

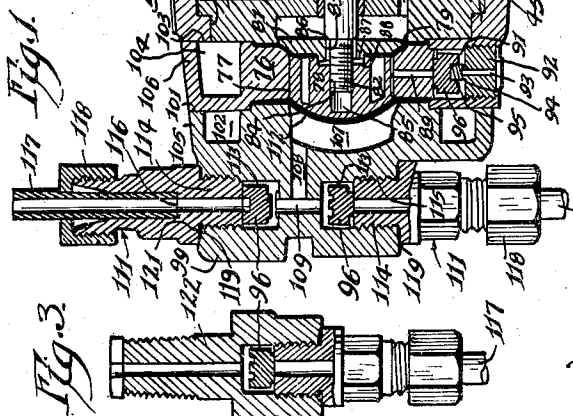
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CHEMICAL FEED PUMP

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CHEMICAL FEED PUMP

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The present invention relates to an improved construction and manner of operation of a chemical feed pump for accurately proportioning and delivering small quantities of fluid under pressure. This application is a continuation-in-part of application Serial No. 859,987, filed December 16, 1959, now Patent No. 3,036,525.

Chemical feed pumps are used in many industries where small quantities of a chemical solution are fed at a predetermined fixed rate to a conduit carrying liquid to be treated. These pumps generally carry liquids which are highly corrosive in nature, such as acids or alkalies, and are required to be metered in proper amounts to achieve the desired results. Such pumps are utilized as swimming pool chlorinators and for chlorine and fluorine treatment of drinking water supply where deviations in the feeding rate might produce undesirable consequences.

Among the objects of our invention is the provision of an improved feed pump overcoming the disadvantages of prior pump designs which includes a combination of a pumping plunger and a pumping diaphragm which is separate from but contacting the plunger throughout the plunger stroke. The diaphragm is formed from highly resistant compounds capable of a long life and not subject to rapid failure from handling corrosive liquids or hazardous chemicals.

Another object of the present invention is the provision of a pump which does not require operating fluid in the chamber between the pump plunger and the pumping diaphragm, the plunger chamber being sealed by means of a second flexible diaphragm secured to the cylinder containing the pump plunger and to the plunger which prevents any leakage of liquid being pumped into the chamber containing the pump operating mechanism. Substantially all the air contained in the chamber between the two diaphragms is expelled during the forward stroke of the pump through an air vent having a check valve. Thus, on a return stroke of the plunger, a vacuum is created in the plunger chamber behind the pumping diaphragm to draw the diaphragm out of the pumping chamber and partially into the plunger chamber.

Another object of the present invention is the provision of a rotatable cylinder head on the pump. In this pump, the outlet must be directed vertically upward to provide for proper operation of the non-return or check valves in the inlet and discharge passages in the cylinder head. Whether the pump is mounted upright or on its side on a wall installation, the cylinder head can be rotated relative to the pump housing so that the outlet or discharge fitting is directed upward.

The present invention further comprehends a novel and improved adjusting mechanism that accurately varies the pumping stroke of the pump plunger and thus varies the amount of liquid being pumped. This adjusting mechanism is manually changed by rotation of a calibrated annular dial on the pump which reciprocates a limiting member that determines the length of the return stroke of the pump plunger. The limiting member is accurately reciprocated by movement of the dial through a threaded engagement between the dial and the limiting member.

The present invention further comprehends a novel check valve utilized in the inlet, outlet and air vent passages of the pump. The check valve has a cylindrical body with upwardly extending legs which are formed so as to partially extend or bulge from the surface of the

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valve body. The legs allow liquid or air to pass around the valve body and limit movement of the valve so that liquid or air is always free to pass through the exit in the valve chamber.

The present invention also comprehends a novel plunger actuating means mounted on the drive shaft of a motor or speed reducer. This actuating means includes a pair of cams, one of which is canted and engages the rear end of a piston rod connected to the plunger. The assembly is mounted for limited longitudinal movement on the drive shaft so that pressure of the plunger on the return stroke will be directly transmitted through the cam to the mounting plate for the pump motor.

Further objects of the present invention are to provide a construction of maximum simplicity, efficiency, economy and ease of assembly and operation, and such further objects, advantages and capabilities as will later more fully appear and are inherently possessed thereby.

In the drawing:

FIGURE 1 is a vertical cross sectional view of the present invention showing the internal structure of the pump including the novel adjustment mechanism and the rotary mounting of the cylinder head.

FIG. 2 is an enlarged perspective view of the novel check valve utilized in this invention.

FIG. 3 is a view partially in cross section showing the fitting connecting the line from the feed pump to the conduit containing the liquid to be treated.

