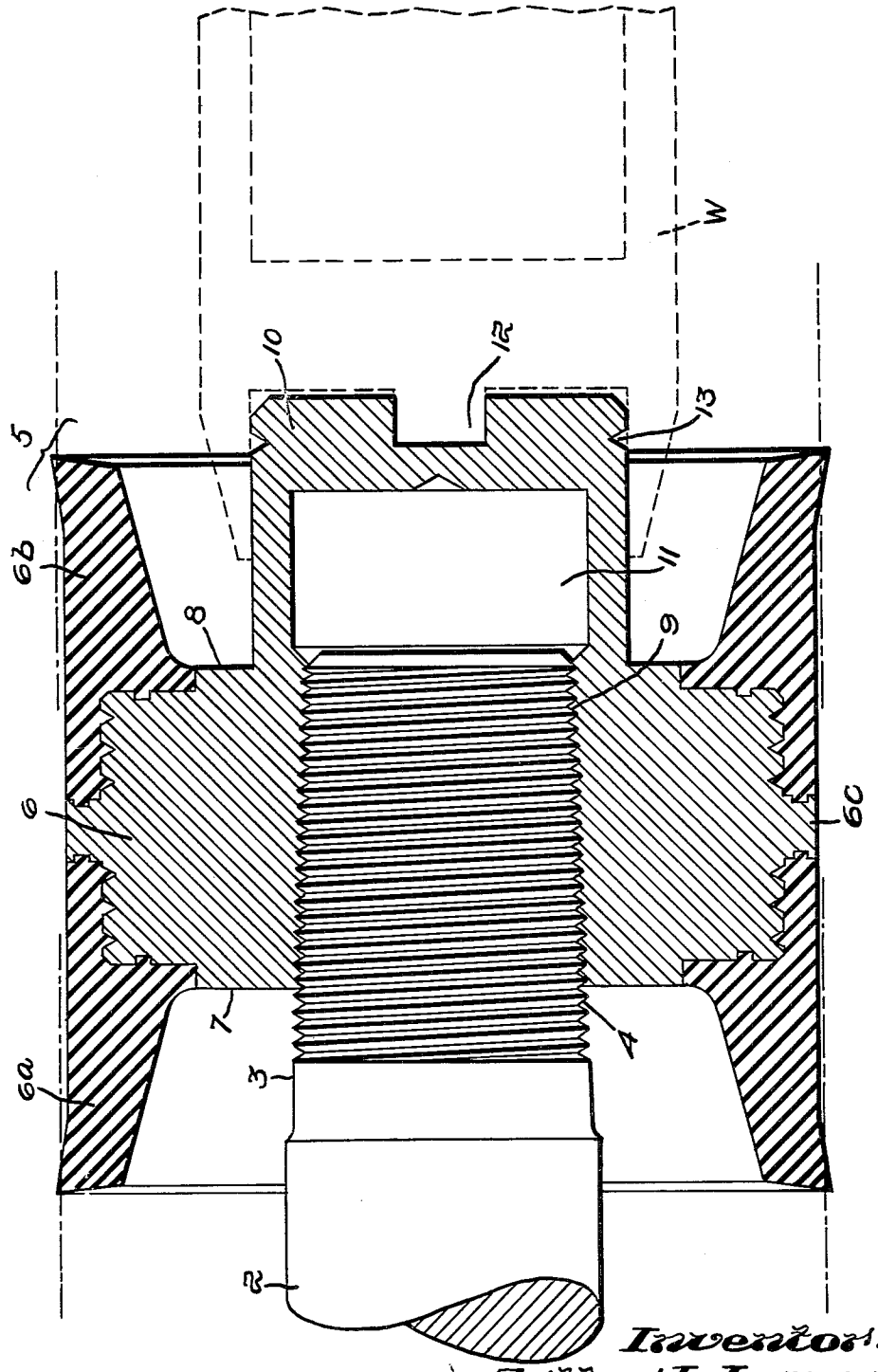
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RECIPROCATING PUMP PISTON AND ROD CONNECTION

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RECIPROCATING PUMP PISTON AND ROD CONNECTION

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This invention concerns reciprocating pumps and particularly double-acting pumps used for the circulation of drilling fluid or "slush" in oil well drilling operations. It aims to provide for such pumps a piston with a tapered threaded connection adapted for removal and replacement without disturbing the operative installation of the piston rod in the pump cylinder.

