel of the piston 31 in such a way as not to cut the rubber of the ball or to allow bolt 35 to strike a plug 64. In addition, air connection 41 is made through this seat above the taper so that the position of the ball does not close off the air connection at any time.

Figure 5 illustrates a modified cylinder 46 which is closed to the atmosphere of the vessel 10 at both ends. A plate 47 seals the lower end of cylinder 46 to form a space A_3 which is closed to the atmosphere of the vessel. The plate 47 has an opening provided with a resilient grommet 48 to make an air tight engagement with the rod 30. A second tube 49 communicates with the space A_3 and connects by a coupling 50 to a conduit 51 leading to a three way valve 52. Conduit 53 of the valve 52 is open to the outside atmosphere while conduit 54 is connected to a source of air pressure.

The ejector chamber 27 receives a fluid jet nozzle 55 to which a gas such as air is supplied under pressure. A fitting 56 secured to the chamber 27 receives suitable pipe 58 to which a flexible hose 59 is attached. The hose 59 terminates in any suitable type of discharge nozzle 60 to which liquid may be introduced if desired through the tube 61.

Particularly in the embodiment of Figure 2, the relative proportions of the maximum cross-sectional diameter of the piston 31 and the ball valve 28 can be important. The diameter of the piston 31 should be sufficiently larger than that of the ball valve 28 so that sufficient force develops to overcome the downward thrust of the compressed fluid within the container 10 and the weight of material within the container lying above the ball valve 28. The resistance encountered is primarily a function of the flat plate area of the ball valve normal to the direction of its movement. In general, the diameter of piston 31 is selected on the basis of pressure needed to overcome the resistance transmitted to it by the valve rod 30 plus the resistance encountered by piston 31 itself due to friction with cylinder walls and fluid resistance, if more than negligible. In one embodiment, for example, the largest possible cross-sectional area of piston 31 was four times the cross-sectional area of ball valve 28. In short, the flat plate area of piston 31 is sufficiently larger than the flat plate area of ball valve 28 to overcome the resistance met in pulling ball valve 28 through the ma-

terial in container 10 plus the friction resulting from the seal formed by the deformation of piston 31 against the wall of a cylinder such as cylinder 32.

The inside diameter of a cylinder like cylinder 32 is the same as the outside diameter of piston 31 in a non-deformed state so that assembly is easy. Turning the bolt into nut 65 brings plates 36 and 37 closer together to compress the piston 31. The latter being elastic deforms laterally against the wall of a cylinder thereby forming a seal which restricts the flow of fluid between container 10 and space A_1 . In view of the foregoing, it will be apparent that deforming piston 31 more than is necessary to obtain the required force can so increase the friction between piston 31 and the cylinder walls as to lock or freeze the piston in place. In order to close the ball valve 28, pressurized fluid is allowed to enter space A_1 and must be of sufficient pressure to overcome the resistance encountered by the ball valve 28 and the piston itself. This operation can also be influenced by the diameter of the piston 31.

In one form of practicing the invention, the container 10 is first charged with material and then pressurized through the pipe 25 to a pressure of about 20 p.s.i.g. to about 75 p.s.i.g., depending on the operation of the gun or nozzle 60. Closed space A_1 is also pressurized through the conduit 45 and valve 43 to a pressure exceeding that in the container 10, for example 80 p.s.i.g., so that the ball valve 28 is not unseated by the pressure within the container. When it is desired to use the material in the container, three way valve 43 is merely vented to the outside atmosphere, and the pressure within the vessel 10 is used not only to force the pulverulent material into the ejector chamber 27, but actually to lift the ball valve 28 so that this action is possible. It will be noted, therefore, that no manual lifting or other work is required by an operator to eject material under pressure from the container 10. During this time, the deformable piston 31 is moved upwardly and forced against the seat provided by the tube 39. Since the piston is deformable, the covering 33 and lead 34 are distorted to a shape such as that shown in Figure 3. Accordingly, the piston 31 makes an extended surface seal against the seat of the tube 39 and cylinder walls 32 or 46, even though either or both the piston 31 and tube 39 with the cylinder walls 32 or 46 have some degree of wear and/or are somewhat misaligned. The seal provided by the piston 31 is leak proof in spite of the relatively high pressures present within the vessel 10, the tighter the seal of the piston 31 becomes.

When it is desired to close the ball valve 28, space A_1 is pressurized through conduit 45 and valve 43 to force the piston 31 downwardly and thereby engage the ball valve 28 against its seat. During the axial movement of the rod 30, the taper of the conical seat directs the ball valve 28 toward its seat. A collar 62 (Figure 4) supported by a bar 63 secured to the section 14 may also be used to guide this movement.

In order to avoid any inadvertent lifting of the ball valve 28, as when space A_1 is not suitably pressurized to withstand the pressure of the container 10, and to provide complete control of the operation of the piston 31 in the cylinders 32 or 46, the embodiment of Figure 5 may be used. In this instance space A_3 is pressurized or vented through the valve 52 in the same manner that valve 43 controls the pressure of area A_1 .

As the material from container 10 reaches the ejector chamber 27, the air from the nozzle 55 carries the material through the hose 59 to the discharge nozzle 60 and thus to a point of use.

After an appreciable period of use, there may be major wear between the cylinders 32 or 46 and the deformable piston 31. In our apparatus, this can be compensated for without disassembling the cylinders from the vessel 10. A plug 64 communicates with the cylinders 32 or 46 and may be removed to insert a suitable wrench for

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fitting the head of the bolt 35. Since a nut 65 on the bolt 35 is secured to the plate 37, merely turning the bolt brings the plates 36 and 37 closer together and extends the deformable piston 31 laterally and into a tighter engagement with the cylinder.

