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REPLACEABLE LINER CONSTRUCTION FOR MUD PUMPS

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Fig. 1

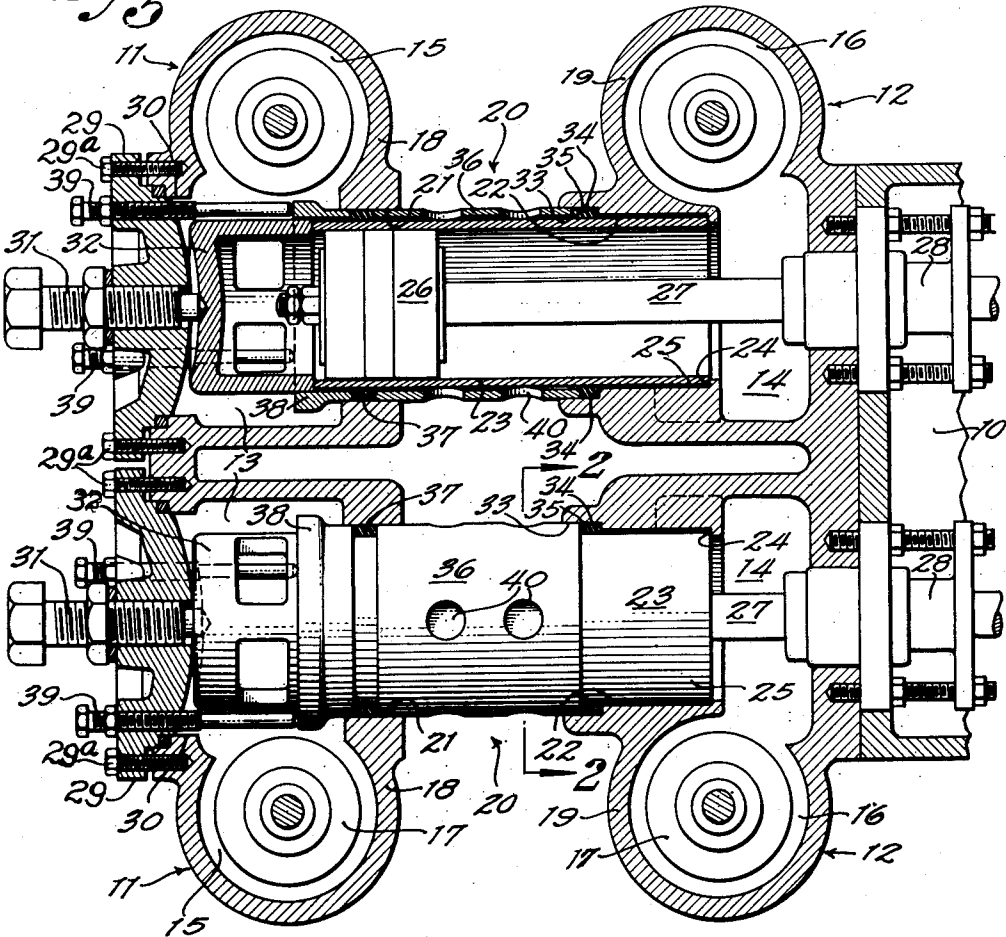
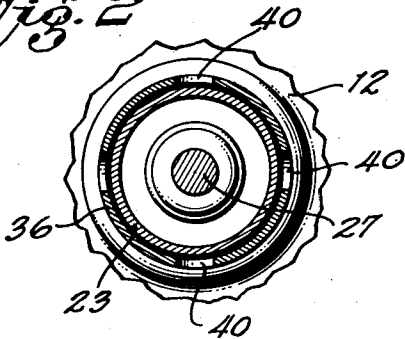


Fig. 2



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REPLACEABLE LINER CONSTRUCTION
FOR MUD PUMPS

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10 Claims. (Cl. 309—3)

Our invention relates to a cylinder construction especially suited for use in mud pumps which are used in conjunction with rotary well drilling operations to pump a mud mixture down through a drill pipe during drilling operation.