The drawing shows in longitudinal section one embodiment of the improved piston and rod assembly.

In the operation of slush pumps the presence of abrasive matter in the mud or slush inevitably causes wear of the piston, giving it at the best a limited working life. Some pistons of the molded type having the rubberous packing integrally molded onto the metal body or core of the piston, such as those of the Leman Patent 2,473,064, remain serviceable over continuous operating periods of many hours but eventually must be replaced.

Built-up or assembled pistons are composed of a number of separate parts made up onto the rod and in general require more frequent replacement. My present invention is applicable to both piston types.

Replacement of pump pistons as here concerned has usually heretofore necessitated that both the rod and the piston thereon be removed from the pump. Such removal of the rod and piston together is a time-consuming and not always easy procedure, often taking in excess of an hour, barring mishap. The loss of drilling time while pumps are shut down for such piston replacement, particularly with drilling rigs having but one pump, represents in toto a substantial cost factor in oil well development.

In accordance with the invention the construction and arrangement of the piston and its connection with the rod is made such that the piston can be changed without removing the rod from the pump. Most slush pumps have readily accessible cylinders, as illustrated for example in Leman Patent No. 2,124,788, noting the removable plate at the water end and associated removable packing-adjusting spider 12. The piston as here concerned is adapted for installation and removal at such accessible outer end of the pump cylinder. With a torque-applying tool or wrench of appropriate length the worn piston may be broken out by a single turn of the tool, then backed off from the rod by hand and unitarily removed directly through the cylinder access opening. Another piston is then readily installed by a simple reverse procedure. The replacement piston can be rotated by hand until the threads are in full metal to metal contact. Then but one turn with the wrench expands the piston hub and completes the piston installation.

Referring more particularly to the accompanying drawing of one embodiment of the present invention, the piston rod of a double-acting reciprocating slush pump is indicated at 2. As illustrated the outer terminal part 3 of the rod is tapered and provided with screw threading 4.

The piston as a unit is designated generally at 5, and by way merely of preferred example is shown as a molded

piston. It comprises a solid metal core including a generally cylindric body 6 presenting opposed axially spaced transverse inner and outer end faces 7 and 8 respectively. The core body 6 has an axial bore 9 extending with uniform taper from the inner end face 7 to the radial plane of the outer end face 8. The tapered bore 9 of the core is dimensioned and internally threaded for conformant fit on the threaded tapered rod portion 3–4. The threading is such that the piston may be turned up by hand until the threads meet metal to metal throughout, whereupon further relative turning by a tool will cause expansion of the piston core, secure but readily reversely freeable seating of the piston on the rod, and sealing of the threads.

Intimately bonded to the core body 6 is the circumferential rubberous packing *6a*, *6b* for slidable sealing contact with the cylinder inner wall or liner under the reciprocating double pumping action. While such packing or rubberous sleeve means may be variously formed, the present invention is here shown in conjunction with the full-lip piston construction as disclosed and claimed in said Leman Patent 2,473,064, with which it especially cooperates. Such full-lip piston packing structure and arrangement, with the end-projective lip-presenting packing elements *6a*, *6b* symmetrically disposed at opposite sides of the medial peripheral rib *6c* of the piston core body 6, is herein sufficiently illustrated. Reference to said Leman Patent 2,473,064 may be had for more detailed disclosure of such full-lip rubberous packing means per se. In this regard, the longitudinal dotted line on the drawing indicates the inside diameter of the cylinder bore or bore liner within which the packing is received. It will be noted that the lips of the piston, in non-compressed position before installation, are greater in diameter than the liner bore but the intermediate body of the rubberous packing is smaller than the liner bore. This makes for easy rotation and sliding of the piston in the replacement process here concerned.

