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Fleckenstein et al.

[11] **3,742,768**

[45] **July 3, 1973**

[54] **TIMING MOTOR DRIVE MECHANISM FOR WATER SOFTENER VALVES**

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[21] Appl. No.: **231,145**

[52] **U.S. Cl.** ..... **74/3.52,** 200/35 R, 200/38 R

[51] **Int. Cl.** **G05g 17/00**

[58] **Field of Search** ..... 74/3.5, 3.52, 3.54; 200/35 R, 38 R

[56] **References Cited**

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Attorney—Robert C. Brown, Jr., Malcolm S. Brodway et al.

[57] **ABSTRACT**

A water softener valve timing mechanism utilizing a timing motor to shift the valve through the various operating and softening stages. A linkage is operated periodically to shift a drive gear for the valve into engagement with a pinion of the timing motor. An adjustable cam controls a brine line valve for variably controlling the amount of water filled in the brine tank of the system to thereby control salt usage.

12 Claims, 6 Drawing Figures

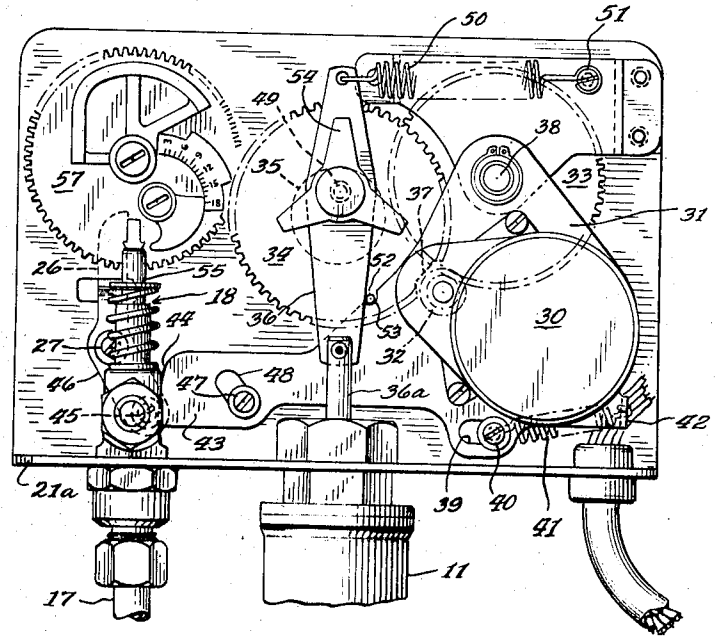
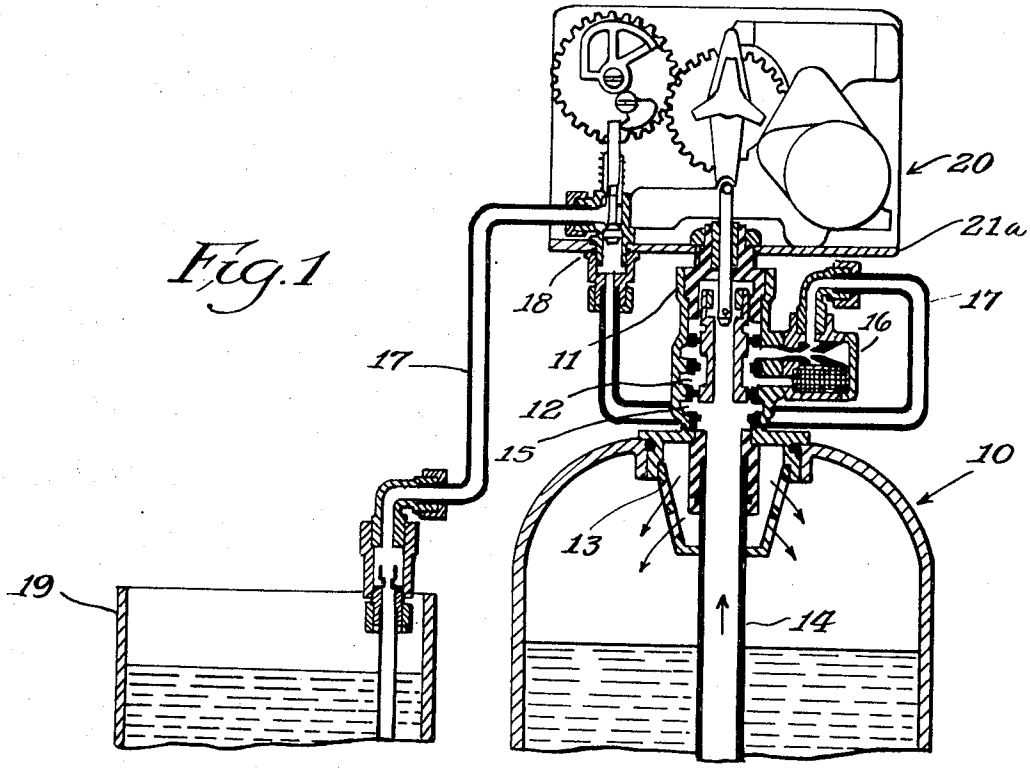


