

March 13, 1956

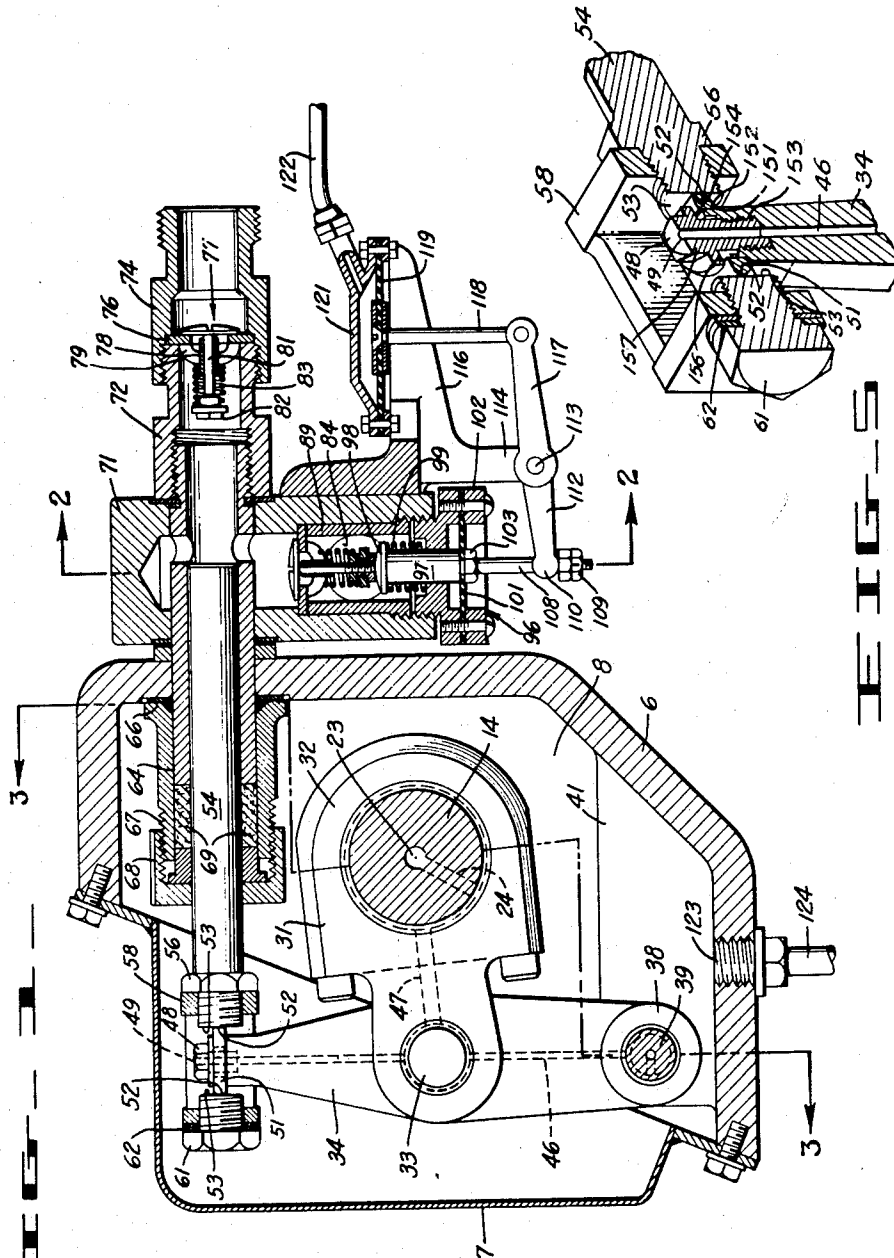
R. L. HARRIS ET AL

2,737,817

WATER PUMP

Filed Oct. 9, 1951

3 Sheets-Sheet 1



INVENTOR.
ROBERT L. HARRIS
LEO O. PELLINEN
MARCUS LOTHROP