Although the invention has utility with various types of devices wherein a piston operates within a cylinder, it is of special utility with pumps employed for the pumping of liquids containing solid or abrasive substances, and for the purpose of briefly disclosing the invention without limiting its use, we shall herein explain the invention with relation to the fluid or working end of a power driven mud pump of double acting type, used in the rotary system of deep well drilling. Pumps of this character have a cylinder in which a piston is operated by means of a piston rod and the ends of the cylinder are connected to pumping or working chambers, each of which chambers has associated therewith a suction valve and a discharge valve, so that as the piston is reciprocated fluid will alternately be drawn into and discharged from the working chambers at the ends of the cylinders. In view of the fact that the material pumped, for example drilling mud, is of an abrasive character, the wear on the cylinder wall is ordinarily quite severe and it has become a practice to provide for the cylinder a replaceable steel liner which is secured in the cylinder opening between the working chambers of the pump.

It is an object of the invention to provide a heavy duty pump construction having a replaceable cylinder of simple form and effective, yet inexpensive, means for holding the cylinder in operative position in the pump body.

It is an object of the invention to provide a cylinder of removable or replaceable character, and novel means whereby the ends of this cylinder may be effectively sealed in a pump body so that leakage along the exterior of the cylinder is substantially prevented.

A further object of the invention is to provide in a pump construction having a replaceable cylinder or liner, a sealing means for sealing off both ends of the liner, this sealing means being so constructed that it is not subjected to alternations of applied pressure due to operation of the pump, thereby achieving extended useful life in the sealing members employed.

A further object of the invention is to provide a structure of the character set forth in the foregoing wherein a replaceable liner is moved into and out of operative position between spaced working chambers, with the intermediate portion

of the liner exposed to the exterior, without disturbing the spaced relation of the working chambers and without the necessity of dismantling the pump structure.

5 An additional object is to provide a cylinder of removable or replaceable character and novel means for sealing the ends of the cylinder so that leakage along the exterior of the cylinder is substantially prevented and means for equalizing the effectiveness of the seals at each end of the cylinder.

10 A further object is to provide in a pump construction of the character described sealing means for the ends of a replaceable cylinder, which sealing means may be adjusted to a certain extent while the pump is in operation.

15 A further object is to provide in a pump of the character described a replaceable cylinder or liner, which cylinder is a simple cylinder of uniform diameter externally as well as internally, involving a reduction in manufacturing time and cost over replaceable liners now employed, having collars formed thereon or threaded to receive flanges or otherwise requiring special machine operations.

20 The present invention lends itself readily to a pump construction wherein the replaceable cylinder extends across an open face between two hollow pump bodies so that any leakage which might occur around either end of the cylinder will flow to the exterior of the pump and be there visible so that the attendant will have knowledge of the leakage around the cylinder. In ordinary pump construction, the replaceable liner is held in a bore which is completely enclosed, with the result that when leakage occurs around the exterior of the liner due to failure of the packing means, such leakage cannot be observed from the exterior, but eventually makes itself known through the drop in the efficiency of the pump. When the material being pumped contains abrasive substances, extended leakage around the exterior of the pump will often result in cutting of channels in the walls of the bore in which the liner is placed. In the pump construction disclosed herein, any leakage which may pass out around the exterior of either end of the replaceable cylinder or liner will be visible from the exterior, thereby bringing to the attendant immediate knowledge of the failure of a seal around the replaceable cylinder, so that he may then take steps required to correct this condition.

25 Further objects and advantages will be brought out in the following part of the specification.

Referring to the drawing which is for illustrative purposes only,

Fig. 1 is a plan view in section of the operating portion of a pump embodying our invention.

Fig. 2 is a sectional view taken along the line 2-2 of Fig. 1.

