June 4, 1957 D. MURPHY 2,794,399

PUMP AND LUBRICATOR COMBINATION

Filed Nov. 24, 1953 2 Sheets-Sheet 1

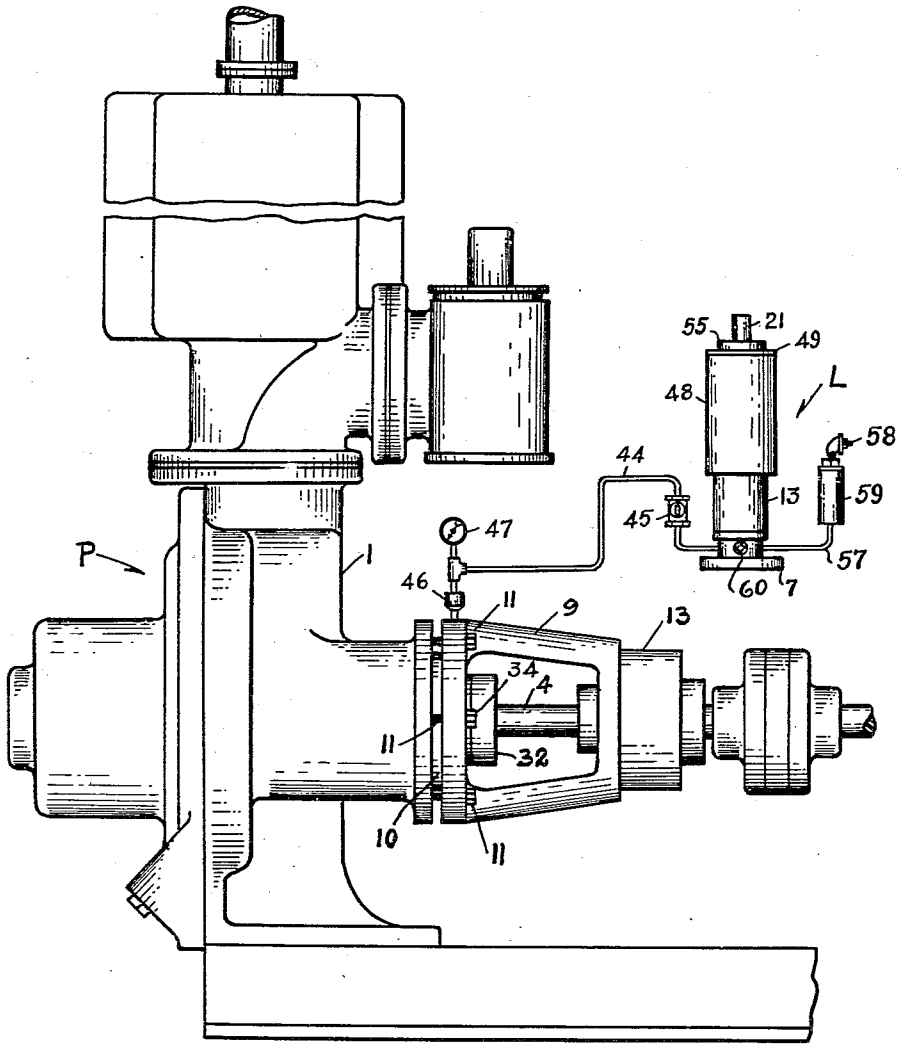


Fig. 1.