BY *Marcus Lothrop*

March 13, 1956

R. L. HARRIS ET AL

2,737,817

WATER PUMP

Filed Oct. 9, 1951

3 Sheets-Sheet 2

FIG. 2

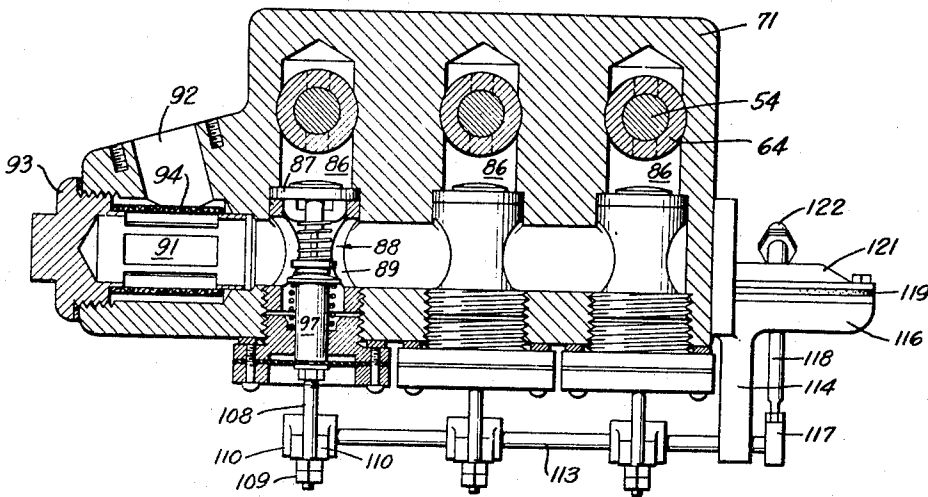
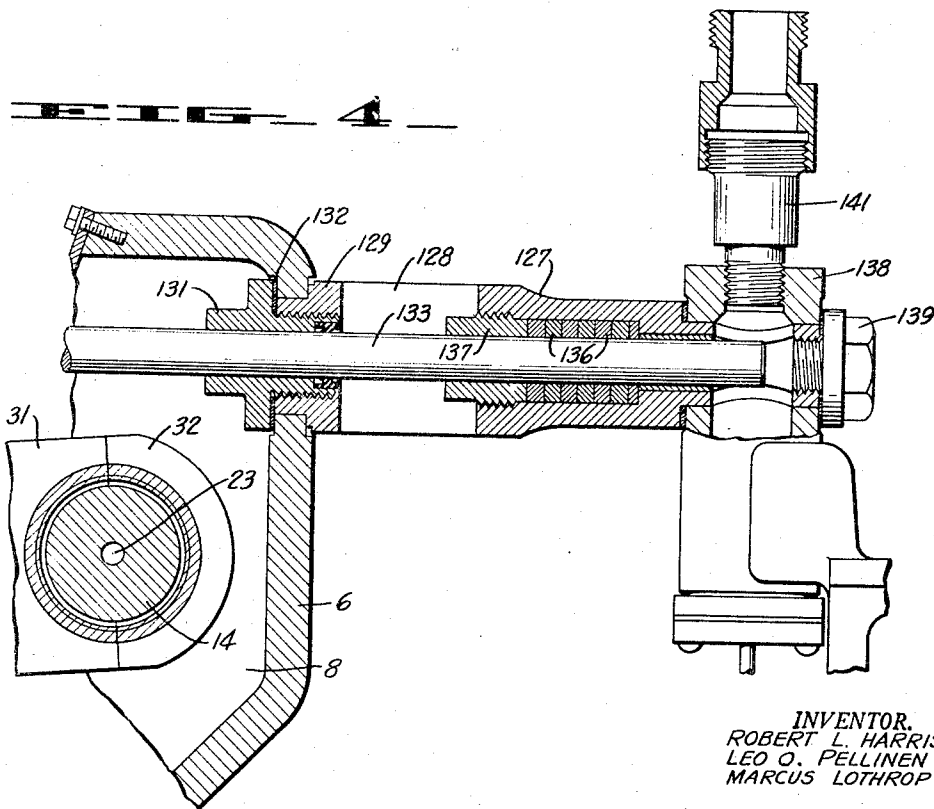