Fig. 1 shows the pumping end 10 of a pump having a suitable power end, not shown, the pumping end comprising one or more pairs of hollow bodies 11 and 12 which are spaced apart and have working chambers 13 and 14. These hollow bodies 11 and 12 have valve pots 15 and 16 respectively disposed on a vertical axis and these valve pots have intake and discharge valves, the intake valves 17 only being shown in the drawing, the discharge valves being in the upper part of the valve pot.

The hollow bodies 11 and 12 are rigidly connected by fluid intake and discharge members, not shown, and have adjacent walls 18 and 19, and are separated, as stated, by an open space 20. The hollow bodies 11 and 12 are provided with aligned liner openings 21 and 22 respectively to receive the end portions of replaceable liners 23, the liner opening 21 being somewhat larger than the opening 22 for a purpose to be more fully disclosed hereinbelow. The liner opening 22 has a flanged seat 24 against which the end portion 25 of the liner 23 engages, and is held by pressure means to be hereinafter described.

The pump is provided with the usual pistons 26 secured on piston rods 27 which are reciprocable through packing devices 28 and connected to the power actuating portions of the pump. The hollow bodies 11 are provided with removable wall members or cover plates 29, which may be secured in place in the well known manner by use of cap screws or studs 29a, to normally close the liner access ports 30 in the front walls of the hollow bodies 11, and ports 30 are of such diameter that the liners 23 and the packing means to be hereinafter described may be passed therethrough when the cover plates 29 are removed.

In order to secure the liners 23 in fixed position, with the ends 25 in sealing engagement with each seat 24, we provide in each cover plate 29 a heavy screw 31 to exert pressure against a cage 32 of open work construction, and which is disposed in engagement with the leftward end of the liner 23, as shown.

In describing our sealing means for the ends of the liners, we show the liner opening 22 of the hollow bodies 12 having an enlarged outer opening 33, forming a circular seat 34, forming a recess or cavity for a compressible packing ring element 35, which engages the outer cylindrical surface of the liner 23. A spacer cage, or lantern, 36 of generally cylindrical shape is disposed over the liner 23 and has an end portion thereof extending within the opening 33 and the opposite end portion thereof extending in the opening 21 of the hollow body 11, the opening 21 being of substantially the same diameter as the opening 33 and forming a space for a compressible packing element or ring 37, similar to the packing element 35. A sealing pressure collar 38 is disposed in each working chamber 13 and has a portion extending into the opening 21 for engagement with the packing element 37, pressure for which is supplied by a plurality of screws 39 extending through a cover plate 29 and engageable with each collar 38. The spacer cage 36 may be provided with a plurality of apertures 40, through

which any leakage of fluid from the inside of the liner 23 to the outside may pass and be perceived.

It should be clear from the foregoing description that we have provided a novel and simplified liner cylinder and improved means for securing the liner in fixed position in the pump, and improved sealing means for the ends of the liner. The adjustment of the pressure collar 38 by screws 39 will compress the packing element 37 against the spacer cage 36, which, in turn, compresses against the packing element 35, and effective seals are made between the end portions of the liner 23 and the liner openings 21, 22, and 33. It should be also clear that since the liners 23 are secured in fixed position on the seats 24 by the cages 32 and the screws 31, that there can be no longitudinal movement of the liners by the action of the pistons 26 occasioned by any excess frictional interengagement thereof. It may be also perceived that adjustment of the pressure applied to the packing elements 34 and 37 may be adjusted even while the pump is in operation, since the adjusting screws 39 extend to the outside through the cover plates 29 and the packing elements are not affected by the movement of the pistons 26.

It will also be clear that the liners 23 are simple cylinders of uniform diameter, external as well as internal, and that the cost and time of manufacture thereof will be considerably less than that of conventional liners which have collars formed thereon or are threaded to receive flanges or other specially formed parts.