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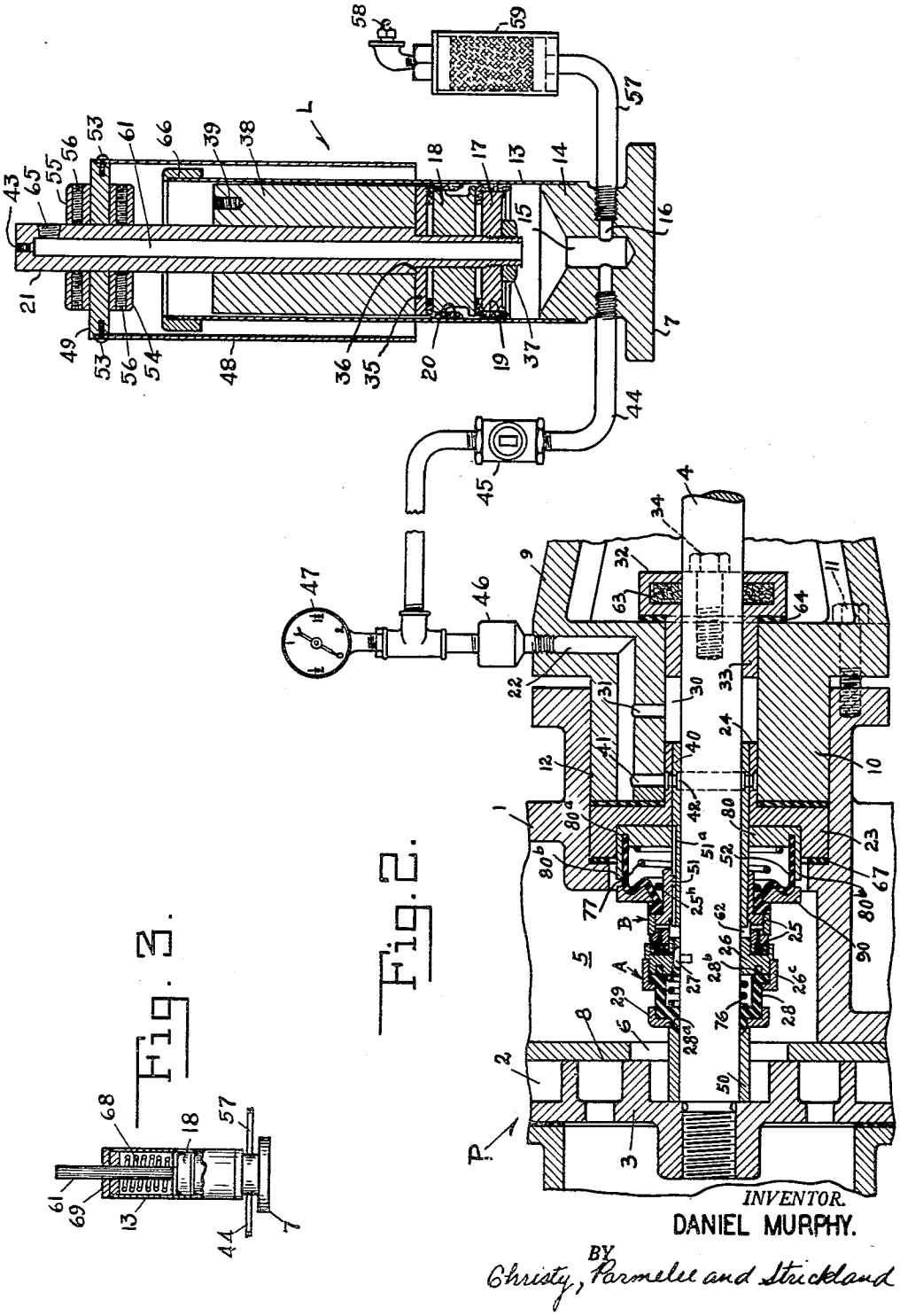


Fig. 2.

Fig. 3.

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PUMP AND LUBRICATOR COMBINATION

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3 Claims. (Cl. 103—111)

My invention relates to pumps, particularly to a rotary impeller pump of the type which includes a sealing device to prevent the escape of liquid between the rotating shaft of the pump and the wall of the pump housing through which the shaft extends.

The provision of pumps for propelling liquids containing abrasive particles has for years presented a serious problem. That is to say, in the operation of such pumps, liquid and abrasive particles tend to work into the packing, or other device, employed to seal the rotating impeller shaft in the region where it projects through the stationary wall of the pump housing, with the effect that the abrasive particles abrade and scour the shaft and quickly destroy the required sealing effect. The problem is particularly serious in potteries, where pumps are employed to propel "slip," and in vitreous enameling plants, where enameling liquids including glass frit are pumped. Pumps employing conventional packings were found to withstand the effects of the abrasive liquids for only a matter of hours, requiring untold loss of production time in the plants and excessive maintenance costs.

Over the past decade and longer, I have worked toward a solution of the problem, and have perfected means for sealing rotating pump shafts against the leakage of liquid into and through the critical region between the shaft and the wall or walls of the pump housing through which the shafts extend. In this connection reference is made to the following United States Letters Patent granted on my applications: Patent No. 2,251,020, granted August 8,1944, Patent No. 2,453,249, granted November 9, 1948, Patent No. 2,505,868, granted May 20, 1950, and Patent No. 2,658,775, granted November 10, 1953.