Fig. 1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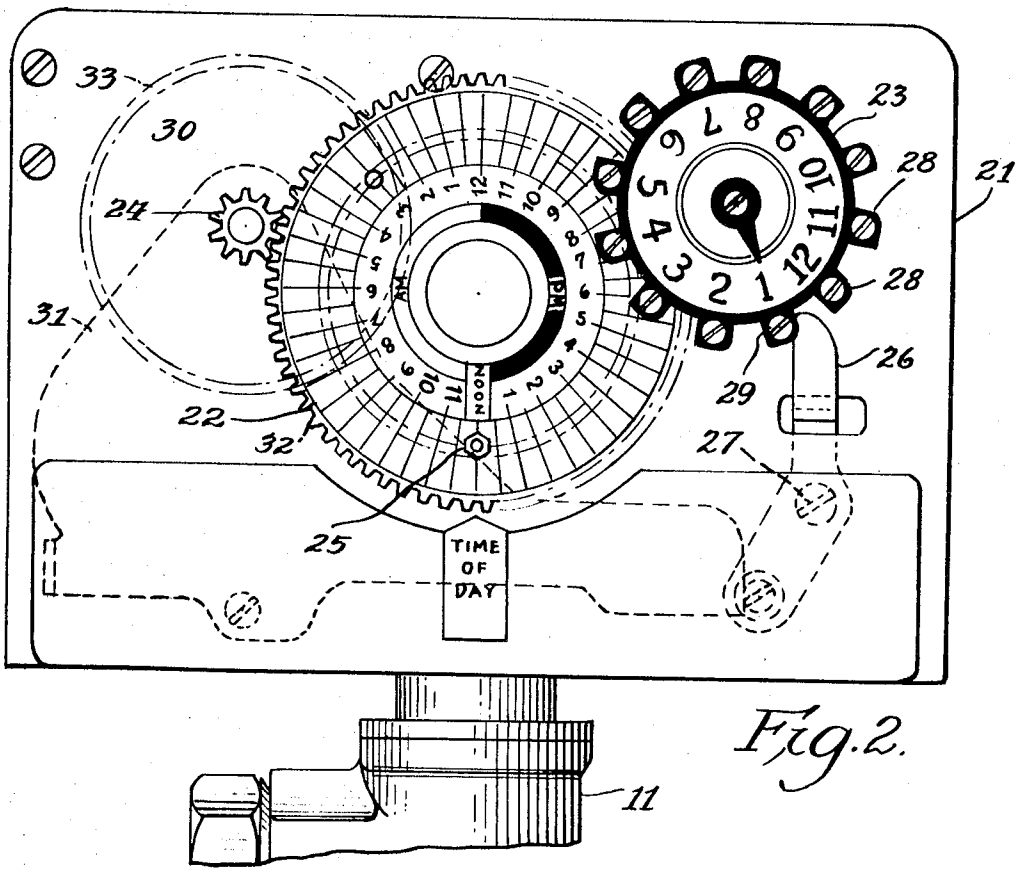
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TIME OF DAY
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Fig. 2.

