May 3, 1932. C. A. SUNDSTRAND 1,856,599

WATER MODIFYING APPARATUS

Filed Oct. 12, 1929 3 Sheets-Sheet 1

Fig. 1

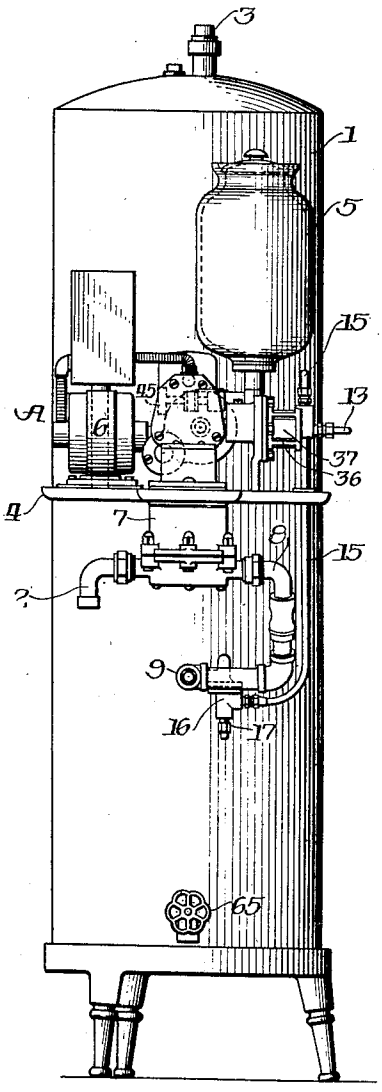


Fig. 2

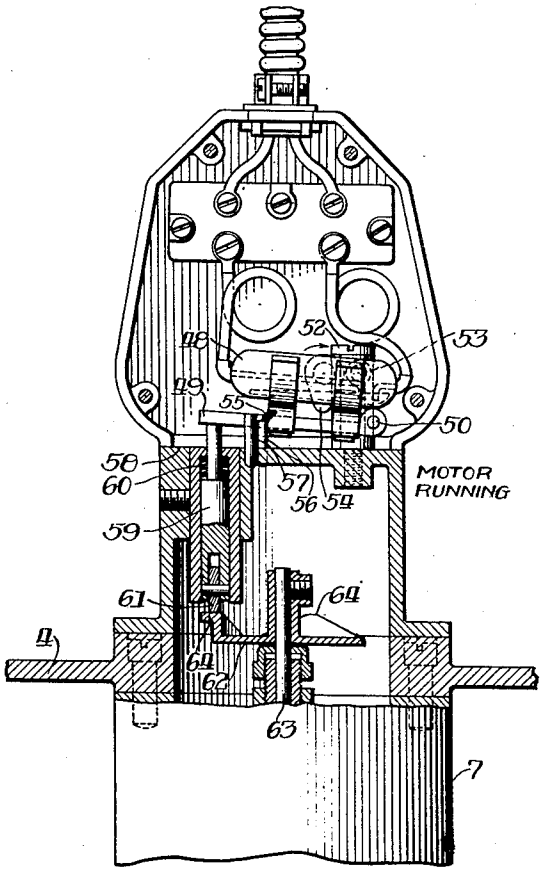


Fig. 3

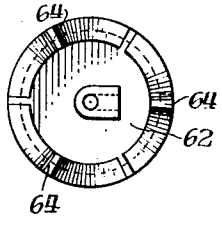
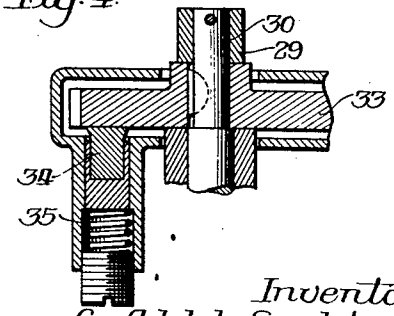