In these references disclosure is made of rotary sealing devices that replace the stuffing boxes and packing glands, which through the prior years were used as the shaft-sealing means of rotary impeller pumps. My rotary sealing devices (as well as the prior packing glands) require effective lubrication, and for this reason I have given my more recent attention to the development of more effective means for lubricating pump shafts and the sealing devices associated therewith.

It is to be understood that my present invention consists in certain new and useful improvements in a lubricator, and/or in a particularly effective combination thereof with a rotary pump seal, and my object is to augment and improve the efficiency and durability of pumps in service, particularly pumps of the types referred to in the prior Letters Patent and patent application, above noted.

Another object is to provide a simplified, inexpensive and dependable apparatus for supplying lubricant continuously, and under a substantially uniform load or pressure, to the relatively moving parts of a pump, or other mechanism requiring lubrication. Other objects will present themselves in the ensuing specification.

The invention will be understood upon reference to the accompanying drawings, in which:

Fig. 1 is a view in side elevation of a rotary pump and lubricator combination embodying my invention;

Fig. 2 is a fragmentary view, showing to larger scale and in vertical section the lubricator and the portions of the pump with which it particularly cooperates; and

Fig. 3 is a view on the scale of Fig. 1, illustrating

partly in side elevation and partly in vertical section a lubricator embodying certain modifications in structure.

The pump P shown in Fig. 1 of the drawings is adapted to be served by a lubricator L. The pump comprises a body 1, within which is formed the usual impeller chamber 2 (Fig. 2), and within the chamber a vaned impeller 3 is borne upon a rotary shaft 4. Under the influence of the rotating impeller, liquid is drawn from an intake passage 5 through the eye 6 of the pump, and is delivered at the periphery of chamber 2 to a discharge passage (not shown). When the pump is in operation, the pressure exerted upon the rotating impeller, holds the impeller in abutment upon the side wall 8 of the pump chamber 2.

The body 1 of the pump carries rigidly mounted upon it a windowed housing 9; and within the housing two bearings are provided for rotatably supporting the shaft 4 of the impeller. The shaft 4 at its outer end (to the right, Fig. 1) is adapted to be coupled to a suitable motor, and the mounting of the shaft in said two spaced-apart bearings is effective to prevent whipping of the shaft when the pump is in operation.

One of the bearings includes an annular block 10, conveniently made integrally with the housing 9, and this block with its integral housing is secured by set-screws 11 in a cylindrical seat 12, formed exteriorly upon the body of the pump. The other bearing may be a ball-bearing contained in the outer end of housing 9 (Fig. 1), as shown in Patent 2,658,775 referred to above.

In the seating of the bearing block 10 in the body 1 of the pump an annular bearing plate 23 is, by the effect of the said screws 11, clamped to place at the left-hand end (Fig. 2) of the cylindrical seat 12, forming to all intents and purposes an integral part of the stationary pump body, as well as an effective part of the seal structure, presently to be described. This annular plate is provided with a rigid shaft-encompassing sleeve or cylindrical extension 24. The extension is in this case integral with the plate. The plate 23 with its sleeve-like extension 24, when clamped to place, constitutes within block 10 a bearing member proper. The extension 24 carries interiorly a bronze bushing 40, within which the shaft 4 is borne for rotation. Lubricant ducts are indicated at 41, 42. The annular plate 23 is sealed to the wall of the pump casing, by means of a gasket 67.

In the assembly the plate 23, with its bushed extension 24, snugly encircles the shaft. The fit is, however, not so snug as to exert any restraint upon the free turning of the shaft within the sleeve. A cylindrical space or chamber 30, formed by and between the shaft 4 and the block 10, is closed to the left by the plate 23 with its extension 24, and to the right is closed by a block 32 having a sleeve-like extension 33 that is adjustably anchored in the bearing block 10 by screws 34. The space or chamber 30 provides a reservoir that is normally filled with a supply of lubricating grease delivered through a passage 31. The block 32 may include within its outer end a channel in which a felt packing 63 is contained, and between the block and the body 10 of the bearing a rubber gasket 64 is clamped, thus preventing the escape of grease outwardly from chamber 30.

