Oct. 25, 1960 D. S. REYNOLDS ET AL 2,957,420

METERING PUMP

Filed Nov. 25, 1955 4 Sheets-Sheet 1

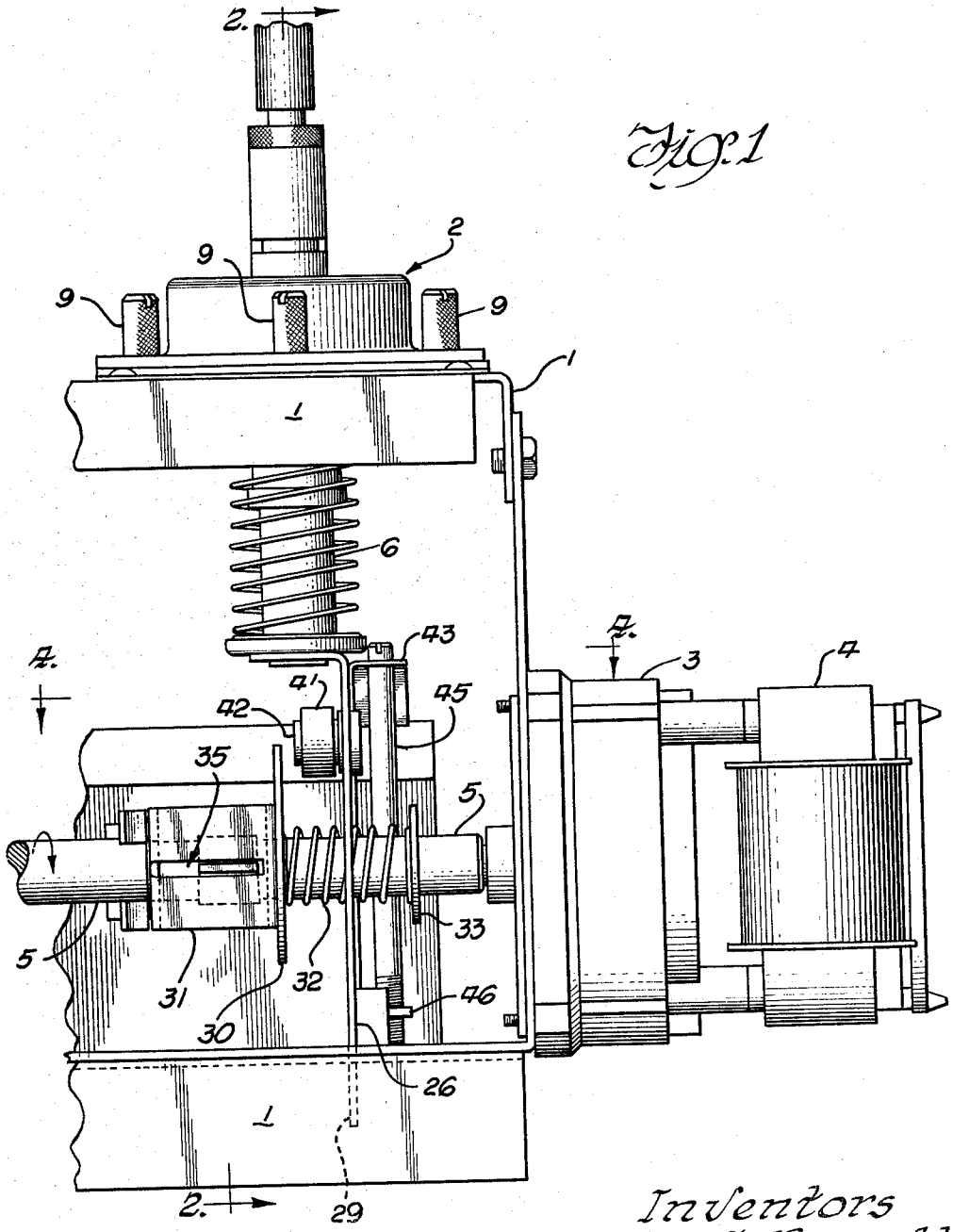