Our invention, as described, is adaptable to certain variations which take into consideration that it may be desirable to provide a pump in which the internal diameter or piston size can be changed. For example, if a power driven pump has a motor of given size and it is desired to increase the pressure of the pumped fluid, this may be done by reducing the internal diameter of the cylinder and the piston. This may be done in the present invention by providing replaceable liners having cylindric portions or collars of the same outside diameter such as that of the liner 23, the said collars being in engagement with the packing elements 35 and 37, the remainder of the cylinder having a reduced inner and outer diameter, as should be manifest. A further variation contemplated with cylinders of different sizes is the provision of a single collar for engagement with both the packing elements 35 and 37, which arrangement involves the reduction in length of the spacer cage 36 to a small amount, and the extension of the cylindrical portions of the hollow bodies 11 and 12 toward each other to receive the packing elements 35 and 37.

We claim as our invention:

1. In a cylinder and liner device of the character described, the combination of: a hollow body structure having a pair of spaced working chambers with inner walls separated by a space which is substantially open to the exterior of the hollow body structure, said inner walls having aligned liner openings therein, one of said working chambers having a removable wall to provide a liner access opening aligned with said liner openings; a liner insertable through said liner access opening to a position wherein the ends thereof will communicate with said chambers through said liner openings of said inner walls; and sealing means comprising a pair of sealing members around said liner to resist leakage of fluid through said liner openings and around the exterior of the two end portions of said liner into

said open space, said sealing means being actuatable independently of said liner to simultaneously actuate said sealing members.

2. In a cylinder and liner device of the character described, the combination of: a hollow body structure having a pair of spaced working chambers with inner walls separated by a space which is substantially open to the exterior of the hollow body structure, said inner walls having aligned liner openings therein, one of said working chambers having a removable wall to provide a liner access opening aligned with said liner openings; a liner insertable through said liner access opening to a fixed position wherein the ends thereof will communicate with said chambers through said liner openings of said inner walls; sealing means around said liner to resist leakage of fluid through said liner openings and around the exterior of both end portions of said liner into said open space, said sealing means being actuatable independently of said liner and having a pair of spaced annular seals and annular seal actuating means to engage the ends of said annular seals facing toward said space; and means acting independently of said sealing means to prevent axial movement of said liner.

3. In a cylinder and liner device of the character described, the combination of: a hollow body structure having a pair of spaced working chambers with inner walls separated by a space which is substantially open to the exterior of the hollow body structure, said inner walls having aligned liner openings therein, one of said working chambers having a removable wall to provide a liner access opening aligned with said liner openings; a liner insertable through said liner access opening to a fixed position wherein the ends thereof will communicate with said chambers through said liner openings of said inner walls; sealing means around said liner to resist leakage of fluid through said liner openings and around the exterior of both ends of said liner into said open space, said sealing means comprising a pair of spaced annular seals; means to actuate said sealing means comprising annular means in said space having annular shoulders in thrust engagement with said seals; and means acting independently of said seal actuating means to prevent axial movement of said liner.

4. In a cylinder and liner device of the character described, the combination of: a hollow body structure having a pair of spaced working chambers with inner walls separated by a space which is substantially open to the exterior of the hollow body structure, said inner walls having aligned liner openings therein, one of said working chambers having a removable wall to provide a liner access opening aligned with said liner openings; a liner insertable through said liner access opening to a fixed position wherein the ends thereof will communicate with said chambers through said liner openings of said inner walls; means engaging said liner so as to prevent axial movement thereof; sealing means around said liner to resist leakage of fluid through said liner openings and around the exterior of both ends of said liner into said open space, said sealing means being actuatable independently of said liner and comprising a pair of sealing members and spacer means to separate them; and means disposed in one of said chambers adapted to be actuated in an axial direction to actuate both of said sealing means.