Fig. 4



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WATER MODIFYING APPARATUS

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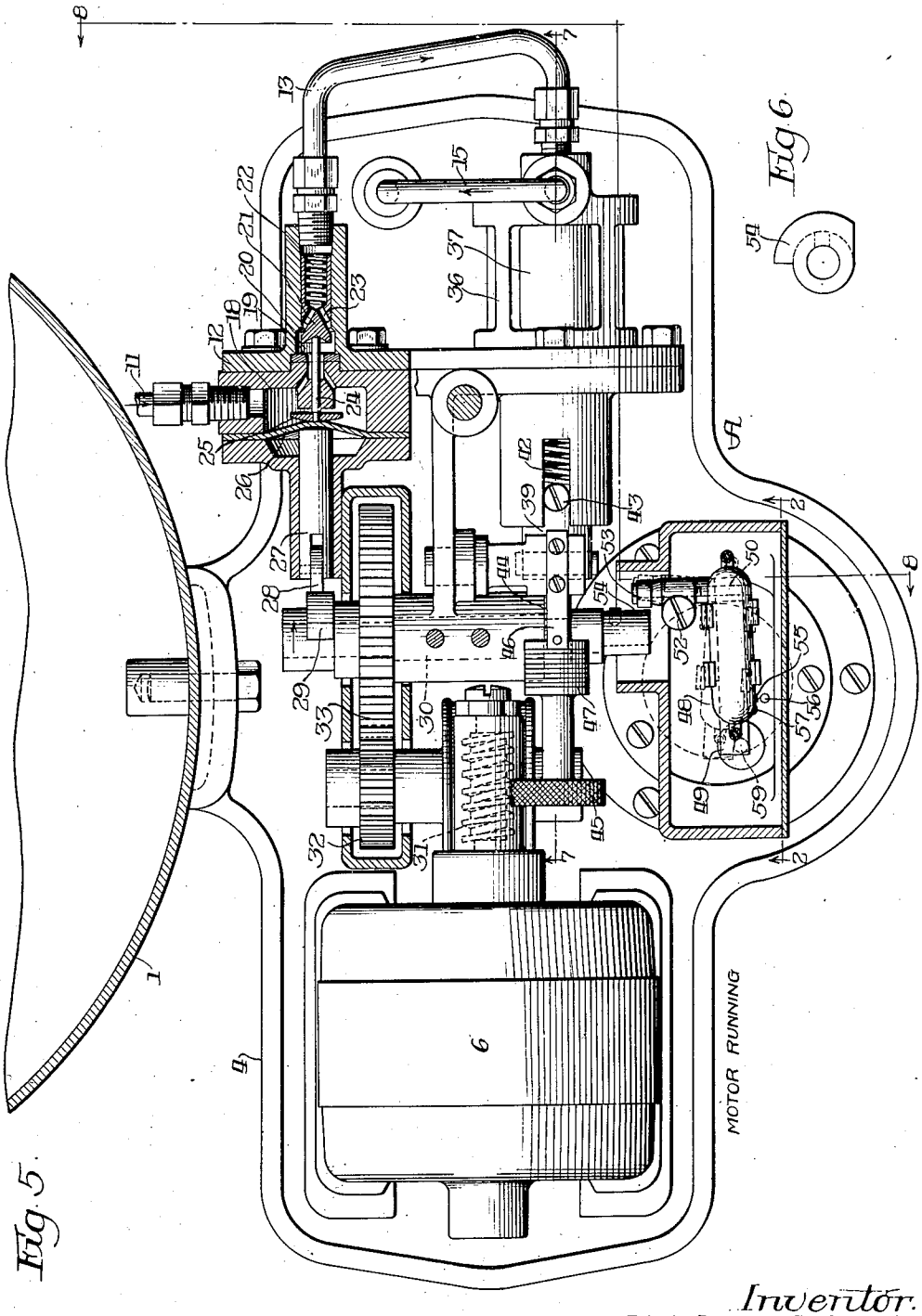