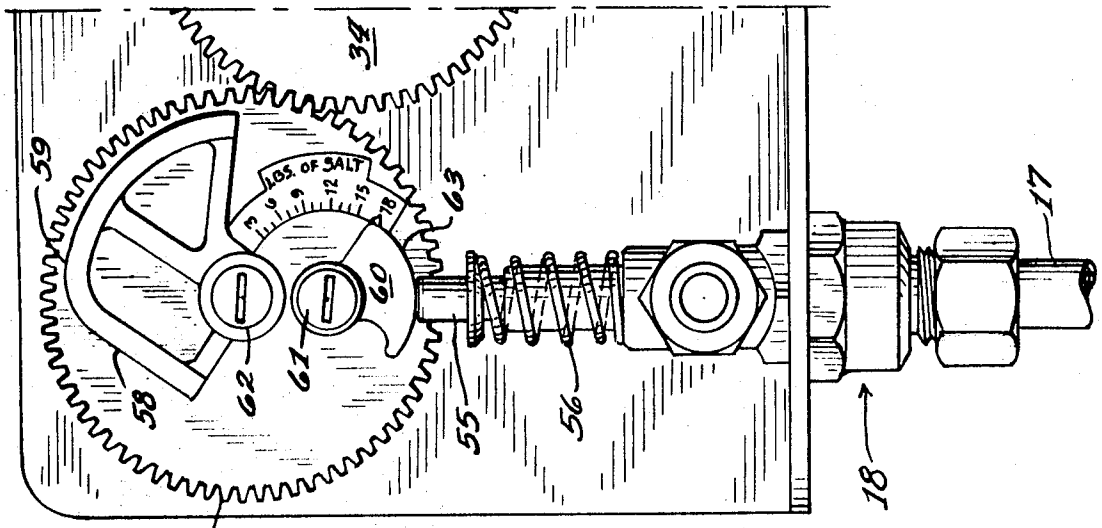
LBS. OF SALT
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Fig. 4

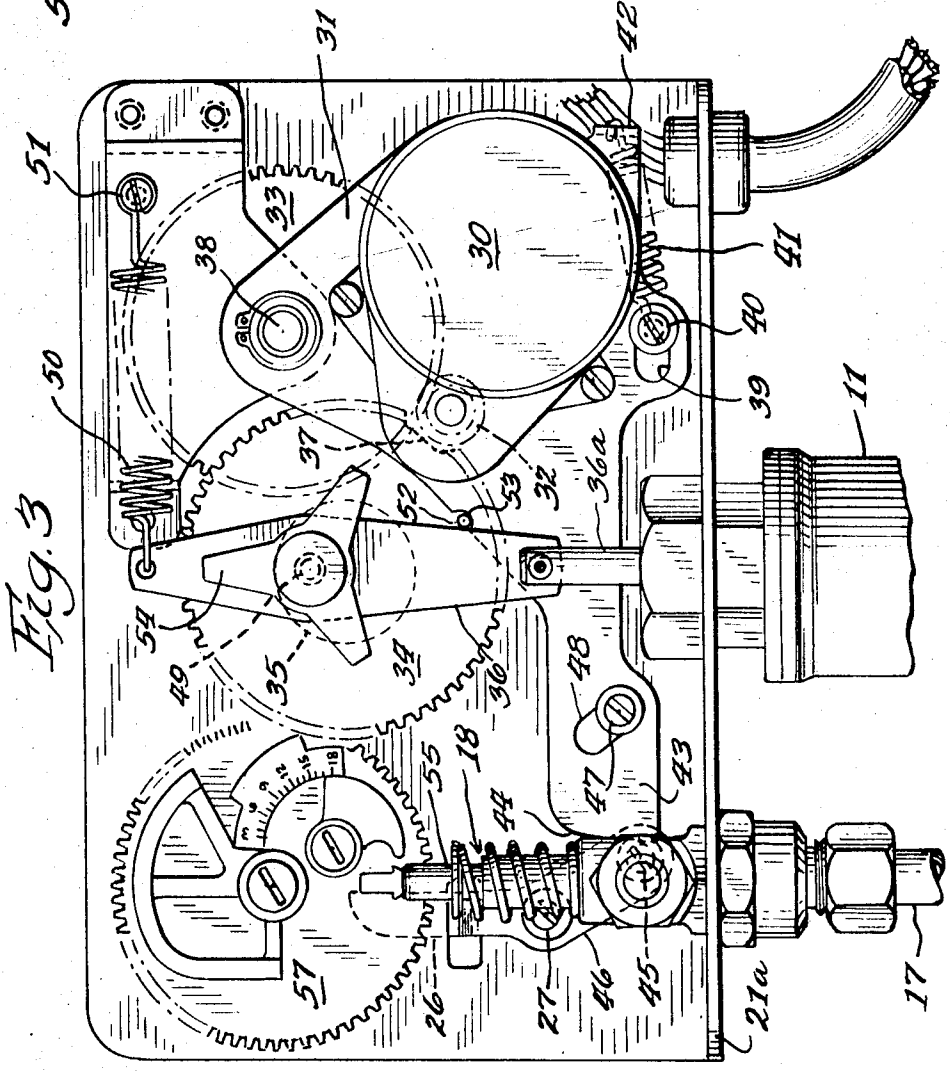
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Fig. 3

