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LUBRICATED PISTON

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12 Claims. (Cl. 309—6)

This is a continuation-in-part of my copending application Serial No. 221,963, filed July 29, 1938, for Fluid operated pump, to which reference is hereby made.

A primary object of my invention is to provide a piston adapted to reciprocate in a cylinder in which a fluid is conveyed through the piston to the periphery thereof, including means for regulating the pressure at which such fluid is discharged to the periphery of the piston. I further prefer to utilize a regulating means such that the pressure of the fluid may be maintained below a predetermined maximum value.

A further object of the invention is to provide a novel type of piston having means for lubricating the surface thereof during operation.

Other objects and advantages will be apparent from the following description and drawing, in which:

Fig. 1 is a vertical sectional view of my invention.

Fig. 2 is a fragmentary sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is a cross-sectional view taken on the line 3—3 of Fig. 1.

In the drawing I show a piston 150 having a cylindrical body 151, adapted to make a sliding fit in a bore 93 of a cylinder liner 98, the exterior thereof being provided with annular channels 152 receiving piston rings 153 as is well known in the art. The cylindrical body 151 has an upper central bore 154 threadedly receiving the lower end of an upper piston rod 110 having a longitudinal passage 111 therethrough, and has a lower central bore 155 threadedly receiving the upper end of a lower piston rod 132, the ends of the rods being spaced apart by a chamber 156. Offset from the axis of the cylindrical body 151 is a valve cylinder 157 which is closed at its lower end by a lower plug 158 and has at its upper end an upper plug 159 provided with a passage 160 therethrough. Slidably disposed in the valve cylinder 157 is a regulator valve member 161 having a cup-shaped piston 162 within which a compression spring 163 is disposed so as to engage both the piston and the upper plug 159, and the valve member is provided with a transverse opening 164 which registers with a port 165 communicating between the interior of the valve cylinder 157 and the exterior of the cylindrical body 151. The cylindrical body 151 is provided with a transverse opening 166 into which is threaded a transverse pin 167 having a vertical fluid passage 168 communicating with a longitudinal fluid passage 169, one end of the

transverse pin projecting into the transverse opening 164 of the valve member 161 and having threaded thereon a tubular cap 170 having a valve orifice 171 therein. Secured to the valve member 161 and projecting upwardly in the transverse opening 164 is a conical valve element 172 adapted to seat in the lower end of the valve orifice 171 to close it, the valve member being provided with a passage 173.

My piston 150 is designed to permit a flow of operating fluid under relatively high pressure through the passage 111 to the sliding surfaces of the piston and the liner 98 to lubricate them and to prevent foreign materials from lodging therebetween, which is broadly covered in my Patent No. 2,081,220, issued May 25, 1937, the present construction being an improvement thereon. My invention is of particular utility in connection with a deep well pump. In a deep well installation, such as, for example, a well 6500 feet deep, the pressure of the operating fluid may be as high as 4000 pounds per square inch, whereas in using the piston 150 in the pump shown in my above referred to application Serial No. 221,963, the fluid load on the piston 150 may only be 400 pounds per square inch. Obviously, if operating fluid under a high pressure, such as 4000 pounds per square inch, is conveyed to the outer surface of the piston, it will either cause excessive leakage lengthwise of the piston or will require an excessive functional duty to be imposed on the piston rings 153. Consequently, a principal object of my piston design is to provide a pressure reducing means for reducing the pressure of the operating fluid to a value approximating the fluid load on the piston 150.