Fig. 1

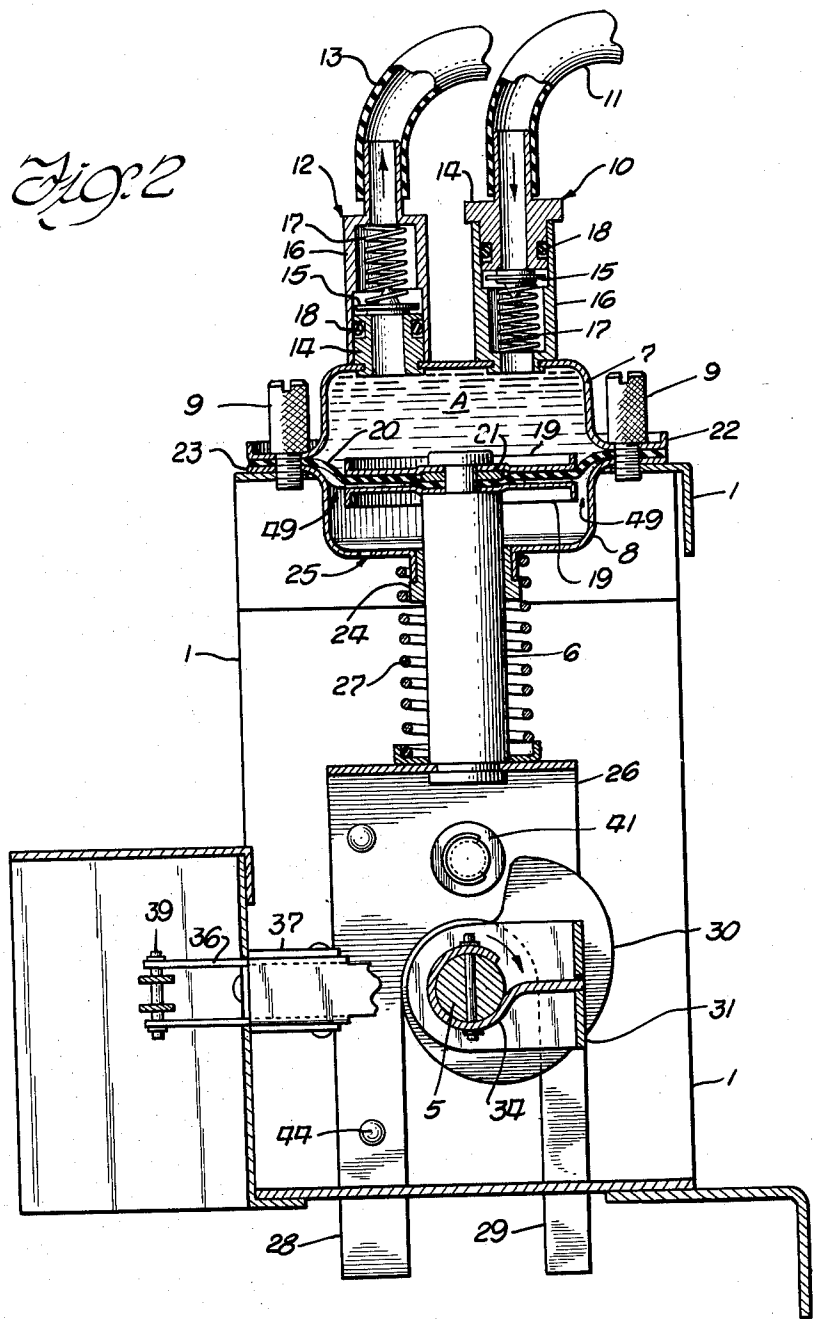
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METERING PUMP