A sealing structure cooperates with the shaft-encompassing member 23 to prevent liquid from being sucked into the pump from the bearing structure when the pump is in operation, and alternately to prevent liquid from draining from the pump into the bearing structure when the pump is at rest. The sealing structure comprises essentially two seal members or devices A and B, one rotatable with the shaft 4 and the other secured against rotation, with the two arranged in yielding abutment upon one another on sealing surfaces extending annularly of the shaft 4. The first seal member or device A com-

prises a collar portion 26 keyed, as at 27, to the shaft 4. The collar portion 26 is thus made to rotate with the shaft, while being adapted to slide on the shaft to maintain, as presently will appear, snug contact with a collar portion 25 of the second seal member or device B.

Organized with the collar portion 26 is a tubular member or sleeve 28 formed of a flexible and elastic material that is resistant to deterioration under the effects of both the liquid being pumped and the lubricant used in the bearing structure. A synthetic rubber known on the market as "neoprene" has been found to be a suitable material of which to form the member 28. Important characteristics of the member 28 are that it is mounted in shaft-encircling position; that at one end of its tubular or ring-like body it is wedged, as at 28*a*, against the chamfered edge of a rigid sleeve 50 on the shaft; and that it is secured, by means of a keeper ring 29, in sealed union to the body of the shaft. The body of member 28 includes a flange 28*b* that fits *a* groove formed in the collar portion 26, where it is secured in liquid-tight union by means of a keeper 26*c*. The assembled seal member or device A is adapted to rotate in unison with the shaft 4, and the collar portion 26 is free to move axially of the shaft against the resistance of, or with the assistance of, the force of a spring 76 arranged as shown. Preferably, if not essentially, the elastic body of the member 28 is so organized in the assembly that it cooperates with the spring 76 to press and maintain the collar portion 26 in snug "running" contact with the face of the wearing or collar member 25, whereby a sealed engagement of the relatively rotatable portions 25 and 26 is maintained both when the pump is in operation and when it is idle. The member 28, by virtue of its physical nature, is adapted to maintain such sealed engagement even though a slight misalignment exists between the relatively rotating parts.

The proportions and dimensions of the several elements of the sealing device are such that, when the elements are assembled on the shaft, the screwing of the body of the impeller into place on the threaded end of the shaft will compress the spring 76. The seal assembly A is liquid-tight and capable of withstanding the pressure of lubricant which is injected through a passage 22 into the shaft bearings, such lubricant working its way along the shaft to the chamber that houses the spring 76 within the flexible sleeve member 28.

A slight clearance is provided between the collar member 26 and the shaft 4, so that the collar may wobble in the event that there is any misalignment of the rotating parts, and by such wobbling maintain tight surface-to-surface contact of member 26 with the member 25. If there is substantial wear of the bearings, or if the bearings have a running tolerance substantially more than one-thousandth of an inch, the lateral play of the shaft may in time result in unequal wear between the collar members or portions 26 and 25, with the result that leakage will develop. It is in contravention of this undesirable consequence that the collar portion 25 of the seal member or device B is formed separately from the bearing portion 23 and its complementary part 80. The portion 25 is adapted to wobble sympathetically with the collar member 26 and thereby maintain the desired fluid-tight engagement regardless of any misalignment of the rotating parts.

The bushing 40 is extended to the left of the stationary bearing portion 23 to receive the seal member 25 in a loose fit, and a key 51 on sleeve portion 25*h* engages a slot 51*a* in bushing 40 and secures the member 25 against rotation, while permitting to required degree the axial and angular movements of such member relatively to the stationary bearing portion 80. The member 25 is sealed to the stationary bearing portion by means of a flexible shaft-encompassing sleeve 52 formed in this case of the same material as the sealing element 28.

The body of the sleeve 52 at its larger end is received in a groove 80*a* formed in the portion 80 of the stationary bearing 23. The smaller end of the sleeve 52 is formed to fit snugly upon the extension 25*h* of seal member 25, and is clamped thereon by means of a collar 90. The flexible body of the sleeve 52 is externally reinforced and supported by the collar 90 and by a cylindrical extension 80*b* on the portion 80 of the stationary bearing member 23. This flexible sleeve, sealed to and extending between seal member 25 and stationary portion 80, is very effective to withstand the pressure of lubricant delivered to the bearing structure. The annular space within the sleeve 52 provides a lubricant reservoir. A spring 77 in such reservoir opposes the force of spring 76 of the first sealing device described, and serves to keep the annular sealing surfaces of the members 25 and 26 in the desired snug "running" contact.

