Jan. 15, 1963 R. J. BROWNE ET AL 3,073,256

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Filed Dec. 29, 1959 2 Sheets-Sheet 1

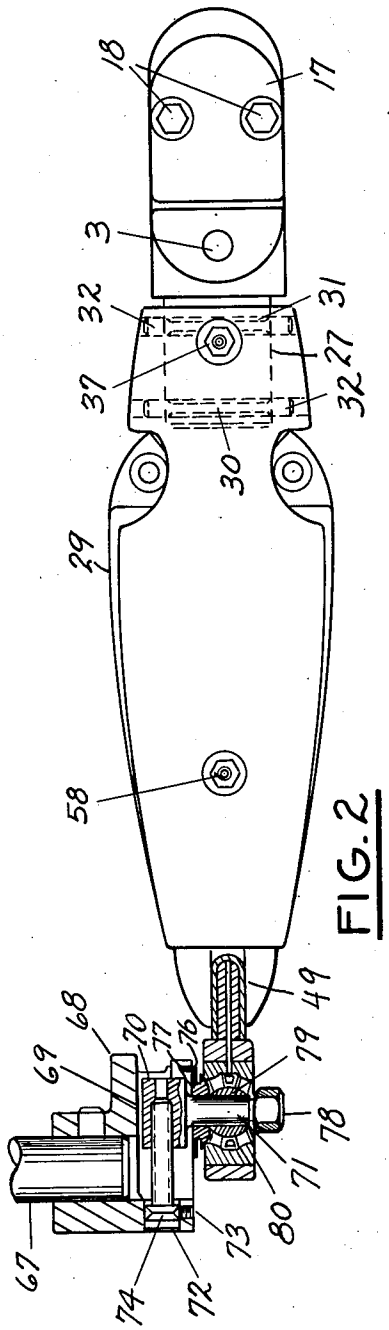

FIG. 2

