Nov. 22, 1927. 1,650,077

C. LAMB ET AL

VALVE STRUCTURE FOR SLUSH PUMPS

Filed May 19, 1926

Fig. 1.

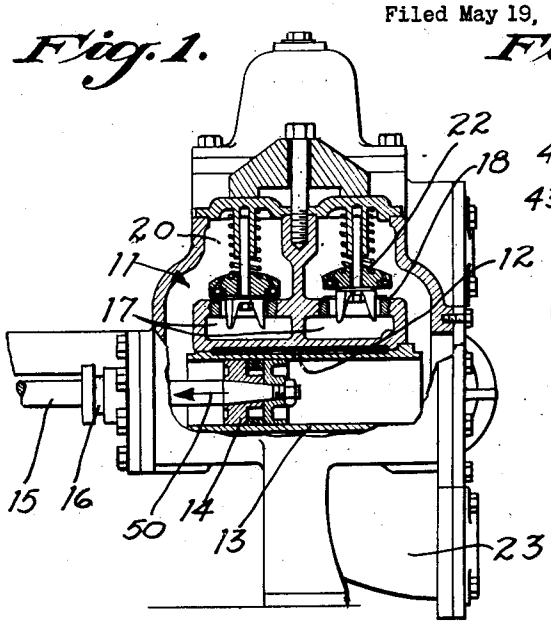


Fig. 2.

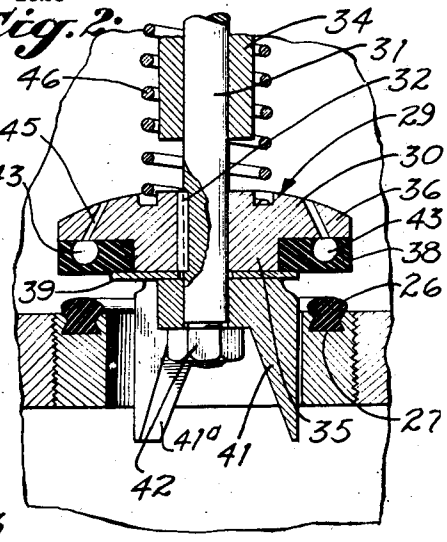


Fig. 4.

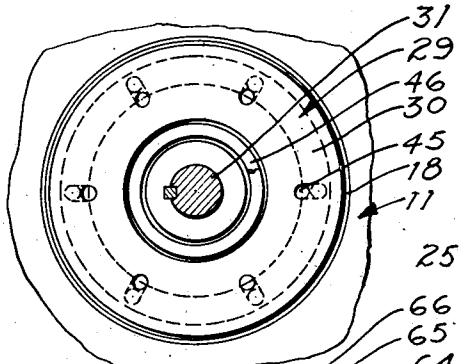


Fig. 5.

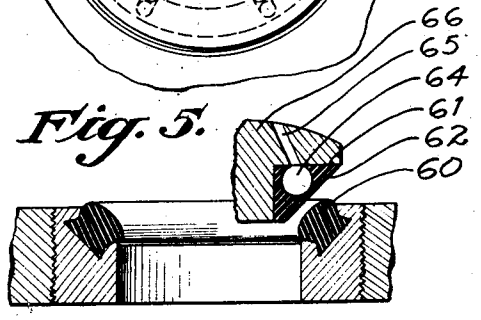
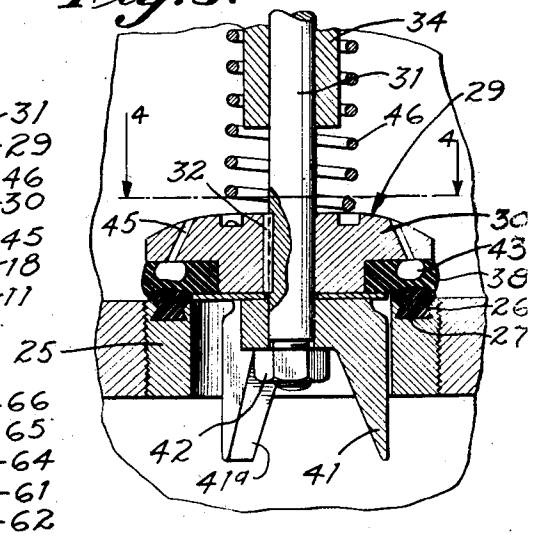


Fig. 3.



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UNITED STATES PATENT OFFICE.

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VALVE STRUCTURE FOR SLUSH PUMPS.

Application filed May 19, 1926. Serial No. 110,044.

Our invention relates to valve constructions, and it relates particularly to a novel form of valve construction especially adapted for use in pumps which handle fluid carrying abrasive particles.

In the oil drilling industry, slush is pumped into a well, being drilled, by a slush pump. The slush carries in suspension abrasive particles which quickly wear away the valves and seats of the pump. It is common practice to make the valve seats of hardened steel and the valves of rubber so that practically all the wear will be upon the rubber valve rather than upon the seat. This arrangement is utilized because of the fact that it is much cheaper to replace a rubber member than it is to replace the steel seat. It is quite a common occurrence in the oil drilling industry to renew the rubber valves on a slush pump every few hours.