Fig. 6.

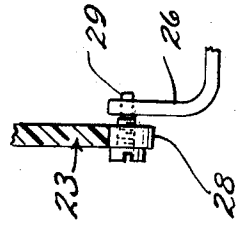
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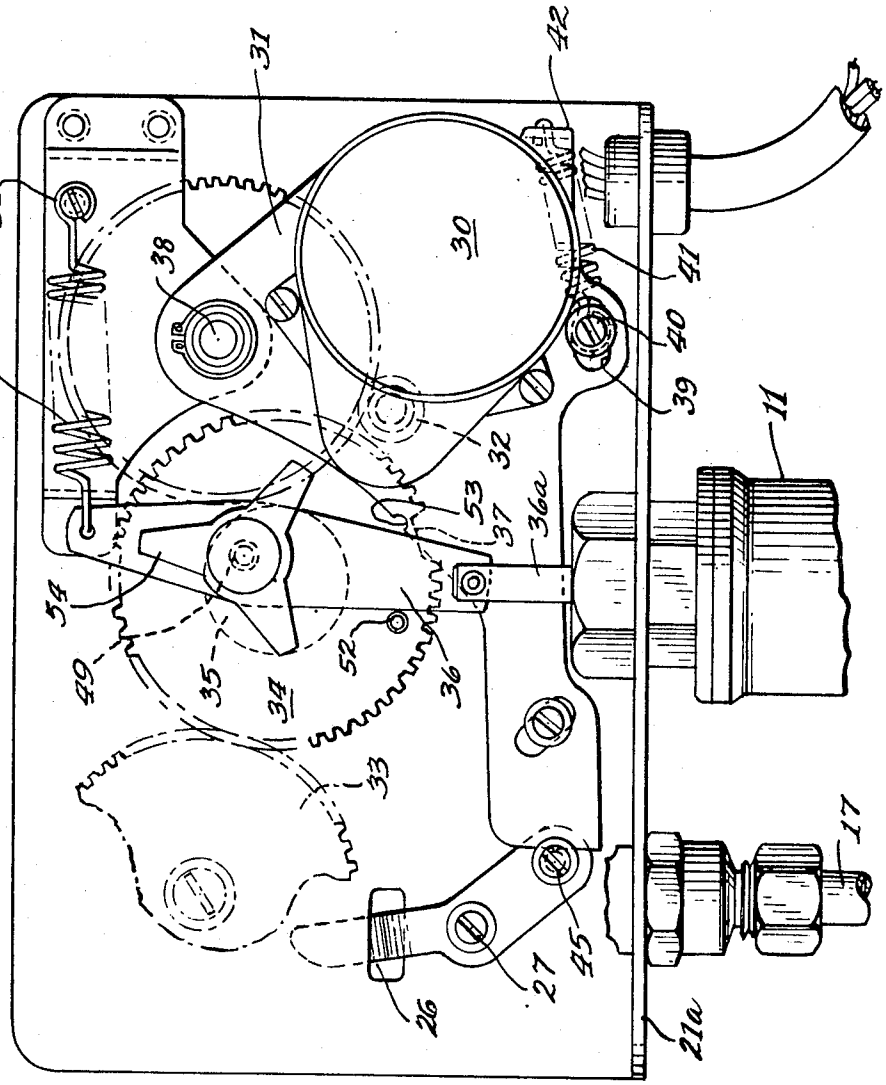
Fig. 5.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TIMING MOTOR DRIVE MECHANISM FOR WATER SOFTENER VALVES

The invention is directed to new and useful improvements in control valves for water softeners and is particularly concerned with improvements in a drive between a piston operated valve and a timing motor which is used to operate the valve in a preselected periodic fashion.