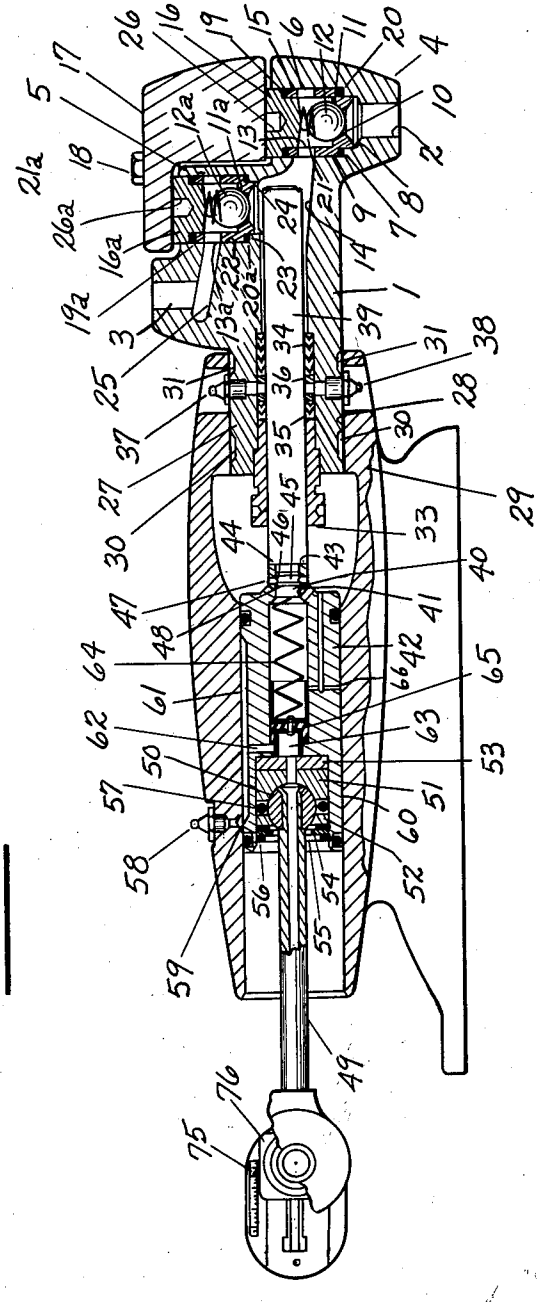

FIG. 1

INVENTORS
Robert J. Browne
BY Hering K Hetz
Ralph Hammar
attorney

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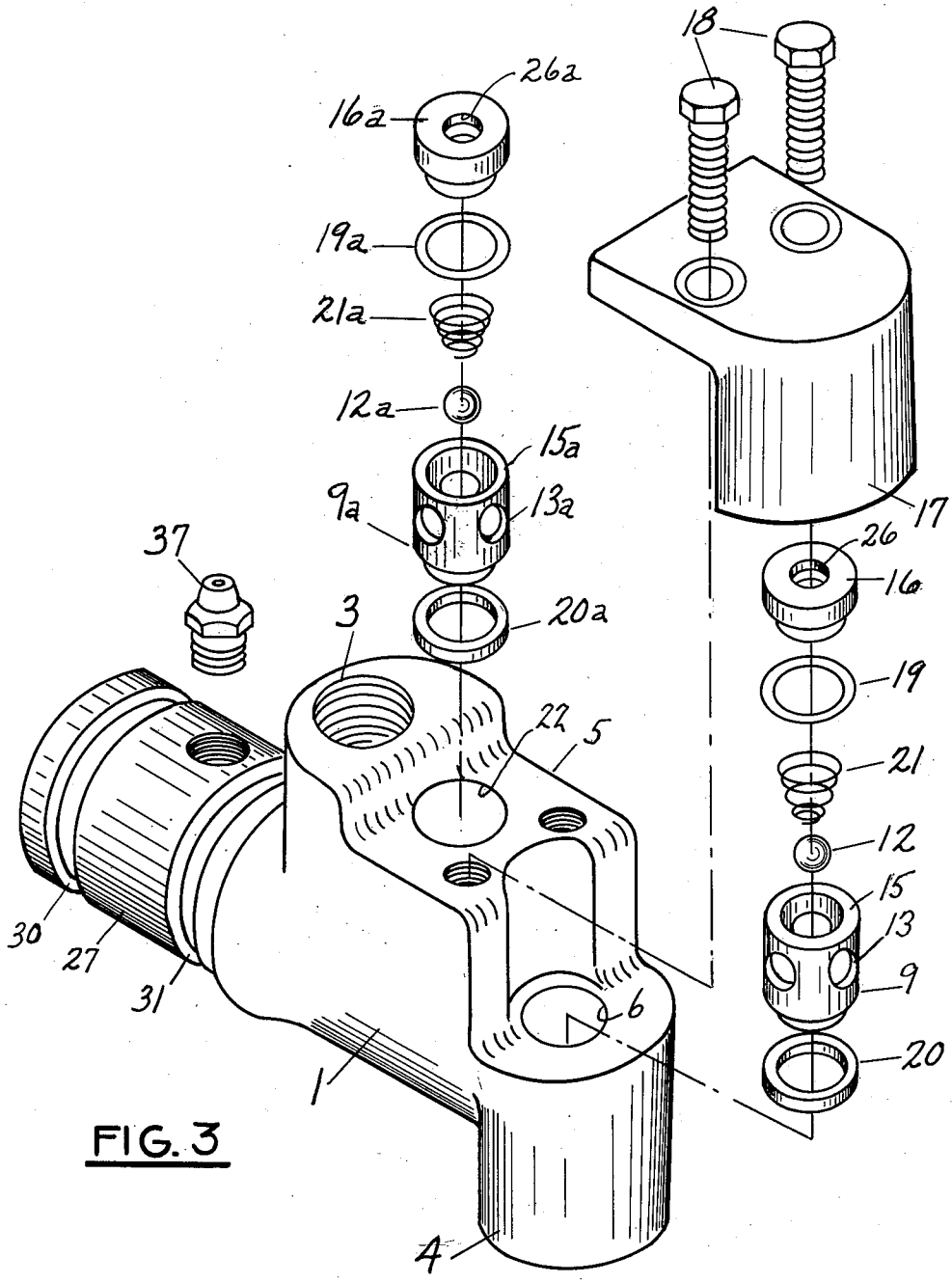