FIG. 4



INVENTOR.
ROBERT L. HARRIS
LEO O. PELLINEN
MARCUS LOTHROP

BY *Marcus Lothrop*

March 13, 1956

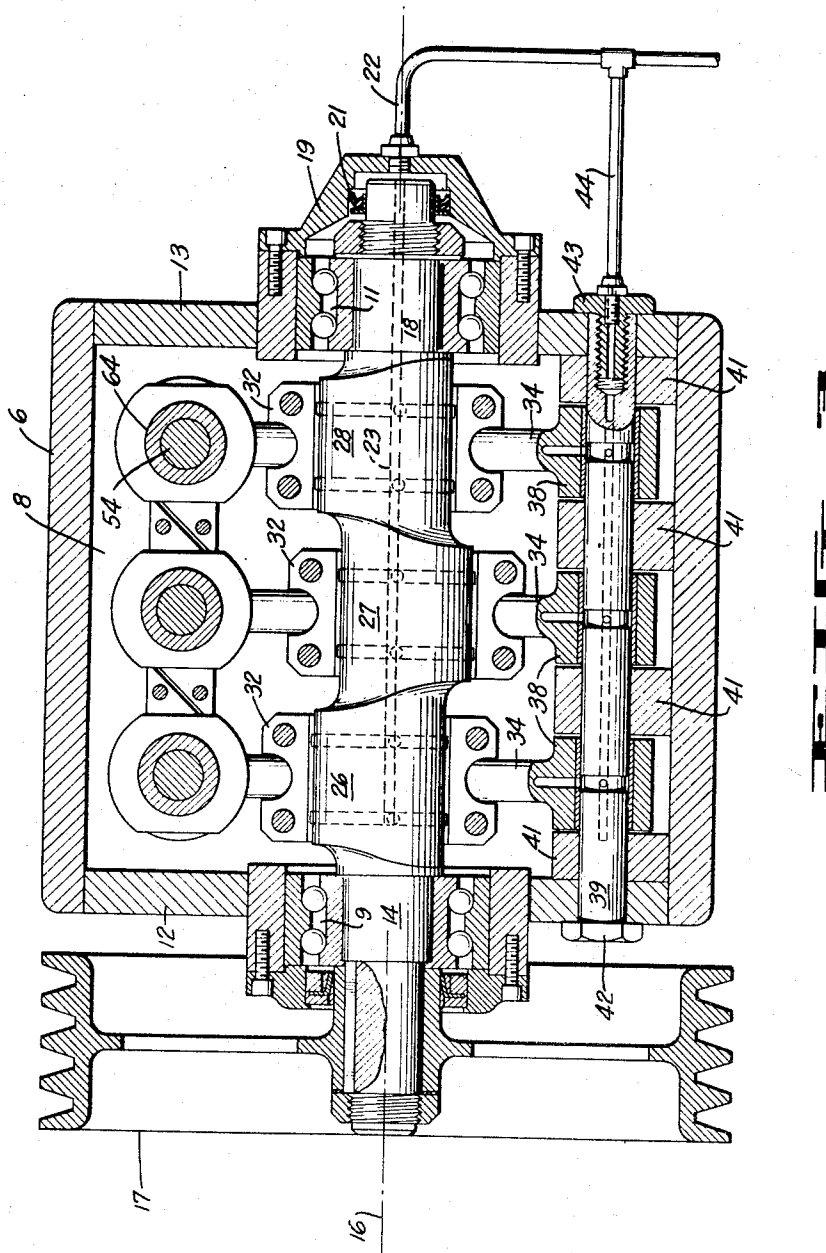
R. L. HARRIS ET AL

2,737,817

WATER PUMP

Filed Oct. 9, 1951

3 Sheets-Sheet 3



INVENTOR.
ROBERT L. HARRIS
LEO O. PELLINEN
MARCUS LOTHROP

BY *Marcus Lothrop*

1

2,737,817

WATER PUMP

Robert L. Harris, Berkeley, Leo O. Pellinen, San Francisco, and Marcus Lothrop, Berkeley, Calif., assignors to Yuba Manufacturing Company, San Francisco, Calif., a corporation of California

Application October 9, 1951, Serial No. 250,451

4 Claims. (Cl. 74—104)

Our invention relates to mechanically driven devices for increasing the pressure of fluids, particularly of water or comparable liquid from substantially atmospheric pressure to a pressure of several thousand pounds per square inch.