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Fig. 2



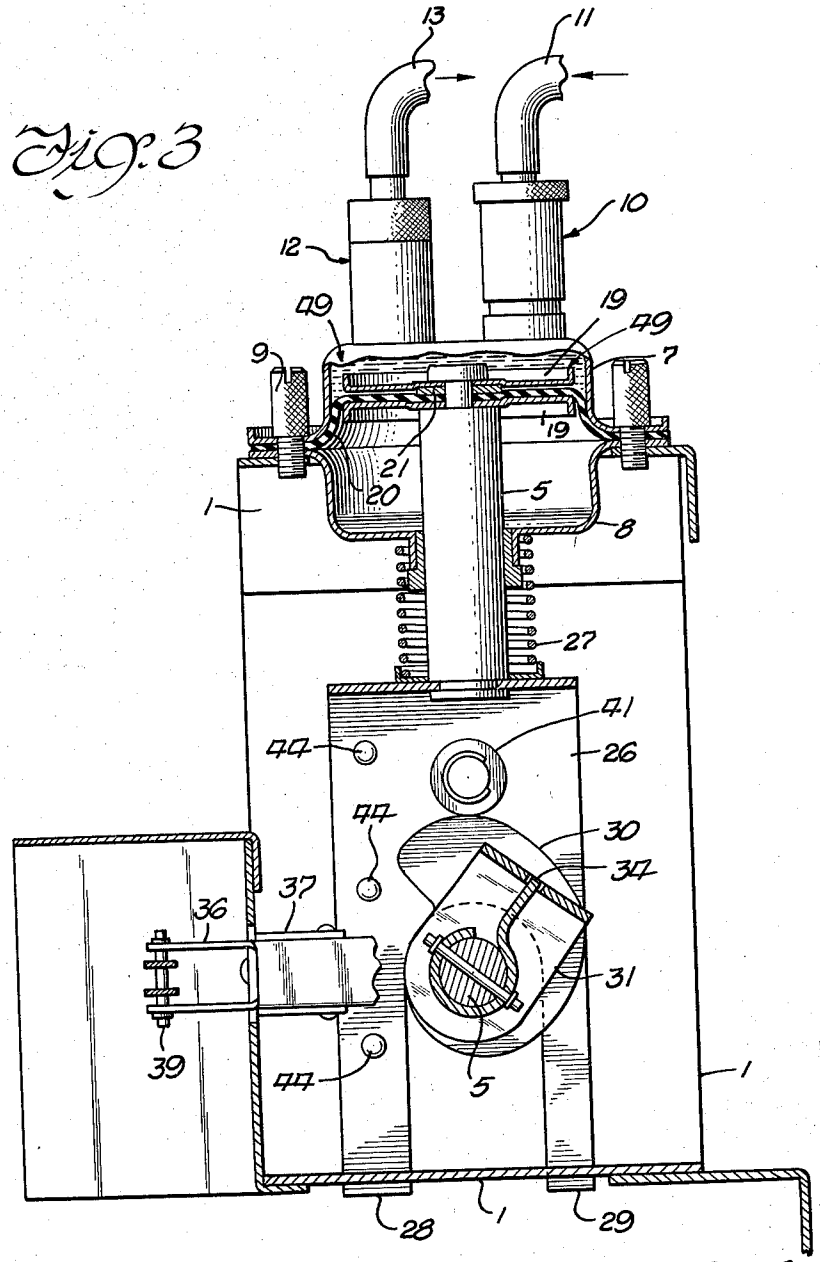

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Fig. 3




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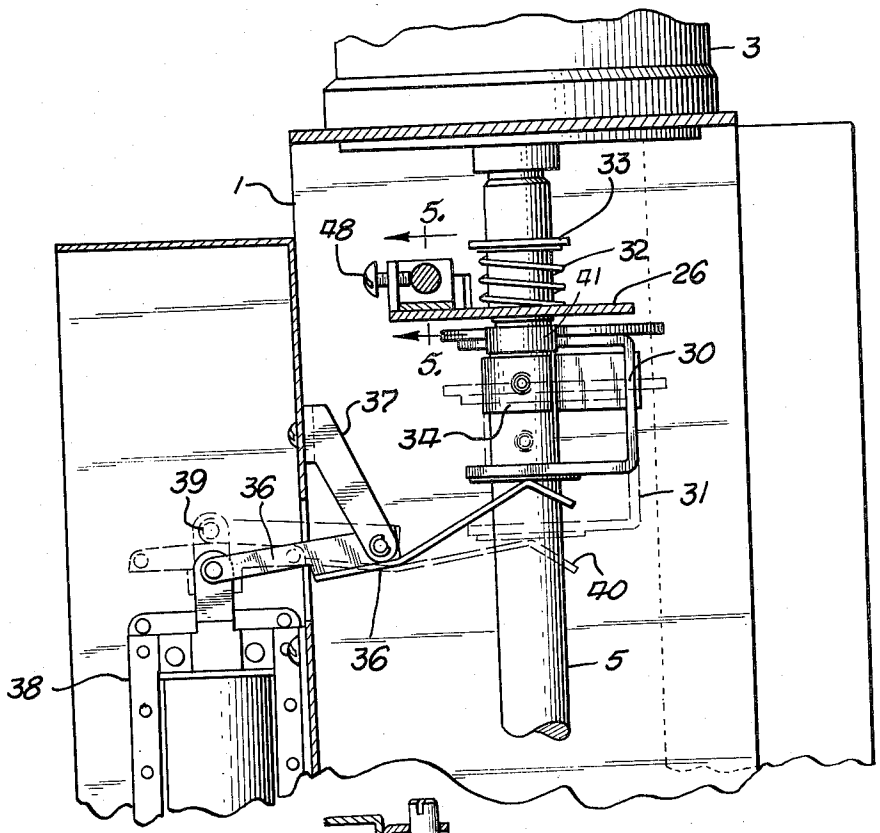
by Lloyd J. Thurber

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METERING PUMP

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Fig. 4



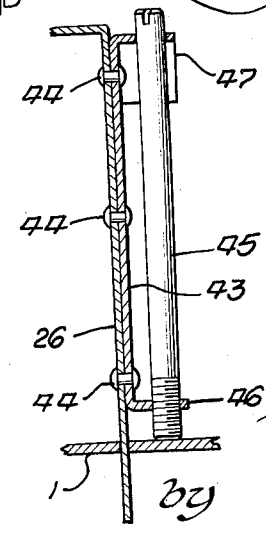




Fig. 5

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2,957,420

# METERING PUMP

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5 Claims. (Cl. 103—23)

This invention in general relates to positive displacement pumps and more particularly to a pump for displacing predetermined precise like quantities of liquids having a wide range of viscosity for each operation thereof.

One of the important uses of the novel pump and its operating means is in automatic beverage dispensers wherein a variety of viscous syrups are mixed with carbonated water and the resultant mixture dispensed to the customer in a cup.

Prior to this invention, beverage dispensers used various means for metering and displacing viscous liquids such as piston type pumps, and corrugated diaphragm pumps. In some machines, pressure was applied to the syrup container and the desired amount of syrup displaced by utilizing valves and timing devices. All of these devices for displacing and metering syrup are often subject to inaccuracy, mis-operation or failure, principally due to temperature changes which greatly alters the viscosity of the syrup and because of the congealing gummy properties of the syrup itself.

