Feb. 23, 1965 L. J. PIANOWSKI ETAL 3,170,599

AUTOMATIC LIQUID DISPENSER

Filed Oct. 10, 1962 2 Sheets-Sheet 1

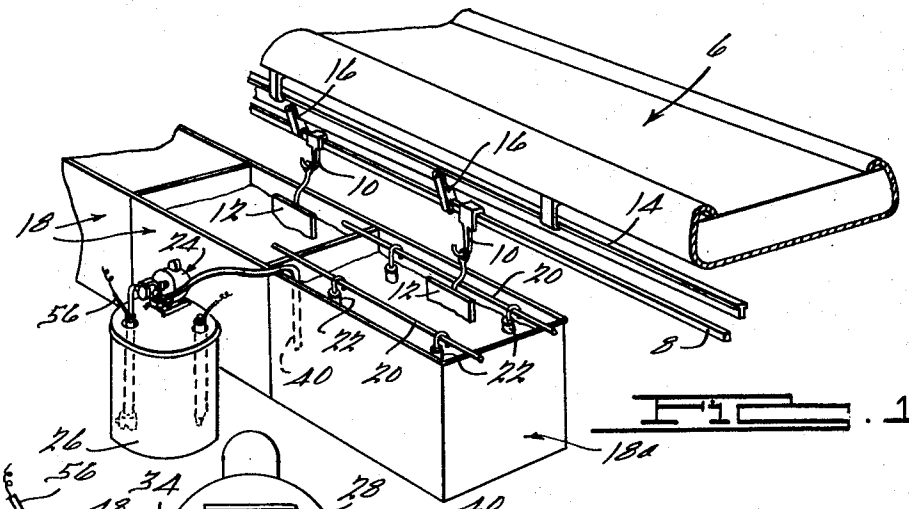


FIG. 1.

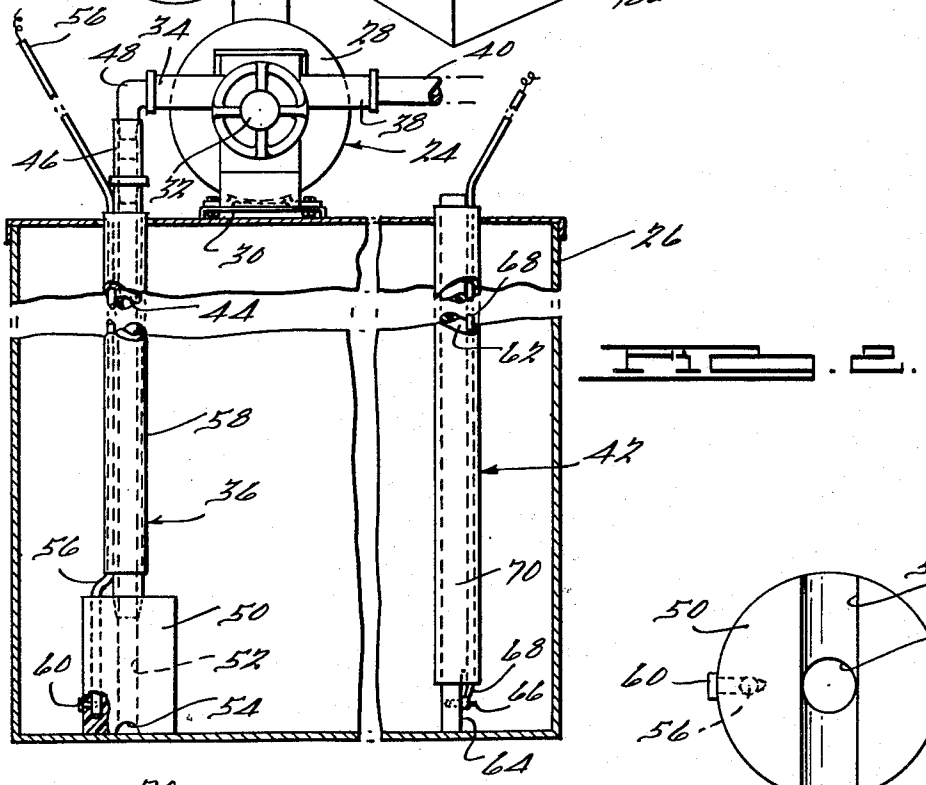


FIG. 2.

FIG. 3.