FIG. 3

INVENTORS
Robert J. Browne
BY Heinz K Hetz
Ralph Hammar
Attorney

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Robert J. Browne, Chalfont, and Heinz K. Hetz, Cheltenham, Pa., assignors to American Meter Company, Incorporated, Philadelphia, Pa., a corporation of Delaware

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This invention is a variable stroke pump for feeding liquids at accurately controlled rates. In many uses the liquids are corrosive and may also have an appreciable solids content. The operating pressures may be high, i.e. hundreds or thousands of pounds per square inch. These and other factors impose severe operating requirements which are met by the present invention.

In the drawing, FIG. 1 is a longitudinal section of a pump, FIG 2 is a top plan of the pump, and FIG. 3 is an exploded perspective of the pump cylinder.

The pump has a cylinder 1 with an inlet connection 2 on its underside at the outer end and an outlet connection 3 on its upper side toward the center. Between the inlet and outlet the cylinder is of stepped formation with the lower step 4 directly above the inlet and the upper step 5 between the inlet and outlet. In the step 4 is a vertical counter bore 6 concentric with the inlet 2 and terminating in a shoulder 7 around an inlet way 8. Slidably received in the bore 6 is a cup shaped valve seat member 9 having its bottom clamped against the shoulder 7. In the bottom wall of the seat member 9 is an inlet opening 10 surrounded by stepped seats 11 which cooperate with a ball check 12 in a manner described in greater detail in application Serial No. 843,695. In the side walls of the seating member 9 are a plurality of angularly spaced openings 13, one or more of which register with an upwardly inclined passageway 14 in the outer end of the cylinder. During the suction stroke, the ball 12 is lifted off the seats 11 and liquid flows through the openings 10 and 13 into the outer end of the cylinder. During the pressure stroke, the ball engages the seats 11 preventing back flow. The upward sloping of the surface 14 in the direction of flow prevents build up of solids in the outer end of the cylinder. The solids tend to drain or settle back toward the valve and to be entrained in the liquid flowing through the valve during the succeeding suction stroke. The arrangement also is self bleeding of air or other gases which may be liberated during the pumping process.

Seated on the rim 15 of the valve seating member 9 is a cap 16 clamped against the rim of the seating member by a valve cover 17 secured by cap screws 18 threaded into the cylinder. The valve cover 17 is of stepped shape complementary to the steps 4 and 5 on the cylinder. An O-ring gasket 19 is arranged between the cap 16 and the rim of the seat member and a gasket 20 is arranged between the bottom of the seating member and the shoulder 7. These gaskets prevent metal to metal contact of similar metals which could result in galling. A coil spring 21 is arranged between the under side of the cap 16 and the ball 12 to supplement the force of gravity in obtaining the check valve action. The part of the cap 16 above the gasket 19 has a sliding fit in the bore 6 and the part of the cap below the gasket 19 has a sliding fit in the seat member. The part of the seat member between the gaskets 19 and 20 has a sliding fit in the bore 6 and the part of the seat member below the gasket 20 has a sliding fit in the inlet 20. This construction permits high pressure

operation and does not require a high degree of precision of manufacture.

In the step 5 is a bore 22 terminating in a shoulder 23 surrounding an outlet 24 from the cylinder. Slidably received in the bore 22 is a check valve of the same construction as at the inlet, corresponding parts being indicated by the same reference numerals with the subscript "*a*." The discharge openings 13*a* register with an inclined way 25 which has the same kind of self cleaning and self bleeding action as the inclined way 14 at the inlet. During the suction stroke, the ball 12*a* closes against its seat 11*a* preventing back flow through the outlet 3. During the pressure stroke, the ball 12*a* is lifted off its seat and forced under pressure to the outlet.

The valves are easily serviced. When the valve cover 17 is removed, the caps 16, 16*a* may be removed by screwing the cap screws 18 into threaded sockets 26, 26*a*. This exposes the valve seating members 9, 9*a* which may be readily lifted out by a hook inserted in any one of the openings 13, 13*a*. The servicing of the valves does not require the breaking of the plumbing connections to the inlet 2 or outlet 3.