These and other objections are completely overcome in the novel construction of the present pump and driving means therefor, in which the clogging disadvantages of piston pumps and the inherent inaccurate delivery of diaphragm pumps are completely eliminated.

A principal object of this invention is the provision of the pump for displacing precise quantities of variable viscosity fluids having a positive piston action without the use of rings and other friction sealing means.

A further object of the invention is the provision of a positive displacement pump having a reciprocating rigid piston provided with a yieldable non-sliding seal.

Another object of the invention is the provision of a positive displacement pump and means for operating same for displacing the same precise predetermined quantities of viscous liquid over a wide range of operating conditions when initiated.

These and other objects and advantages in one embodiment of the invention appear in the following specification and drawings in which—

Fig. 1 is a side elevation of the pump and driving means therefor;

Fig. 2 is a cross sectional end view of the pump and driving means taken through section line 2—2, Fig. 1;

Fig. 3 is an end view substantially the same as Fig. 2 in changed position;

Fig. 4 is a cross sectional plan view of the driving means taken through section line 4—4 Fig. 1;

Fig. 5 is a cross sectional view taken through section line 5—5 Fig. 4.

Referring to Fig. 1, a frame assembly 1 serves as a supporting means for a pump assembly 2, a speed reducer 3, electric motor 4 and a pump operating mechanism which is responsive to the rotation of a main shaft 5 when initiated to reciprocate the pump piston rod 6.

