Dec. 15, 1942. R. L. FOSTER 2,304,992

EXPOSED LINER CONSTRUCTION

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Fig. 1

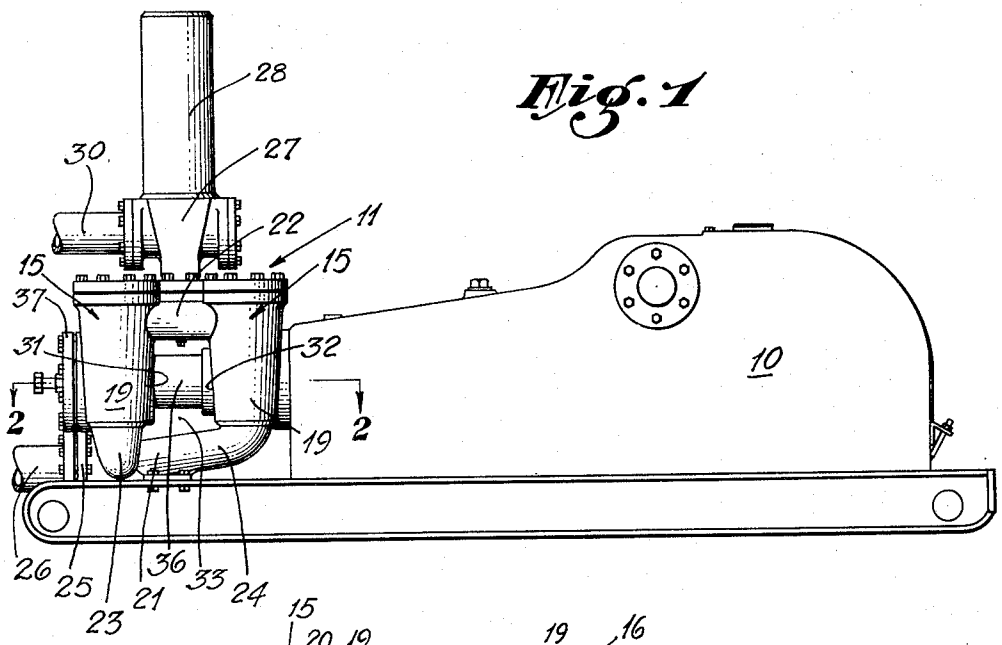
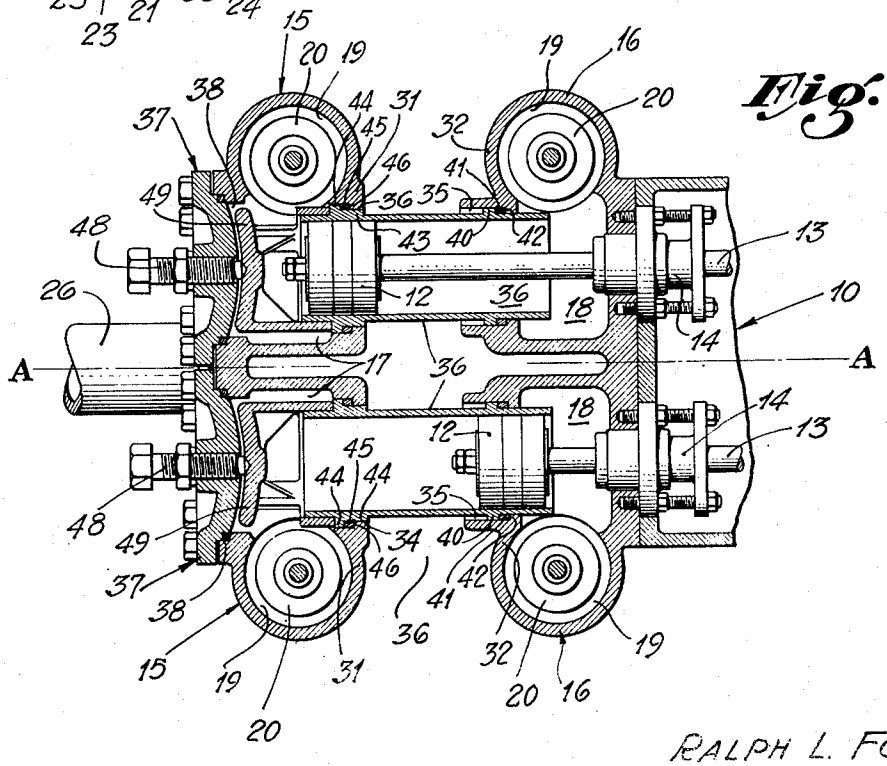


Fig. 2



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EXPOSED LINER CONSTRUCTION

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7 Claims. (Cl. 103—177)

My invention relates to a cylinder and liner construction for use in pumps and/or engines, and relates in particular to an arrangement wherein an intermediate portion of the liner is exposed to the exterior and the ends of the liner are in sealed communication with spaced working chambers.

