

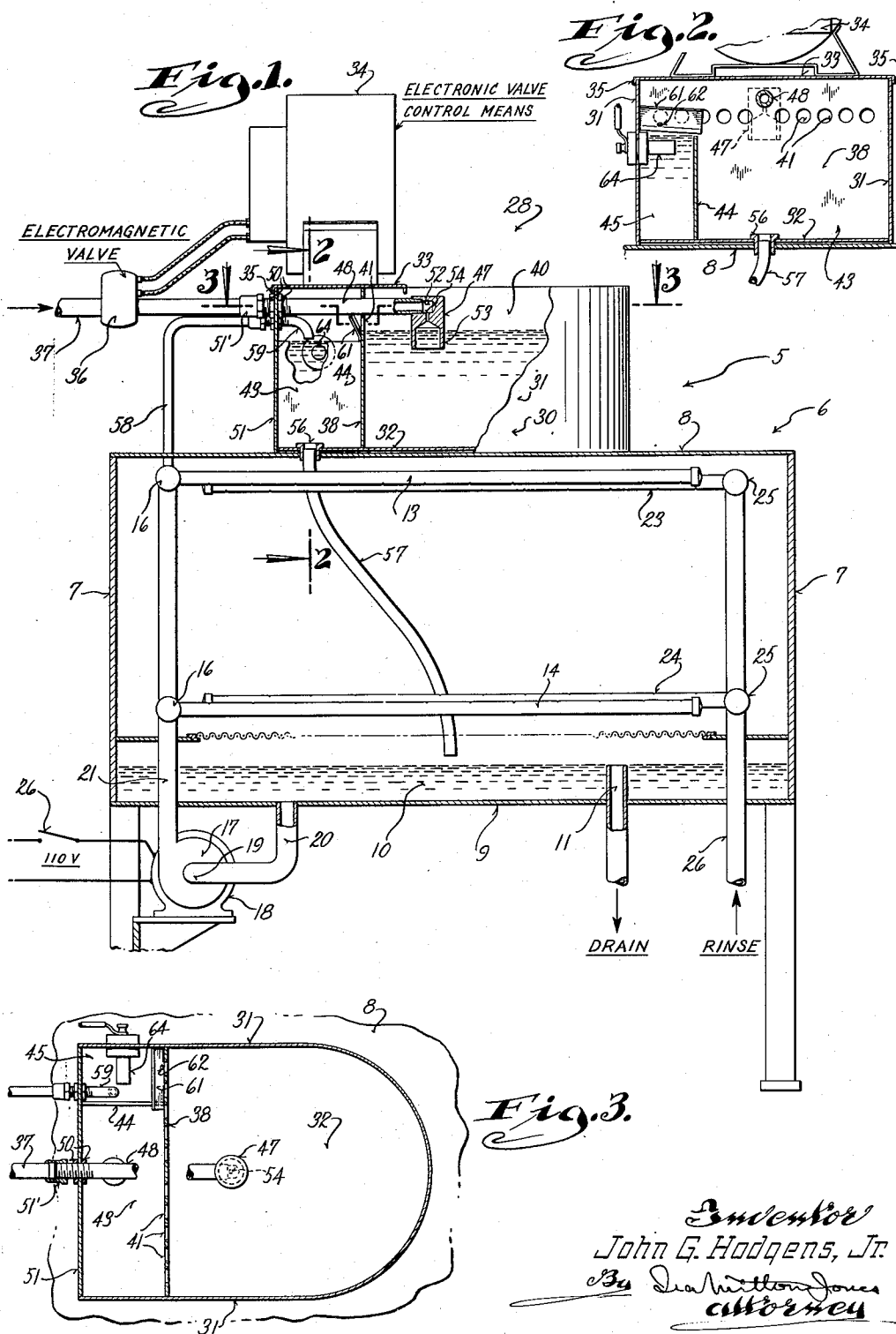
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UNITARY SOLUTION CONTROL APPARATUS

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UNITARY SOLUTION CONTROL APPARATUS

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1

This invention relates to the control of solutions such as are used in apparatus for washing or treating various articles; and is a continuation of my copending application entitled Electronic Solution Control Apparatus, Serial No. 32,640, filed June 12, 1948, now Patent No. 2,621,673. Like the aforesaid copending application this invention also has as its primary object the maintenance of a body of solution at a predetermined concentration.

The washing and/or treating solutions here in question are generally of the type employed in dishwashing machines or in apparatus for cleaning bottles, cans, and other receptacles. Such solutions may be either alkaline or acid in nature, and it is inevitable through continued use that their concentrations change, necessitating frequent addition thereto of a regenerating medium to maintain them at a predetermined concentration most effective for the washing or cleaning operations being performed. When either an alkaline or acid solution becomes weaker during use, a concentrated regenerating medium must be added thereto to strengthen the solution and restore it to the desired concentration; while water or a suitable diluent must be added to either an alkaline or acid solution which becomes stronger during use to weaken and restore it to the desired concentration.

In dishwashing machines, for instance, the alkaline washing solution loses effectiveness by continued use and the addition of fresh rinse water to the supply of solution contained in the machine. Also, by way of example, some acid solutions may tend to become stronger than desired after being in use for some time, and the regeneration of such acid solutions is effected by the addition thereto of water or some other diluent to effect lowering of the concentration to the desired value. Electronic control apparatus for governing the concentration of either alkaline or acid solutions are shown and described in my copending application, Serial No. 591,489, filed May 2, 1945, now abandoned.

As brought out at length in the aforesaid copending applications, the addition of a regenerating medium to the supply of solution is preferably effected automatically. This is accomplished electronically by controls rendered operative at the dictation of electrode means contacted by the solution to effect transfer of regenerating medium from a supply thereof to the reservoir in which the solution is maintained, solely in accordance with the electrical resistance of the solution.

2

The control apparatus of my aforesaid copending application, now Patent No. 2,621,673, was made as a unit capable of being used with any washing or cleaning apparatus for the control of the solution used therein, and embodied a test cell through which the solution was circulated to have the resistance thereof detected. In the case of a dishwashing machine, circulation of washing solution through the test cell is readily accomplished using the same pump employed to spray the solution upon the dishes being washed.

While the provision of a unitary control apparatus had many advantages, it also had one disadvantage which resulted from the fact that the test cell usually was located a distance from the supply of solution being controlled. Hence it was inevitable that the concentration of the solution in the test cell would not be the same as that of the supply of solution at any one instant during regeneration of the supply. In other words, during regeneration, there was a lapse of time before the regenerating medium became dispersed throughout the supply of solution and the effects of thus adding regenerating medium to the supply of solution could be manifested in the test cell.

This lag or lapse of time usually resulted in the transfer of more than the desired amount of regenerating medium to the supply of solution, causing a waste of detergents in the case of dishwashing apparatus; and gave the effect of insufficient sensitivity on the part of the electronic control instrumentalities.

However, a more serious objection was encountered whenever the washing machine was turned off by the operator, at which time the circulation of washing solution through the test cell of the electronic control ceased. If the controls were in a feeding cycle at this time, that is, effecting transfer of concentrated washing liquor to the supply of washing solution, there was nothing to stop the addition of the regenerating liquor to the supply of solution in the absence of circulation of the strengthening solution through the test cell. Obviously, automatic control of the transfer of regenerating liquid to the supply of solution is lost under the conditions outlined.

Accordingly, it is one of the objects of this invention to provide an electronic solution control apparatus which will have control over the concentration of the supply of solution at all times; and in which the time lag inherent in past controls is eliminated.

More specifically this invention has as one of

its objects to provide an improved method of controlling the concentration of a solution, wherein, during regeneration, regenerating medium from a source thereof is introduced in small amounts into the test cell simultaneously with transfer of regenerating liquid to the supply of solution being controlled. When regenerating liquid is introduced simultaneously into the test cell and the supply of solution substantially in proportion to their respective volumes, the time lag hereinbefore referred to may be entirely eliminated; and the test cell will be able, more or less, to anticipate changes in concentration of the supply of solution during regeneration even though circulation of solution through the cell should cease.

Hence, the control of regeneration by the electronic solution control apparatus is not dependent upon the functioning of the washing machine, or other device with which the control apparatus may be used. The feeding of regenerating medium always will be interrupted whenever the small quantity of regenerating medium introduced into the test cell has restored the solution therein to the desired concentration.

While the regenerating medium may be fed simultaneously to the test cell and the reservoir containing the supply of solution in proportion to their respective volumes, a slight excess of the regenerating medium preferably is fed into the test cell to cause it to interrupt regeneration prematurely and temporarily, that is, well before the supply of solution has been completely regenerated, and for a period of time corresponding to the afore-mentioned time lag in the circulatory system for the cell. During this interruption, the regenerating liquid charged into the reservoir has a chance to mix with the solution being controlled and to disperse itself therein; and regeneration will be resumed after a brief interval in consequence to the replacement of the stronger solution in the test cell by weaker solution from the supply. In this manner, regeneration may be interrupted several times before the concentration of the supply of solution has been fully restored, so that a complete regenerating cycle may comprise a number of short feed cycles rather than one long feed cycle which is apt to result in overfeeding.

In solution control apparatus of the type in question, and especially for use with dishwashing machines and the like, it is customary to provide the apparatus with a regenerating vessel in which dry or powdered washing materials are deposited. It is necessary to dissolve these chemicals by the addition of water to the regenerating vessel. This forms a concentrated regenerating liquid in the vessel which overflows the same and is transferred to the supply of washing solution in the machine whenever water is introduced into the regenerating vessel. These dry or powdered washing materials have a tendency to form a hard cake in the regenerating vessel, and it has been necessary to subject the materials to a needle-like stream of water during regeneration to aid in cutting into and dissolving the caked material in the regenerating vessel.

During regeneration, however, the force of the needle-like stream of water introduced into the regenerating vessel frequently resulted in considerable splashing of the concentrated chemical solution over the apparatus and the machine upon which it was mounted, and both soon became unsightly. Also, such splashing involved

waste of washing materials, which, of course, was highly objectionable.

In addition, if the washing materials in the regenerating vessel contained high foaming ingredients, the needle-like stream of water introduced into the vessel resulted in such agitation as to cause the vessel to overflow with suds, thereby creating an extremely messy condition.

Accordingly, it is another object of this invention to provide a solution control apparatus of the character described in which splashing and foaming of materials in the regenerating vessel is minimized or largely eliminated.

More specifically this invention provides a novel agitator cup through which water is introduced into the regenerating vessel and by which splashing and foaming of liquid in the regenerating vessel is minimized. This cup has a small orifice in its underside to direct a needle-like stream of water downwardly into the regenerating vessel, and it is so fixed with respect to the vessel that the orifice is above the overflow level of regenerating liquid in the vessel to prevent clogging of the orifice, while an annular side wall on the cup concentric with the orifice protrudes below the overflow level into the regenerating liquid to eliminate splashing and foaming of the liquid.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described, and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawing illustrates one complete example of the physical embodiment of the invention constructed in accordance with the best mode so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a somewhat diagrammatic side elevational view of a dishwashing machine illustrating the application of the solution control apparatus of this invention thereto, part of the control apparatus being broken away and shown in section and the entire dishwashing machine being shown in cross section;

Figure 2 is a cross sectional view through the control apparatus taken along the plane of the line 2—2 of Figure 1; and

Figure 3 is a sectional view of the control apparatus taken along the plane of the line 3—3 of Figure 1.

Referring now more particularly to the accompanying drawing in which like numerals indicate like parts the solution control apparatus of this invention, generally designated 5, is shown as being mounted on the top of a dishwashing machine 6. Inasmuch as the control apparatus may be used to control a variety of different solutions, either alkaline or acid, the dishwashing machine shown is merely for purposes of illustration.

The washing machine 6 may be of conventional construction and has upright side walls 7, a top wall 8, and a bottom wall 9. At least one of the side walls is generally made movable to provide for loading and unloading of the washer. A supply of washing solution 10 is maintained in the bottom of the washer to a predetermined depth as determined by the height to which a drain 11 projects up from the bottom wall of the washer.

5

Dishes loaded into the machine for washing are adapted to have washing solution forcefully sprayed thereon by means of horizontal spray pipes 13 and 14 near the top and bottom of the washer, respectively. The pipes 13 have a series of small diameter apertures in their undersides to spray water downwardly on the dishes, and the pipes 14 have similar apertures in their top sides to spray water upwardly onto the dishes. The spray pipes 13 and 14 connect with headers 16 into which the washing solution is conducted by means of a pump 17 driven by an electric motor 18. The inlet 19 of the pump, of course, is communicated with the reservoir provided by the bottom of the washing tank through an inlet pipe 20 and the outlet of the pump connects with the headers 16 through a pipe 21.

A second set of upper and lower spray pipes 23 and 24 respectively may be provided for rinsing the washed dishes and these pipes are preferably interleaved between the pipes 13 and 14 and supplied with fresh water through headers 25 connecting with a fresh water supply line 26.

After a batch of dishes has been washed in the machine, the pump 17 is stopped by opening the motor switch 26 and fresh rinse water is fed into the rinsing pipes 23 and 24 under the control of a valve, not shown, so as to rinse the washing solution from the dishes.

The rinse water used at the end of each washing operation falls into the reservoir at the bottom of the washing tank and mixes with the supply of solution 10 causing dilution thereof. If this diluted washing solution is pumped into the spray pipes 13 and 14 in a subsequent washing cycle without having been regenerated by the addition of suitable detergents in concentrated form thereto, it will be apparent that the washing solution will have insufficient cleansing action to satisfactorily complete the next washing cycle. Hence, concentrated washing material, preferably in liquid form, must be added to the supply of solution 10 from time to time to bring the solution back to the proper concentration or degree of effectiveness. The regenerating device 28 of this invention performs this function automatically.

The regenerating device 28 is a unit separate from the washing machine and may be mounted directly upon the top wall 9 of the washer as illustrated. It comprises a tank 30 having up-right side walls 31, a bottom wall 32, and a detachable cover 33 which not only serves to cover a portion of the tank at one end thereof but which also has the electronic control device 34 mounted thereon. Screws 35 detachably hold the cover in place on the front end of the tank 30.

The electronic control device 34 contains an electrical system such as that shown and described in my afore-mentioned Patent No. 2,621,673 or copending application, Serial No. 591,489, now abandoned and is adapted to control the energization and de-energization of an electromagnetic valve 36 in a water supply line 37 to effect initiation and termination of regeneration, respectively, of the supply of solution 10.

The tank 30 is provided with a partition wall 38 which extends entirely across the forward covered end of the tank to define a regenerating vessel 40 in the uncovered rear portion of the tank. While the partition wall 38 extends upwardly to the underside of the cover, it has a series of apertures 41 therein spaced from one another and centered along a horizontal line located at an elevation above the bottom of the

6

tank corresponding to approximately three-quarters the depth of the tank. Hence, upon the addition of water to the regenerating vessel 40 it will be apparent that the liquid level in the regenerating vessel will be maintained at a predetermined depth corresponding to the location of the apertures 41 in the partition wall 38, and that liquid in the regenerating vessel may be caused to overflow the partition wall and enter the forward portion of the tank.

The regenerating vessel is adapted to contain a concentrated regenerating medium in a dry or powdered state and regeneration of the washing solution 10 is adapted to be effected by forming a concentrated solution in the regenerating vessel and causing the concentrated liquor to overflow into a mixing chamber 43 under the covered portion of the tank at its front end. The mixing chamber 43 is formed partly by the partition wall 38 and by a second partition wall 44 extending rearwardly across the front portion of the tank and connecting with the partition wall 38 at substantially right angles thereto. Hence, the partition wall 44 cooperates with the wall 38 to also provide a test receptacle or cell 45, the chamber and cell both being adjacent to the front of the regenerating vessel 40 and having the wall 38 common thereto.

Water is introduced into the regenerating vessel to form a concentrated washing liquor therein by means of a novel agitator cup 47 carried on the inner end of a nipple 48 just rearwardly of and beneath the cover 33 of the tank. The nipple extends forwardly through a relatively close fitting aperture in the partition wall 38 across the space above the mixing chamber 43 to have its front end project through the front wall of the tank, to which it is fixed as by a pair of nuts 50 threaded onto the forward end of the nipple and clamping the upright front wall 51 of the tank therebetween. A coupling element 51' may be employed to connect the water supply line 37 with the forward threaded end of the nipple so as to enable water to be introduced into the regenerating vessel through the nozzle or agitator cup whenever the electromagnetic valve 36 is opened.

The nozzle or agitator cup 47 of this invention has an inlet 52 into which the inner end of the nipple 48 is threaded, and is provided with a downwardly extending annular skirt 53 formed as part of the body of the cup. The lower end portion of the skirt projects downwardly sufficiently far as to be immersed in the regenerating liquid in the vessel 40. A relatively small orifice 54 connecting with the inlet 52 opens into the upper portion of the skirt 53, centrally thereof, and is adapted to direct a needle-like spray of water downwardly through the skirt and into the regenerating vessel to dissolve the dry regenerating materials therein. The force of the stream of water injected into the vessel also tends to break up caked material therein and facilitate the formation of a concentrated regenerating liquor in the vessel.

The particular construction and placement of agitator cup or nozzle 47 results in substantial improvement in the operation of the solution control apparatus of this invention. One advantage is obtained by reason of the fact that the nozzle is mounted in such a position relative to the level of liquid in the regenerating vessel that the orifice 54 is maintained a slight distance above the liquid level and hence will not become clogged with dried alkaline washing materials. Another ad-

vantage is that the depending skirt 53, being immersed in the regenerating liquid, prevents splashing of the regenerating liquor onto the solution control apparatus and, in fact, over the washing machine itself, thereby obviating the need for frequent cleaning of the mechanisms.

Whenever the electromagnetic valve 36 is opened to cause water to be injected into the regenerating vessel through the nozzle 47, the concentrated washing liquor in the vessel overflows into the mixing chamber 43 through the apertures 41 in the wall 38. The concentrated washing liquor thus transferred to the mixing chamber discharges into the reservoir of the washing machine through a drain fitting 56 in the bottom of the mixing chamber. The drain fitting 56, of course, projects downwardly through an opening in the top wall 8 of the washing machine, and has a length of tubing 57 connected therewith to conduct the concentrated liquor and the overflow of solution from the test cell to one side of the washing zone and down to the supply of liquid in the reservoir of the machine. This prevents the concentrated washing liquor from falling onto the dishes or other articles being washed.

As stated, regeneration can take place only upon energization of the electromagnetic valve 36. This valve is controlled by the electronic control device 34 mounted on the cover 33 of the apparatus, and the electronic control device is rendered operative and inoperative in consequence to changes in the electrical resistance of the washing solution 10 brought about by changes in its concentration. Dilution of the washing solution by rinse water weakens the solution and increases its electrical resistance; while strengthening of the solution, as by the addition of a regenerating medium thereto, decreases its electrical resistance.

The electrical resistance of the washing solution 10 is detected in the test cell 45, which is adapted to hold a measured sample of the solution. For this purpose solution from the supply 10 is circulated through the test cell by means of the pump 17. A branch pipe 58 joined with the outlet of the pump 17 in any suitable manner, as by connection to one of the upper headers 16, connects with an anti-siphon spout 59 fixed to the front wall 51 of the tank 30 and directed downwardly toward the open top of the test cell to deliver solution thereto. Hence, the pump 17 will cause the test cell to be filled with washing solution from the supply 10 to a depth corresponding to the height of the partition 44 separating the cell from the mixing chamber 43, without danger of the solution in the cell being siphoned back into the pump whenever the same is shut off. Solution overflowing from the test cell, of course, enters the mixing chamber 43 for return to the reservoir of the washing machine by the tube 57. Hence, the circulation of solution through the test cell and the tube 57 in this manner has the effect of continuously washing the tube, preventing any build up therein of concentrated washing liquor as would be the case if the tube was used solely to conduct the regenerating liquid into the reservoir.

Referring to Figures 1 and 2, it will be noted that the partition wall 44 has a height such as to maintain the level of solution in the test cell slightly beneath the level of regenerating liquor in the vessel 40. Stated in another manner, the partition 44 does not extend upwardly quite as far as the level of the openings 41 in the partition

wall 38 so that the solution circulated through the test cell cannot run into the regenerating vessel 40 through the two openings 41 which lie directly above the open top of the test cell; while at the same time, these two openings are adapted to direct overflowing regenerating liquor toward the test cell.

It is one of the features of this invention to divert a small metered amount of regenerating liquor into the test cell whenever regeneration is taking place. For this purpose, a trough 61 is fixed to the cell side of the wall 38 to catch the regenerating liquid which flows through the apertures above the test cell and to direct such liquid into the mixing chamber 43. A small aperture 62 in the bottom of the trough, however, enables the desired small amount of the regenerating liquor to flow into the test cell to raise the concentration and consequently lower the resistance of the solution therein.

From the description thus far, it will be seen that, during regeneration, regenerating liquid is simultaneously fed into the test cell and the supply of solution in the washing machine. According to this invention, the amount of regenerating liquid diverted into the test cell through the aperture 62 during regeneration should bear a predetermined relationship to the amount of liquid fed into the mixing chamber for delivery to the reservoir of the washing machine. This, of course, is determined by the size of the aperture 62, and with a minimum amount diverted into the test cell, the amounts fed to the cell and the reservoir should be substantially proportional to the volumes of the cell and the solution in the reservoir, respectively. Such proportionate feeding of regenerating liquor into the cell and the mixing chamber causes the concentration of solution in the test cell and the supply 10 to increase substantially uniformly, but with the increase of concentration of solution in the cell leading slightly the corresponding increase of concentration in the supply of solution, by reason of the more direct transfer of regenerating medium into the test cell.

Preferably, however, the aperture 62 is made large enough as to cause a slight excess of regenerating liquor to be diverted into the test cell to effect strengthening of the solution therein well in advance of the corresponding increase in concentration of the solution in the reservoir of the washing machine, for a purpose to be described shortly.

The electrical resistance of the solution in the test cell is detected by electrode means 64 which, in fact, forms a part of the electronic control device 34. The electrode means may comprise a pair of electrodes or a single electrode as shown and explained at length in the aforesaid copending application, now Patent No. 2,621,673. In any event the electronic control device 34 functions at the dictation of the electrode means to cause opening of the electromagnetic valve 36 whenever the electrical resistance of the solution in the test cell indicates that the solution is weaker than desired; and causes closing of the valve 36 upon return of the solution to the desired concentration. Thus when the solution in the test cell is weaker than desired the electromagnetic valve is caused to open and effect initiation of regeneration of the solution by the transfer of regenerating medium from the vessel 40 to the supply of solution 10 in the washing device and to the test cell. Such feeding of regenerating medium simultaneously to the cell and the

supply 10 will continue until the electrical resistance of the solution circulating through the test cell and detected by the electrode means therein indicates that the solution in the cell has been restored to the desired concentration; and the electromagnetic valve 36 is then caused to close by means of the electronic control device 34 at the dictation of the electrode means.

If the regenerating medium is fed to the cell and the supply of solution in amounts proportional to their respective volumes, it is possible that complete regeneration may comprise a single comparatively long feed cycle. However, a slight excess of regenerating medium preferably is fed into the test cell, as stated hereinbefore, so as to deliberately cause regeneration to be interrupted prematurely by the electronic control means. This is done to establish a time interval during which the regenerating medium, already mixed with the overflow of solution from the test cell, can further admix with and become dispersed in the supply of solution. Obviously, regeneration is resumed as soon as weaker solution from the supply has replaced the stronger solution in the test cell, at the dictation of the electrode means in the cell.

In this manner, complete regeneration of the supply of solution may comprise several relatively short feed cycles, rather than one comparatively long feed cycle which might result in overfeeding of regenerating medium to the supply before regeneration is terminated by the electronic control device at the dictation of the electrode means in the test cell.

One of the advantages of simultaneously feeding regenerating liquid into the test cell and the supply of solution in the manner described is that it enables far more accurate control of the concentration of the solution than was hitherto possible. This desirable result is achieved by the elimination of any time lag which occurs when the concentration of the solution in the test cell is increased only by the addition of regenerating medium to the supply of solution.

Another highly important advantage which is gained by simultaneously feeding the regenerating medium into the test cell and the supply of solution according to the method described, is that the solution control apparatus is enabled to function properly even though the pump 17 may have been stopped during a regenerating cycle. With the pump shut off, it has been impossible in the past to terminate a previously started regenerating cycle, and regeneration could continue indefinitely until noticed by an operator of the machine, or until the pump had been restarted to again circulate solution from the supply to the test cell.

The provision of a mixing chamber 43 into which both the solution from the test cell and the regenerating medium overflows is also a highly important feature of the apparatus of this invention, but this feature is shown and claimed in my aforesaid copending Patent No. 2,621,673. It is sufficient to note that the premixing of regenerating medium with the overflow of solution from the test cell effects much more rapid dispersion of the regenerating medium throughout the body of solution in the reservoir of the machine, and hence has the effect of making the electronic controls more sensitive and accurate.

From the foregoing description taken together with the accompanying drawing it will be readily

apparent to those skilled in the art that this invention provides a solution control apparatus which will operate in an improved manner to effect highly accurate control of the concentration of a solution while positively precluding "run away" regeneration of the solution being controlled. It will also be apparent that the provision of the nozzle or agitator cup of this invention eliminates the objectionable splashing of regenerating medium over the apparatus which was hitherto experienced, along with the clogging of the small orifice of the nozzle.

What I claim as my invention is:

1. Unitary solution control apparatus of the character described, comprising: a tank having a bottom wall and upright side walls; means defining a mixing compartment in one portion of the tank having an outlet in a lower portion thereof connectable with a supply of solution which requires regeneration from time to time; means in the tank defining a testing receptacle adjacent to said mixing compartment and adapted to receive solution from the supply thereof; an overflow connection between the testing receptacle and the mixing compartment whereby solution delivered to the testing receptacle fills the same to a predetermined level and overflows into the mixing compartment for return to the solution supply; means defining a regenerating vessel in said tank adjacent to the testing receptacle and the mixing compartment adapted to contain a regenerating liquid; means providing an overflow connection between said vessel and the mixing compartment at a higher level than that of the solution in the testing receptacle whereby liquid delivered to the regenerating vessel fills the same to said higher level and overflows into the mixing compartment; and a trough on the tank below the level of the overflow connection between the vessel and the mixing compartment and outside the vessel to receive the overflow from said vessel, a portion of said trough being above the testing receptacle and having a hole therein for diverting into the testing receptacle a relatively small proportion of the liquid which overflows from the regenerating vessel.

2. Unitary solution control apparatus of the character described, comprising: a tank having a bottom wall and upright side walls; means defining a mixing compartment in one portion of the tank, said mixing compartment having an outlet in a lower portion thereof from which solution may flow to a supply thereof which requires regeneration from time to time; means in the tank defining a testing receptacle adjacent to said mixing compartment and through which solution from the supply thereof may be circulated past electrical detecting means therein which govern the operation of electrical control instrumentalities; an overflow connection between the testing receptacle and the mixing compartment whereby solution delivered to the testing receptacle fills the same to a predetermined level and overflows into the mixing compartment for return to the solution supply; means defining a regenerating vessel in said tank adapted to contain a regenerating liquid; means providing an overflow connection between the regenerating vessel and the mixing compartment at a higher level than that of the solution in the testing receptacle whereby liquid delivered to the regenerating vessel fills the same to said higher level and overflows into the mixing compartment; means on the tank for diverting into the testing

receptacle a relatively small proportion of the regenerating liquid which overflows from the regenerating vessel at the dictation of said electrode means.

3. Unitary solution control apparatus of the character described, comprising: a tank having a bottom wall and upright side walls; means defining a mixing compartment in one portion of the tank having an outlet in a lower portion thereof connectable with a supply of solution which requires regeneration from time to time; means in the tank defining a testing receptacle adjacent to said mixing compartment and adapted to receive solution from the supply thereof; an overflow connection between the testing receptacle and the mixing compartment whereby solution delivered to the testing receptacle fills the same to a predetermined level and overflows into the mixing compartment for return to the solution supply; means defining a regenerating vessel in said tank adjacent to the mixing compartment and into which water is adapted to be introduced to form regenerating liquid; means providing an overflow connection between said vessel and the mixing compartment at a higher level than that maintained in the testing receptacle whereby liquid introduced into the regenerating vessel fills the same to said higher level and overflows into the mixing compartment for addition to the supply of solution; a substantially cup-shaped nozzle through which water is adapted to be introduced into the regenerating vessel; and means mounting said nozzle on the tank over the regenerating vessel and in an inverted position with its open end facing downwardly and extending into the regenerating vessel a distance beneath the level of liquid which is maintained by said overflow connection between the regenerating vessel and the mixing compartment.

4. In an automatic solution control apparatus of the type comprising a test cell through which solution from a supply thereof spaced from the test cell may be constantly circulated, detecting means in said test cell responsive to a characteristic of the solution that varies with its concentration, and a regeneration vessel from which concentrated medium is transferred to the supply of solution at the dictate of the detecting means in the test cell, means for accurately regulating the transfer of concentrated regenerating medium to the supply of solution, said means comprising: means for diverting into the test cell a portion of the regenerating medium leaving the regenerating vessel during regeneration so that concentrated regenerating medium will be fed to the test cell to raise the concentration of solution in the test cell to the desired value at least as soon as said value is reached in the supply thereof, and regeneration will be stopped even before the fully regenerated solution from the supply thereof reaches the test cell.

5. In an automatic solution control apparatus of the type wherein solution from a supply thereof, the concentration of which is to be maintained at a predetermined value, is constantly circulated past detecting means responsive to a characteristic of the solution which varies with its concentration, and concentrated regenerating medium is added to the solution at the dictation of said detecting means to maintain the solution at said value of concentration: means defining a regenerating vessel for holding a supply of concentrated regenerated medium, said vessel having outlet means through which such medium leaves the

vessel to be fed to the supply of solution; means defining a test cell adjacent to the regenerating vessel, in which the detecting means is located and through which solution from the supply thereof may be constantly circulated for detection of said characteristic thereof, said test cell being adapted to be located at a distance from the supply of solution so that some delay might occur between the time when regenerating medium leaves the regeneration vessel and the detection of the consequent increase in solution concentration at the test cell; and means defining a restricted communication between the outlet means of the regeneration vessel and the test cell for diverting a small portion of concentrated regenerating medium flowing out of the regenerating vessel during regeneration to the test cell, so that the concentration of the solution in the test cell at any instant is substantially equal to that which will obtain at the supply of solution when the medium leaving the regenerating vessel at that instant is mixed with the supply.

6. An automatic solution control apparatus of the type in which solution from a supply thereof is circulated past detecting means responsive to a characteristic of the solution which varies with its concentration and concentrated regenerating medium is added to the solution at the dictation of said detecting means to maintain the solution at a predetermined concentration, said apparatus comprising: a tank; an upright partition wall in said tank defining a regenerating vessel occupying a portion of said tank at one side of said wall and in which concentrated regenerating medium may be stored and out of which it is caused to overflow across said wall a substantial distance above the bottom of the tank at the dictation of the detecting means; a second upright partition wall in said tank at the other side of and lower than and intersecting said first designated wall and cooperating therewith to define a mixing compartment having an outlet at its bottom and a test cell having the detecting means therein and having an inlet through which solution from the supply thereof may be constantly introduced for circulation past said detecting means and an overflow outlet into the mixing compartment across said second wall at a level below the outlet from said regenerating vessel; said first designated wall being common to the test cell, the mixing compartment and the regenerating vessel; and a troughlike duct adjacent to said first designated wall at said other side thereof and below the level of said outlet thereacross and extending across said second wall to receive concentrated medium flowing out of the regeneration compartment and conduct it to the mixing compartment, said duct having a restricted outlet in its bottom above the test cell to divert into the test cell a small proportion of the medium leaving the regenerating vessel so that if circulation through the test cell is interrupted such flow of regenerating medium will not continue beyond a point corresponding to a predetermined solution concentration.

7. An automatic solution control apparatus of the type in which solution from a supply thereof is circulated past detecting means responsive to a characteristic of the solution which varies with its concentration and concentrated regenerating medium is added to the solution at the dictation of said detecting means to maintain the solution at a predetermined concentration, said apparatus comprising: a tank; a first partition in said tank defining a regenerating vessel on one side of the

partition for holding a supply of concentrated regenerating medium and a premixing chamber on the other side of the partition, said regenerating vessel having an overflow outlet across said partition, into said premixing chamber, at a level spaced above the bottom of the regenerating vessel so that during feeding of concentrated regenerating medium at the dictation of the detection means such regenerating medium debouches from the regenerating vessel into the premixing chamber, said premixing vessel having an outlet at its bottom connectable with the supply of solution; a second partition in said tank defining a test cell on one side thereof, said premixing chamber being on the other side of said second partition, said test cell having the detecting means therein and having an inlet connectable with a source of solution being constantly circulated from the supply thereof and an overflow outlet into said premixing chamber across said second partition at a level below the outlet of the regenerating vessel so that solution circulated through the test cell past said detecting means will combine in the premixing chamber with concentrated regenerating medium being added to the supply to premix the same; and a duct below the outlet of the regenerating vessel and into which the same debouches, said duct having a restricted outlet into the test cell for diverting a portion of the concentrated regenerating medium leaving the regenerating vessel into the test cell to increase the concentration of the solution therein above that which would normally obtain, so that in the event of interruption of circulation of solution through the test cell regeneration will be halted before the solution at the supply becomes excessively concentrated.

8. Solution control apparatus of the character described, comprising: means defining a collecting chamber having an outlet through which solution may return to a supply thereof which requires regeneration from time to time; means defining a solution testing receptacle alongside the collecting chamber and through which solution from the supply thereof may be constantly circulated past electrode means for detecting the electrical resistance of solution in the receptacle; means communicating said collecting chamber with the testing receptacle at a level spaced a distance above the bottom of the receptacle so that solution delivered to the receptacle will fill the same to said level and will overflow into the collecting chamber for return to the supply of solution; a regenerating vessel alongside the collecting chamber; means communicating said vessel with the collecting chamber at an elevation spaced a distance above the level at which solution is adapted to be maintained in the testing receptacle so that liquid delivered to the regenerating vessel will maintain the same filled and will overflow into the collecting chamber; and means for diverting a relatively small proportion of the overflow of regenerating liquid from the regenerating vessel into the testing receptacle.

9. In apparatus of the character described: a regenerating vessel having bottom and upright side walls; outlet means for said regenerating vessel spaced a distance above the bottom wall thereof and by which a predetermined level of liquid may be maintained in the vessel; means for introducing water into the vessel to dissolve solid regenerating materials therein to thereby form a

concentrated liquid for use as a regenerating medium, said means comprising an inverted cup-like nozzle having a body portion provided with an inlet connectable with a water supply line and having a small orifice connecting with said inlet and opening through the underside of the nozzle body at the center thereof to provide a discharge port through which water may be forcefully discharged downwardly in the form of a fine needle-like jet, and an imperforate tubular skirt on the nozzle having its upper portion closed by the nozzle body and its open lower portion projecting a distance below the body substantially concentric with said discharge port thereof; and means mounting said nozzle in fixed relation to the regenerating vessel with the open end of the skirt thereof projecting downwardly into the vessel a distance beneath said outlet means and with the discharge orifice so located with respect to the outlet means that the discharge orifice will be maintained a distance above the level of liquid in the vessel to minimize clogging thereof by said liquid while the lower portion of the skirt will be immersed in the liquid contained in the vessel to largely preclude splashing of the liquid by the force of the jet of water discharged thereinto from the nozzle.

10. The solution control apparatus of claim 9 wherein said mounting means for the nozzle comprises a nipple fixed with relation to the vessel and connected with the inlet of the nozzle, said nipple leading to the exterior of the vessel to provide for connection of the nozzle with a water supply line at a point remote from the regenerating vessel.

11. An apparatus of the type having electrical control instrumentalities for controlling the transfer of regenerating liquid from a regenerating vessel to a supply of solution at the dictation of electrode means in accordance with the electrical resistance of the solution as detected by said electrode means: characterized by the provision of a test cell remote from the supply of solution, for housing said electrode means, and through which solution from the supply thereof may be constantly circulated; and further characterized by the provision of means under the control of said electrode means for effecting feeding of a limited amount of regenerating liquid into said test cell simultaneously with said transfer of regenerating liquid to the supply of solution, during substantially the entire period regenerating liquid is being transferred to the supply of solution, so that the concentration of the solution in the test cell, during regeneration, will exceed the concentration of solution entering the test cell from the supply of solution.

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