The present invention is directed to improvements in timing motor and valve actuating mechanisms of the type illustrated in Fleckenstein U.S. Pat. No. 3,616,820, issued Nov. 2, 1971.

The principal purposes of the present invention are to provide improved and more economical mechanism fo effecting a drive between a continuously operating timing motor and a linkage which drives the operating piston of a water softener valve, to arrange such a mechanism so as to reduce the operating forces necessary to bring about engagement between a timing motor and the drive linkage for the valve, and to arrange such a drive system with mechanism which provides a predetermined and adjustable period of brine tank filling time in the softener system while effecting a positive shut-off of the brine tank line when either a brining or brine tank filling operation is not needed.

These and other purposes will appear from time to time in the course of the following specification when taken with the accompanying drawings in which:

FIG. 1 is a schematic view of a typical water softener system provided with the present invention;

FIG. 2 is a front view of the water softener control illustrated in FIG. 1;

FIG. 3 is a rear view of the control mechanism illustrated in FIGS. 1 and 2;

FIG. 4 is a view of the brine tank valve control illustrated in FIG. 3 while illustrating a different position of the operating parts;

FIG. 5 is a view of the control illustrated in FIG. 3 while illustrating a different operative position of the parts; and

FIG. 6 is a detail view of certain operating elements illustrated in FIG. 2.

Like elements are designated by like characters through-out the specification and drawings.

With particular reference to the drawings and in the first instance to FIG. 1, the numeral **10** generally designates a typical water softening tank having a control valve **11** fixed to the top thereof so as to selectively direct hard water through an inlet passage to the valve (not shown) and through an inlet space **12** in the valve for flow through an outlet **13** in the top of the water softener tank. Water then flows downwardly through the tank where it is softened and then upwardly through an outlet pipe **14**, which, in the service position illustrated in FIG. 1, communicates with an outlet space **15** in the valve.

The valve has an aspirator assembly **16** which is connected with a line through a shut-off valve **18** to a brine tank **19**. A control generally designated at **20** is fixed to the top of the valve and is adapted to drive the piston of the valve at selected time intervals through a slowly moving and uninterrupted reciprocating cycle. As the piston moves, the various passages of the valve are connected for control of regenerative operations such as backwashing, brining, slow rinsing, rapid rinsing, and brine tank filling, respectively, before the valve returns to the service position.

The valve illustrated in FIG. 1 is generally representative of that disclosed in Fleckenstein U.S. Pat. No. 3,616,820.

The control of the present invention utilizes an upstanding support plate **21** which is fixed to the top of the valve by a lateral flange **21***a*. The support plate **21** supports a time-of-day wheel **22**, a skip-day wheel **23**, a drive pinion **24** for the time-of-day wheel, an actuating element in the form of a pin **25** projecting outwardly from the time-of-day wheel **22**, and an actuating arm **26** which is pivotally mounted as at **27** on the upstanding support plate **21**, all as generally disclosed in the aforesaid U.S. Pat. No. 3,616,820. The skip-day wheel **23** includes a plurality of circumferentially spaced lugs **28** which are adapted to be engaged by the actuating element **25** once each day so as to shift the skip-day wheel **23** through an arc corresponding to the spacing between adjacent lugs. The movement may be 30° with the 12 lugs illustrated. The lugs **28** carry small bolts **29** which are adapted to engage actuating arm **26** and move it angularly in periodic fashion. As disclosed in said patent, a timing motor **30** is arranged to drive time-of-day wheel **22** through a full revolution each day so as to bring actuating element **25** into engagement with a lug **28** and shift actuating arm **26**. By removing a bolt **29** from its associated lug **28**, shifting of the skip-day wheel **23** in response to contact with the actuating element **25** will simply move the lug **28** adjacent to the actuating arm **26** past the arm without moving it.