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, I 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 in a cylinder and liner construction of a pump means whereby the liner may be supported in such a manner that leakage exterior of the liner may be readily observed.

It is a further object of the invention to provide a cylinder and liner construction having a replaceable liner extended between spaced working or pumping chambers, with sealing means at the ends of the liner, and with an intermediate portion of the liner extending through a space in open communication with the exterior of the structure so that leakage of fluid past either of the sealing means to the ends of the liner may be observed, thereby avoiding extended operation of the device through a period of time wherein there is a leakage of fluid around the exterior of the liner, as often occurs in pumps of the type now extensively employed in the well-drilling industry.

It is a further object of the invention to provide a cylinder and liner construction of the character set forth herein, wherein the liner may be readily placed and replaced and effective sealing of the end portions of the liner may be accomplished.

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 as is necessary in replacing the liner disclosed in Patent No. 1,513,584 to Cornwall.

It is a further object of the invention to provide a device of the character set forth in the foregoing paragraph wherein the sealing means for sealing around the end portions of the liner are actuated through axial movement of the liner, and wherein simple means for producing the necessary axial movement of the liner is provided.

It is a further object of the invention to provide a cylinder and liner construction wherein a liner having collars near the ends thereof is extended between spaced hollow bodies forming spaced working chambers and wherein sealing means for sealing around the end portions of the liner are disposed between the collars and the walls of the hollow bodies.

An important advantage of the invention is that the liner, being packed off at both ends thereof, avoids possibility of the liner being locked in the pump due to sand packing between the liner and the enclosing wall of the pump in which the liner is ordinarily disposed. This packing of sand around the ordinary liner often makes it necessary to employ liner pullers and sometimes it has been found necessary to cut out a stuck liner with an acetylene cutting torch.

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

Referring to the drawing which is for illustrative purposes only:

Fig. 1 is an elevational view of a mud pump embodying my invention.

Fig. 2 is an enlarged cross section taken as indicated by the line 2—2 of Fig. 1.

The pump shown in Fig. 1 has a power end 10 and a pumping end 11, power for actuating pistons 12, Fig. 2, being transmitted from the power end 11 to the pistons 12 by means of connecting rods 13 which pass through packing devices 14.

The working section 11 of the pump is built symmetrically on opposite sides of the central vertical plane A—A, Fig. 2, and each section comprises a pair of hollow bodies 15 and 16 which form working chambers 17 and 18. These hollow bodies 15 and 16 each have a valve pot 19 disposed on a vertical axis, and in each of these valve pots 19 there is an intake valve 20 which is disposed in the lower parts of the valve pot, and in the upper part of each valve pot 19 there is a discharge valve which is not shown for the reason that the valve employed in the practice of the invention may be any of those well known to the art.

The hollow bodies 15 are rigidly connected to the hollow bodies 16 by fluid intake and fluid discharge members 21 and 22 which connect respectively to the lower and upper ends of the valve pot. The intake means 21 comprises tubular members 23 and 24 which are respectively welded to the lower ends of the valve pots 19 of the hollow bodies 15 and 16. These intake passage members 23 and 24 are likewise connected to a flange 25 to which intake piping 26 may be connected as shown in Figs. 1 and 2. The discharge passage members 22 are welded to the upper portions of the valve pots 19 of the hollow bodies 15 and 16 and connect the same with a discharge fitting 27 which carries a surge chamber 28 and to which the discharge piping of a fluid system 30 may be connected, as shown in Fig. 1.

The hollow bodies 15 and 16 are disposed in spaced relation, and the adjacent walls 31 and 32 of the hollow bodies 15 and 16 are accordingly separated by an open space 33 which is in open communication with the exterior of the structure 11. The adjacent walls 31 and 32 of the hollow bodies 15 and 16 are provided with aligned liner openings 34 and 35 to receive the end portions of replaceable liners 36 in which the pistons 12 are operative. The hollow bodies 15 are provided with removable wall members, or cover plates 37, which normally close liner access ports or openings 38 in the front walls of the hollow bodies 15 and of such diameter that the liners 36 may be passed therethrough when the cover plates 37 are removed.