Referring particularly to the disclosure in the drawing and to the illustrative embodiment of the novel invention shown therein, the feed pump comprises a housing 11 which encloses a gear head motor 12 and actuating mechanism 29 for the pump. The housing 11 includes rubber grommets 13 providing feet on the base, a removable front plate 14 and a ventilated back wall 15 to allow air circulation in the housing to cool the motor 12. The louvers 16 in the wall 15 are so arranged that any moisture accumulating on the housing 11 will run off of it and the louvers 16 in cascade fashion and in such manner that no moisture gains access to the interior of the housing.

The ventilated wall 15 also contains an opening 17 through which projects an electric cord 18 connected to a power source to operate the motor 12. The motor includes a fan 19 to circulate within the housing air entering the ventilated wall 15 and to cool the motor during operation. The gear head motor 12 is anchored by screws 20 or other suitable means to a mounting plate 21, with the motor or drive shaft 22 for the motor extending through an opening 23 in the plate 21. The mounting plate 21 is adjustably supported relative to a stationary or fixed plate 24 abutting the front plate 14. Screws 25 extend through the plates 24 and 21 and nuts 26 and lock washers 27 hold the plate 21 in adjusted position. Lock nuts 28 are shown on the upper screw 25 to hold the relative spacing of the plates constant. The reason for the adjustability of the plate 21 will later become evident.

The actuating mechanism 29 for the pump is mounted on the drive shaft 22 for rotation therewith. This mechanism includes a pair of annular cam rings or members 31 mounted on a supporting body 32; said body having a central opening 33 to accommodate the drive shaft 22. The supporting body consists of a central flange 34 with two end cylindrical portions 35 and 36 spaced apart by said flange. The cylindrical portion 35 is concentric with the drive shaft 22 and central opening 33 while the cylindrical portion 36 is canted relative to the cylindrical portion 35. A cam ring or member 31 is mounted on each of the cylindrical portions 35, 36, the cam ring 31 on the canted cylindrical portion 36 providing a cam surface 37 for horizontal reciprocation of a piston rod 38. A longitudinal slot 39 in the center opening 33 of

the supporting body accommodates a key 41 secured in a slot 42 in the drive shaft 22. A spring retainer ring 43 is mounted in an annular groove 44 on the drive shaft 22 so that the actuating assembly 29 has limited longitudinal movement on the motor or drive shaft 22.

A substantially cylindrical hollow dial housing 45 extends through aligned openings 46 in the plate 24 and the front wall 14 of the housing 11 and has an outwardly extending flange 47 which abuts the interior surface 48 of the plate 24. The dial housing 45 terminates at its outer end in an inwardly extending flange 49. A calibrated dial ring 51 is secured to the dial housing 45 by suitable means as at 52, and an indicator or pointer 53 on the face plate or front wall 14 cooperates with the dial ring 51 to indicate the quantity of solution fed by the pump. The dial housing 45 and dial ring 51 are rotatable relative to the face plate 14 and plate 24. A stop 54 mounted on the plate 24 cooperates with a second stop 55 on the flange 47 to limit the arc of rotation of the dial housing 45 to substantially one revolution.

The interior of the dial housing 45 is threaded at 56 on the inner surface of the housing adjacent the actuating mechanism 29, and receives an adjustable threaded plate 57 threaded on its periphery as at 58. The adjustable plate contains a central opening 59, and an offset opening 61 accommodates the forward end of the drive shaft 22. When the dial housing 45 is rotated relative to the pump housing 11, the drive shaft 22 extending into the opening 61 prevents rotary movement of the plate 57, but the engagement of the threads 56, 58 causes the adjustable plate to reciprocate relative to the dial housing 45.

At the forward end of the dial housing 45, there is a flanged base plate 62 slidably fitting within an opening 63 defined by the encompassing turned flange 49, with this base plate provided with a peripheral flange 64 abutting the flange 49 on the dial housing 45 to provide for relative rotation between these elements but prevents any longitudinal movement therebetween. The plate 62 has a central opening 65 which opens into a larger central depression or recess 66 on the side opposite to the actuating mechanism 29 and an offset vent opening 65^a to allow escape of air from this central depression 66.

The piston rod 38 extends through the dial housing 54 and the base plate 62, and is slidably mounted in an encompassing tubular sleeve 67 which is press-fitted in the opening 65 in the base plate 62. The rod 38 terminates at the end adjacent to the actuating mechanism 29 in a reduced portion 68. A back-up plate 69 is fitted at one end onto the reduced portion 68 and abuts a shoulder 71 defining the point of reduction of the rod 38. A collar or sleeve 72 having a ball or bearing 73 rotatably mounted at one end is press-fitted over the reduced portion 68 of the rod 38 and clamps the back-up plate 69 against the shoulder 71. This sleeve 72 is of a diameter slightly smaller than the diameter of the opening 59 in the adjustable plate 57. A compression spring 74 encompasses the rod 38 and abuts the back-up plate 69 at one end, and the opposite end of the spring abuts the plate 62 surrounding a cylindrical hollow projection 75. The spring constantly biases the piston rod 38 through the back-up plate 69 towards the actuating mechanism 29.

