

[54] **PACKING CARTRIDGE FOR
RECIPROCATING PUMP**

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[52] U.S. Cl. **277/35, 277/59, 277/75**

[58] Field of Search **277/35, 59, 75, 76, 277/70, 1, 9, 123, 124, 125, 105, 106**

[56] **References Cited**

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Primary Examiner—William T. Dixon, Jr.

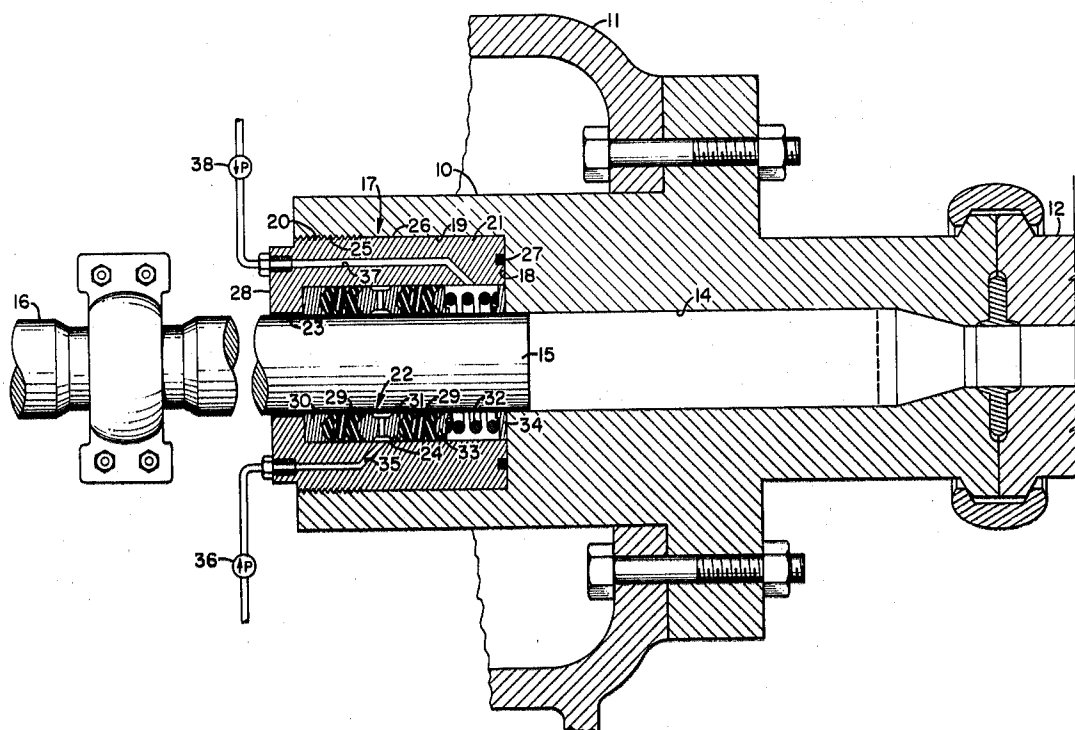
Assistant Examiner—Robert I. Smith

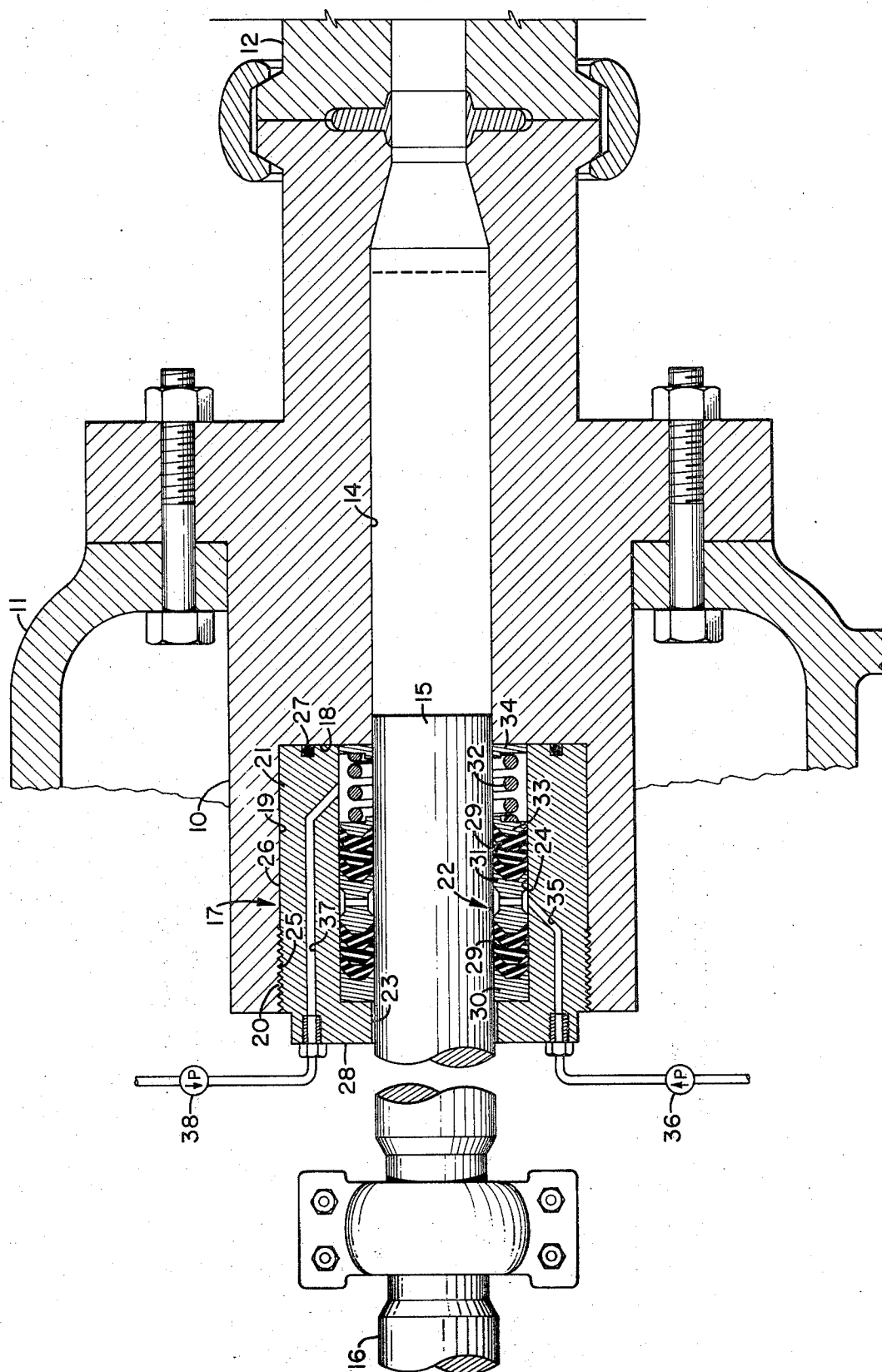
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[57] **ABSTRACT**

A packing cartridge for a reciprocating pump which includes a sleeve adapted to be connected to a recessed end of the fluid end housing and a packing assembly mounted in the sleeve. A lubricating port formed in the sleeve extends from an exposed end thereof to the interior of the sleeve and provides means for delivering lubricant to the packing assembly.

4 Claims, 1 Drawing Figure





PACKING CARTRIDGE FOR RECIPROCATING PUMP

BACKGROUND OF THE INVENTION

1. Field of the Invention:

This invention relates to reciprocating pumps. In one aspect, it relates to plunger packings for reciprocating pumps.

2. Description of the Prior Art:

A major problem associated with high-pressure reciprocating pumps is that of providing a satisfactory seal for the plunger. This seal is normally in the form of soft, nonabrasive packing adapted to seal the radial space between the pump plunger and the fluid end housing. The failure of the plunger packing is a particularly serious problem when the fluid being pumped contains suspended particles of silt, clay, sand or similar abrasive material. The abrasive material tends to erode the packing causing early and frequent failure. Packing failure is normally evidenced by the leakage of fluid past the packing. A small amount of leakage can be tolerated but when this becomes excessive, the pumping operations must be temporarily discontinued to permit replacement of the packing.