Each liner 36 has near its inner or rightward end a collar or shoulder 40 adapted to compress a ring of packing material 41 against a shoulder 42 in the opening 35 of the wall 32. The leftward or outer end of each liner 36 has thereon a cylindric enlargement 43 and an annular collar or shoulder 44 adapted to compress an annular packing member 45 against an annular shoulder 46 in the opening 34 of the wall 31.

Rightward axial movement of the liners 36 moves the shoulders 40 and 45 in rightward direction so as to compress the packing rings 41 and 45 against the shoulders 42 and 46. In order to impart the required rightward axial movement to the liners 36, I provide in each cover plate 37 a heavy screw 48 to exert pressure against a cage 49 of open work construction, and which is disposed in engagement with the leftward end of a liner 36, as shown in Fig. 2.

It will be perceived that in my simplified construction, the working chambers are formed in separate hollow bodies which are connected together by the intake and discharge pipes of the pump, and that accordingly the weight of the working unit 11 is materially reduced.

An important advantage of my present invention is that in addition to the saving of weight, the liner 36 is sealed off at both ends and arrangement is made whereby the effectiveness of the sealing means may be periodically observed. Should leakage occur around either of the sealing rings 41 or 45, such leakage can be readily observed in the ample space 33 between the hollow bodies 15 and 16, and steps can be taken to correct the fault so that continued leakage will not result in the cutting away or channelling of the pump structure around the external face portions of the liner. Likewise, an additional feature of my invention is that the liners 36 may be placed and replaced with facility, and without the necessity of dismantling the unitary structure comprising the working unit 11. When a liner 36 has become worn, the cover plate 37 lying adjacent the front or leftward end thereof may be removed and the liner may be taken out through the associated liner access opening 38.

I claim as my invention:

1. In a pump structure of the character described, the combination of: a hollow rigidly formed body structure having a pair of spaced working chambers, with the juxtaposed respective inner walls thereof separated by a space which is open to the exterior of said hollow body structure, said inner walls having aligned liner openings therein, and at least one of said working chambers having a removable wall to provide a liner access opening, each of said working chambers having an intake valve pot and an outlet valve pot, and said body structure comprising a bifurcated intake pipe for connecting said intake valve pots with a fluid supply conduit and a bifurcated outlet pipe for connecting said outlet valve pots with a fluid discharge conduit, at least one of said pipes being disposed proximately adjacent said liner openings and directly bridging said inner walls across said space for holding said inner walls rigidly related, with said liner openings in fixed alignment; 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 said liner will be exposed to the exterior of said hollow body structure; and sealing means around said liner to resist leakage of fluid through said liner openings and around the exterior of the end portions of said liner into said open space.

2. In a pump structure of the character described, the combination of: a hollow rigidly formed body structure having a pair of spaced working chambers, with the juxtaposed respective inner walls thereof separated by a space which is open to the exterior of said hollow body structure, said inner walls having aligned liner openings therein, and at least one of said working chambers having a removable wall to provide a liner access opening, each of said working chambers having an intake valve pot and an outlet valve pot coaxial with said intake valve pot, the axes of said intake and outlet valve pots being perpendicular to the direction of, and adjacently displaced from the axis of said openings, and said body structure comprising a bifurcated intake pipe for connecting said intake valve pots with a fluid supply conduit and a bifurcated outlet pipe for connecting said outlet valve pots with a fluid discharge conduit, at least one of said pipes being disposed proximately adjacent said liner openings and directly bridging said inner walls across said space for holding said inner walls rigidly related, with said liner openings in fixed alignment; 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 said liner will be exposed to the exterior of said hollow body structure; and sealing means around said liner to resist leakage of fluid through said liner openings and around the exterior of the end portions of said liner into said open space.