Gear **24** may be mounted for axial shifting movement to disengage it from the gear teeth of time-of-day wheel **22** and thus allow "setting" of the time-of-day wheel for the correct time.

Timing motor **30** is fixed to a mounting lever **31** and includes a drive pinion **32**. Pinion **32** is part of a gear train for the motor shaft. The pinion is adapted for engagement with an intermediate gear **33** which is fixed for movement with the pinion **24** to drive the time-of-day wheel. The motor drive pinion **32** is also adapted to periodically drive a gear **34** to actuate the piston of the control valve. Gear **34** includes a hub **35** formed thereon which acts as a crank for a connecting rod or lever **36**. Lever **36** is connected to the piston rod **36***a* of the piston in the valve. Gear **34** includes a cut-away portion **37** in its periphery so that when this cut-away portion is opposed to pinion **32** no drive is effected between the pinion **32** and gear **34**.

The mounting plate or lever **31** for motor **30** is pivotally mounted as at **38** so that the mounting plate may swing about the axis of the gear **33**. Such swinging movement is limited as by means of a slot **39** in the mounting lever. A bolt or pin **40** is fixed to the plate **21** and rides in this slot **39** so as to limit swinging movement of the motor mounting plate in a counterclockwise direction as seen in FIG. 3 to approximately 5° to 15°. A spring **41** extends between the pin **40** and a flange **42** of the mounting plate so as to bias the motor mounting lever in a clockwise direction and toward the normal position illustrated in FIG. 3. This mounting arrangement allows the motor and its mounting plate to swing counterclockwise to the position illustrated in FIG. 5 wherein drive pinion **32** is still engaged with gear **33** but spaced from gap **37**. In this position, pinion **32** cannot engage gear **34** even if the gear **34** is rotated to move gap **37** away from the position illustrated in FIG. 3.

Motor mounting plate 31 includes an extension 43 presenting a cam surface 44 to camming pin 45 carried by an extension 46 of actuating arm 26. When actuating arm 26 is moved counterclockwise in FIG. 3, it then cams motor mounting plate counterclockwise as seen in FIG. 5

A pin 47 may be carried by plate 21 and ride in a slot 48 in the extended end of the motor mounting plate so as to provide stability for the same.

Connecting rod 36 is extended on both sides of its pivotal connecton 49 with the crank or hub 35. The extension on the side opposite to the connection with the piston rod 36*a* is connected with a spring 50. Spring 50 has one end fixed to the support plate 21 as at 51 so that the spring 50 exerts a biasing force on the connecting rod 36 in a clockwise direction as illustrated in FIG. 3.

Gear 34 carries an outwardly projecting latching pin 52 on the surface thereof. This latching pin, when the position of the elements is as illustrated in FIG. 3, is adapted to seat within a recess 53 in an upper edge of the mounting plate.

A knob 54 may be fixed to the connecting rod 36 so as to enable manual rotation of the parts for purposes of inspection or repair.

The shut-off valve 18 for the brine line 17 includes an actuating stem 55 for the valve closing element. Stem 55 is biased by a spring 56 towards an upper position wherein the valve is closed.

In order to periodically open this valve and afford communication between the brine tank line 17 and the aspirating passage from time to time, a gear 57 is mounted for rotation on plate 21 and is driven by gear 34 whenever the drive is effective between the pinion 32 and gear 34. Gear 57 carries a first cam 58 having an arcuate surface which is adapted to contact stem 55 and depress the same for a periodic time interval corresponding to the time interval when it is desired to pass brine from tank 19 to the softener tank 10 to regenerate same. The cam may include a stem actuating arcuate surface 59 of sufficient length to hold the brine line open for a period of time until all brine has been exhausted from the brine tank 19, after which the valve 11 causes hard water to flow to the softening tank to effect a slow rinsing of the same. The valve 18 is then closed. The valve 11 then causes hard water to flow upward in the softening tank to effect a rapid rinsing of the same. Since the valve 18 is then closed, there is no possibility of the rinsing water, which may carry some resin therein, passing to the brine tank.