5. In a cylinder and liner device of the charac-

ter described, the combination of: a hollow body structure having a pair of spaced working chambers with inner walls separated by a space which is substantially open to the exterior of the hollow body structure, said inner walls having aligned liner openings therein, one of said working chambers having a removable wall to provide a liner access opening aligned with said liner openings; a liner insertable through said liner access opening to a fixed position wherein the ends thereof will communicate with said chambers through said liner openings of said inner walls; and sealing means around said liner to resist leakage of fluid through said liner openings and around the exterior of said liner into said open space, said sealing means being actuatable independently of said liner, and including packing elements in said liner openings, a spacer cage between a pair of said packing elements, and compression means for said packing elements and said cage.

6. In a cylinder and liner device of the character described, the combination of: a hollow body structure having a pair of spaced working chambers with inner walls separated by a space which is substantially open to the exterior of the hollow body structure, said inner walls having aligned liner openings therein, one of said working chambers having a removable wall to provide a liner access opening aligned with said liner openings; a liner insertable through said liner access opening to a fixed position wherein the ends thereof will communicate with said chambers through said liner openings of said inner walls; and sealing means around said liner to resist leakage of fluid through said liner openings and around the exterior of said liner into said open space, said sealing means being actuatable independently of said liner, and including packing elements in said liner openings, a spacer cage between a pair of said packing elements, a compression collar engageable with one of said packing elements, and clamping means for said collar extending through said removable wall.

7. In a cylinder and liner device of the character described, the combination of: a working structure comprising a pair of spaced hollow bodies forming working chambers, the adjacent walls of said bodies being separated by a space substantially open to the exterior of said structure and having liner openings therein adapted to receive packing elements, one of said liner openings having a flanged liner seat; a liner positioned with the ends thereof in communication with said chambers and one of said ends in seating engagement with said flanged liner seat, pressure means disposed in one of said chambers to secure said liner in said position; and a pair of sealing means between both end portions of said liner and said adjacent walls of said hollow bodies, to seal around the ends of said liner and prevent leakage into said open space.

8. In a cylinder and liner device of the character described, the combination of: a working structure comprising a pair of spaced hollow bodies forming working chambers, the adjacent walls of said bodies being separated by a space substantially open to the exterior of said structure and having liner openings therein adapted to receive packing elements, one of said liner openings having a flanged liner seat; a liner positioned with the ends thereof in communication with said chambers and one of said ends in seating engagement with said flanged liner seat, said

liner being a simple cylinder, pressure means disposed in one of said chambers to secure said liner in said position; and sealing means between the ends of said liner and said adjacent walls of said hollow bodies, to seal around the ends of said liner and prevent leakage into said open space.

9. In a cylinder and liner device of the character described, the combination of: a working structure comprising a pair of spaced hollow bodies forming working chambers, the adjacent walls of said bodies being separated by a space substantially open to the exterior of said structure and having liner openings therein adapted to receive packing elements, one of said liner openings having a flanged liner seat; a liner positioned with the ends thereof in communication with said chambers and one of said ends in seating engagement with said flanged liner seat, said liner being a cylinder, pressure means disposed in one of said chambers to secure said liner in said position; and sealing means between the ends of said liner and said adjacent walls of said hollow bodies, to seal around the ends of said liner and prevent leakage into said open space,

and having a collar portion for engagement with said packing elements.

10. In a cylinder and liner device of the character described, the combination of: a working structure comprising a pair of spaced hollow bodies forming working chambers, the adjacent walls of said bodies being separated by a space substantially open to the exterior of said structure and having liner openings therein adapted to receive packing elements, one of said liner openings having a flanged liner seat; a liner positioned with the ends thereof in communication with said chambers and one of said ends in seating engagement with said flanged liner seat, said liner being a cylinder, pressure means disposed in one of said chambers to secure said liner in said position; and sealing means between the ends of said liner and said adjacent walls of said hollow bodies, to seal around the ends of said liner and prevent leakage into said open space, and having a collar portion adjacent each end for engagement with said packing elements.

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