Secured to the base plate 62 is a cylinder 76 having a central chamber 77 for a pump plunger 78. Clamped between the cylinder 76 and the base plate 62 is the periphery of a sealing diaphragm 79. The diaphragm has a central opening and is clamped along its inner periphery between the pump plunger 78 and a clamping plate 81. The front end 82 of the piston rod 38 is reduced and threaded and extends through a central opening 83 in the clamping plate 81 and threadably engages the internal threads 84 in the blind central opening 85 in the plunger 78. A shoulder 86 defining the reduced end 82 of the rod 38 abuts the clamping plate 81 and

a cylindrical projection 87 on the clamping plate cooperates with a complementary recess 88 in the plunger 78 to properly position the plunger and plate together.

At the lower portion of the cylinder wall, an air vent passage 89 extends between the plunger chamber 77 and a valve chamber 91. The valve chamber 91 extends to the periphery of the cylinder and is closed by a threaded plug 92 threadably engaging the interior threaded surface of the valve chamber. The plug has a central vent passage 93 and a central projection 94 to locate one end of the compression spring 95. A check valve 96 is located in the valve chamber 91 and the opposite end of the spring 95 engages the central body of the valve.

Referring to FIG. 2, the novel check valve 96 comprises a substantially cylindrical body part 97 having spaced rod-like protuberances or legs 98 extending longitudinally along its circumference to provide longitudinal passageways therebetween. These protuberances or legs 98 project at one end beyond the end 97^a of the body and at their other end stop short of the other end 97^b of the body. As seen in FIG. 1, the check valve 96 in its closed position is seated to cover the air vent passage 89. When pressure in the vent passage overcomes the pressure of the spring 95, the valve 96 is lifted off its seat, but the legs 98 limit movement of the valve so that flow can move around the valve body 97 and into the space created above the valve body 97 by the legs 98.

Forward of the cylinder 76 is the cylinder head 99. The cylinder head 99, cylinder 76 and base plate 62 are all secured together by screws or other suitable fastening means. The surface 101 of the cylinder head 99 adjacent to the cylinder has an annular groove 102 therein. Likewise, the surface 103 of the cylinder 76 has an annular groove 104 therein; interrupted for the air vent 89 and check valve 95. These annular grooves 102 and 104 provide outer annular clamping surfaces 105 and 106, respectively, and there is no cantilever bolt force as normally found on flanged bolted fittings.

The cylinder head 99 contains a central pumping chamber 107, a passage 108 extending between the pumping chamber and a passage 109 connecting inlet and outlet fittings 111. Extending across the pumping chamber 107 and the end of the plunger chamber 77 is a pumping diaphragm 112 with its periphery clamped between the cylinder head 99 and the cylinder 76. This diaphragm is separate from but contacting the pump plunger 78. Both diaphragms are formed or compounded of a thin flexible material which is corrosion-resistant. An example of such a diaphragm is a layer of woven Dacron sandwiched between coatings of Kel-F (monochlorotrifluoroethylene) of equal thickness with the thickness of the Dacron layer.

The transversely extending passage 109 terminates in inlet and outlet valve chambers 113. The identical inlet and outlet fittings 111 each have a threaded extension 114 which engages the internal threads 115 in the valve chamber 113. Check valves 96 are located in each valve chamber 113 with the legs 98 of each valve extending upwardly. To insure proper operation of the check valves, the outlet fitting 111 must always be extending vertically upward. The inlet and outlet fittings 113 include a stepped central passage 116 to receive the flexible tubing 117 and a threaded extension to receive a tubing gland nut 118. A sealing ring 119 is clamped between a shoulder 121 on the fitting and the cylinder head 99 where less strain will occur on the threads in the valve chamber 113 when the fitting is tightened in the head.

The flexible tubing 117 extends from the outlet fitting 111 and leads to a fitting 122 which contains a check valve 96 and is connected to the conduit carrying the liquid to be treated. The tubing 117 extending from the inlet fitting 111 terminates in an identical fitting 122 which is submerged in a tank of the chemical solution to be fed by the pump. A porcelain weight encompasses the tubing 117 above the fitting 122 to retain the fitting in the chemical solution.