Gear 57 carries a second valve actuating cam 60 which is pivotally mounted on the gear 57 on an axis, defined by a mounting screw 61. This axis is offset from the axis of gear 57, as defined by the mounting screw 62. The arcuate cam surface 63 of the cam 60 may be angularly adjusted about axis 61 to thus set a selected amount of time that the cam surface 63 will contact and depress stem 55. By adjusting the position of this cam surface about axis 61, the time of engagement with the valve stem 55 may be adjusted between a few minutes and around 30 to 40 minutes, depending upon the length of the cam surface.

Cam 60 is positioned on the gear 57 in spaced relation to cam 58 so that during rotation of gear 57, cam 58 will first engage stem 55 to open the brine valve 18 during the regeneration period. When the cam surface 59 passes over the stem, the valve 18 is again closed until gear 57 rotates sufficiently to bring cam surface 63 into engagement with the valve stem 55. Opening of the brine valve 18 at this period of time affords communication between the hard water inlet passage in the valve and the brine tank by means of the passage through the aspirator. This allows filling of the brine tank with makeup water. The period of time that the brine valve 18 is held open at this stage of the regenerative operation thus controls the amount of makeup water which is supplied to the brine tank 19. This, in turn, controls the amount of brine which eventually is available for regenerating the softening tank.

The operation of the timing and drive mechanism is as follows:

Timing motor 30 runs continously so that its drive pinion 32 continually rotates the time-of-day wheel 22 through the gears 24 and 33. During the time of day wherein the normal water softening operation takes place, valve drive gear 34 is disengaged from the drive pinion 32 of the motor by reason of the gap 37 of the drive gear being opposed to the drive pinion 32.

At predetermined time intervals, as, for example, once every 24 hours, the actuating element 25 on the time-of-day wheel 22 moves into a position where it contacts a lug 28 on the skip-day wheel 23. This engagement causes the skip-day wheel to move throug a partial revolution and in turn causes an element 29 on the skip-day wheel to contact actuating arm 26 and partially rotate it. Actuating arm 26 then cams motor mounting plate 31 counterclockwise as is seen in FIG. 3, and this moves the mounting plate away from the element 52 on the valve drive gear 34 so as to unlatch this element from the recess 53. Spring 50 then biases valve connecting rod 36 clockwise as seen in FIG. 3, and this produces a few degrees of movement of the valve driving gear 34 sufficient to move the gap of the valve drive gear away from the motor pinion 32. At this time the motor mounting plate is in the position of FIG. 5 until the element 29 on the skip-day wheel 23 passes over the end of arm 26. Spring 41 then returns the motor mounting plate to the position of FIG. 3. This brings about engagement between the motor pinion 32 and the teeth of the valve drive gear 34.

The timing motor then rotates valve drive gear 34 through the remainder of a complete revolution and this in turn shifts the valve piston through the various stages of movement required for the regenerative operations. The movement is continuous and uninterrupted even at the bottom dead center position of the hub 35 and connecting lever 36.

When the valve drive gear has rotated to a position wherein the gap 37 is again opposed to the drive pinion 32 of the motor, the motion is interrupted. At this point the valve connecting lever 36 is substantially at top dead center position. It is preferred that this point of stopping occur when the connecting rod is several degrees beyond the exact top dead center position to allow easier starting of the drive.

As the valve driving gear 34 and connecting lever 36 approach the top dead center position, latching pin 52 on the drive gear 34 drops into the latching recess 53. Pin 52 is held in firm contact with the lower edge of latching recess 53 by means of spring 50 acting through lever 36, hubs 35 and gear 34.

The spring bias for the motor mounting lever 31 allows the motor drive pinion 32 to move slightly in the event that gears in the drive pinion 32 and valve drive

gear 34 do not engage properly at the start of the operation (as by teeth of the gears exactly opposing one another). An additional small increment of movement of the pinion will then allow the teeth to engage smoothly.

Actuating arm 26 may be moved manually to shift motor mounting plate 31 and thus allow manual rotation of gear 34 through actuation of knob 54. This is desireable for purposes of inspection and/or repair.