Fig. 5

Fig. 6

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WATER MODIFYING APPARATUS

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Fig. 7

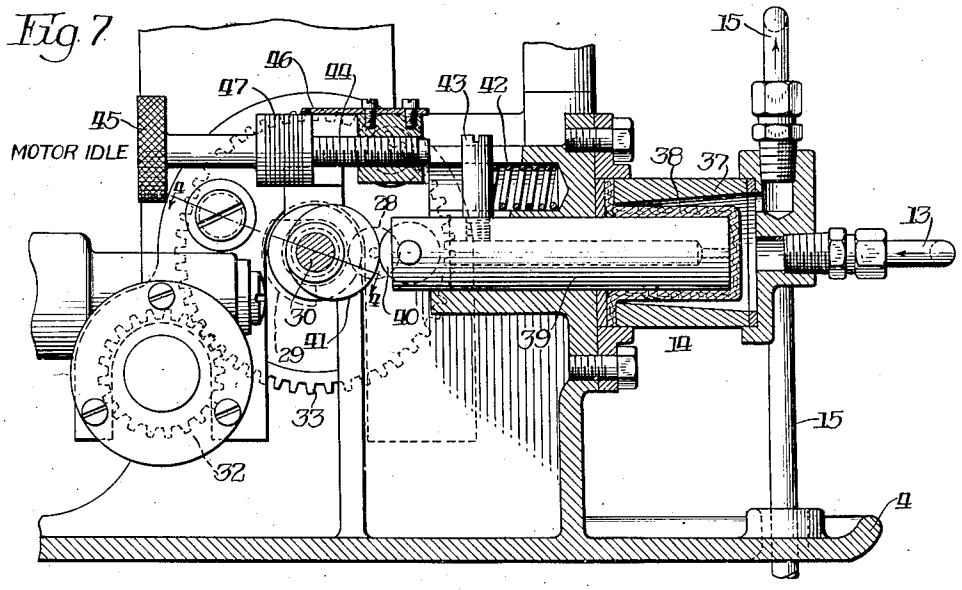
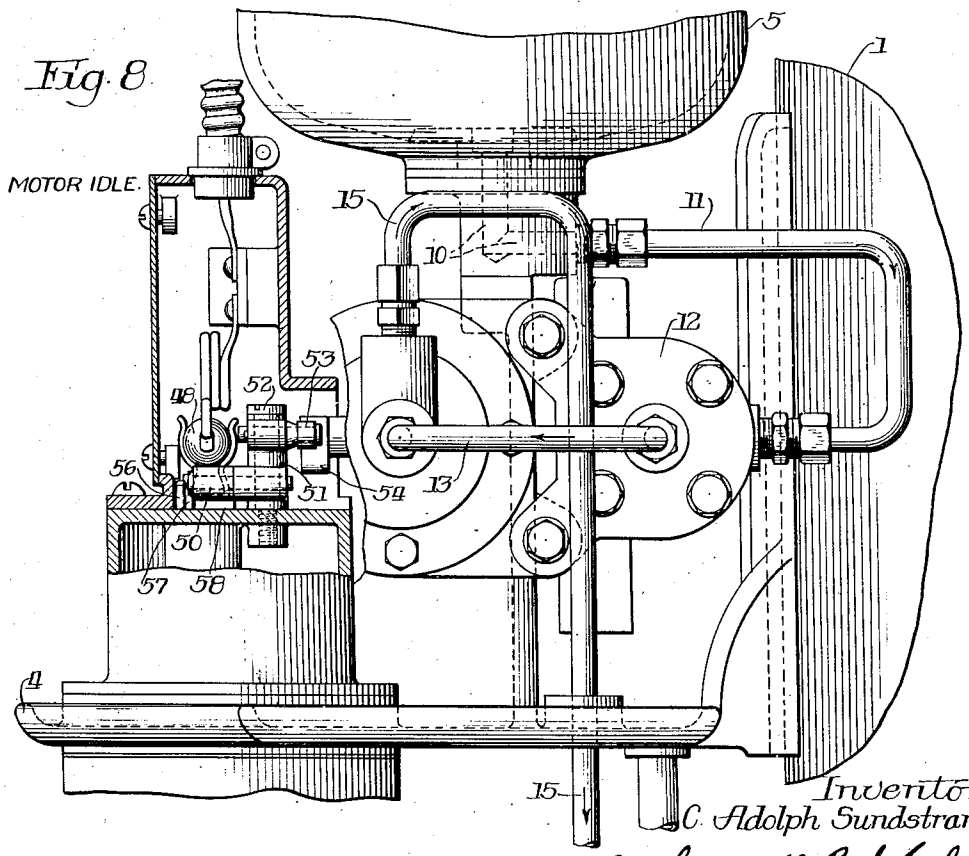


Fig. 8



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UNITED STATES PATENT OFFICE

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WATER-MODIFYING APPARATUS

Application filed October 12, 1929. Serial No. 399,145.