When the pump is assembled, the cylinder head 99, cylinder 76 and the base plate 62, are secured together and are capable of rotation relative to the housing 11 and also relative to the dial housing 45. The dial housing 45 in a like manner is capable of rotation relative to the housing 11. Rotation of the dial housing 45 will result in longitudinal movement of the adjustable plate 57. The pumping or forward stroke of the plunger always moves the plunger to a consistent forward position due to the constant high point of the actuating cam 31. On the return stroke of the plunger 78 and the piston rod 38, the back-up plate 69 abuts the adjustable plate 57 to limit the return stroke of the plunger. Thus the capacity of the pump is variable depending on the length of the return stroke of the plunger 78.

In the assembled pump, the mounting plate 21 is adjusted relative to the plate 24 through the nut 26 and lock nut 28 on the upper screw 25. To obtain a proper calibration, the dial housing 45 is rotated to bring the adjustable plate 57 to its extreme forward position where the calibrated dial ring registers zero gallons per minute and the return stroke of the plunger is negligible. The mounting plate 21 is then adjusted with the motor 12 operating until the high point of cam surface 37 on the canted cam 31 contacts the ball 73 of the piston rod 38. The mounting plate 21 is then locked in its adjusted position and the pump is ready for operation.

When the pump motor 12 is energized and the dial housing 45 is rotated to position the adjustable plate 57 for a prescribed rate of flow, the actuating mechanism is rotated by the drive shaft 22 of the motor 12 and the cam surface 37 will contact and urge the ball 73 on the piston rod 38 forward for a portion of the cam area. On the initial forward stroke of the pump plunger 78, air entrapped between the plunger and the pumping diaphragm 112 is forced out through the air vent passage 89 and the spring biased check valve 96. The plunger contacts the pumping diaphragm 112 and urges it into the pumping chamber 107 to force chemical solution from the chamber through the outlet fitting 111. When the cam surface 37 no longer urges the piston rod 38 forward, the compression spring 74 acting against the back-up plate 69 urges the piston rod 38 to return to its position where the back-up plate 69 abuts the adjustable plate 57. The actuating mechanism 29 is allowed limited longitudinal movement so that the force of the compression spring 74 acting on the piston rod 38 is directly transmitted through the actuating mechanism 29 to the mounting plate 21. When the plunger 78 moves backward, the check valve 96 closes the air vent passage 89, and since the sealing diaphragm 79 seals the rear opening of the plunger chamber 77, a vacuum is created in front of the plunger 78 which draws the pumping diaphragm into contact with the plunger 78 on its return stroke. Each subsequent cycle of the pump plunger 78 will then repeat the above cited operation.

This invention is particularly useful as a swimming pool chlorinator, in water treatment installations for the control of hydrogen sulfide, iron, fluorine or chlorine in the water or for water softener regeneration plants, but is not limited thereto as other uses will be apparent to those skilled in the art.

While disclosing a specific embodiment of the invention, we do not wish to be limited by this disclosure, but

claim all equivalents in this invention which are inherent in this disclosure and the claims.

Having disclosed the invention, we claim:

1. A variable stroke cam actuating mechanism for a pump or the like having a drive motor and a reciprocally mounted piston rod, comprising a generally cylindrical dial housing rotatably mounted on the pump and surrounding the piston rod, a base plate at one end of the dial housing, an adjustable plate threadedly engaging the interior of the dial housing adjacent the opposite end for reciprocation relative thereto, means preventing rotation of said adjustable plate so that on rotation of said dial housing said adjustable plate will move longitudinally within the dial housing, said adjustable plate having a central opening to accommodate said piston rod, cam means driven by said motor for reciprocating said piston rod, and means on said piston rod cooperating with said adjustable plate to limit the stroke of said piston rod.

2. A variable stroke actuating mechanism as set forth in claim 1, in which said means preventing rotation of said adjustable plate includes an offset opening in said plate adapted to receive the end of the drive shaft of said motor.

3. A variable stroke actuating mechanism as set forth in claim 1, in which said means to limit the stroke of the piston rod includes a back-up plate secured to said piston rod and of a diameter greater than the diameter of the central opening in said adjustable plate.

4. A variable stroke actuating mechanism as set forth in claim 3, in which a compression spring encompasses said piston rod between said back-up plate and the base plate to bias said piston rod toward said actuating means.

5. A variable stroke actuating mechanism as set forth in claim 1, in which said cam means for reciprocating the piston rod includes a supporting body mounted on the drive shaft of the motor adjacent its outer end, a pair of cylindrical end portions on said body separated by a radial flange, the cylindrical portion adjacent the end of said piston rod being canted relative to the drive shaft, and cam rings mounted on said cylindrical portions with the cam ring on the canted portion contacting said piston rod over at least a portion of the cam's rotation.

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