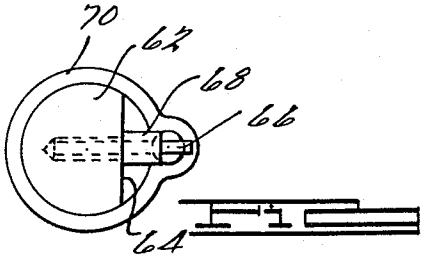


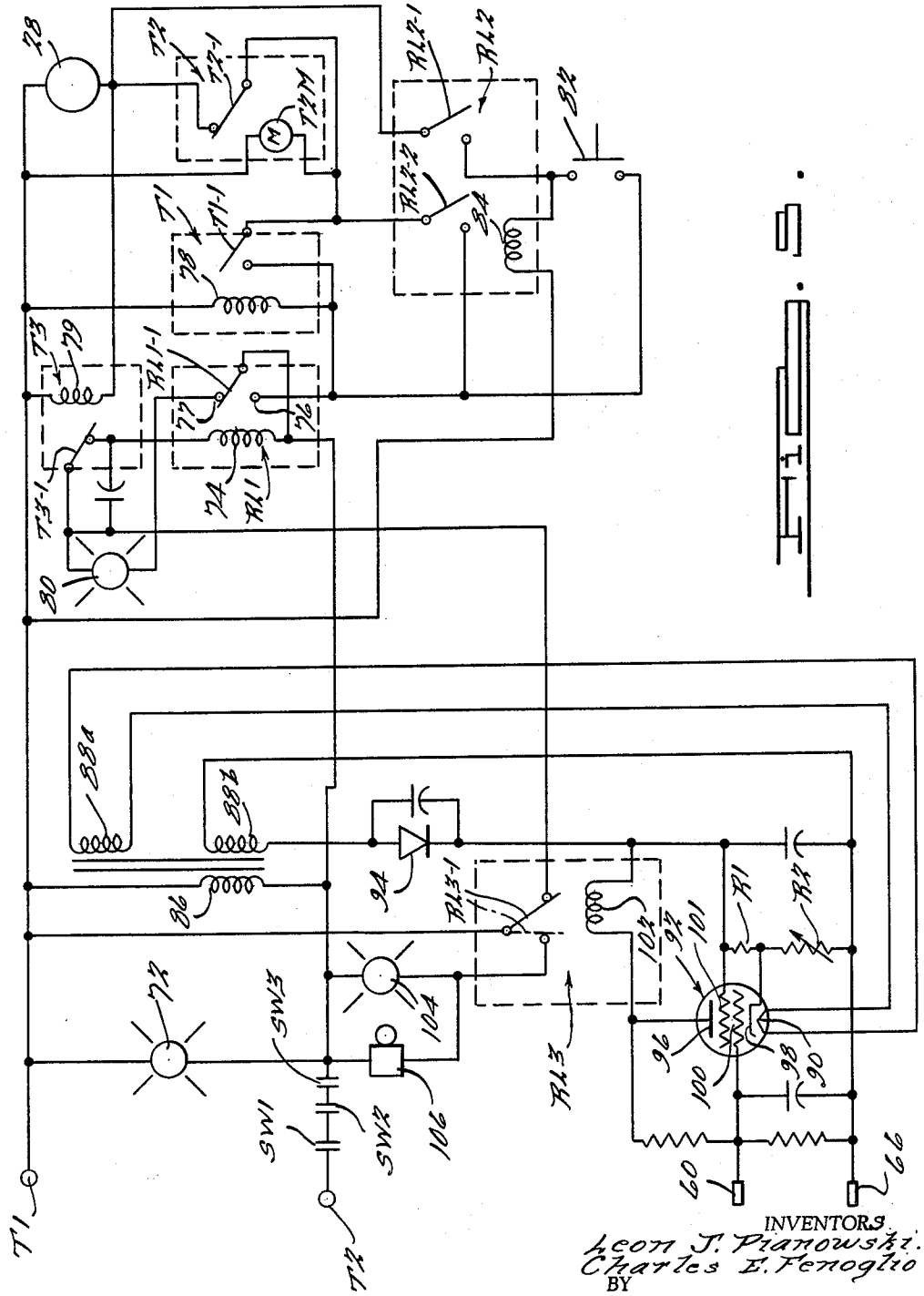
FIG. 4.

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AUTOMATIC LIQUID DISPENSER

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AUTOMATIC LIQUID DISPENSER

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The present invention broadly pertains to liquid treating apparatus, and more particularly to a liquid dispensing apparatus for replenishing liquid treating solutions. More specifically, the present invention is directed to an automatic liquid dispensing apparatus employed in electroplating and electrofinishing operations and which apparatus can be directly coordinated with the operation of automatic electroplating machines for dispensing controlled quantities of makeup solution at selected time intervals thereby maintaining optimum solution composition and concentration and achieving consistent uniformity of treatment of the workpieces.