Referring to Fig. 2, the pump assembly 2 consists



of a cylindrical upper casing 7 and a lower mating casing 8 which are secured in coaxial relation in frame 1 by screws 9 shown in Fig. 1. These two casings comprise the equivalent of a pump cylinder. A poppet type intake valve assembly 10 secured in casing 7 is connected to a source of syrup to be pumped by inlet pipe 11. A poppet type exhaust valve assembly 12 is also connected in casing 7, as shown, and connected to supply pipe 13 for delivering the syrup. The valves are substantially identical except they are positioned for reverse operation. Each valve assembly contains a seat member 14, a valve 15 and housing 16. Each valve is retained against its corresponding seat by a coil spring 17.

Rubber O rings 18—18 positioned in annular grooves in the seat members 14 frictionally seal each valve seat to their corresponding housing. Thus it is apparent that the valves may be quickly disassembled for servicing.

The piston assembly of the pump comprises a pair of rigid circular flanged discs 19—19 secured in coaxial relation to the end of the piston rod 6, as shown in Figs. 2 and 3, with a relatively small clearance 49 from the inner walls of the casings 7 and 8. A seal washer 20 made from yieldable sheet material such as rubber is sandwiched between and in coaxial position with respect to discs 19—19. It is important that the elastomer used has a high modulus of elasticity and is chemically inert with respect to the fluid used. Neoprene has been found a satisfactory material for most fluids. A small spacer washer 21 is coaxially secured between the upper side of the sealing washer and the lower side of the upper disc 19 for securing and sealing the washer 20 to the piston. The outer edge of the seal washer is also rigidly secured between the circular flanges 22 and 23 of the upper and lower casings 7 and 8. When the piston assembly is in the mid-position between the two casings, then the sealing washer is substantially planar and in a relaxed condition.

A cylindrical bearing 24 is coaxially secured in the lower casing 8 as a journal for piston rod 6. An aperture 25 in casing 8 serves as a vent for the free passage of air when the pump is reciprocated.

A slide member 26 rigidly attached to the lower end of the piston rod 6 is retained in frame 1 for vertical reciprocation by slide projections 28 and 29 journalled through suitable guide slots in the lower portion of frame 1. A coil spring 27 is positioned around the projecting end of piston rod 6 and is normally compressed between the lower end of casing 8 and an upper offset of slide member 26.

One of the objects of the invention is the provision of a pump which will deliver consecutive like quantities of syrup for each cycle thereof when initiated. Hence each intake and each discharge stroke of the piston must move through a precise predetermined distance without regard to the precision of the initiation means. This objective is fulfilled by the control elements hereinafter described.

Referring to Fig. 1, the main shaft 5 is rotated in the direction shown by arrow either intermittently or continuously by electric motor 4 through appropriate speed reducer 3. A slow-rise, quick-fall, cam 30, best shown Fig. 2, is integral with a U-shaped bearing member 31 and slidably retained on shaft 5. A compression type coil spring 32 is positioned around shaft 5 and bears at one end against a thrust washer 33 affixed to shaft 5 and its opposite end urges the cam and its bearing member 31 in the position shown Fig. 1. Referring to Figs. 1, 2 and 4, a drive dog 34 pinned to shaft 5 extends through a longitudinal slot 35 for driving the cam 30 in either of its two longitudinal positions.

Referring to Fig. 3, an operating lever 36 is pivotly

secured to a support 37 on frame 1. An electromagnet 38 for initiating the pump control when energized is secured to frame 1, and its armature is pivotly secured to one end of lever 36 by pin 39. The opposite end of lever 36 terminates in a fork 40 which is positioned to straddle shaft 5 and bear against bearing member 31. Thus, it is apparent that when the electromagnet 38 is energized, the cam will be moved along its axis of rotation against the restraining action of spring 32 from the position shown Fig. 1 to the position shown Fig. 4 while in driving engagement of the dog 34. Since the engagement of the dog with the driving member is at a considerable distance from the shaft 5, the friction forces resisting the shifting are minimized.