Pumps of this sort are useful in a number of different environments but find a particular application in connection with the supply of water under pressure to a steam generator as disclosed in the copending application of Harris, et al., Serial Number 24,656, filed May 1, 1948, now Patent 2,645,210 issued July 14, 1953. In this environment, it is necessary for the pump to pump either cold or hot water to a pressure of 1500 to 2500 pounds per square inch in an intermittent fashion, depending upon the requirements, and to use a substantially continuous source of relatively high speed rotational driving power.

It is therefore an object of our invention to provide a water pump satisfactory for such service.

Another object of our invention is to provide an improved water pump.

A still further object of the invention is to provide a water pump in which variations due to temperature differences do not produce substantial or deleterious misalignments in the pumping mechanism.

A still further object of the invention is to provide a water pump which can be thoroughly lubricated.

A still further object of the invention is to provide a water pump in which various of the wearing parts have a relatively long life but can readily be exchanged or replaced.

A still further object of the invention is to provide a water pump in which the pumping function is readily controlled in an intermittent fashion.

Other objects, together with the foregoing, are attained in the forms of the invention described in the accompanying description and illustrated in the accompanying drawings, in which

Figure 1 is a cross section on a vertical plane transversely through one form of water pump constructed in accordance with our invention, certain portions of the control mechanism being disclosed in cross section on a different plane.

Figure 2 is a cross section, the plane of which is indicated by the line 2—2 of Figure 1.

Figure 3 is a cross section on several planes, all of which are indicated by the line 3—3 of Figure 1.

Figure 4 is a detail in cross section somewhat similar to Figure 1, but showing a modified form of pump.

Figure 5 is an isometric view, enlarged from the scale of Figure 1, of the connection between a lever and a plunger, the parts being shown in cross-section on a plane containing the plunger axis and normal to the rotational axis of the crank shaft.

As preferably constructed, the pump of our invention includes a housing 6 preferably formed of plate bent and welded to provide an enclosure and having a detachable cover 7 to enclose a crank case 8. Extending through the

2

crank case and journaled in suitable bearings 9 and 11 in the end walls 12 and 13 of the housing, is a crank shaft 14. The bearings 9 and 11 are of the antifriction type and serve to support the crank shaft 14 for rotation about a generally horizontal axis 16. One end of the crank shaft carries a belt pulley 17 for appropriate rotation of the crank shaft from a suitable source of power, not shown.

The other end of the crank shaft is provided with a reduced portion 18 extending into a closure cap 19 carrying an oil seal 21 and connected by an appropriate conduit 22 to a source of lubricating oil under pressure, not shown. Oil entering the closure 19 flows through a central bore 23 in the crank shaft and into appropriate radial bores 24 (Figure 1) in order to afford lubrication of each one of three eccentric journals 26, 27 and 28 formed as part of the crank shaft itself. The journals, being three in number, are polarly spaced at 120 degrees around the crank shaft and are axially spaced at equal intervals.

Encompassing the individual eccentric cranks of the crank shaft are connecting rods 31, each of which is provided with an appropriate cap 32 and is preferably bifurcated or forked to provide a straddle connection or mounting for a wrist pin 33 having its axis parallel to the axis 16. The wrist pin likewise passes through the associated one of a number of levers 34 disposed within the crank case 8. Each of the levers at its lower end is enlarged to provide a boss 38 encompassing a single through tube 39 passing providing a swing axis for the levers 34. The tube 39 passes through a number of bosses 41 preferably welded into the housing 6. At one end the through tube has an enlarged head 42 abutting the side wall 12 of the housing and at its other end is provided with a closure plug 43 threaded into the tube so that upon tightening of the closure plug 43 the tube 39 is anchored in the housing. The tube, when the plug 43 is released, can be withdrawn to release any or all of the levers 34 from the housing. The levers are detached from the connecting rods by sideways removal of the wrist pins 33. These rub on each other at their ends as they are unanchored and are held from lateral displacement only by the side walls of the cover 7.

The closure plug 43 is hollow and is provided with a pipe connection 44 extending to the conduit 22 so that a supply of lubricant is brought into the tube 39 and through suitable passages in it is conducted to longitudinal bores 46 in the various levers 34. The bores 46 lubricate part of the wrist pin 33, the other part being lubricated by connecting ducts 47 in each of the branches of the forked connecting rod 31 which periodically communicate with the radial passages 24 in the crank shaft.