This invention relates to apparatus for treating water or other liquids, as, for example, to soften or chlorinate water.

It has heretofore been proposed to supply water-softening solution by means of apparatus driven through the force of water flowing through the system, but such apparatus has been found unsatisfactory for the reason that if the water pressure falls below normal the water may not have force enough to drive the solution-supplying means. Moreover, even with normal water pressure, if the faucet be opened only slightly the power available may be insufficient to cause operation of the solution-supplying means. One object of the present invention is to overcome these deficiencies of the prior art, which object I have attained by employing an electric motor to drive the solution-supplying means, water pressure being depended upon only to operate the motor switch. Inasmuch as the power required to operate the switch is very slight, fluctuations in water pressure, or variations in the extent of opening of the faucet, do not affect the certainty of operation of the switch.

In certain prior-art apparatus, it has been attempted to supply the solution under the influence of gravity alone, but it has been found that under various conditions such apparatus will fail to supply solution in the desired definite proportion to water flowing through the system. It is one of the objects of the present invention to obviate this difficulty. This object has been attained by employing a pump for positively supplying a definite charge of solution at each actuation of the pump, the pump being driven by a source of power other than the water pressure.

In the accompanying drawings:

Figure 1 is a front elevation of an apparatus embodying the features of my invention.

Fig. 2 is a fragmental sectional view of the motor switch and switch-operating means.

Fig. 3 is a detail view of the meter cam which operates the motor switch.

Fig. 4 illustrates one form of means to prevent the motor from running through momentum after the circuit has been broken.

Fig. 5 is a plan view with certain parts in section, showing the apparatus for supplying solution to the water.

Fig. 6 is a detail view of the cam for operating one of the by-pass valves.

Fig. 7 is a fragmental sectional view of the pump.

Fig. 8 is a fragmental view, with parts in section, looking from the right-hand side of Figs. 1, 5 and 7.

Inasmuch as the present apparatus may be used for supplying either a water-softening compound or a chlorine-bearing solution, I will hereinafter use the generic term "water-modifying solution." I would have it understood that the invention is also applicable to the modification of other fluids than water.

The embodiment herein shown of the invention comprises a storage and settlement tank 1, together with apparatus for automatically supplying proper quantities of a water-modifying solution to the water entering the tank 1, said apparatus being in the form of a compact unit supported upon the tank 1. In an embodiment of the invention intended for installation in hotels and other places where large quantities of water are used, the automatic apparatus for supplying water-modifying solution to the water may be located elsewhere than on the storage and settlement tank. In Fig. 1, the automatic mechanism for supplying the solution to the water is designated by the letter A.

The connection to the city water supply or other source of supply of water under pressure is indicated at 2. The outlet 3 is at the upper end of the tank.

The unit A comprises a base 4 in the nature of a shelf arranged to be attached to the tank 1 in any preferred manner. 5 is a reservoir for the water-modifying solution. A definite quantity of the solution is injected into the stream of water entering the tank 1 by mechanism driven by an electric motor 6. The operation of the motor is controlled by a switch which is arranged to be operated by water power, herein shown as obtained through the medium of the measuring mechanism of an ordinary water meter 7. (The registering mechanism of the water meter

is omitted.) The reservoir 5, the motor 6, the mechanism driven by the motor, the motor switch and the water meter 7 are supported by the shelf 4. As shown in Fig. 1, the water meter 7 is connected into the line through which water is supplied to the tank 1, the pipe 2 being connected to the inlet of the water meter and the line of piping 8 being connected to the outlet of the meter. The piping 8 is connected to the tank 1 at 9.