Lubricant supplied by lubricator L, presently to be described, is forced through the passages 31 and 41 and thence between the shaft 4 and the bushing 40 into the chamber 62 between sealing members 25 and 26, thus providing a store of lubricant to be drawn upon as needed by the relatively rotating parts. Under the effect of lubricator L, not only is the chamber 62 thus charged, but the reservoirs within the sealing members 26 and 52 are also filled.

It will be perceived that the passage of the pump shaft through the wall of the pump is effectively sealed against leakage.

The lubricator L, which serves the pump mechanism described, comprises a base 7 adapted to be mounted on any suitable support adjacent the pump P. For example, the lubricator may be mounted on the same foundation or base as the pump, and it is for purposes of illustration only that the lubricator is located as shown in the drawings.

Rising from the base 7 is a cylinder 13 formed of brass tubing that is reinforced at its upper end by an external ring 66 of cast iron. The base 7 includes a portion 14 that extends into the lower end of the cylinder 13 and provides a cylinder head having a funnel-like passage 15 leading downwardly into a transverse passage 16 in the said base. In the cylinder 13 a plunger is provided, comprising two piston heads 17 and 18 formed of lead and two leather cup washers 19 and 20 assembled upon the lower end of a steel piston rod 21. The upper cup washer 20 is secured between the upper piston head and a follower disk 35 of cast iron, while the lower cup washer 19 is secured between the two piston heads 17 and 18. The lower end of the piston rod 21 is threaded, and a nut 37 is tightened thereon, to secure the follower and plunger elements tightly assembled between such nut and a shoulder 36 on the piston rod.

Positioned on the piston rod 21 and seated upon the follower disk 35 is a heavy cylindrical block 38 of lead, including in its upper end a threaded hole 39, into which a suitable tool may be screwed to facilitate handling the block when it is being entered into or removed from the assembly, and a similar threaded hole 43 is provided for the same purpose in the upper end of the piston rod.

The cylinder 13 below the piston head assembly is filled with a suitable lubricating grease, and due to the weight of the block 38 a constant and uniform pressure is applied to the grease, forcing it through passages 15 and 16 into a duct or tube 44 leading to the lubricant-feeding passage 22 of the bearings and sealing device of the pump P. The tubing 44 includes a valve 45 and a regulator 46 for controlling the flow of lubricant under the pressure of the block 38, and a gage 47 is connected to the tubing to indicate lubricant pressure.

A dust-guard covers the otherwise open upper end of the cylinder 13, such guard comprising a tube 48 of sheet steel, closed at its upper end by a centrally perforate header 49 of lead. The header is secured to the tube by means of screws 53. The dust-guard is secured to the piston rod 21, and rises and falls with such rod and the piston

head assembly and lead block (38) mounted thereon, as will presently appear in greater detail. The attachment of the dust-guard to the piston rod is effected by clamping the header 49 between two locking collars 54 and 55 of lead, adjustably secured upon the rod by means of screws 56.

The lubricator L is charged with grease through a tube 57, leading from an Alemite fitting 58, through a 100-mesh wire filter 59, into the passage 16 in the base 7.

When charging the lubricator L, the valve 45 is closed, and connection of a high pressure grease "gun" or pump is made to the fitting 58. Such "gun" or pump forces lubricating grease through tube 57 into the bottom of the cylinder 13. The inflowing grease, under the high pressure of delivery, forces the plunger assembly, the lead block and the dust-guard upwardly, until the follower disk 35 and lower end of the dust-guard sleeve 48 almost reach the top of the cylinder 13. Then, the delivery of grease is stopped and the high pressure "gun" or pump disconnected from fitting 58, which fitting includes the usual and well-known check valve (not shown) that prevents back flow of grease through the charging tube 57. The valve 45 is opened and the flow of grease into the lubricating passages of the pump may proceed under the effect of the pressure imposed upon the body of grease in the cylinder 13 by the total weight of the two lead piston heads 17 and 18, steel piston rod 21, lead block 38, lead header 49, and lead locking collars 54 and 55.

When the system of lubricating passages and reservoirs in the pumps have been filled, the flow of grease ceases, but the lubricator serves to maintain the grease in the system under a constant and uniform pressure, whereby, as in the service of the pump lubricant is progressively dissipated, the loss is continuously restored by the lubricator.