We have found that by making both the valve and the seat of rubber or other resilient material, a better seating of the valve is effected, and that there is less wear on either members. It is thought that there is less wear because of better seating effect which prevents any slight leakage of fluid when the valve is seated.

It is accordingly one of the objects of our invention to provide a valve construction adapted for a pump in which the valve seat and the valve are made of a resilient material.

Another object of our invention is to provide a valve construction for a pump in which the valve seat and the valve are constructed to conform to the shape of each other by utilizing the hydraulic pressure of the fluid being handled by the pump. This feature of our invention is accomplished by providing the valve with a pressure chamber and communicating this pressure chamber with the cylinder of the pump. When the valve is closed and there is a pressure in the cylinder, this pressure is transferred to the pressure chamber in the valve and the valve is distended so that a very efficient seating is accomplished.

It is accordingly a further object of the invention to provide a valve construction for a pump in which the valve is distended by the hydraulic pressure of the fluid being pumped.

Other objects and advantages of the invention will be presented hereinafter.

Referring to the drawing in which we illustrate our invention,

Fig. 1 is a fragmentary view, partially sectioned, showing a pump using valves of our invention.

Fig. 2 is an enlarged section through the valve construction of our invention, the valve being in lifted position.

Fig. 3 is a view similar to Fig. 2, but showing the valve seated.

Fig. 4 is a section taken on the line 4—4 of Fig. 3.

Fig. 5 is a section showing an alternative form of the invention.

Referring to Fig. 1, the numeral 11 represents the slush end of a slush pump. The numeral 12 represents a cylinder of the slush pump in which a liner 13 is secured. Adapted to reciprocate in a horizontal direction in the liner 13 is a piston 14 which is secured to a piston rod 15. The piston rod 15 extends to the exterior of the cylinder 12 through a gland 16. The slush pump shown in the drawing is a double acting slush pump, that is, slush is pumped on both strokes of the piston 14. Intake passages 17 are formed above the liner 13, openings 18 being provided for communicating the intake passages 17 with chambers 20 which form a part of the cylinder 12. The flow of slush from the intake passages 17 through the openings 18 into the cylinder 12 is controlled by valve constructions 22 of this invention. The slush pump is provided with an outlet 23, but the details thereof and the details of the outlet valve are not shown since they do not concern this invention.

Referring to Figs. 2 to 4 inclusive, we will describe in detail the valve construction of this invention. The numeral 25 denotes a metallic seat retainer or seat holder which is threadedly secured in one of the openings 18. The upper end of the seat retainer 25 is provided with an annular resilient seat 26 which is molded in place. The upper face of the seat retainer 25 is provided with an annular channel 27 into which a lower part of the resilient seat 26 extends in order to attach it to the seat retainer. The numeral 29 represents the valve of the invention, which has a valve body 30 secured to a valve stem 31 by means of a key 32. The upper end of the valve stem 31 is centralized by a tubular projection 34 which extends from the upper part of the walls of the slush

pump. The lower part of the body 30 is in the form of a cylindrical projection 35 which projects downward from an upper flange part 36 thereof. Surrounding the cylindrical projection 35 is the resilient valve member 38 of our invention. This valve member 38 is in the form of an annulus and is held in place by a washer 39 which surrounds the lower end of the valve stem 31. Also placed on the lower end of the valve stem 31 is a guide 41 which is secured in place by a nut 42 threadedly secured on the extreme lower end of the valve stem 31. The guide 41 has wings 41ª which extend inside the seat retainer 25 and restrain the valve 29 from side movement. The resilient seat member 38 is provided with an annular pressure chamber 43 which may be so placed that it connects with the upper face of the resilient seat member 38. Ducts 45 are formed through the flange 36. The lower ends of these ducts 45 communicate with the annular pressure chamber 43 and the upper ends thereof communicate with the cylinder 12. In Fig. 2 the valve 29 is shown in lifted position, and in Fig. 3 it is shown in seated position. A coil spring 46 is provided for the purpose of moving the valve so that the resilient valve member 38 will contact the resilient seat 26.

The operation of the invention is as follows:

Referring to Fig. 1, let us consider that the piston 14 is moving in the direction indicated by the arrow 50. At this time slush is being drawn into the right end of the cylinder 12 and the right valve 29 is in lifted position so that the slush may flow from the right inlet passage 17 through the right opening 18 into the right end of the cylinder 12. The left valve 29 is at this time seated so that the fluid will not pass into the left passage 17. When the piston moves in a direction opposite to the direction indicated by the arrow 50, the right valve 29 will be moved downward, partly by gravity and partly by the action of one of the springs 46, until the resilient valve member 38 contacts the adjacent resilient seat 26. After this contact has been made the hydraulic pressure in the right end of the cylinder 12 increases and very often to as much as 750 pounds per square inch.