A cam follower 41 journalled on stud 42 secured in slide 26 is positioned for engagement and vertical movement by cam 30 when the cam is shifted into position shown Fig. 4. It is now apparent that when the electromagnet 38 is energized the cam 30 will move to a position for engagement with the follower roller 41 and the rotation of shaft 5 will cause the piston assembly to complete the discharge stroke through a precise predetermined distance by an adjustment means to be hereinafter described. An electric circuit and electric switches operatively related to shaft 5, not shown, control the periodic energizing the electromagnet 38 in order to provide the desired cycle displacement of syrup from the pump.

Referring to Figs. 1, 4 and 5, a bracket 43 is secured to the slide 26 by rivets 44 and the stroke adjustment shaft 45 is threaded into the lower offset 46 of bracket 43 and guided in the clearance hole in bracket offset 47 and having its lower end normally bearing against a lower portion of the frame 1. A lock screw 48 is threaded through the side of offset 47 and adapted to engage and hold adjustment shaft 45 when a predetermined vertical adjustment of the shaft is made. By this means the rest position of the piston assembly of the pump may be raised or lowered between predetermined limits which adjustment in turn provides adjustment in the length of stroke in response to the action of the cam 30 and a corresponding precise adjustment in the syrup delivery qualities of the pump.

In operation the pump is considered in rest position as shown Fig. 2 with the piston assembly in predetermined downward position and the chamber A filled with the syrup to be dispensed and both valves 15 in closed position. The elastic seal washer is now in stretched condition in tight contact around the periphery of the flange of the upper disc 19. Then assuming the shaft 5 is rotated by the motor 4, the cam will rotate in the direction shown by arrow. When the electromagnet 38 shown Fig. 4 is energized, then the cam 30 will be shifted to a position directly under the cam roller 41. Continued rotation of the shaft 5 will engage the cam with roller 41 and raise the slide, piston rod and piston assembly to maximum displacement completing the discharge stroke. The movement will discharge the contents in chamber A through the self-opening exhaust valve assembly into discharge pipe 13. The continued rotation of cam 30 will permit the roller 41 to engage the "quick-fall" portion of the cam 30 and allow the slide and piston assembly to descend to its original position shown Fig. 3 by virtue of the energy previously stored in spring 27 thus completing the intake stroke of the pump. At the beginning of this stroke, the exhaust valve 15 will close and the intake 15 will simultaneously open, thus permitting the chamber A to precisely refill with syrup through inlet pipe 11, without contamination of air, thus completing one complete cycle of the pump.

It has been found that the suction value of a pump of this character will raise exceedingly viscous fluids sufficiently high to be useful in beverage dispensers without augmenting normal atmospheric pressure.

It is to be noted that an important feature of this invention resides in the use of the elastic seal washer 20 which is secured only at its outside periphery and a small area within the piston. Thus the discs 19—19 serve as a piston type pump by alternately applying large area pressure and suction to the liquid during its forward and return stroke and the seal washer because of its elastic nature and position will stretch to a conical shape permitting the piston function without the use of a friction seal.



It is also to be noted that the seal washer is not constructed and does not function like the well known diaphragm pump, in that diaphragm pumps are made from flexible non-elastic material and usually contain annular corrugation to provide the desired movement. Thus when diaphragm pumps encounter heavy viscous fluids, the diaphragms themselves are subject to distortion a resulting non-uniform sequential discharge particularly when used with fluids having large variable temperature-viscosity properties.

The advantages of the elastic seal suction pump resides in the relatively small effective area of the seal as compared to the large area of the rigid piston and also the fact that the seal when in stretched condition exerts great force against counter-movements or distortion by fluid being displaced.

Having described our invention, we claim:

1. A positive displacement pump device for displacing predetermined like quantities of fluid for each cycle thereof comprising a frame means, a casing in said frame having a wall portion defining a cylinder, a piston positioned in said cylinder adapted for coaxial reciprocation therein from a rest position to a discharge position, said piston having its outer peripheral edge spaced inwardly from the cylindrical wall portion of said casing, an elastic diaphragm secured at its inner portion to said piston and about its outer edge to said cylinder for hermetically sealing the space between said piston in said cylinder, piston rod means secured at one end to said piston, said rod means journalled for reciprocating movement in said frame parallel to the axis of said cylinder, a drive shaft journalled for rotation in said frame having its axis normal to and substantially intersecting the axis of said cylinder, a cam means axially slidably keyed on said shaft and adapted for movement axially on said shaft from an idle position to an operating position, a cam follower operatively connected to said piston rod means and positioned for engagement and movement by said cam when said cam is moved to its said operating position, spring means cooperatively related with said frame means and said piston rod means for normally urging said piston into rest position whereby the movement of said cam from its idle position to its operating position will engage said follower and reciprocate said pump.