Because of the recurring problem of packing failure, most pumps are designed to facilitate the replacement of the packing. In many pumps, the packing can be replaced merely by removing a packing nut and withdrawing the worn packing from the fluid end housing by sliding it rearwardly along the plunger. A section of the rod connecting the power end and plunger normally must be disconnected to provide the necessary clearance for retrieving the worn packing and for inserting the new packing. In design, this appears to be a relatively simple procedure but, in practice, difficulties are frequently encountered which makes the packing replacement a tedious and time-consuming operation. For example, the packing or elements thereof frequently become stuck or lodged within the housing. In this event, the plunger must be completely withdrawn from the fluid end housing, permitting the use of tools to retrieve the packing.

Conventional plunger packings also present design problems in assemblies that require lubrication. Lubricant is normally introduced into the center of the packing through ports formed in the fluid end housing. As in any pressure vessel, two intersecting bores present points of high stress concentration which weaken the entire structure. Moreover, the interior of the fluid end housing in the packed interval frequently becomes eroded or scoured from use. When this occurs, the fluid end housing must be replaced at a considerable cost to the operator.

Packing cartridges, on occasion, have been used as plunger packings on reciprocating pumps. The cartridge containing packing elements is adapted to be secured to an enlarged section formed in the fluid end housing. The cartridge, being inexpensive, is an expendable member so that when it becomes worn or damaged from use, it can be replaced with a new cartridge. The packing cartridges of the prior art, however, present certain disadvantages, particularly in providing a lubricating system for the packing. In prior art systems, lubricating ports extend through the fluid end housing and register with ports formed in the cartridge.

In this design, a static seal must be provided on either side of each lubricating port for sealing the joint between the cartridge and fluid end housing. Rubber O-rings extending circumferentially around the cartridge and positioned at the joint have been used for this purpose. However, these seals have not proven satisfactory for high-pressure service mainly because the seals cannot be pressurized sufficiently to effect a high-pressure barrier at the joint.

SUMMARY OF THE INVENTION

The present invention provides an improved packing for plunger pumps which permits rapid replacement of the packing and eliminates the necessity of boring lubricating or other ports in the fluid end housing. Briefly, the improved packing is a cartridge which includes a sleeve adapted to be connected to the fluid end housing, and a packing assembly contained in the sleeve. With the cartridge connected to the fluid end, the sleeve and packing assembly surround the plunger and provide a fluid-tight seal therefor. A face seal is used to seal the joint between the sleeve and the housing.

In order to provide lubrication for the packing assembly, a lubrication port is formed in the sleeve. The lubrication port extends from an exposed end or portion of the sleeve axially through a portion thereof and exits into the interior of the sleeve. A lubricating pump is connected directly to the sleeve and delivers lubricant via the port to the packing assembly.

Under certain conditions, it may be desired to provide a coolant or wash fluid for flooding a space on the pressure side of the packing assembly. The wash fluid is highly desirable when the pump is handling a fluid containing suspended abrasives. For example, in oil field drilling operations, the suspended solids in the drilling mud tend to cut out the pump packing in a relatively short period of time. By flooding the zone immediately in advance of the packing, the fluid containing the abrasives is prevented from reaching the packing, or at least is diluted sufficiently that the effect of the abrasives is somewhat mitigated. The wash fluid may also function as a coolant if high-temperature fluids are being pumped. The wash fluid port can be formed in the same manner as the lubricating port, extending from an external end of the sleeve axially through a portion thereof and exiting into the interior of the sleeve at a point in advance of the packing.

It should be noted that the ports formed in the sleeve in accordance with the present invention avoids the necessity of boring holes in the fluid end housing and also eliminates the need for providing internal seals for the lubricating ports. It is recognized that the ports in the sleeve produce points of high stress concentration in the same manner that they do in the fluid end housing. However, the sleeve is a relatively inexpensive member and can be replaced at a fraction of the cost required to replace the fluid end housing.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawing illustrates, in longitudinal section, a portion of a reciprocating pump containing the improved packing cartridge of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in the drawing, the fluid end of a recipro-

cating pump comprises separate steel forgings which include a fluid end housing 10 mounted on pump frame 11 and a crossbore body, shown partially as 12, coupled to the housing 10. The crossbore body 12 can be similar in structure as that disclosed in assignee's co-
 pending Application Ser. No. 179,705, filed Sept. 13, 1971. Other structures may also be employed. The housing 10 has formed therein a cylindrical bore 14 which is in fluid communication with the flow passages in the crossbore body 12. A plunger 15 is mounted for relative movement in the bore 14. The plunger 15 extends beyond the rear extremity of the housing 10 and is connected to the power end of the pump (not shown) by a drive rod 16. The power end through rod 16 reciprocates the plunger 15 between a fully retracted position (solid line position of the drawing) and a fully extended position (broken line position of the drawing). This reciprocating action draws fluid into the pump fluid end and discharges it at high pressures. In order to seal the annular space between the plunger 15 and housing 10, a packing is normally provided in an end section of the housing 10. The packing of the present invention is in the form of a cartridge 17.