By virtue of the organization described, the pump may serve without attention for periods of one week or more, whereas pumps in the critical service mentioned at the outset of this specification have normally required substantially constant inspection and service.

It may be noted that from time to time the lubricators should be emptied and cleaned, and for such purpose a screw-plug 60 (Fig. 1) is provided in the base 7, such screw-plug normally closing an outlet passage extending from passages 15 and 16 communicating with the bottom of cylinder 13. Again, it may be desirable to remove the plunger and dust-guard assembly from the apparatus, without disturbing the charge of grease in the cylinder. For the latter purpose the piston rod 21 is formed with a bore 61, which opens at its lower end into the cylinder 13 and is closed at its upper end by a threaded plug 65. Upon removing the plug 65 an air vent is opened into the cylinder 13, whereby the plunger and dust-guard may be readily removed from the assembly.

In Fig. 3, I illustrate that the lead block 38 may be replaced by a helical spring 68 compressed between the piston head 18 and a cylinder head 69 fixed in the upper end of cylinder 13. While the spring 68 is not as effective as the lead block, in some cases the spring may be employed to produce the desired constantly applied pressure upon the store of lubricant in the cylinder.

Various other modifications of the structures described will occur to the engineer and mechanic, without departing from the spirit of the invention defined in the appended claims.

I claim:

1. In the combination of a pump having a housing including an impeller driven by a rotating shaft extending through a wall of the housing, sealing means for said shaft assembled with said housing and comprising two shaft-encompassing sealing devices arranged in snug contact with one another and mounted with one device secure against rotation and the other device free for rotation with said shaft, and a lubricating system for said pump; the invention herein described wherein said lubricating system comprises a vertical storage cylinder for a charge of heavy lubricating grease, a piston head in said cylinder, means comprising a heavy block bearing on said piston head for exerting constant pressure upon said charge of lubricating grease, lubricant passages and a reservoir in said pump communicating with said sealing means, a duct leading from said cylinder to said lubricant passages for supplying thereto lubricating grease under the pressure-exerting effect of said heavy block, means for charging lubricating grease into said cylinder including a strainer, a charging passage leading from one side of said strainer into said cylinder on the lubricant-storing side of said piston head, and a fitting for a high pressure grease gun, whereby lubricating grease may be forced through said strainer into said charging passage and thence into said cylinder.

2. In the combination of a pump having a housing including an impeller driven by a rotating shaft extending through a wall of the housing, sealing means for said shaft assembled with said housing and comprising two shaft-encompassing sealing devices arranged in snug contact with one another and mounted with one device secure against rotation and the other device free for rotation with said shaft, and a lubricating system for said pump; the invention herein described wherein said lubricating system comprises a vertical storage cylinder for a charge of heavy lubricating grease, a piston head in said cylinder, means comprising a heavy block extended through the open upper end of said cylinder and bearing upon said piston head for exerting constant pressure on said charge of lubricating grease, lubricant passages and a reservoir in said pump communicating with said sealing means, a duct leading from said cylinder to said lubricant passages for supplying thereto lubricating grease under the pressure-exerting effect of said heavy block, a piston rod extending upwardly from the top of said cylinder, and a hood enclosing the upper end of said cylinder and movable with said piston.

3. In the combination of a pump having a housing including an impeller driven by a rotating shaft extending through a wall of the housing, sealing means for said shaft assembled with said housing and comprising two shaft-encompassing sealing devices arranged in snug contact with one another and mounted with one device secure against rotation and the other device free for rotation with said shaft, and a lubricating system for said pump; the invention herein described wherein said lubricating system comprises a vertical storage cylinder for a charge of heavy lubricating grease, a piston head in said cylinder, means comprising a heavy block bearing on said piston head for exerting constant pressure upon said charge of lubricating grease, lubricant passages and a reservoir in said pump communicating with said sealing means, a duct leading from said cylinder to said lubricant passages for supplying thereto lubricating grease under the pressure-exerting effect of said heavy block, means for charging lubricating grease into said cylinder including a strainer, a charging passage leading from one side of said strainer into said cylinder on the lubricant-storing side of said piston head, a fitting for a high pressure grease gun, whereby lubricating grease may be forced through said strainer into said charging passage and thence into said cylinder, a piston rod extending upwardly from the top of said cylinder, and a hood enclosing the upper end of said cylinder and movable with said piston.

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