It will now be apparent that we have provided improved apparatus for feeding ground material under pressure. The outlet means of our container is actuated by a fluid-operated control and does not require any manual assistance in actually opening or closing the outlet means. In particular, we use a piston and cylinder arrangement in which the piston is pressure-deformable to make an extended surface seal. Any major wear on the cylinder and piston may be easily compensated for by an adjustment. Very rough treatment can be imposed upon our apparatus without impairing its operation.

Other forms embodying the features of the invention may be employed, change being made as regards the features herein disclosed, provided those stated by any of the following claims or the equivalent of such features be employed.

We therefore particularly point out and distinctly claim as our invention:

1. Apparatus for ejecting pulverulent material under pressure therefrom including a pressurized vessel having a conically-shaped outlet defining a valve seat and fluid-operated means controlling the flow of said material through the outlet comprising a ball valve engageable with said valve seat, a valve rod secured to the ball valve and having a pressure-deformable piston adjacent one end, a cylinder to receive the piston for sliding engagement therewith, said piston dividing the cylinder into one end open to the vessel and an opposite end closed to the vessel, and means to vary the pressure in said closed end of the cylinder to move the valve rod in cooperation with the pressure in the vessel to raise and lower the ball valve with respect to said seat.

2. Apparatus for ejecting pulverulent material under pressure therefrom including a pressurized vessel having a conically-shaped outlet defining a valve seat, and fluid-operated means controlling the flow of said material through said outlet comprising a ball valve engageable with said valve seat, a valve rod secured to the ball valve and having a pressure-sensitive piston adjacent one end, a cylinder secured at one end to a wall of the vessel substantially opposite to said conically-shaped outlet to receive the pressure-sensitive piston for movement therein, said piston defining one space within the cylinder closed to the atmosphere of the vessel and another space open to the atmosphere of the vessel, and means to vary the pressure in said closed space of the cylinder to move the valve rod in cooperation with the pressure in said vessel to raise and lower the ball valve with respect to said seat, said pressure-sensitive piston being deformed by the pressure differential between the pressure of the closed space of the cylinder and that of the pressurized vessel to make an extended surface seal with the cylinder, said conically-shaped outlet serving to guide the ball valve toward said seat.

3. Apparatus as claimed in claim 2 further including an ejector chamber to receive the pulverulent material from the conically-shaped outlet, and means to pass fluid under pressure through the ejector chamber to carry the pulverulent material to a point of use.

4. Apparatus as claimed in claim 2 further including an ejector chamber to receive the pulverulent material from the conically-shaped outlet, a discharge conduit joined to the ejector chamber to direct the pulverulent material to a point of use, and means to pass fluid under pressure through the ejector chamber to carry the pulverulent material through the discharge conduit to said point of use.

5. Apparatus for ejecting pulverulent material under

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pressure therefrom including a pressurized vessel having a conically-shaped outlet defining a valve seat, and fluid-operated means controlling the flow of said material through said outlet comprising a ball valve engageable with said valve seat, a valve rod secured to the ball valve and having a pressure-deformable piston adjacent one end comprising ductile metal contained in a resilient jacket, a cylinder disposed within the vessel and secured to one end of a wall of the vessel substantially opposite to said conically-shaped outlet to receive the deformable piston for sliding movement therein, said piston defining one space within the cylinder closed to the atmosphere of the vessel and another space open to the atmosphere of the vessel, a seat for the deformable piston in the closed space of the cylinder, and means to vary the pressure in said closed space of the cylinder to move the valve rod in cooperation with the pressure in said vessel to raise and lower the ball valve with respect to said seat, said piston being deformable by the pressure differential between the pressure of the closed area of the cylinder and that of the pressurized vessel to make an extended surface seal against said seat in the closed area and the adjacent walls of the cylinder and having a cross-sectional area normal to said valve rod sufficiently exceeding a like cross-sectional area of said ball valve to effect such movement of said valve rod.

6. Apparatus as claimed in claim 5 wherein said pressure-deformable piston further comprises a plate on opposite sides of the jacketed ductile metal disposed axially of the cylinder, and means to move the plates relatively to each other to vary the seal of the deformable jacketed metal with the seat therefor and the walls of the cylinder.

7. Apparatus as claimed in claim 5 wherein said pressure-deformable piston further includes a plate on opposite sides of the jacketed ductile metal disposed axially of the cylinder, and bolt means extending through the plates and jacketed ductile metal adapted to draw the plates together to increase the area of the seal of the deformable jacketed metal with the seat therefor and walls of the cylinder, and the vessel has a normally closed opening communicating with said closed area of the cylinder to permit access to the bolt means.

8. Apparatus as claimed in claim 5 further including guide means carried by the pressurized vessel and substantially encompassing the valve rod to guide its movement in raising and lowering the ball valve with respect to the seat for said valve.

9. Apparatus for ejecting pulverulent material under pressure therefrom including a pressurized vessel having a conically-shaped outlet defining a valve seat, and fluid-operated means controlling the flow of said material through said outlet comprising a ball valve engageable with said valve seat, a valve rod secured to the ball valve and having a pressure-deformable piston adjacent one end comprising ductile metal contained in a resilient jacket, a cylinder disposed within the vessel and secured at one end to a wall of the vessel substantially opposite to said conically-shaped outlet to receive the deformable piston for sliding movement therein, a seal at the other end of the cylinder about the valve rod to close the cylinder from the atmosphere of the vessel, and means alternatively to vary the pressure in the cylinder on opposite sides of the deformable piston to reciprocate the piston and valve rod and raise and lower the ball valve with respect to its seat, said piston being deformable by the pressure drop existing thereacross to make an extended surface seal with the walls of the cylinder.

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