A plunger packing wash system for a pumping mechanism for fluids containing abrasive materials in suspension therein comprising a wiping gland in the periphery of the cylinder of the pumping mechanism around the plunger, the annular clearance between the gland and the plunger being controlled so as to provide a maximum velocity flow at the surface of the plunger, at least one annular chamber in the wiping gland, open pore foam in at least one of the annular chambers, and a source of wash liquid at a pressure greater than the suction pressure of the pump communicating with the wiping gland on the intake or suction stroke of the plunger.

6 Claims, 6 Drawing Figures
PLUNGER PACKING WASH SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to improvements in pumps employed in connection with rotary drilling of wells, and in particular, to improvements in pumps for fluids carrying abrasives in suspension in the fluid pumped.

2. Description of the Prior Art

Drilling fluid employed in the drilling operations of oil and water wells contains abrasive materials in suspension therein. These materials quickly wear the surfaces of the working parts of the pump unless the surfaces are constantly cleaned.

U.S. Pat. No. 2,367,185, dated Jan. 16, 1945, in the name of A.P. Cary, is exemplary of prior art attempts to solve the aforementioned problem by flushing the piston rod and liner or cylinder with water or other suitable fluid, at each operation of the moving part, and, at the same time, providing wiping means for the moving part to remove the abrasive substances from the contacting surfaces before the packing on either the piston or the stuffing box of the rod comes into contact with the moving surfaces.

While prior art flushing and wiping arrangements, as exemplified by Cary, have proven to be satisfactory in some respects, they have also proven to have major limitations. For example, when double acting pumps such as Cary work on the backstroke, as to require cleaning of the piston shaft during the retraction into the packing, there is a high pressure on the working system, which requires the use of an extremely high pressure wash system in order to overcome the work pressure. Additionally, pumps such as Cary only accomplish washing on the suction or backstroke, which results in a major contamination from abrasive materials in suspension in the drilling fluid on the discharge stroke.

SUMMARY OF THE INVENTION

The present invention provides an improved plunger packing wash system to keep the engaging surfaces of the plunger and packing clear of all abrasive substances in suspension and to pump fluid so as to prolong the life of the several parts of the pump beyond that common to the conventional type of equipment.

The improved plunger packing wash system of the present invention includes a wiping gland in the periphery of the cylinder around the plunger, the annular clearance between the gland and the plunger being controlled to provide a maximum velocity flow at the surface of the plunger. At least one annular chamber is provided in the wiping gland and at least one of the chambers so provided is packed with open pore foam continuous with the surface of the plunger. A source of wash liquid at a pressure greater than the suction pressure of the pump communicates with the wiping gland during the suction or backstroke of the plunger. Valve means responsive to the movement of the plunger controls the flow of wash liquid to the wiping gland. When the plunger moves between its extended or discharge position to its retracted or backstroke position, wash liquid communicates with the wiping gland. Likewise, when the plunger moves between its retracted or backstroke position to its extended or discharge position, the valve means precludes the flow of wash liquid to the wiping gland, maintaining a fresh charge of wash liquid in the annular chamber of the gland. Accordingly, the wash liquid therein is slowly discharged with the drilling fluid and the plunger is continuously wiped and cleaned by the open pore foam and by the wash liquid which is maintained therearound.

In a preferred embodiment a surge chamber and bypass arrangement may be provided in the wash system to compensate for, as well as to dampen, the resultant surges.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary, longitudinal, cross sectional view of a pump showing the improved piston packing wash system of the present invention.

FIG. 2 is an enlarged cross sectional view showing typical annular chambers in the wiping gland with one such chamber being filled with open pore foam.

FIG. 3 is an enlarged fragmentary longitudinal cross sectional view of a pump similar to FIG. 1 but showing the piston and cylinder area.

FIG. 4 is a cross sectional view taken on the line 4—4 of FIG. 3.

FIG. 5 is an enlarged fragmentary, cross sectional view showing exemplary non-adjustable packing which may be used in lieu of spring loaded vee packing.

FIG. 6 is a schematic outline of an exemplary surge chamber and a bypass arrangement which may be provided in the wash system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A typical pump or pumping mechanism 10, which may be employed in but which is not necessarily limited to the drilling operations of oil and water wells, is disclosed in FIG. 1. As can be seen, the pump 10 is provided with a pump body 12 including an intake and outlet manifold 14 provided with an inlet connection 16 communicating with a well or any suitable supply reservoir and an outlet connection (not shown) communicating with any desired vessel or the like. Valve seats 20 and 22 are provided at the connections between the intake connection 16 and the outlet connection and the intake and outlet manifold 14, respectively. Intake and outlet valves, such as the spring loaded check valves 24 and 26, control the flow of fluid from the intake connection 16, into the manifold 14, and through the outlet connection.

A plunger cylinder 28 is fixedly attached to the intake and outlet manifold 14 by means of coupling 30 and the bracket 32, which, along with the seal 34, such as an O-ring, secure the cylinder 28 and the manifold 14 in sealing engagement.