Each of the levers 34 at its upper end is provided with a shoulder 151 merging with a tubular portion 152 and is counterbored, as at 153, to receive a bolt 48. A central bore 49 of a very small diameter in the bolt communicates with the upper part of the passage 46. Oil under pressure passing through the lever escapes in a fine stream from the aperture 49 and sprays against the under surface of the cover 7 and then falls by gravity onto the mechanism immediately beneath it for purposes of cooling and lubrication.

To provide appropriate alignment without binding even though the temperature stresses in the pump produce distortion, a block 51 is mounted on the tubular portion 152 and is loosely held by the bolt 48. The block preferably is made of hardened material having a central passage-way 154 which fits easily on the tubular portion 152, thus providing a journal mounting. The block 51 is of a dimension slightly less than the space between the upper end 151 of the lever 34 and the under surface 156 of the shoulder bolt head 157 so that the block 51 is freely rotatable with respect to the end of the lever 34 about an

axis coinciding with the bore 46 and disposed perpendicularly to the axis of the hollow tube 39 and the axis 16 of the crank shaft 14.

The block 51 on its opposite edges is rounded about a center on the central axis of the block and of the lever to afford a pair of arcuate bearing surfaces 52, bearing against the adjacent flat surfaces 53 of hardened material. One of the flat surfaces 53 is provided by the end of a plunger 54 and is referred to as a "flat end." The plunger is reduced and threaded adjacent an enlarged shoulder 56 to serve as an engaging mounting for a generally quadrilateral cage 58 having a hollow center. The cage is tightly screwed onto the end of the plunger 54 and is of a dimension to leave the plunger end projecting and exposed. The other flat surface, opposite the "flat end" is provided by a plunger 61 tightened into the opposite side of the cage against shims 62. The spacing between the two hardened flat surfaces 53 is adjustable by changing the shims and is made slightly greater than the diametrical dimension of the block 51.

To support each of the plungers 54, there is disposed in the housing 6 a similar number of cylinders 64, each having a shoulder 66 bearing against the inner surface of the housing 6 and also provided with a threaded portion 67 engaged by the threads of a packing nut 68. Appropriate packing 69 within the cylinder precludes substantial leakage between the cylinder and the plunger.

The cylinders 64 are of sufficient extent to project through the housing 6 and to receive and serve as supports for a manifold block 71, common to all of the cylinders and fitting easily over the projecting portions thereof. The block 71 and the cylinders 64 are pressed against the housing 6 by tubular nuts 72 screwed over the threaded end of the cylinders. Interposed between the various meeting surfaces are appropriate gaskets to preclude leakage. When the nuts 72 are tightened, the manifold block 71 and the cylinders and the housing 6 are tightly and firmly secured together, although by removing the various nuts 72, the manifold block itself or any one or more of the various cylinders can readily be changed.

The nuts 72 serve also as outlet conduits. Each of them receives a tube nut 74 leading to a discharge manifold, not shown. Interposed between the nuts 72 and 74 is a diaphragm seat 76 for an outlet poppet valve 77. The diaphragm 76 is provided with a pierced center and has arms 78 supporting a bearing sleeve 79. A valve stem 81 projecting from the valve 77 carries lock nuts 82 at one extremity. A closure spring 83 is interposed between the nuts 82 and the arms 78. The poppet valve so provided opens under superior pressure to permit discharge of fluid, yet closes under a reverse differential pressure to prevent back flow. By removing the hollow nut 74, the diaphragm 76 can be removed and the valve assembly can thus be cleaned or replaced or repaired without difficulty.

A somewhat similar inlet valve arrangement is provided for each of the cylinders but is located in the manifold block 71. Each cylinder 64 is provided with a cross bore 84 affording communication with the associated one of several interior bores 86 of the manifold block. A valve diaphragm seat 87, identical with the diaphragm seat 76, is disposed against a shoulder in the manifold block 71 and carries a valve assembly 88 exactly like that of the outlet valve. The diaphragm 87 is removably held in position by a lantern 89 having apertured walls and screwed into the lower end of the passage 86. The inlet valve can readily be removed and replaced upon removal of the lantern 89 which preferably has a hexagonal interior for the reception of a wrench for that purpose.