At the outer end of the piston 5 the core body 6 is integrally projected to define a concentric cap-like extension or hub 10 affording complete closure for the outer end of the bore 9 and constituting a torque-transmitting coupler or seating element for a wrench or other torque-applying tool W. This hub extension 10 has a concentric internal hollow recess 11 of somewhat enlarged diameter over that of the adjacent end of the bore 9 which leads into the recess. The latter makes for piston lightness and affords desirable clearance for the end face of the rod as well as providing a sump for possible foreign matter pushed along the threading in turning up the piston onto the rod.

This internal hollow recess or cavity 11 of substantial volume materially aids security of the piston on the rod. When the piston 5 is made up on the rod the cavity 11 traps air at atmospheric pressure. The threads of the tapered threaded connection 3, 4 seal off this cavity. When in operation the piston hub is on the leading side of the piston, hydraulic pressure puts the cylindrical part of the hub in compression. This through compression of the trapped air in the cavity tends to hold the piston on the rod and to counteract the expansive tendency arising from any deflection of the piston, particularly for the larger sizes of pistons.

The circumferential and the transverse end walls of the core extension 10 and the integral union thereof with the core body 6 at the outer end wall 8 thereof are proportioned and arranged to receive and transmit to the core body torque force substantially in excess of any likely to be required in tightening or loosening the piston on the rod in making piston replacement in the field.

The piston hub extension 10 is externally formed and

arranged for positive coupling engagement by the manipulating tool or wrench W. Various types of complementary formations on the hub extension and the tool may be employed. As illustrated the extension **10** is cylindrical, the wrench W having a like-shaped and dimensioned socket therefor in the end face. Otherwise the hub and tool socket may be of any comformant contour, of polygonal or other non-round cross-sectional form. If of non-round section, or in any case, the hub extension **10** and the tool W have positive interengaging male and female formations, such as the diametral slot 12 in the end wall of the piston core extension and a corresponding rib at the bottom of the tool socket. Alternatively the hub extension **10** may be formed with a female socket for seating a conformant male end of the tool.

To aid in withdrawal of the piston the hub extension **10** may have means for engagement by a puller, such as an annular or other circumferential recess or other gripping formation **13**. Generally, however, any such special provision for pulling is unncessary, particularly in the case of a full-lip piston as herein illustrated, like that of said Leman Patent 2,473,064, since such piston is relatively free in the cylinder liner and can be moved by hand both rotatively and axially as earlier herein noted. Accordingly the present invention while applicable to slush pump pistons generally is peculiarly suited for incorporation with such full-lip piston.

Applicant is aware that it is known to smoothly taper a pump piston rod and the piston bore, as for example in Tyler Patent 1,833,343 or in said Leman Patent 2,473,-064, the rod end beyond the smooth taper being cylindrical and threaded for one or more retainer and lock-up nuts. Also it has been suggested to taper thread a piston and rod as in McQuaid Patent 1,718,474 or in MacClatchie Patent 2,519,144. But it is believed that I am the first to devise a piston with a tapered threaded connection and which is readily capable of being directly installed and secured on the rod as a unit and of being reversely backed off for replacement while the rod remains otherwise in normal use position in the pump cylinder.

This highly advantageous result is herein accomplished with a piston of unitary simplicity and free of added special glands or packing between the piston and rod or special enlargements or other non-standard formations on the piston rod such as needed for example in Stillwagon Patent 2,216,577 relating to a piston which cannot be changed without rod removal and which requires wrench application at both ends of the piston.