A plunger 36 having a plunger rod 38 is axially mounted within the cylinder 28 and movable therein between an extended position, as shown in FIG. 1, and a retracted position, as shown in FIG. 3. Movement of the plunger 36 is accomplished by joining the plunger rod 38 through suitable coupling means 40 to any desired power source.

A wiping gland 42 is provided in the periphery of the cylinder 28 around the plunger 36. The annular clearance or annulus 44 between the wiping gland 42 and the periphery of the plunger 36 is controlled so as to provide a maximum velocity flow at the surface of the plunger 36 consistent with the plunger diameter, stroke length, and pump speed, to keep the amount of wash fluid required to the absolute minimum and effectively...
wash the plunger during the suction or backstroke thereof. For example, the annular clearance 44 between the wiping gland 42 and the plunger 36 may be kept as small as possible within practical limits because of machinery tolerances and the need to provide sufficient clearance to keep the "rubbing" of the plunger 36 and the gland 42 to a minimum. Accordingly, a high forward velocity of the "wall" of clean wash fluid is produced which results in a greater length of travel or movement of the clean wash fluid for a given amount taken in as the plunger 36 moves in the suction or backstroke.

It will, of course, be evident that on small diameter plungers and/or in short stroke pumps, it is more practically possible to use a closer fit between the wiping gland and the plunger and to obtain a resulting higher velocity of flow of clean wash fluid than it is on larger diameter plungers and/or in longer stroke pumps.

As can be seen, the wiping gland 42 includes the lands 46 which divide it into at least one annular chamber 48. Open pore foam 50 is provided within at least one of the annular chambers 48 contiguous with the surface of the plunger 36 so as to provide a means of wiping the plunger 36 and keeping the wash liquid therearound. Suitable packing, such as spring loaded Vee packing 52, as shown in FIGS. 1 and 3, or non-adjustable packing 53, as shown in FIG. 5, along with the retaining nut or cap 54 and the bushing or retaining member 56, secure the lands 46 and the open pore foam 50 within the wiping gland 42.

It will, or course, be understood that the number of annular chambers 48 in the wiping gland 42 is optional, as is the use of open pore foam 50 in one or more of the chambers. For example, the embodiment of FIG. 2 discloses the use of open pore foam 50 in only one of the two annular chambers 48 of the wiping gland 42.

A source of wash liquid, such as water or the like, 58, at a pressure greater than the suction pressure of the pump 10, communicates with the wiping gland 42 during the suction or backstroke of the plunger 36. Valve means, such as the check valve 60, which is responsive to the movement of the plunger 36, controls the flow of clean wash liquid to the wiping gland 42.

The pressure of the clean wash liquid must be sufficiently greater than the main pump suction line pressure so that a positive flow of clean wash liquid can be achieved. Such pressure is determined by the friction loss in the inlet lines 59, the pressure necessary to overcome the spring load on the inlet check valve 60, and the pressure necessary to effectively move the clean wash liquid through the wiping gland 42 and ahead of the open pore foam 50 as the plunger 36 moves back during its suction or backstroke. For example, it has been found that this pressure may be as high as two to three times the main pump suction line pressure.

As will be more fully explained hereinafter, the inlet check valve 60 closes during the extended or discharge stroke of the plunger 36, keeping a fresh charge of clean wash liquid in the annular chambers 48 of the gland 42.

As shown by the schematic outline of FIG. 6, a suitable surge chamber and by-pass arrangement may be provided in the wash liquid supply system to compensate for, as well as to dampen, the resultant surges. The source of wash liquid 58, such as a supply reservoir (not shown), is connected to the suction of a supply pump 62, which has a greater capacity than the actual demand in order to insure a steady supply of clean wash liquid to the inlets of the check valves 60. The discharge of the supply pump 62 is taken to a volume tank 64. A suitable by-pass 66, pressure control valve 68 and pressure gauge 70 permit regulation of the pressure in the system leading to the check valves 60 by varying the amount of the wash liquid allowed to by-pass and return to the supply reservoir, since, as was previously explained, the supply of wash liquid exceeds the demand therefore. A flow meter 72 may be positioned in the line leading to the surge chamber 74 (or surge chambers, if a surge chamber is used at each connection of the inlet lines 59) from the volume tank 64 to permit a reading of the amount of wash liquid being used. The surge chamber or chambers 74 serve to dampen the normal pulsations resulting from the intermittent flow to each plunger 36, which provides for a smoother flow of wash liquid with less chance of damage to the system and better filling of the annulars 44 during the suction stroke of the pump 10.

Further, it will be understood that the plunger packing wash system of the present invention may also be adapted for use with a close fitting sleeve-liner arrangement, not requiring a packing arrangement, if the area occupied by the spring loaded Vee packing 52, rear bushing or retaining member 56 and retaining nut or cap 54, was replaced by a very close fit, i.e., very small annular clearance, between the cylinder 28 and the plunger 36. The very close fit between the cylinder 28 and the plunger 36 actually accompanies the cylinder with a minimum of leakage and the fluid wash provides a clean fluid to prevent wear and/or galling of the cylinder 28 and the plunger 36.