The lantern 89, having perforated walls, affords communication beneath the valve diaphragm 87 with an inlet passage 91 formed in the manifold block 71 and providing free flow to all of the inlet valves. The passage 91 merges with an inlet duct 92 to which an inlet pipe (not shown) is attached. A screen plug 93 is screwed into the end

of the manifold block and carries a screen 94 to intercept major debris.

As so far described, the inlet valves operate precisely as do the outlet check valves in response solely to differential pressure. During reciprocation of the various plungers within their respective cylinders, all of the valves operate cyclicly to pump in the customary fashion.

Pursuant to our invention we provide means for preventing or interrupting the pumping cycle without stopping rotation of the crank shaft. Each of the inlet valves is provided with one of several identical lifting structures. Screwed into the lower end of the bore 86 and thus engaging the manifold block 71 is a diaphragm plug 96 carrying a through plunger 97 having an enlarged mushroom head 98 forced against the valve 88 by a strong spring 99.

The spring 99 is adequate to overcome the force of the spring 83 and to open the valve during any inlet stroke of the plunger and to continue to hold the valve open during subsequent outlet strokes of the plunger. When not restrained, the spring 99 is effective to hold the inlet valve 88 open. Reciprocation of the plunger 54 is then effective to produce only a local surging of liquid between the cylinder 64 and the inlet passage 92. It does not in any wise force any of the liquid to open the outlet check 77 and to discharge under pressure from the pump. Thus when the spring 99 alone is effective, the individual cylinder cannot pump.

Extending across the diaphragm plug 96 and across the plunger 97 is a flexible diaphragm 101, preferably of rubber, to serve as a water seal yet permit motion of the plunger 97. A ring 102 holds the diaphragm in position on the plug and permits changing of the diaphragm from time to time if necessary and a nut 103 holds the diaphragm in tight relationship to the plunger 97.

Since the crank portions of the crank shaft are disposed at 120 degree intervals, the inlet check valves 88 operate at different times or in sequence, yet they must all be lifted if the pump is to be entirely disabled. The spring 99 alone can lift the inlet valve 88 in any cylinder in which the plunger is receding. But if the plunger is advancing under pressure, say 1500 or 2000 pounds per square inch, the spring 99 has too little force to open the inlet valve and to disable its cylinder at the moment. Instead, the spring 99 is effective upon the next succeeding outward or suction stroke of the plunger.

Since it is desired to have one mechanism disable the entire pump, even through the individual cylinders can be disabled only in sequence, we provide an extension 108 on the plunger 97 and place a pair of lock nuts 109 at the lower end thereof to serve as an abutment. The forked end 110 of a disabling lever 112 engages against the abutment 108 when the spring 99 is in its uppermost position. The lever is capable of rotating downwardly far enough to lower the plunger 97 and to compress the spring 99 until the mushroom head 98 is out of contact with the stem of the valve 88 so that the valve can operate normally and cyclicly. In other words, when the lever 110 is in its lowermost position, as shown in Figure 1, the pump operates in the usual way. When the lever 110 is in a raised position, the spring 99 as soon as it can be effective, lifts the valve 88 and disables its particular cylinder.

To operate all of the levers 112 in unison, they are mounted on a common shaft 113 journaled in brackets 114 and 116 depending from the manifold block 71. At one end, the shaft 113 carries a lever 117 extending to a rod 118 fastened to a flexible diaphragm 119 in a vacuum chamber 121 supported on the bracket 116. A connecting tube 122 extends to a suitable source of vacuum preferably under the control of an intermittently operating valve, not shown. In the position of the parts in Figure 1, the vacuum has drawn the diaphragm 119 toward the vacuum chamber 121 thus rotating the lever 117 counterclockwise and lowering the plungers 97 into

5

the active position of the pump. When the vacuum is interrupted, air is admitted to the chamber 121 to lower the diaphragm 119 in the usual way and the springs 99 are then effective to disable the various valves in sequence. In this way, by controlling the vacuum off and on, the pump is enabled and disabled to pump.

In the form of the device shown in all of the figures except Figure 4, any leakage of water around the plunger and escaping the packing 69 is into the housing 6 where the water joins the lubricating oil. The mixture is withdrawn through a drain plug 123 periodically or can be continuously withdrawn through a pipe 124 for removal of the water elsewhere and for return of the oil through the pipe 22 for further lubrication.