At the rear extremity of the fluid end housing 10, the bore 14 is enlarged, as by a counterbore, to provide an annular recess in the housing 10. The recess is sized to receive the cartridge 17. The recess is defined by a radial surface 18 and a cylindrical surface 19. An internally threaded section 20 is provided at the mouth of the recess. The inner extremity of the recess, defined by surface 18, is disposed sufficiently close to the front end of the plunger 15 in its fully retracted position to permit the plunger to be tilted sufficiently to place its rear end radially clear of the front end of the drive rod 16. This distance will normally be less than one inch. As described in more detail below, this permits the packing to be replaced without removing a pony rod section from the drive rod 16.

The packing cartridge 17 includes a sleeve 21 and a packing assembly 22 mounted in the sleeve 21. The sleeve 21 may be constructed from standard steel bar stock. A bar of the proper length is bored to form an axial opening therethrough—a portion of the opening is shown as 23—and then counterbored to form an enlarged section 24. The outer periphery of the bar is machined to provide the sleeve 21 with a threaded section 25 and a cylindrical section 26. The threads of section 25 mate with the internal threads 20 and the cylindrical section 26 fits in close conformity with the internal surface 19 of housing 10. A forward end of the sleeve 21 carries a face seal 27.

With the sleeve 21 mounted in the recessed end of the housing 10, its forward end containing the face seal 27 is disposed internally of the housing 10. The face seal 27 is compressed into sealing engagement with the surface 18 formed in the housing 10. The outer end 28 of the sleeve 21 is disposed externally of the housing 10 and may be provided with a hex head or similar structure sized to fit a wrench.

The packing assembly 22 fits in the enlarged section 24 of the sleeve 21 and includes a plurality of seal rings 29, adapter 30, and a lantern ring 31. It is preferred that the packing assembly 22 also include a compression spring 32 for maintaining a minimum force on the ring assembly. Retainer rings 33 and 34 are employed on opposite sides of the compression spring 32. The lantern ring 31 located intermediate the seal rings 29

is positioned to register with a lubricating port 35 formed in the sleeve 21. The lubricating port 35 has an inlet at the outer end 28 of the sleeve 21 and an outlet in fluid communication with the radial passages of the lantern ring 31. A lubricating pump 36 fed with a suitable lubricant such as oil is connected directly to the head end 28 of the sleeve 21 and delivers lubricant via port 35 to the packing assembly 22.

When the fluid to be pumped is corrosive or contains abrasives, the sleeve 21 can be provided with a second port 37 for delivering a wash fluid to the pressure side of the packing assembly 22. Port 37 has an inlet at the exposed end 28 of the sleeve 21 and an outlet in fluid communication with the interior of the sleeve 21 at a point in advance of the packing rings. A pump 38 delivers a wash fluid such as water to flood the pressure side of the packing assembly 22.

The seal rings 29 are preferably of the self-energizing type. They may be conventional "V" rings, "U" rings, "W" rings and the like. These rings are normally molded rings of elastomeric material containing fibrous reinforcement. From 4 to 8 seal rings are satisfactory for most pumping operations.

As mentioned previously, the cartridge sleeve 21 is constructed to receive the packing assembly 22 for a particular plunger diameter. However, the pump can be modified to accommodate a different plunger size merely by equipping the housing 10 with a sleeve 21 particularly sized for the packing assembly of a selected plunger. This feature permits the use of a wide range of plungers in the same fluid end housing 10.