In operation, when the plunger 3 moves from its extended or discharge position, as shown in FIG. 1, to its retracted or backstroke position, as shown in FIG. 3, the reduction of pressure within the manifold 14 causes the intake valve 24 to open and drilling fluid is drawn through the intake connection 16 into the manifold 14 and into the cylinder 28. Contemporaneously therewith, the pressure of the clean wash liquid overcomes the load of the spring 61 in the check valve 60 and the suction pressure within the manifold 14. The clean wash liquid fills the annular chambers 48 in the wiping gland 42. The annular clearance 44 between the wiping gland 42 and the plunger 36 is such that it provides a maximum velocity flow of the clean wash liquid at the surface of the plunger 36. Both the open pore foam 50 and the annular clearance 44 assist in wiping, cleaning and keeping the clean wash liquid around the plunger 36 during the retracted or backstroke thereof. When the plunger 36 moves from its retracted or backstroke position, as shown in FIG. 3, to its extended or discharge position, as shown in FIG. 1, it pushes against the drilling fluid within the cylinder 28 and the manifold 14, causing the intake valve 24 to close and the outlet valve 26 to open. The drilling fluid is then discharged through the outlet connection. Contemporaneously therewith, the increased pressure within the cylinder 28 and the manifold 14 quickly equals the pressure of the clean wash liquid 58 and the spring 61 of the check valve 60 closes the flow of clean wash liquid to the wiping gland 42. However, a fresh charge of clean wash liquid 58 is maintained in the annular chambers 48 of the wiping gland 42. The open pore foam 50, the annular clearance 44 between the wiping gland 42 and the plunger 36, along with the fresh charge of clean
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wash liquid 58, assist in wiping, cleaning and keeping the clean wash liquid around the plunger 36 during the extended or discharge stroke.

While certain preferred embodiments of the invention have been specifically illustrated and described, it is understood that the invention is not limited thereto, as many variations will be apparent to those skilled in the art, and the invention is to be given its broadest interpretation within the terms of the following claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a pumping mechanism for pumping fluids containing abrasive materials in suspension therein having an intake and outlet manifold provided with an intake valve and an outlet valve, at least one cylinder communicating with said manifold, a plunger axially mounted within said cylinder and movable therein between an extended position and a retracted position, said pump pulling fluid through said intake valve into said manifold and said cylinder when said plunger moves from its extended position to its retracted position and discharging fluid through said outlet valve when said plunger moves from its retracted position to its extended position, the improvement, in combination therewith, comprising a wiping gland in the periphery of said cylinder around said plunger, the annular clearance between said wiping gland and said plunger being controlled to provide a maximum velocity flow at the surface of said plunger, said wiping gland being provided with at least one annular chamber, open pore foam in at least one of said chambers contiguous with the surface of said plunger, and a source of clean wash liquid at a pressure greater than the suction pressure of said pump communicating directly with said wiping gland and said open pore foam, upstream of said open pore foam, when said plunger moves from its extended position to its retracted position, including valve means responsive to the movement of said plunger for controlling the flow of clean wash liquid to said wiping gland, whereby said plunger is continuously wiped and cleaned both when it moves from its extended position to its retracted position, during which time clean wash liquid communicates with said wiping gland, and when it moves from its retracted position to its extended position, during which time said valve means precludes the flow of clean wash liquid to said wiping gland, and maintains a fresh charge of clean wash liquid within said annular chamber of said wiping gland, the fresh charge of clean wash liquid being slowly discharged with the fluid being pumped.

2. The pumping mechanism according to claim 1, wherein the pressure of said clean wash liquid is sufficiently greater than the main pump suction pressure so that a positive flow of wash liquid can be achieved.

3. The pumping mechanism according to claim 1, wherein surge chamber and by-pass means are provided between said source of wash liquid and said valve means to dampen the normal pulsations resulting from the intermittent flow of wash liquid to said plunger, providing for a smoother flow of wash liquid with less chance of damage to the system and better filling of said wiping gland during the suction stroke of said pump.

4. The pumping mechanism according to claim 3, wherein said surge chamber and by-pass means comprises a supply pump communicating with said source of wash liquid, said supply pump having a greater capacity than the actual demand to insure a steady supply of said wash liquid to said valve means, a volume tank which receives the discharge from said supply pump and communicates with each of said valve means, a by-pass communicating between said volume tank and said source of supply, second valve means to control the regulation of pressure in the system leading to said valve means by varying the amount of fluid allowed to by-pass and return to said source, and at least one surge chamber disposed between said volume tank and each of said valve means.

5. The pumping mechanism according to claim 4, wherein a flow meter is disposed between said surge chamber and said volume tank to permit a reading of the amount of wash liquid being utilized.

6. The pumping mechanism according to claim 1, wherein said wiping gland is provided with two annular chambers having open pore foam in each chamber.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,749,529 Dated July 31, 1973

Inventor(s) DAVID J. CORNELSEN

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Please correct the title page of the Patent as follows:

"Cancel the residence of the Inventor reading "Grainesville, Tex." , and substitute therefor --Gainesville, Tex.--.

Signed and sealed this 18th day of December 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR. RENE D. TEGTMeyer
Attesting Officer Acting Commissioner of Patents