2. A control device for a reciprocating pump comprising a means forming a frame, a pump having a reciprocating piston in said frame adapted to displace like quantities of liquid for each reciprocation thereof, an actuator for said piston journalled for slidable movement in said frame and operatively connected at one end to said piston, a drive shaft journalled for rotation in said frame substantially at right angles to the path of movement of said actuator, cam means slidably retained on said shaft for movement from a predetermined inactive position to a predetermined active position, said cam means being rotatably driven by a dog fixed to said shaft in driving engagement with a slot extending parallel with said drive shaft in said cam means, a cam follower positioned on said actuator in the path of movement of said cam means when the latter is in said active position, means operatively connected to said cam means to reciprocate the same on said shaft into and out of operative engagement position with said follower, spring means positioned in said frame and bearing against said actuator for normally urging said actuator and said pump in rest position whereby a controlled movement of said cam means from in-

active to active position will engage the cam with said follower and reciprocate said actuator and pump.

3. A control device for a reciprocating pump comprising a means forming a frame, a reciprocating pump in said frame adapted to displace like quantities of liquid for each reciprocation thereof, an actuator for said pump journalled for slidable movement in said frame and connected at one end to said pump, a drive shaft journalled for rotation in said frame substantially at right angles to the path of movement of said actuator, cam means axially slidably retained on said shaft for movement from a predetermined inactive position to a predetermined active position, means on said shaft in rotatable driving, axially slidable engagement with said cam means, a cam follower positioned on said actuating member in the path of movement of said cam means when the latter is in said active position, spring means positioned in said frame bearing against said actuator for normally urging said actuator and said pump in rest position, a second spring means on said shaft and bearing against said cam means for normally urging said cam means in its inactive position, an electromagnet in said frame, lever means pivotally mounted in said frame and articulated with said cam and said magnet for moving said cam from said inactive position to active position when the latter is energized, whereby energizing said magnet for a predetermined period will reciprocate said pump a predetermined number of times when said shaft is rotating.

4. A control device for a reciprocating pump comprising a means forming a frame, a pump having a reciprocating piston in said frame, an actuator for said piston journalled for slidable movement in said frame and connected at one end to said piston, a drive shaft journalled for rotation in said frame substantially at right angles to the path of movement of said actuator, cam means axially slidably retained on said shaft for movement from a predetermined inactive position to a predetermined active position, a radially extending dog mounted on said shaft in rotatable driving, axially slidable engagement with a slot in said cam means, a cam follower positioned on said actuating member in the path of movement of said cam means when the latter is in said active position, means operatively connected to said cam means to reciprocate the same on said shaft into and out of operative engagement position with said follower, and spring means operatively connected to said actuator to urge the same to rest position, whereby a controlled movement of said cam means from inactive to active position will engage the cam means with said follower and reciprocate said actuator.



5. A control device for a reciprocating pump comprising a means forming a frame, a reciprocating pump in said frame, an actuator for said pump journalled for slidable movement in said frame and connected at one end to said pump, a drive shaft journalled for rotation in said frame substantially at right angles to the path of movement of said actuator, cam means axially slidably retained on said shaft for movement from a predetermined inactive position to a predetermined active position, driving means on said shaft in rotatable driving, axially slidable engagement with said cam means, a cam follower positioned on said actuating member in the path of movement of said cam means when the latter is in said active position, spring means positioned in said frame bearing against said cam means for normally urging said cam means in its inactive position, an electromagnet mounted on said frame, lever means connecting said electromagnet and said cam means for axially moving said cam means on said shaft from said inactive position into operative engagement with said follower when said electromagnet is energized, whereby a controlled movement of said cam means from inactive to active position will engage the cam with said follower and reciprocate said actuator and pump.


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