At the inner end of the cylinder 1 is an integral tubular extension 27 received in a bore 28 in the pump body 29. The body 29 does not come into contact with the liquid being pumped and need not be made of corrosion resistant material. On the extension 27 are annular grooves 30, 31 having tapered sides receiving conical ended set screws 32 (FIG. 2). In use, there is at all times a hydraulic pressure in the cylinder exerting a force tending to move the extension 27 out of the bore 28. This loads the conical ends of the set screws 32 in shear. This design positively locates the cylinder without requiring extreme accuracy in machining. The cylinder can be rotated on its axis to accommodate piping. If necessary, new holes may be drilled and tapped for the fittings 37, 38. Within the extension 27 is an externally threaded packing nut 33 for packing 34, 35 on opposite sides of a lantern ring 36. Lubrication is supplied through a grease fitting 37 opposite the lantern ring 36. Excess pressure is prevented by a relief fitting 38. When the packing is to be flushed, the lubricating fittings 37, 38 are removed and flushing piping is connected in place of the fittings.

The pump plunger 39 has a reduced portion 40 received in a bore 41 in a cross head 42 with a shoulder 43 on the piston abutting the end 44 of the cross head. In the reduced portion 40 of the plunger is a groove 45 receiving the conical ends 46 of set screws 47. It will be noted that the groove 45 is offset with respect to the set screws so that as the set screws are tightened, the conical ends engage tapered side 48 of the groove 45 and pull the shoulder 43 solidly against the end 44 of the cross head with sufficient force to prevent stress reversal. The heavy piston load during the pressure stroke is transmitted directly from the end 44 of the cross head to the shoulder 43 on the piston. During the suction stroke, the lighter force from the cross head to the plunger is transmitted through the conical ends of the set screws 47.

The opposite end of the cross head 42 is connected to a connecting rod 49 by a ball joint comprising a ball 50 fixed to the end of the connecting rod and ball socket members 51, 52 within the cross head. The socket member 51 which takes the pressure thrust, is larger than the socket member 52 and rests on a thrust washer 53. The socket member 52 is preloaded against the ball 50 by a spring washer 54 arranged between a washer 55 and a

retaining ring 56. An O-ring seal 57 between the socket members 51 and 52 prevents leakage of lubricant. The ball joint connecting rod bearing is free to expand and contract with temperature changes and is self compensating for wear. The bearing is also self aligning and because it is located within the cross head, the thrust from the connecting rod transmits no moment to the cross head which would tend to tilt the plunger relative to the packing, causing misalignment and unnecessary wear.

The lubrication for the cross head and connecting rod is supplied through a fitting 58 feeding lubricant to a groove 59 in the cross head bore 60. A longitudinal groove 61 in the cross head registers with the groove 59 in all positions on the cross head. When grease is supplied to the fitting 58 it flows through an opening 62 in the cross head into a hollow lubricant reservoir 63 where the grease is maintained under pressure by a spring 64 acting on a piston cup 65. As grease is forced into the reservoir, the spring 64 is compressed until the piston cup moves past a vent opening 66, after which the grease flows out the vent opening indicating that the reservoir is full. The capacity of the reservoir in the cross head is sufficient so that lubrication is required only at infrequent intervals. Grease may be added through the fitting 58 while the pump is operating.

The connecting rod is driven by a crank shaft 67 having fixed thereto a crank 68 with a radial T-slot 69 slidably receiving the head 70 of a bolt 71. An adjusting screw 72 rotatably anchored in the crank by means of a set screw 73 and a groove 74 is threaded into the head 70 of the bolt and adjusts it along the T-slot. The set screw 73, which is of the self locking or shake proof type, is adjusted into the groove 74 until the stroke adjusting screw 72 is free to rotate without any axial play or looseness. This arrangement simplifies manufacture and assembly and insures accurate location of the stroke adjusting screw without precise machining. The position of the bolt in the T-slot is indicated by a pointer 75 on a plate or stroke indicator 76 fixed to conical washer 77 bearing on the outer surface of the T-slot. When the bolt is located in the desired position in the T-slot, a nut 78 is tightened, compressing the inner race 79 between the nut and the washer 77. At the same time, the bolt head 70 is clamped solidly against the T-slot, thereby establishing a rigid connection between the bolt and the crank so that none of the driving load is taken by the adjusting screw. The connecting rod bearing is of the self aligning, anti-friction type arranged between the inner race 79 and the outer race 80 fixed in the connecting rod.