Referring now to Fig. 5: The lower end of the reservoir 5 is connected by means of the passage 10 and the tube 11 to a check valve 12. From the check valve 12 the solution flows through a tube 13 to a pump 14, and thence through a tube 15 to a check valvt 16 (Fig. 1). The outlet from the check valve 16 is connected to the line of piping 8 through which water is supplied to the tank 1. 17 (Fig. 1) is a pet cock for discharging air from the tube 15.

The check valve 12 comprises a casing having a chamber 18 (Fig. 5). At the outlet 19 of the chamber 18 is a valve seat 20 against which a valve member 21 is arranged to be pressed by a coiled spring 22. In the valve member 21 is a plurality of ducts 23 to permit solution to flow past the valve when the latter is unseated and enter the central bore of the valve member, said bore communicating with the tube 13. To unseat the valve member 21, I provide a stem 24 guided in the valve casing for sliding movement, one end of the stem bearing against the valve member and the other end having a head 25 which bears against one side of a flexible diaphragm 26 in the chamber 18. A plunger 27 bears against the other side of the diaphragm and has a roller 28 which is arranged for engagement by a cam 29 (Figs. 5 and 6). Said cam is fixed upon one end of a shaft 30.

The motor 6 is connected to rotate the shaft 30 through worm gearing 31, a spur pinion 32 and a spur gear wheel 33. In order that the driven mechanism shall not run through momentum after the motor switch is opened, means of any preferred character may be provided, as, for example, a magnetic clutch incorporated in the motor, or a brake shoe 34 (Fig. 4) which is pressed by means of a spring 35 against one side of the gear wheel 33. It will be seen that in the rotation of the cam 29 the check valve member 21 will be positively unseated against the pressure of the spring 22, thus allowing solution to flow by gravity from the reservoir 5 past the check valve.

The pump 14 (Fig. 7) comprises a casing 36 (Fig. 5) which contains a glass cylinder 37. One end of the pump is connected to the solution supply pipe 13 and the solution discharge pipe 15, as shown in Fig. 7. The cylinder 37 is of glass in order that observation may show whether air is trapped in the cylinder. To permit air to escape from the cylinder through the tube 15 when the pet cock 17 is opened, the interior wall of the cylinder is made tapering. and the larger (upper) end of the cylinder chamber communicates directly with the entrance to the tube 15.

The piston of the pump consists of a cup-shaped rubber diaphragm 38 and a plunger 39, one end of which fits within said diaphragm. The other end of the plunger 39 carries an anti-friction roller 40 that bears against a cam 41 fixed on the shaft 30. An expansive coiled spring 42 bears against a stud 43 which is fixed to the plunger 39. As the shaft 30 revolves, the plunger 39 will be reciprocated by the cam 41 and the spring 42, thus alternately allowing the pump cylinder to be filled with solution from the reservoir 5 and causing solution to be positively forced from the pump cylinder into the pipe 15.

On the intake stroke of the pump piston the check valve 16 prevents solution or water from flowing back through the pipe 15, while on the ejecting stroke of the piston the check valve 21 prevents solution from being forced back through the pipe 13. It will be seen that inasmuch as the pump piston is positively reciprocated through a stroke of definite length, a definite quantity of solution will be forced into the line of piping 8 at each actuation of the pump. The cams 29 and 41 are so timed that the check valve 21 is unseated at about the time the pump piston begins its retracting movement and is seated just before the pump piston begins its ejecting stroke.

The length of the stroke of the pump piston, and consequently the capacity of the pump, may be regulated in any preferred manner, as, for example, by means of an adjusting screw 44 (Fig. 7) arranged to limit the spring-actuated movement of the stud 43. The screw 44 is provided with a knurled head 45. A stationary pointer 46 overlying a graduated cylindrical surface 47 on the screw 44 permits of conveniently adjusting the pump to supply the desired quantity per stroke.

While the motor circuit may be opened and closed by means of any preferred nature, I have herein shown a mercurv switch 48 (Figs. 2 and 5) which is arranged to be tilted in a vertical plane to open and close the circuit by power derived from the water meter 7.

It is desirable to supply solution in a predetermined proportion to the amount of water entering the tank 1. The speed of the water meter varies with the extent to which the faucet is opened in drawing off water for use. It also varies with fluctuations in city water pressure. The speed of the motor 6, on the other hand, is substantially constant. In view of these conflicting conditions, I have provided means whereby the motor operates intermittently, each operation of the motor causing a single revolution of the cam shaft

30, the motor being arranged to operate the switch 48 to open the motor circuit at the end of each revolution of the cam shaft.

The mercury switch 48 is supported upon an arm 49 which is mounted to swing in a vertical plane upon a horizontal pivot 50. The pivot 50 is supported by a block 51 which is mounted to swing upon a vertical pivot 52. As shown in Fig. 8, the pivot pin 50 projects from one side of the block 51. At the opposite side of the block 51 is a roller stud 53 arranged to bear against a cam 54 on the cam shaft 30. A spring 55 connected to the arm 49 and anchored at 56 tends to hold the roller stud 53 against the cam 54 and tends to swing the arm 49 against a stop pin 57. Gravity tend to swing the arm 49 down to the surface 58 (Fig. 2).

When the arm 49 is held against the stop pin 57 it is above and in the path of movement of a plunger 59 (Figs. 2 and 5). An expansive spring 60 tends to move the plunger 59 downwardly until its upper end is flush with or below the surface 58. Said spring holds a roller 61 on the lower end of said plunger in contact with a rotary cam 62, which is fixed to the upper end of the shaft 63 of the water meter 7. As indicated in Figs. 2 and 3, the form of cam 62 chosen for illustration herein has three high points 64 thereon.

When the apparatus is idle, the arm 49 will be held by gravity in its lower position wherein it rests upon the surface 58, the motor circuit being then open. If the water meter stopped in such position that the plunger 59 is in its lowermost position, the spring 55 will be holding the arm 49 against the stop pin 57, the arm 49 being then directly above the plunger 59. But if the water meter happened to stop in such position that the upper end of the plunger 59 is above the surface 58, the spring 55 will be holding the arm 49 against the side of the upper end of the plunger. The high point of the cam 54 will be below the roller stud 53.

Under usual conditions, the speed of the meter cam 62 is approximately three and one-half R. P. M. when a faucet is wide open. In the construction selected for illustration herein, the cam has three high points, consequently the switch will be operated to start the motor approximately ten times per minute while a faucet is wide open, or about once every six seconds. The character of the motor and the gearing is such as to produce a revolution of the cam shaft 30 in less than the length of time elapsing between reciprocations of the plunger 59. In the construction herein illustrated the cam shaft 30 may be assumed to revolve once in three seconds, hence the motor runs about one-half the time while a faucet is wide open.

Every time the plunger 59 is elevated by a cam point 64 the mercury switch 48 will be raised into closed-circuit position, whereupon the motor will start and will operate the cam shaft 30 to inject a definite quantity of solution into the tube 15. As the cam shaft 30 is completing a revolution the cam 54 will engage the roller stud 53 and swing the block 51 on the axis 52, thereby swinging the arm 49 clockwise, as viewed in Fig. 5, so as to withdraw the arm 49 from the plunger 59, whereupon the arm 49 drops under the action of gravity, thus suddenly opening the motor switch. The mechanism is so timed that the cam shaft 30 will have made one revolution before the switch 48 could be lowered into open-circuit position by the descent of the plunger 59.

In the embodiment herein shown, there is one injection of solution for each gallon of water entering the tank 1. Precipitation occurs in the lower portion of the tank. At suitable intervals the sludge may be drained off through the valve 65 (Fig. 1).

When the invention is employed in connection with a system for supplying relatively large quantities of water, the motor circuit may be controlled by means other than a meter. For example, if water is being pumped from a well to a reservoir by means of a motor-driven pump, the circuit of which is arranged to be opened and closed automatically in accordance with the amount of water withdrawn from the reservoir, the motor for operating the solution-injecting mechanism may be connected into the same circuit with the water pump so as to start and stop simultaneously with the latter.

It will be seen that in the embodiment herein shown the only load to which the water meter is subjected is the operation of the plunger 59 against the force of the spring 60 and the weight of the arm 49 and switch 48. This load is so light that the meter may be depended upon to operate even though a faucet be only slightly open or the water pressure be abnormally low. Indeed the load is less than that entailed in the operation of the ordinary registering mechanism.

In the prior art, it has been proposed to use a metal bellows in connection with a piston, but it has been found that such a bellows is liable to collapse and thus render operation of the bellows ineffective to force solution into the water. Attempts have also been made to use a rubber diaphragm as a piston or ejector, but such a diaphragm has been unsatisfactory, as the margin eventually becomes weak, and, being unsupported, renders positive ejection impossible. These difficulties I have overcome by the use of a pump plunger covered by a close-fitting rubber cover. Since the rubber cover is supported by the plunger at all points against collapse due to pressure in the cylinder, it cannot sag or collapse. Positive ejection is

ensured by the plunger, and leakage and corrosion are prevented by the rubber.

In prior water-softeners, the check valve has been opened by gravity and closed by spring pressure, but experience has shown that the spring may be too strong when there is but little solution in the jar and too weak when the jar is full. I have obviated such uncertainty of operation by positively opening the valve, and by using a sufficiently strong spring to ensure closure of the valve even when the jar is full.

I claim as my invention:

1. The combination of a water system, a pump for positively forcing solution into the system, a shaft for driving the pump, a motor for driving the shaft, a switch in the circuit of the motor, said switch being arranged to swing on two axes, a meter in the water system, a rotary cam driven by the meter, a plunger reciprocated by the cam, said plunger being arranged to swing the switch on one axis to close the circuit, and a cam on the shaft for swinging the switch on the other axis to withdraw the switch from the plunger at the end of each revolution of the shaft.

2. The combination of a water system, a pump for positively forcing solution into the system, a motor for actuating the pump, a tiltable switch in the circuit of the motor, a meter in the water system, a rotary cam driven by the meter, a plunger reciprocated by the cam, said plunger being arranged to tilt the switch to close the circuit, and means driven by the motor for laterally withdrawing the switch from the plunger at the end of each cycle of operations of the pump.

3. The combination of a fluid system, a pump for positively forcing solution into the system, a motor for actuating the pump, a switch in the circuit of the motor, a meter in the fluid system, a rotary cam driven by the meter, a plunger reciprocated by the cam, said plunger being arranged to close the switch, and means driven by the motor for withdrawing the switch from the control of the plunger at the end of each cycle of operations of the pump.

4. The combination of a water system, a pump for positively forcing solution into the system, a shaft for driving the pump, a motor for driving the shaft, a switch in the circuit of the motor, a meter in the water system, said meter being arranged to close the switch, and means driven by the shaft for withdrawing the switch from the control of the meter at the end of each revolution of the shaft.

5. The combination of a water system, a pump for positively forcing solution into the system, a motor for actuating the pump, a switch in the circuit of the motor, a meter in the water system, said meter being arranged to close the switch, and means driven by the motor for withdrawing the switch from the control of the meter at the end of each cycle of operations of the pump.

6. The combination of a water system, a pump for positively forcing solution into the system, a motor for actuating the pump, a switch in the circuit of the motor, a member reciprocable by pressure in the water system, said member being arranged to close the switch, and means driven by the motor for withdrawing the switch from the control of said member at the end of each cycle of operations of the pump.

7. The combination of a fluid system, a pump for positively forcing solution into the system, a motor for actuating the pump, a switch in the circuit of the motor, means driven by the pressure of fluid flowing through said system for closing the switch, and means actuated by the motor for opening the switch upon the termination of each cycle of operations of the pump.

8. The combination of a fluid-conducting system, a solution reservoir, a pump for positively forcing solution into the system, a check valve between the reservoir and the pump, means for positively opening the check valve, a motor for actuating the pump and the check-valve-operating means, a switch in the circuit of the motor, and means driven by the pressure of fluid flowing through said system for operating the switch.

9. The combination of a fluid system, a solution reservoir, a pump for positively forcing solution into the system, a check valve between the reservoir and the pump, and means for positively opening the check valve and for actuating the pump.

In testimony whereof, I have hereunto affixed my signature.

CARL ADOLPH SUNDSTRAND.