Also, the valve operating mechanism as disclosed herein may be made manually starting as by dispensing with time-of-day wheel 22, skip-day wheel 23, and drive pinion 24. Regeneration of the softener system is then started through manual shifting of actuating arm 26. Upon release of the actuating arm 26, spring 41 then biases the motor mounting plate and pinion 32 to a position where the pinion 32 may engage the teeth of gear 34 and slowly rotate this gear through the remainder of a complete revolution until gap 37 is again opposed to pinion 32. This provides a full regeneration cycle. The drive is then stopped.

We claim:

1. A timing motor timing and actuating mechanism for water softener valves including a water softener valve having a movable control element for controlling various stages of normal softening operation and regeneration in a water softener system, a timing motor adapted to run continuously and a drive gear adapted to be operatively rotated thereby, means providing a driving connection between said drive gear and said control element for translating rotation of said gear into movement of said element, said drive gear having a gap in the periphery thereof, said gap being adapted to be moved into opposition to a drive pinion of said timing motor to prevent engagement between said pinion and said gear, said pinion being adapted to drive said drive gear when said gap is moved away from said pinion, resilient means interconnected with said drive gear so as to bias said drive gear away from a position wherein said gap is opposed to said pinion, latching means for holding said drive gear in a position wherein said gap is opposed to said drive pinion, and means for unlatching said latching means to allow said resilient means to move said connecting rod and gear to bring about engagement between said gear and said pinion and thereby commence movement of said control element.

2. The structureof claim 1 wherein said motor and drive pinion are mounted for swinging movement toward and away from said drive gear, and spring means bias said motor and pinion toward a position adjacent said drive gear.

3. The structure of claim 2 wherein said unlatching means includes means periodically operated by said timing motor.

4. The structure of claim 1 wherein said resilient means interconnected with said gear include a spring connected to a lever connected with a hub of said gear.

5. The structure of claim 1 wherein said motor and said pinion are mounted for swinging movement toward and away from said drive gear, and means bias said motor and pinion toward said drive gear, said latching means including an element carried by said drive gear and engageable with a recess in a motor mounting lever whereby swinging movement of said motor, pinion, and mounting lever disengages said element from said recess to allow rotation of said drive gear.

6. The structure of claim 1 wherein said motor and pinion are supported by a lever which is swingably mounted to allow movement of said motor and pinion toward and away from said drive gear, and means bias said motor and pinion toward said drive gear, said latching means including an element carried by said drive gear and engageable with said lever when said motor and pinion are positioned for a driving enegagement with said drive gear, said unlatching means including a movable actuating arm engageable with said lever and adapted upon movement thereof to cause swinging movement of said lever, motor and pinion away from said drive gear, said unlatching means further including mechanism driven by said timing motor for periodically moving said actuating arm.

7. The structure of claim 1 wherein said driving connection means includes a connecting rod connected to said control element and connected to said drive gear at a point eccentric to the axis of rotation of said drive gear, said resilient means including a spring connected to an extension of said connecting rod.

8. In a time controlled drive of the type using a motor driven drive pinion periodically and selectively engageable with a rotatable drive gear for operating apparatus and wherein said drive gear includes a gap in its periphery to interrupt the drive when said pinion is opposed to said gap, the improvement comprising means movably mounting said motor and drive pinion for swinging movement toward and away from a position adapted for selective engagement with said drive gear and disengagement with said drive gear nesting within said gap, means biasing said motor and pinion toward said position, resilient means for partially rotating said drive gear to thereby move said gap away from said nested position wherein said gap is opposed to said pinion, means for causing swinging movement of said motor and pinion away from said gap, and latching means for holding said motor and pinion in a position wherein said pinion is within said gap, said latching means being unlatched by said swinging movement causing means to thereby permit said resilient means to partially rotate said drive gear away said position and bring about engagement between said drive gear and said pinion.

9. The drive of claim 8 wherein said latching means is defined by an element carried by said drive gear and engageable in a recess in a lever movable with said motor.

10. The drive of claim 9 wherein said lever is fixed to said motor for movement therewith.

11. The drive of claim 10 wherein a mechanism periodically actuated by said motor actuates said means for causing swinging movement of said motor and pinion and engagement between said pinion and gear.

12. The system of claim 11 wherein said spring biases said motor and pinion toward a position wherein said pinion may engage said gear, with said gap circumferentially spaced from said nested position.

* * * * *