Referring now to Fig. 3 this high hydraulic pressure forces the valve 29 firmly downward with much pressure so that the valve member 38 pressurally engages the resilient seat 26. At the same time a pressure equivalent to the pressure in the right end of the cylinder 12 exists in the annular pressure chamber 43, by reason of the fact that communication is provided between the pressure chamber 43 and the right end of the cylinder 12 by the ducts 45. This high pressure in the pressure chamber 43 distends the resilient valve member 38 and it will occupy a position shown in Fig. 3. This distending of the resilient valve member 38 causes the lower face thereof to conform to the shape of the upper face of the resilient seat 26. Actual use of this construction has absolutely proved that a better seating is accomplished than is possible in other valve constructions. This will be readily understood when it is considered that the pressure which distends the resilient valve member, causing it to conform to the shape of the resilient seat, is from 500 to 750 pounds per square inch. This extremely high pressure gives a seating which is absolutely fluidtight and cannot possibly leak. The area of contact of the resilient valve member 38 and the resilient seat 26 is increased to a maximum by reason of the conforming of the member 38 to the shape of the seat 26. Without the distending means of the invention the area of contact between the seat and valve member would be comparatively small, and the liability to leak increases proportionately. The operation of the valve of the invention is such that the valve 29 will first pressurally engage the resilient seat and thereafter the resilient valve member will be distended. This is a desirable sequence of action.

In Fig. 5, we show an alternative form of the invention. Fig. 5 shows a valve construction having a conical resilient seat 60 and a resilient valve member 61 having a conical face 62 which is adapted to engage the seat 60. The valve member 61 is provided with an annular pressure chamber 64 which is communicated to the cylinder of the pump through an opening 65 formed in a body 66 of this valve. The operation of this form of the invention is the same as the operation of the form shown in Figs. 1 to 4 inclusive. Fig. 5 is included to show that the invention may be embodied in several different forms which come within the scope of this invention.

We claim as our invention:

1. In a valve the combination of: a head member; a seat member; and resilient facing members provided upon said head and seat members and adapted to meet when said valve is closed, one of said facing members having a pressure chamber therein which communicates with a space adjacent to said member in which a pressure is adapted to be built up tending to close said valve, the other of said facing members having a convex surface to which said first facing member conforms when said valve is closed under pressure.

2. In a valve the combination of: a head member; a seat member; and resilient facing members provided upon said head and seat members and adapted to meet when said valve is closed, one of said facing members having a pressure chamber therein which communicates with a space adjacent to said

member in which a pressure is adapted to be built up tending to close said valve, the other of said facing members having a convex surface to which said first facing member conforms when said valve is closed under pressure, said pressure chamber being of such shape, size and location as to provide a relatively thin wall of material upon the meeting face of the facing member having such chamber.

3. In a valve, the combination of: a seat member having an opening communicating between spaces having different fluid pressures; a head member adapted to move in the space of the greater of said fluid pressures to close said opening; and an annular facing provided on one of said members, the other of said members having a seat, said facing being formed of resilient material, there being a substantially annular cavity formed in said facing to provide surface facing walls of unequal thickness, a thinner one of said walls being adapted to contact said seat when said head member closes said opening, there being passage means which communicate between said space of higher pressure and said cavity.

4. In a valve, the combination of: a seat member having an opening communicating between spaces having different fluid pressures; a head member adapted to move in the space of the greater of said fluid pressures to close said opening; and an annular facing provided on one of said members, the other of said members having a seat, said facing being formed of resilient material, there being a substantially annular cavity formed in said facing substantially circular in cross-section to provide surface facing walls of unequal thickness, a thinner one of said walls being adapted to contact said seat when said head member closes said opening, there being passage means which communicate between said space of higher pressure and said cavity.

5. In a valve, the combination of: a seat member having an opening; a head member adapted to close said opening, there being a convex annular seat formed upon one of said members; and a facing provided upon the other of said members and adapted to contact said seat, said facing comprising a body of resilient material having a relatively thin annular seat contacting wall, and thicker side walls supporting said annular wall on its inner and outer edges.

6. In a valve, the combination of: a seat member having an opening; a head member adapted to close said opening, there being a seat formed of resilient material upon one of said members; and a facing provided upon the other of said members and adapted to contact said seat, said facing comprising a body of resilient material having a relatively thin annular seat contacting wall, and thicker side walls supporting said annular wall on its inner and outer edges.

7. In a valve, the combination of: a seat member having an opening; a head member adapted to close said opening, there being a convex annular seat formed of resilient material upon one of said members; and a facing provided upon the other of said members and adapted to contact said seat, said facing comprising a body of resilient material having a relatively thin annular seat contacting wall, and thicker side walls supporting said annular wall on its inner and outer edges.

In testimony whereof, we have hereunto set our hands at Los Angeles, California, this 13th day of May, 1926.

CHARLES LAMB.
DOUGLAS R. RADFORD.