The packing cartridge 17 mounted on the pump can be replaced by the following procedure. A new cartridge is preassembled as illustrated in the drawing. The plunger 15, in its fully retracted position, is disconnected from rod 16. The worn cartridge is unscrewed from the housing 10 and slid rearwardly along the plunger 15. The clearance between the plunger 15 and bore 14 which normally is 1/16 to one-eighth of an inch permits the plunger 15 to be tilted slightly. In certain designs, it may be necessary to provide a slightly enlarged section at the mouth of the bore 14 to permit the plunger 15 to be tilted sufficiently. In the tilted position, the rear end of the plunger 15 clears the front end of rod 16. The plunger 15 then can be moved rearwardly until its front end enters the counterbore. The plunger 15 then can be tilted further permitting the removal of the worn cartridge 17 and the insertion of the new cartridge. The plunger 15 is then re-inserted into the bore 14 and the new cartridge screwed into the fluid end housing 10. The cartridge 17 is screwed into the housing 10 until the face seal 27 is compressed against the housing surface 18. The screwing action also compresses the spring 32 sufficiently to provide a minimum force on the ring assembly. For drilling and fracturing pumps, a preload force between about 150 and 250 pounds is satisfactory.

The lubricating pump 36 and wash fluid pump 38, if used, are connected to the cartridge 17 and the plunger 15 is reconnected to the rod 16 placing the reciprocating pump in condition for operation. It should be noted that this design permits the packing to be replaced without removing a pony rod section from the drive rod 16. This not only facilitates the replacement of the packing but eliminates wear on the rod section.

An alternative procedure for replacing the packing is to preassemble a new cartridge and a new plunger. The

worn plunger and cartridge are then withdrawn as a unit from the fluid end housing and replaced with the new plunger and cartridge assembly.

The following field test illustrates the effectiveness of the plunger packing constructed according to the present invention. A pump having a 3-1/2 inch plunger reciprocating through a 9 inch stroke was provided with a packing cartridge similar to that shown in the drawing. Details of the cartridge were as follows:

Sleeve (21)	
Outside Diameter, inches	6.432
Length, inches	6.688
Thread Type	Standard Acme
Packing Assembly (22)	
Type Seal Rings	Molded V-Rings
Number of Seal Rings	6
OD of Seal Rings, inches	4.500
ID of Seal Rings, inches	3.500

Oil was used as the lubricant and was delivered to the packing assembly at an average pressure of 300 psi. The fluid pumped was a drilling mud containing about 10 volume percent suspended solids. The drilling mud was pumped at an average rate and pressure of 160 gallons per minute and 10,000 psi, respectively. The packing performed satisfactorily for 40 hours. Following the test, the worn plunger and cartridge were withdrawn from the fluid end housing without difficulty. The packing rings under the extreme loading imposed by the pumping pressure were found to be firmly lodged in the sleeve 21.

The packing cartridge of the present invention offers several advantages over prior art packings. It permits rapid replacement of the packing; it confines wear to an expendable member; and it provides improved lubri-

cation and wash fluid systems.

We claim:

1. In a reciprocating pump which includes a housing having a bore formed therein and a plunger mounted in said housing for reciprocation in said bore, an improved packing cartridge for sealing the annular space between said housing and said plunger which comprises a sleeve adapted to be detachably mounted to said housing in surrounding relation to said plunger and having an outer exposed portion and an inner end disposed adjacent said housing; and a packing assembly mounted in said sleeve and including a plurality of self-energizing seal rings and a lantern ring disposed between two of said seal rings, said sleeve having formed therein a lubricating port having an inlet at said exposed portion and an outlet in fluid communication with the interior of said sleeve at a location opposite said lantern ring.

2. The invention as defined in claim 1 wherein said packing cartridge further comprises a face seal mounted in said inner end of said sleeve, said face seal adapted to seal the joint between said inner end and a transverse surface formed in said housing.

3. A method as defined in claim 1 wherein said packing further includes a spring for maintaining a compressive force on said rings.

4. The invention as defined in claim 3 wherein said sleeve has formed therein a second port for conducting a wash fluid, said port having an inlet at said exposed end and an outlet in fluid communication with the interior of said sleeve at a location in advance of said seal rings.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,785,659 Dated January 15, 1974

Inventor(s) William C. Maurer et al

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

Column 6, line 24, delete "A method" and insert --The invention--;
line 25, after "ing" insert --assembly--;
line 30, delete "end" and insert --portion--.

Signed and sealed this 7th day of May 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents