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G. L. BORELL

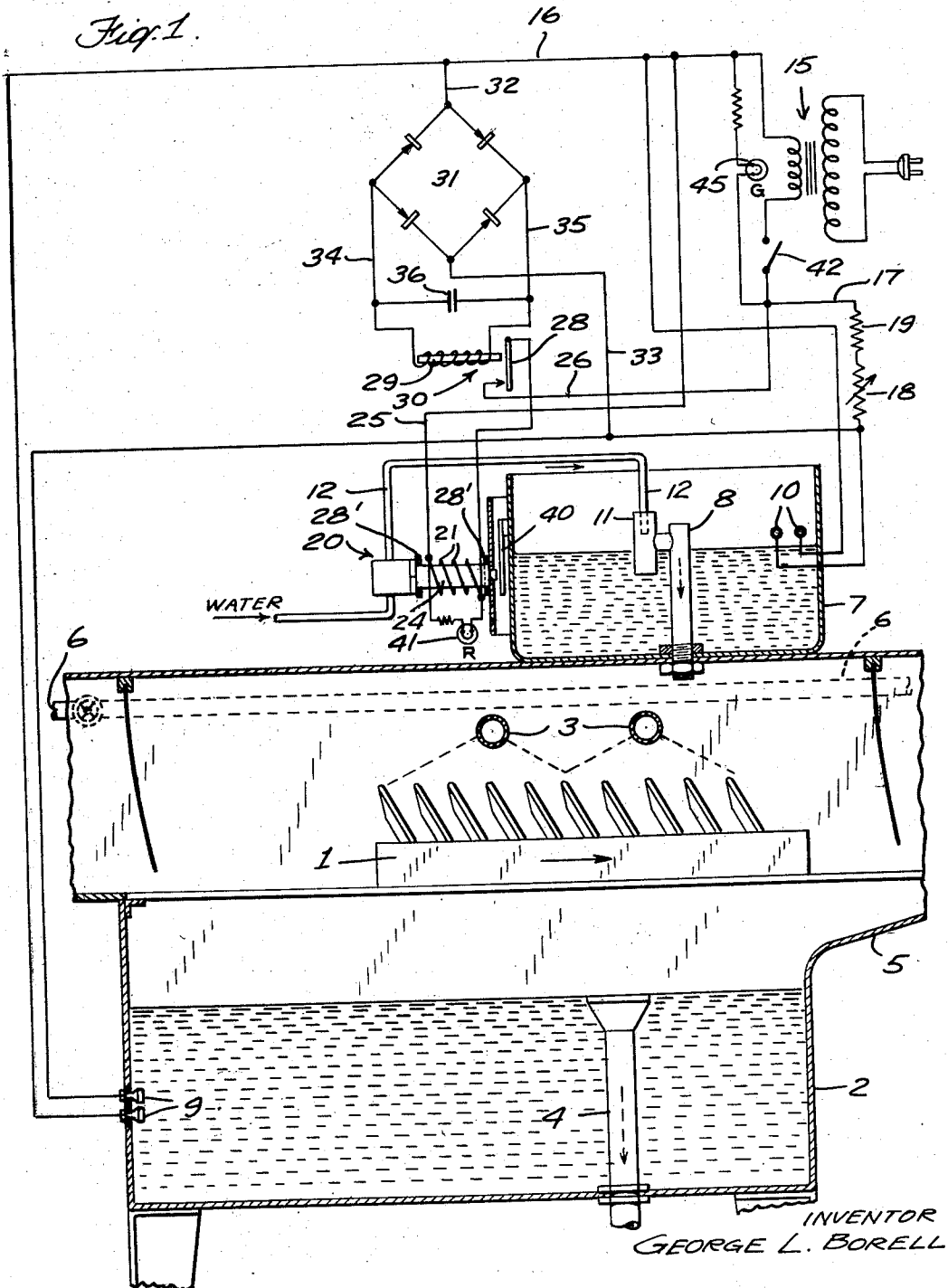
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AUTOMATIC DETERGENT FEEDING CONTROL

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2 Sheets-Sheet 1

Fig. 1.



BY Victor D. Borot  
ATTORNEY

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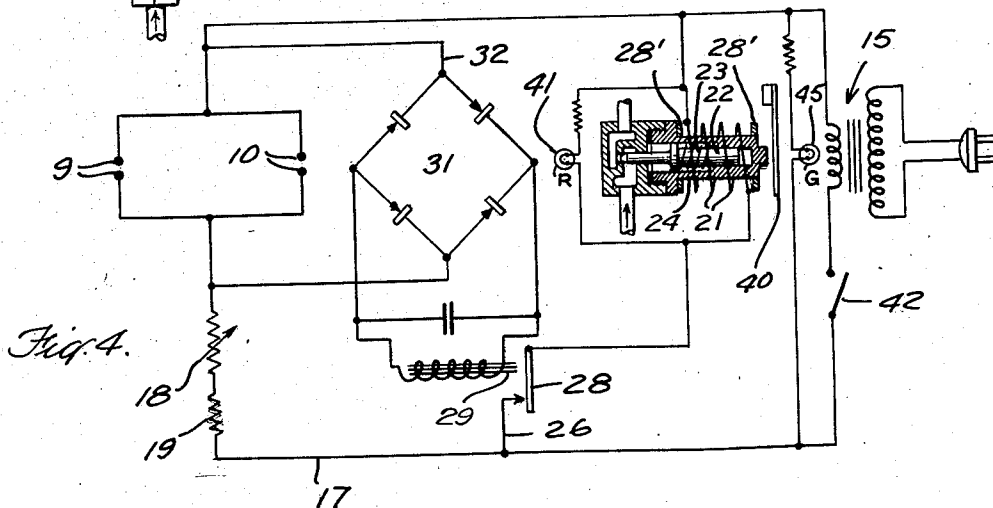
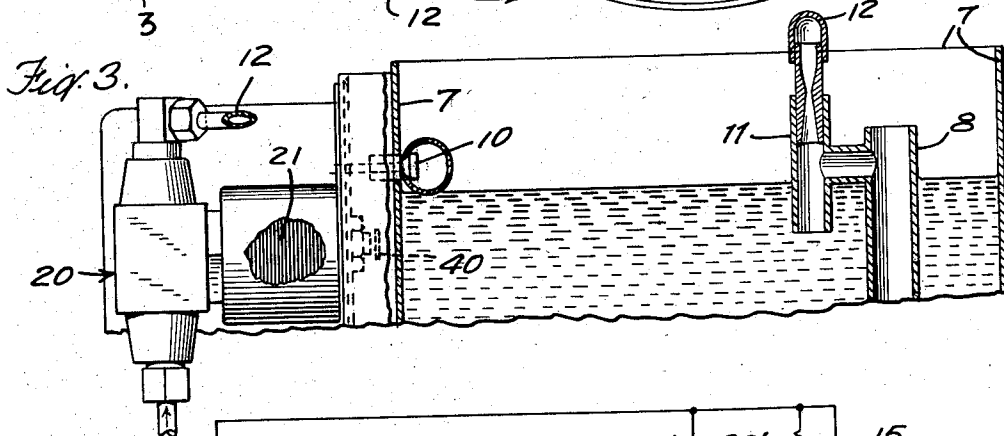
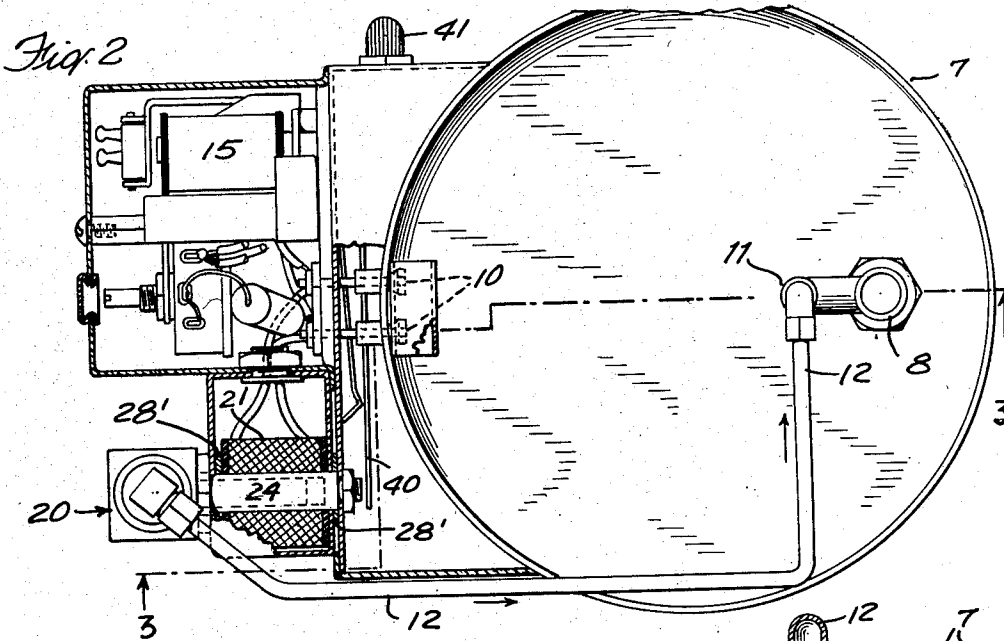
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## AUTOMATIC DETERGENT FEEDING CONTROL

George L. Borell, Glen Rock, N. J.

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8 Claims. (Cl. 137—93)

This invention relates to the art of automatically replenishing a constituent of a liquid which is progressively consumed as the liquid is employed in the performance of a process and the depletion of which beyond a certain point will impair the efficacy of the process. The invention has utility in many processes which involve the electrical conductivity of an electrolyte, such as plating by electrolysis, but it has been principally devised and commercially employed in dispensing detergent into the wash water of dish washing machines in response to signals denoting depletion of the detergent. The invention will therefore be described in connection with the dispensing of detergents to dish washing machines. Such automatic dispensing of detergents is particularly desirable for large dish washing machines such as are employed in restaurants, hotels, clubs and the like. Such machines commonly have dishes on trays moved progressively through wash sections and rinse sections, the wash operation being a continuous process. Hot water is pumped over the dishes in the rinse section and runs down onto a drain board and into the wash tank which contains soapy water and from which the soapy water is forcibly delivered upon the dishes in the wash section from above and below. There is an overflow pipe in the wash tank and due to the continual delivery of water from the rinse section the water becomes diluted. It is therefore necessary to add detergent from time to time.

Machines operating upon this principle are well known. The present invention aims to improve upon known machines and produce an automatic dispensing attachment which is simpler, more dependable, more economical in use and cheaper to produce and maintain than those heretofore used.

All automatic dispensers of this character must work upon the principle of employing a mechanism which will in some manner sense the depletion of the detergent in the wash water and send out a signal for replenishment, which signal will cause a fresh quantity of detergent to be delivered to the wash tank.

Obviously between the delivery of the fresh charge to the wash tank and the thorough distribution of the charge there is a lag which is reflected in the signal. Consequently there is apt to be an oversupply. To avoid this it is customary to anticipate the cut-off signal, as, for example, providing a time responsive drain upon the energizing current for a controlling relay. Such anticipation is of course empirical and is in no wise dictated by conditions. Furthermore as a rule it involves the use of electronic tubes or timers which are expensive and vulnerable in use.

The present invention works upon a different principle from previous dispensers in that it utilizes the conditions in the container from which the concentrated detergent solution is dispensed jointly with the conditions in the wash tank to control the replenishing action. In response to a signal from the wash tank a valve is opened and water is admitted to the dispensing container. This raises the level in the container and at a proper height which

determines the amount that is going to be dispensed, the valve is closed and the detergent solution in the amount admitted then runs out into the wash tank. If this is not enough the valve again opens and the operation is repeated until the condition of the wash water is corrected. There is no continuous running until the signal from the wash tank signifies sufficiency. Instead there is a succession of small quantities of detergent added until conditions are corrected. In this way overfeeding to any material extent is impossible.

Specifically there is provided at a selected height in the dispenser container a pair of sensing electrodes similar to those commonly used in the wash tank, and the two pairs are connected in parallel in a voltage divider network which operates the control relay. Hence both control the voltage to the relay winding to open and close the valve repeatedly until the signal voltage to the relay reaches a threshold valve which causes the control action to cease.

The electrodes in the container are also sensitive to the detergent concentration and if the detergent gives out through inadvertent failure of the operator to maintain a supply in the container, the container electrodes will be ineffective to close the valve. Under such condition the water will continue to run from the container into the wash tank and proper control cannot be maintained.

To avoid this undesirable event signal means, both audible and visual are provided to announce when the relay is energized and the valve is open. Ordinarily the signals are just momentary. If they become continuous the operator is thereby sufficiently warned that more detergent material to the container in order to restore the desired control is required.

A feature of the invention is the way such signals are produced. There are various other features of the invention which will appear from the following description of the embodiment illustrated in the drawings.

Fig. 1 is a sectional elevation of the wash section and wash tank and dispensing container of a dish washing machine embodying the invention, together with a diagram of the electrical control system;

Fig. 2 is a plan partially in section of the dispenser container and of the electrical parts carried thereby;

Fig. 3 is a fragmentary section of the container and associated parts on line 3—3 of Fig. 2; and

Fig. 4 is a diagram of the electrical system.

A tray of dishes 1 is shown in the wash section of a dish washing machine, on a conveyor which carries the tray to the rinse section on the right (not shown). Water is pumped from the wash tank 2 and delivered forcibly upon the dishes through the spray means 3. An overflow pipe 4 determines the level of the water in tank 2. A drain board 5 leads the water which is delivered to the rinse section by pipe 6 from the rinse section into tank 2, or, as often is the case, into another tank which overflows into the wash tank. In large machines there are more than one tank receiving the rinse water and progressively overflowing one into another and eventually into the wash tank. The rinse water is of course hotter than the wash water and assumes the proper temperature by the time it reaches the wash tank.

This constant addition of clean water to the wash tank dilutes the detergent concentration and periodically more detergent has to be added to the wash water. This is done automatically from a container 7 disposed above the wash tank and delivers through a discharge standpipe 8 into the wash tank.

To detect or sense the conditions both in the wash tank 2 and in the container 7, each has a pair of closely spaced electrodes which are adapted to contact the contents and will be conductively bridged by the liquid which will afford a resistance which will vary inversely with the alkaline or detergent content of the liquid.

The electrodes 9 in the tank 2 are suitably insulated and supported in the wall well below the top of overflow pipe 4 so as always to be immersed in the wash water. The electrodes 10 for the detergent container 7 are also suitably insulated and secured in the wall of the container in horizontal alinement at a height relative to the standpipe 8 which is important as will now be explained.

Whenever the conductivity of the wash water reaches a certain minimum degree, it causes a valve to open, as we shall see, to admit water to container 7. More solid detergent in the bottom of the container is dissolved and the level of the detergent solution rises in the container until it reaches the electrodes 10 whereupon the resistance across the electrodes is reduced and the water is shut off. This of course depends upon the detergent concentration in the container, and if the operator has allowed the detergent to become exhausted, the conductivity will not be sufficient to close the valve. In such case we shall see that a continuous signal is given.

The construction is such that the discharge from the container 7 does not begin until the inflow of water has ceased due to the closing of the valve. Then if the valve is not again immediately opened an amount of detergent solution exactly equal to the amount of water admitted will run out into the wash tank. Thus the effluence is limited to a definite amount which, as we shall see, is determined by the height of the electrodes 10.

In addition to the open top end of standpipe 8 it has a side opening a certain distance below the end in which is secured the leg of a T-shape tubular member 11 the head of which is disposed vertically. Both the head and leg are tubular and they communicate, the head being open at both ends. Therefore liquid in the container can rise in the head and escape through the leg into the standpipe. The water inlet pipe 12 has its nozzle entered into the top end of the head of the T-member 11 and the entering stream will therefore be confined by the head and directed past the entrance to the tubular leg and out the other end of the head. It is obvious therefore that if unopposed, the bottom of the leg will determine the level of the contents. If however a stream of sufficient force is directed through the head of the T-member it will impinge upon the surface of the liquid and force it down into the head below the bottom of the leg and even to the very bottom of the head. Meanwhile of course the level outside the head is rising and will continue to do so until the water is shut off, whereupon the liquid will again rise in the head and run out of the tubular leg and side orifice into the standpipe until the natural level is again reached. The top opening of the standpipe 8 provides a safety discharge whenever the solution level exceeds the height of the electrodes 10.

It is the electrodes 10 which determine when the water is shut off. As shown, they are located in a plane between the bottom of the leg and the top of the standpipe, and when the solution rises to that plane it conductively bridges the electrodes and the valve is closed. Then the effluence begins and thus its amount is determined.

The electrical circuit by which this joint control by the wash water and the detergent solution in the container is effected is diagrammatically shown in Fig. 4 and also in Fig. 1.

It is a low voltage system fed by a low voltage transformer 15, the output voltage being, for example, twenty one volts comparable to that of an ordinary domestic bell-current transformer. This of course makes for a safe and economical installation.

Wires 16 and 17 constitute the two sides of the supply line and electrodes 9 and 10 are connected in parallel across the line in series with resistances 18 and 19 which determine the distribution of the voltage drop in the connection across the line including the electrodes. The resistance 18 is variable and will be adjusted so that the drop across the measuring electrodes when the detergent need of the wash water is satisfied will be slightly less

than that required to energize the controlling relay to open the valve. Hence under that condition no water is being admitted into container 7.

The water pipe 12 has in it a valve 20 which is controlled by a solenoid 21. The valve has a solenoid controlled plunger 22 which is withdrawn by the solenoid to open the valve against the tension of coil spring 23. The solenoid winding 21 surrounds a hollow core 24 which is closed at the end remote from the valve to form a seal and stop for the plunger to strike when the solenoid is energized. This is for the purpose of a signal, as will later be described.

The solenoid winding is connected across the wires 16 and 17 by wires 25 and 26, the latter including relay contact 28. Also shading coils 28' are provided to adapt the solenoid valve for A.-C. operation.

The control relay 30 includes the electro-magnet 29 and the contact 28. It is connected across the electrodes 9 and 10 through a full wave rectifier 31, wire 32 connecting the rectifier to one side of electrodes 9 and 10 and wire 33 connecting the rectifier to the other side of the electrodes. Wires 34 and 35 connect the output of the rectifier to the opposite ends of the coil of electro-magnet 29. A capacitor 36 is connected in shunt with the electro-magnet to smooth out the pulsating rectified voltage.

It will now be clear how the two pairs of sensing electrodes jointly control the energization of the relay 30 and hence the energization of the solenoid 21 and the opening and closing of the valve 20.

Let it be assumed that the detergent requirement of the wash water is satisfied. The voltage drop across electrodes 9 is comparatively low, the major portion of the drop between wires 16 and 17 being across the resistors 18 and 19. Under such condition electrodes 10 are above the level of the solution in container 7 and consequently have no shunting effect. When the wash solution is diluted, voltage drop between wires 32 and 33 becomes sufficient to activate the relay and close contact 28. Solenoid 21 is thereby energized, the plunger 22 is retracted and the valve 20 is opened and water starts to flow into the head of the T-member 11. The level in the container rises with no effluence into standpipe 8 until the solution bridges electrodes 10, whereupon the drop between the connections of wires 32 and 33 falls and the relay allows contact 28 to open by the usual spring action. Spring 23 moves the plunger 22 to valve closing position and the water is shut off. Thereupon there is an effluence from container 7 through the lateral orifice until the natural level at the bottom of the leg is again reached.

It will be seen, therefore, that in operation, there is a succession of "shots" of a small quantity of detergent delivered into the wash water until an alkaline condition is reached where the drop across electrodes 9 is no longer sufficient to energize the relay and open the valve. Where a succession of shots are required the drop across the electrodes 9 continues within the relay energizing range and as soon as the level in container 7 falls so as to uncover electrodes 10, the electrodes 9 immediately become effective to reopen the valve and start the water flowing again before the level in the container reaches its natural level. Therefore the successive "shots" will be less than the quantity represented by the difference between the natural level in container 7 and the level of electrodes 10. Not until electrodes 9 cease causing a signal for more detergent will the valve stay closed and the solution in container 7 run out until its natural level is reached.

As above stated and as is obvious, if the detergent concentration of the solution in the container 7 is too low, the bridging of the electrodes 10 will not reduce the drop sufficiently to open contact 28 and close valve 20. In that event the liquid level will rise until it flows into the top of standpipe 8 and the wash tank will be getting clear water instead of detergent. The operator should, of

course, be apprised of such untoward condition, and signals for that purpose are provided.

An audible signal is of the buzzer type and comprises a vibratory reed 40 which is within the influence of the alternating flux in core 24. Also the solenoid is designed to be noisy. For example, the tension of spring 23 may be so related to the attraction of the solenoid that the plunger will chatter, that is, it will strike against the bottom of the core at the maximum flux and be slightly withdrawn by the spring as the flux decays and reverses. The easiest method of accomplishing this is to reduce the shading effect of coils 28'.

In addition a red light 41 is connected in shunt with the solenoid through a suitable limiting resistance, thereby providing a visual signal.

The circuit is closed by switch 42 when it is desired to start the automatic dispensing action, which condition is also visually indicated by a lamp 45 connected across the line through a current limiting resistance.

As shown, the electrodes 10 are protected by a removable shield and suitable protecting means may also be provided for electrodes 9.

While the particular embodiment which has been above described and is shown in the drawings has proven satisfactory, the invention may be otherwise embodied without departing from its scope as defined in the following claims.

What is claimed is:

1. Means for controlling the delivery of a replenishing solution to a processing tank, said means comprising, in combination with a processing tank, a container for replenishing solution, an inlet pipe for the container, a control valve for the pipe, a solenoid in control of the valve, an electric supply line, means including a relay winding for connecting the solenoid across the supply line, a set of sensing electrodes adapted to contact the solution in the container, a second set of sensing electrodes adapted to contact the solution in the processing tank, and means controlled jointly by the two sets of electrodes for delivering voltage from the supply line to the relay winding.

2. Means for controlling the delivery of a replenishing solution to a processing tank, said means comprising, in combination with a processing tank, a container for replenishing solution, an inlet pipe for the container, a control valve for the pipe, a solenoid in control of the valve, an electric supply line, means including a relay winding for connecting the solenoid across the supply line, a set of sensing electrodes in the side wall of the container, and a second set of sensing electrodes adapted to contact the solution in the processing tank, a resistor, the two sets of electrodes being connected in parallel and in series with said resistor across the supply line to form a voltage divider network and the relay winding being connected into said network.

3. Means for controlling the delivery of a replenishing solution to a processing tank, said means comprising in combination with a processing tank, a container for replenishing solution, an inlet pipe for the container, a control valve for the pipe, a solenoid in control of the valve, an electric supply line, means including a relay winding for connecting the solenoid across the supply line, means responsive to the height of the solution in the container for modifying the voltage delivered from the supply line

to the relay winding, and separate means responsive to the concentration of a solution in the processing tank for delivering voltage from the supply line to the relay winding.

4. Means for controlling the delivery of a replenishing solution to a processing tank as defined in claim 3 in which the said separate means comprise a set of sensing electrodes adapted to be disposed in the processing tank being connected to the supply line in shunt with the relay winding.

5. Means for controlling the delivery of a replenishing solution to a processing tank as defined in claim 4 in which the electric energy in the supply line is alternating current, together with a full wave rectifier in the shunt connection of the relay winding arranged to deliver direct current to the relay winding.

6. Means for controlling the delivery of a replenishing solution to a processing tank, said means comprising, in combination with a processing tank, a container for replenishing solution, an inlet pipe for the container, a control valve for the pipe, a solenoid in control of the valve, an electric supply line, means including a relay winding for connecting the solenoid across the supply line, means including a set of sensing electrodes in the container connected to the supply line in shunt with the relay winding for modifying the voltage delivered from the supply line to the relay winding, and a second set of sensing electrodes disposed in the processing tank and connected to the supply line in shunt with the relay winding.

7. Means for controlling the delivery of a replenishing solution to a processing tank as defined in claim 6 in which the two sets of electrodes are connected in parallel, together with a voltage distributing resistance in series with the pairs of electrodes in their connection across the line.

8. Means for controlling the delivery of a replenishing solution to a processing tank comprising, in combination with a processing tank, a container for replenishing solution, a standpipe in the container discharging into the processing tank and having a lateral orifice, an inlet pipe for the container directed across said lateral orifice adjacent thereto, a central valve for the pipe, a solenoid in control of the valve, an electric supply line, means including a relay winding for connecting the solenoid across the supply line, means including a pair of sensing electrodes in the container disposed above the bottom of said lateral orifice and connected to the supply line in shunt with the relay winding for modifying the voltage delivered from the supply line to the relay winding, and a second set of sensing electrodes disposed in the processing tank and connected to the supply line in shunt with the relay winding.

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

|           |                |               |
|-----------|----------------|---------------|
| 1,953,491 | Sainte-Martine | Apr. 3, 1934  |
| 1,981,530 | Thomas         | Nov. 20, 1934 |
| 2,377,363 | Noble et al.   | June 5, 1945  |
| 2,483,450 | Wolfner II     | Oct. 4, 1949  |
| 2,490,634 | Keene          | Dec. 6, 1949  |
| 2,498,232 | Andrews        | Feb. 11, 1950 |
| 2,576,253 | Farrell et al. | Nov. 27, 1951 |
| 2,621,673 | Hodgens Jr.    | Dec. 16, 1952 |