In operation, operating fluid under pressure is at all times in the longitudinal passage 111 of the upper piston rod 110 and in the axial passage 135 of the lower piston rod 132, communication therebetween being afforded through the chamber 156 of the piston 150. The operating fluid flows through the vertical and longitudinal fluid passages 168 and 169, through the tubular cap 170, and through the orifice 171 into the transverse opening 164. The spring 163 normally exerts a downward force on the valve member 161 tending to hold it in open position in which the valve element 172 is out of seating engagement with the valve orifice 171. Operating fluid then passes through the passage 173 into the lower end of the valve cylinder 157, and exerts an upward force on the valve member 161 tending to move the valve member upwardly against the action of the spring 163, and any fluid pressure in the

valve cylinder 157 in excess of that required to balance the spring 163 causes the valve member 161 to move upwardly tending to close the valve element 172 in the orifice 171. The spring 163 is selected to balance a counter fluid force slightly greater than the maximum fluid load on the piston 150. For example, if the maximum fluid pumping load on the piston 150 is approximately 400 pounds per square inch, the spring 163 is set to resist movement of the valve member 161 until the pressure of the operating fluid rises above a predetermined maximum, such as 500 pounds per square inch. Thus, if the normal pressure on the operating fluid is 4000 pounds per square inch, the excess pressure in the valve cylinder 157 below the valve member will move the valve member 161 upwardly until the valve element 172 is sufficiently closed so that the spring 163 will balance the pressure of the fluid in the valve cylinder. It will thus be understood that this construction operates as a regulator to maintain the pressure of operating fluid flowing outwardly through the transverse opening 164 and the port 165 below a predetermined maximum, thus preventing excessive leakage of operating fluid lengthwise of the piston 150, and permitting the use of relatively light frictional contact of the piston rings 153 with the bore 93 of the liner 98. It will also be understood that this piston construction may be used to advantage in other devices, and I do not intend to be limited to its use in connection with a fluid operated pump.

Although I have herein shown and described a simple and practical embodiment of my invention, I do not intend to be limited to the details of construction disclosed but intend my invention to be accorded the full scope of the following claims.

I claim as my invention:

1. In a piston device, the combination of: piston means adapted to be slidably received in a cylinder; walls forming a passage for conveying a fluid through said piston means to the periphery thereof, said passage also communicating with a source of fluid under relatively high pressure; and pressure regulating means in the line of said passage adapted to regulate the discharge of fluid therethrough to the periphery of said piston means at a predetermined pressure regardless of the pressure of fluid in said source of supply.

2. In a piston device, the combination of: piston means adapted to be slidably received in a cylinder; walls forming a passage for conveying a fluid through said piston means to the periphery thereof, said passage also communicating with a source of fluid under relatively high pressure; and pressure regulating means in the line of said passage adapted to maintain the pressure of fluid discharged outwardly from said passage to the periphery of said piston means below a predetermined maximum regardless of the pressure of fluid at said source.

3. In a piston device, the combination of: piston means adapted to be slidably received in a cylinder, said piston means having a central chamber and passage means communicating between said central chamber and the outer periphery of said piston means; piston rod means connected to said piston means and having a fluid passage therein communicating with said central chamber, the other end of said fluid passage being connected to a source of fluid under relatively high pressure; and pressure regulat-

ing means in the line of said passage means adapted to maintain the pressure of fluid passing therethrough below a predetermined maximum regardless of the pressure of fluid at said source.

4. In a piston device, the combination of: a piston adapted to be slidably received in a cylinder, said piston having a central chamber, passage means communicating between said chamber and the periphery of said piston, and a bore therein offset from said central chamber; a piston rod connected to said piston and having a longitudinal passage therethrough communicating with said central chamber, the other end of said passage being adapted to be connected to a source of fluid under pressure; a valve member movable in said bore to regulate the flow of fluid through said passage; and means in said bore for controlling the movement of said valve member to maintain the fluid discharged through said passage to the periphery of said piston below a predetermined maximum pressure.

5. In a piston device, the combination of: a piston adapted to be slidably received in a cylinder, said piston having a central chamber, passage means communicating between said chamber and the periphery of said piston, and a bore therein offset from said central chamber; a piston rod connected to said piston and having a longitudinal passage therethrough communicating with said central chamber, the other end of said passage being adapted to be connected to a source of fluid under pressure; a tubular valve member movable in said bore to regulate the flow of fluid through said passage; and means in said bore for controlling the movement of said valve member to maintain the fluid discharged through said passage to the periphery of said piston below a predetermined maximum pressure, said means including a spring engaging said tubular valve member and means for adjusting the tension of said spring.