3. In a pump structure of the character described, the combination of: a hollow rigidly formed body structure comprising two rigidly joined symmetrically related substantially duplicate sections, each section having a pair of spaced working chambers, with the juxtaposed respective inner walls thereof separated by a space which is open to the exterior of said hollow body structure, said inner walls having aligned liner openings therein, and at least one of said working chambers having a removable wall to provide a liner access opening, each of said working chambers having an intake valve pot and an outlet valve pot coaxial with said intake valve pot, the axes of said intake and outlet valve pots being perpendicular to the direction of, and outwardly and adjacently displaced from the axis of said openings and parallel to the axes of the valve pots of the other section, and each said section comprising a bifurcated intake pipe for connecting said intake valve pots with a fluid supply conduit and a bifurcated outlet pipe for connecting said outlet valve pots with a fluid discharge conduit, at least one of said pipes being disposed proximately adjacent said liner openings and directly bridging said inner walls across said space for holding said inner walls rigidly related, with said liner openings in fixed alignment; a liner insertable through each of said liner access openings to a position wherein the ends thereof will communicate with said chambers through said liner openings of said inner walls and said liner will be exposed to the exterior of said hollow body structure; and sealing means around each of said liners to resist leakage of fluid through said liner openings and around the exterior of the end portions of said liners into said open space.

4. In a pump structure of the character described, the combination of: a hollow rigidly formed body structure comprising two rigidly joined symmetrically related substantially duplicate sections, each section having a pair of spaced working chambers, with the juxtaposed respective inner walls thereof separated by a space which is open to the exterior of said hollow body structure, said inner walls having aligned liner openings therein, and at least one of said working chambers having a removable wall to provide a liner access opening, each of said working chambers having an intake valve pot and an outlet valve pot coaxial with said intake valve pot, the axes of said intake and outlet valve pots being perpendicular to the direction of, and outwardly and adjacently displaced from the axis of said openings and parallel to the axes of the valve pots of the other section, and each said section comprising a bifurcated intake pipe for connecting said intake valve pots with a fluid supply conduit and a bifurcated outlet pipe for connecting said outlet valve pots with a fluid discharge conduit, at least one of said pipes being disposed proximately adjacent said liner openings and directly bridging said inner walls across said space for holding said inner walls rigidly related, with said liner openings in fixed alignment, said one of said bifurcated pipes of one section being rigidly connected to the corresponding bifurcated pipe of the other section by a pipe arranged transversely of the axes of said openings of said two sections for connecting said bifurcated pipes to the corresponding fluid conduit; a liner insertable through each of said liner access openings to a position wherein the ends thereof will communicate with said chambers through said liner openings of said inner walls and said liner will be exposed to the exterior of said hollow body structure; and sealing means around each of said liners to resist leakage of fluid through said liner openings and around the exterior of the end portions of said liners into said open space.

5. In a pump structure of the character described, the combination of: a pump housing comprising a pair of spaced working chambers with the inner walls of said chambers separated by a space which is exterior of either of said working chambers, said inner walls having aligned liner openings therein, and at least 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 the external surface of said liner will be exposed to said space; sealing means between the ends of said liner and said juxtaposed walls of said bodies, said sealing means being so formed as to operate in response to axial movement of said liner in a direction away from said movable wall; an openwork strut frame in said one chamber between said liner and said removable wall and abutting said liner; and means on said removable wall and accessible from the exterior thereof for transmitting said axial movement through said frame to said liner.

6. In a pump structure of the character described, the combination of: a pump housing comprising a pair of spaced working chambers with the inner walls of said chambers separated by a space which is exterior of either of said working chambers, said inner walls having aligned liner openings therein, and at least 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 the external surface of said liner will be exposed to said space; sealing means between the ends of said liner and said justaposed walls of said bodies, said sealing means being so formed as to operate in response to axial movement of said liner in a direction away from said movable wall; a spider in said one chamber and spanning and abutting the adjacent end of said liner; and a screw means threadedly mounted in said movable wall and operatively accessible from the exterior of said removable wall for imparting axial movement in said direction to said spider.

7. In a pump structure of the character described, the combination of: a pump housing comprising a pair of spaced working chambers with the inner walls of said chambers separated by a space which is exterior of either of said working chambers, said inner walls having aligned liner openings therein, and at least 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 liners openings of said inner walls and the external surface of said liner will be exposed to said space, said liner having shoulders near the ends thereof, facing away from said removable wall; sealing means between said shoulders and said adjacent walls of said working chambers, and being operable in response to axial movement of said liner in a direction away from said removable wall; an openwork strut frame in said one chamber between said liner and said removable wall and abutting said liner; and means on said removable wall and accessible from the exterior thereof for transmitting said axial movement through said frame to said liner.

RALPH L. FOSTER.