Under the present invention piston change is importantly expedited. As noted the piston as here disclosed can be slid onto the rod and rotated by hand until the threads come up metal to metal throughout. Then a single turn with the wrench fully secures the piston. The slight taper of the connection provides good mechanical advantage on tightening, whereby it is possible to expand the piston sufficiently so that further expansion will not occur in service. The hydraulic force during pumping acts against the transverse surface of the threads and so is at a disadvantage with respect to further expanding the piston. Thus the great problem of preventing relative movement between the threads of the piston and rod is successfully taken care of. This problem has been especially acute with the larger pistons wherein the piston body tends to deflect in the manner of a plate. Once deflective or other relative movement between the threads of the piston and the rod is permitted to start it progressively worsens until the piston is stripped from the rod. Any such possibility is effectively guarded against by the piston means as herein disclosed.

The present invention is not limited to the illustrative embodiment herein shown or described, its scope being pointed out in the following claims.

I claim:

1. A double-acting reciprocating-pump piston and rod assembly comprising a central metallic core having a main generally cylindric body with transverse inner and outer end faces, a medial flange of maximum core diameter, circumferential rubberous packing symmetrically disposed on the core body at the respective sides of the medial flange and having an oversize cylindrical wall-engaging portion free of direct solid support in the transverse plane of the oversize to permit inward flexing in said plane such that the piston is manually movable in the cylinder liner axially and rotatably, a tapered threaded axial bore extending uniformly in the core body from the inner end face to and through the plane of the outer end face thereof, a bore-conformant piston rod threaded into the piston bore and extending beyond the piston medial flange toward the outer piston end, and an integral concentric projecting cap extension on the core body subject to fluid pressure on the outer cap surface and enclosing the adjacent end of the piston rod and formed for engagement by a torque-applying tool.

2. A double-acting reciprocating-pump piston comprising a central metallic core having a main generally cylindric body with tranverse inner and outer end faces, a medial flange of maximum core diameter, circumferential rubberous packing symmetrically disposed on the core body at the respective sides of the medial flange, a tapered threaded axial bore extending uniformly in the core body from the inner end face to and through the plane of the outer end face thereof for direct reception of the conformant end of a piston rod to extend beyond the medial flange toward the outer end of the piston, a tool-coupling integral concentric cap-like hub extension at the outer end face of and of one piece with the core body, and a hollow recess concentrically disposed in said extension, said recess leading from and defining a clearance and compression chamber at the adjacent end of the bore, said chamber at least equal in diameter to said bore end and being otherwise wholly enclosed in and by the body extension, said cap-like extension projecting at the outer piston end for subjection to fluid pressure on the outer extension surface and being constructed and arranged to enclose the adjacent end of a piston rod to be threaded into the piston bore.

3. A double-acting reciprocating-pump piston and rod conection comprising a generally cylindric metallic core with inner and outer end walls and a medial flange of maximum core diameter and having circumferential rubberous packing thereon at opposite sides of the flange, with an oversize cylindrical wall-engaging portion free of direct solid support in the transverse plane of the oversize to permit inward flexing in said plane such that the piston is manually movable in the cylinder liner axially and rotatably, the core having a tapered threaded axial bore extending from the inner end face to the outer end face and formed to receive to a position outwardly beyond the medial flange a like tapered and threaded end of a piston rod, and said core having at the outer end face an integral central longitudinally projecting cap subject to fluid pressure on the outer surface thereof and enclosing the outer end of a positoned piston rod, said cap formed and arranged for interlocking reception of a torque-applying tool to install the piston on and remove it from such rod while the latter is operatively disposed in a pump.

4. A piston and connection according to claim 3, wherein the piston bore leads into an otherwise closed air-compression cavity in the cap and of at least equal diameter to the adjacent end of the bore.

5. A piston and connection according to claim 3 wherein the packing is molded onto the core and comprises at each end of the piston upon the opposite sides of the medial flange an annular lip of substantial projective extent lengthwise and of normal outer diameter greater than that of the piston body.

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