6. In a piston device, the combination of: piston means adapted to be slidably received in a cylinder, said piston means having a central chamber and passage means communicating between said central chamber and the outer periphery of said piston means; piston rod means connected to said piston means and having a fluid passage therein communicating with said central chamber, the other end of said fluid passage being connected to a source of fluid under pressure; a metering valve in the line of said passage means and adapted to meter a flow of fluid through said passage means; and means for operating said metering valve in response to fluid pressure in said central chamber to maintain a fluid flow through said passage means below a predetermined maximum.

7. In a piston device, the combination of: a piston adapted to be slidably received in a cylinder, said piston having a central chamber and passage means communicating between said central chamber and the outer periphery of said piston, there being an offset bore provided in said piston parallel with but offset from the axis of said piston; a piston rod connected to said piston and having a piston rod passage therein communicating between said central chamber and a source of supply of fluid under pressure; a tubular metering valve in said offset bore and movable to control a flow of fluid through said passage means; a valve member carried by said tubular metering valve and adapted to close said passage means; and means for normally yield-

ably maintaining said tubular metering valve in a position in which said valve member opens said passage, but movable to close said valve member in response to a rise in fluid pressure in said passage means.

8. In a piston device, the combination of: piston means adapted to be slidably received in a cylinder; walls forming a passage for conveying a fluid through said piston means to the periphery thereof, said passage also communicating with a source of fluid under pressure; valve means in the line of said passage and movable to control the flow of fluid therethrough from said source to said periphery; retaining means operatively connected to said valve means and adapted to maintain said valve means open when the fluid pressure in said passage is below a predetermined maximum; and closure means operatively connected to said valve means for moving said valve means toward closed position against the action of said retaining means so as to throttle said flow when the fluid pressure in said passage exceeds said predetermined maximum.

9. In a piston device, the combination of: piston means adapted to be slidably received in a cylinder; walls forming a passage for conveying a fluid through said piston means to the periphery thereof, said passage also communicating with a source of fluid under pressure; valve means in the line of said passage and movable to control the flow of fluid therethrough from said source to said periphery; retaining means operatively connected to said valve means and adapted to maintain said valve means open when the fluid pressure in said passage is below a predetermined maximum; closure means operatively connected to said valve means for moving said valve means toward closed position against the action of said retaining means so as to throttle said flow when the fluid pressure in said passage exceeds said predetermined maximum; and means for adjusting the predetermined maximum pressure at which said closure means will move said valve means toward closed position.

10. In combination: walls forming a passage adapted to convey fluid under pressure; a source

of fluid supply communicating with said passage; a valve member in the line of said passage and movable between open and closed position to throttle a flow of fluid through said passage; retaining means for normally retaining said valve member in said open position when the pressure of fluid in said passage remains below a predetermined maximum; and closure means operating in response to a rise in pressure of said fluid in said passage above said predetermined maximum to move said valve member toward said closed position.

11. In combination: walls forming a passage adapted to convey fluid under pressure; a source of fluid supply communicating with said passage; a valve member in the line of said passage and movable between open and closed position to throttle a flow of fluid through said passage; retaining means for normally retaining said valve member in said open position when the pressure of fluid in said passage remains below a predetermined maximum, said retaining means including a spring; and closure means operating in response to a rise in pressure of said fluid in said passage above said predetermined maximum to move said valve member toward said closed position against the action of said spring.

12. In combination: walls forming a passage adapted to convey fluid under pressure, said passage having an inlet end and a discharge end; a source of fluid supply communicating with said inlet end of said passage; a valve member in said passage between said inlet and discharge ends and movable between open and closed positions to throttle a flow of fluid through said passage; means for normally retaining said valve member in open position so long as the fluid pressure in the discharge end of said passage remains below a predetermined maximum; and means operating in response to a rise in fluid pressure in said passage above said predetermined maximum to move said valve member toward said closed position to throttle the flow of fluid therethrough so as to maintain the fluid pressure in said discharge end of said passage below a predetermined value.

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