In instances where it is undesirable to permit the leakage water to mix with the lubricating oil or where no separating mechanism for removing the acquired water is available, we vary the construction slightly to provide the form of device shown in Figure 4 which otherwise is substantially the same as that previously disclosed.

To the same housing 6 a cylinder 126 is attached. This cylinder not only has a tubular barrel 127 but also has a pair of side arms 128 leading to a head 129 designed to abut against the housing 6. A nut 131 engages the head 129 and clamps the cylinder to the housing 6. An appropriate packing ring 132 serves primarily to retain oil within the housing 6 and to keep out dirt. Operating within the barrel 127 is a plunger 133 at its left hand end identical with the plunger 54 but of greater length. The plunger passes through packing 136 adjusted by a packing nut 137 extending into the barrel 127. At its outermost end, the cylinder 127 is reduced to receive a manifold block 138 clamped in position against a shoulder on the cylinder by a closure nut 139. While the lower part of the manifold block 138 is identical with the manifold block 71, the upper part is drilled and tapped to receive outlet check valve assemblies 141 in interior construction like those shown in Figure 1.

In this form of device, any leakage of water around the plunger 133 is into the atmosphere between the side arms 128 and not into the crank case 6. Leakage of water cannot in any wise contaminate the oil.

We claim:

1. An actuator for use with a cylinder having a rectilinear axis and a lever pivoted to swing about a swing axis spaced from and approximately at right angles to said rectilinear axis comprising a plunger reciprocable in said cylinder and having a flat end, a cage on said plunger arranged with the flat end of said plunger exposed therein, a thrust plug in said cage and having a flat surface opposite said exposed end, a thrust block having arcuate cylindrical portions contacting said flat end and said flat surface, and means mounting said block on said lever for pivotal movement thereon about an axis at right angles to said swing axis.

6

2. An actuator for use with a cylinder and with a member movable in an arc approximately coinciding with the axis of said cylinder comprising a plunger reciprocable in said cylinder and having an end, a cage on said plunger arranged with said end exposed therein, a thrust plug in said cage and having a surface opposite said exposed end, a thrust block having arcuate cylindrical portions contacting said end and said surface, and means pivotally mounting said block on said member, the axis of mounting being at right angles to the axis about which said arcuate cylindrical portions are curved.

3. An actuator for use with a cylinder and with a member movable in an arc about a swing axis comprising a plunger reciprocable in said cylinder, means at an end of said plunger defining an end surface and an opposed flat surface arranged transverse to the axis of said plunger, a thrust block disposed between said surfaces and having a journal portion engageable with a cooperating journal portion on said member said journal portions being symmetrical about a journal axis at right angles to said swing axis, and means engaging said member for holding said block against substantial movement axially of said journal portions.

4. An actuator for use with a cylinder and with a member movable about a swing axis and in a plane approximately coinciding with the axis of said cylinder comprising a plunger reciprocable in said cylinder and having an end, a cage on said plunger having interior walls arranged in a quadrilateral contour, planar bearing surfaces disposed at opposite ones of said walls, a thrust block disposed within said cage and having cylindrical portions at opposite edges thereof contacting said bearing surfaces, the elements of said cylindrical portion being parallel to said swing axis, and means mounting said block on said member for rotation thereon about an axis at right angles to said swing axis.

References Cited in the file of this patent

UNITED STATES PATENTS

1,471,820	Beam	Oct. 23, 1923
1,719,537	Dulche	July 2, 1929
1,751,413	Longenecker	Mar. 18, 1930
1,822,546	Sperry	Sept. 8, 1931
1,978,058	Peterson	Oct. 23, 1934
2,005,206	Rockwell	June 18, 1935
2,037,434	Pfauser	Apr. 14, 1936
2,263,657	Towler	Nov. 25, 1941
2,280,261	Pounds	Apr. 21, 1942
2,281,777	Madsen et al.	May 5, 1942
2,296,164	Humphrey	Sept. 15, 1942
2,353,069	Perkins	July 4, 1944
2,419,775	Hazard	Apr. 29, 1947

FOREIGN PATENTS

104,014	Sweden	Mar. 17, 1942
---------	--------	---------------