What is claimed as new is:

1. In a reciprocating piston pump having a horizontal cylinder with an inlet line connection on its under side at its outer end and an outlet line connection on its upper side spaced inward from said outer end, two steps on the upper side of the cylinder, one step being above the inlet connection and the other step being between the inlet and outlet connections, a vertical counter bore in each step having a central opening and a shoulder around the opening, a cup shaped valve seat member in each counter bore with the rim upward, each valve seat member seated on the shoulder and having an inlet in its bottom and a lateral outlet in its side walls with a ball check therebetween, a passageway leading from the outlet of the inlet seat member to the cylinder, a passageway leading from the outlet of the outlet seat member to the outlet line connection, a cap seated on the rim of each valve seat member, and a valve cover fastened to said cylinder and having complementary steps engaging said caps for holding said seat members in said counter bores.

2. In a reciprocating piston pump having a horizontal cylinder with a vertical port and an upwardly presented shoulder around the port, a valve having a cup shaped seat member on the downstream side of the shoulder with its rim upward and its bottom seated on said shoulder and having an opening in its bottom wall registering with said port through which fluid enters the seat member and and opening in its side wall below the rim of the seat member through which fluid leaves the seat member, a cap seated on the rim and closing the top of the seat member, a ball between the cap and the bottom wall of the seat member, said seat member being provided with a seat for the ball between said openings, and a cover secured to the cylinder and engaging the cap to force the cap into sealing engagement with said rim and to force the seat member into sealing engagement with said shoulder.

3. In a reciprocating piston pump having a horizontal cylinder with passages respectively conducting fluid to and from the cylinder, one of said passages having a vertical inlet way and a laterally extending outlet way, a vertical counter bore in the cylinder intersecting the outlet way and terminating in a shoulder around the inlet way, a cup shaped valve seat member having side walls with a sliding fit in said bore and having its rim upward and its bottom seated on said shoulder and having an opening in its bottom wall registering with the inlet way and having at least one additional opening in its side wall below its rim registering with the outlet way, a cap seated on said rim and likewise having a sliding fit in said bore, a ball between the cap and the adjacent surface of the bottom wall of the seat member, said seat member being provided on the adjacent surface of its bottom wall with a seat for the ball, and a cover secured to the cylinder and engaging the cap to force the cap into sealing engagement with said rim and to force the seat member into sealing engagement with said shoulder.

4. In a reciprocating piston pump having a horizontal cylinder with inlet and outlet passages respectively conducting fluid to and from the cylinder, each of said passages having a vertical inlet way and a laterally and upwardly inclined outlet way, vertical counter bores in the cylinder respectively intersecting each outlet way in each passage and terminating in a shoulder around each inlet way, a cup shaped valve seat member removably received in each bore and having its rim upward and its bottom seated on said shoulder and having an opening in its bottom wall registering with the inlet way and having at least one additional opening in its side wall registering with the outlet way, a cap seated on the rim of each seat member, a ball between each cap and the adjacent surface of the bottom wall of each seat member, each seat member being provided on the adjacent surface of its bottom wall with a seat for the associated ball, and a cover secured to the body and engaging the caps to force the caps into sealing engagement with said rims and to force the seat members into sealing engagement with said shoulders.

5. In a reciprocating piston pump having a horizontal cylinder, a packing at one end of the cylinder, a piston extending through said packing toward the opposite end of the cylinder, an inlet line connection to the underside of the opposite end of the cylinder, an outlet connection to the upper side and spaced inward from the opposite end of the cylinder, the opposite end of the cylinder having at its lowermost side a downwardly inclined wall opposite the outlet line connection and a substantial part of the length of the piston at the end of the pressure stroke of the piston, said wall sloping downward into an inlet having therein a ball check valve, and said wall draining solids toward said inlet to prevent accumulation thereof within the cylinder.

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