A large number of liquid treating processes are employed industrially such as electroplating, for example, for the surface treatment of workpieces in which treating solutions are used that must be carefully controlled in composition and concentration to achieve the desired treatment. In modern automated electroplating operations wherein a large number of workpieces are successively passed through a prescribed liquid treating sequence, it is extremely important that each of the workpieces receive substantially the same degree of treatment in order to meet rigorous quality specifications imposed thereon. In such automated treating processes it has heretofore been conventional to manually replenish the consumable constituents in each of the several treating solutions and to conduct frequent chemical analyses of the solutions to assure that they remain within relatively narrow limits of composition and concentration. Such manual replenishment of the treating solutions has been found, however, to constitute an erratic and haphazardous technique which frequently results in relatively large fluctuations in the composition and concentration of the treating solutions resulting in corresponding fluctuations in the treatment of the workpieces. Moreover, the necessity of running frequent chemical analyses of the solution to minimize such large fluctuations in composition by haphazardous replenishment constitutes an extremely costly and time-consuming operation.

It is, accordingly, a primary object of the present invention to provide an automatic liquid dispenser which overcomes the problems and disadvantages heretofore associated with maintaining a substantially constant composition and concentration of replenishable treating solutions.

Another object of the present invention is to provide an automatic liquid dispensing apparatus which is presettable so as to supply a prescribed quantity of makeup solution to a replenishable treating solution at preselected intervals whereby the treating solution is maintained within a relatively narrow range of composition and concentration avoiding large fluctuations therein as have heretofore been encountered in haphazard manual control.

Still another object of the present invention is to provide an automatic liquid dispenser which maintains the treating solutions within relatively narrow controlled limits of concentration and composition obviating the necessity of frequent tedious and time-consuming chemical analyses.

A further object of the present invention is to provide an automatic liquid dispensing apparatus which is of light weight and compact size enhancing its portability characteristics enabling it to be simply mounted on conventional supply containers or drums containing the appropriate makeup solution and to transfer the makeup solution in controlled increments to a principal treating solution maintaining a substantially consistent composition and concentration thereof.

Still a further object of the present invention is to provide an improved automatic liquid dispenser which incorporates liquid level sensing means therein for visually and/or audibly signaling an operator that the supply of makeup solution from a supply container has been depleted.

Yet still another object of the present invention is to provide an automatic liquid dispenser including control means which are interlocked with an automated liquid treating machine such that the dispenser is operative to dispense a preselected controlled volume of makeup solution only at such times that a treating operation is being performed.

Yet still a further object of the present invention is to provide an automatic liquid dispenser incorporating fail-safe components in the control circuit thereof thereby assuring that no oversupply of makeup solution will be dispensed to a treating receptacle in the event of any malfunction in the control circuit.

Another object of the present invention is to provide an automatic liquid dispenser which is of simple, compact and light-weight design, of simple and durable operation and control, of versatile use, and of economical manufacture.

The foregoing and other objects and advantages of the present invention are achieved by an automatic liquid dispenser including a motor-driven pump assembly which is portable and is provided with a suction tube adapted to be inserted in a conventional supply container containing makeup solution and a discharge tube for discharging controlled increments of the makeup solution into a treating receptacle. Energization of the pump is achieved by an automatic control circuit including means therein for energizing the pump motor at preselected intervals and timer means for regulating the duration of operation of the pump. Fail-safe means are further provided for deenergizing the pump motor in the event it runs for a preselected excessive time period. Liquid level sensing means are also incorporated in the dispenser and adapted to be immersed in the supply container for signaling an operator and for deenergizing the control circuit preventing further pump energization when the supply of makeup solution has become depleted. Interlocking circuitry is preferably incorporated in the control circuit of the dispenser and the control circuit of the principal treating machine to assure operation of the dispenser only at such times that an actual treating operation is being performed.

Other objects, features, and advantages of the present invention will become apparent from the subsequent description, taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a fragmentary perspective view of a typical automatic treating machine and a series of liquid treating receptacles, one of which is provided with an automatic liquid dispenser in accordance with the present invention for replenishing the solution therein;

FIG. 2 is a fragmentary vertical sectional view of the liquid dispenser mounted on a supply container with portions of the suction tube assembly and contact probe assembly shown in section for clarity;

FIG. 3 is a plan view of the base of the suction tube assembly shown in FIGURE 2;

FIG. 4 is a plan view of the base of the contact probe assembly shown in FIGURE 2, and

FIG. 5 is a diagrammatic view of the wiring control

circuit for providing automatic integrated operation of the liquid dispenser.

Referring now in detail to the drawings and as may be best seen in FIGURE 1, a typical automated liquid processing system, and more specifically an electroplating operation is illustrated to which the present invention is applicable. A conveying machine is fragmentarily shown in FIGURE 1 of the general type shown and described in U.S. Patent No. 2,591,681, assigned to the same assignee as the present invention, including an elevator chassis indicated at 6 which is movably supported on a frame and is movable to and from a raised position and a lowered position. A work supporting rail 8 is mounted on the underside of the chassis 6 on which a series of work hangers 10 are movably mounted and from which work racks 12 are suspended. The hangers 10 and work racks 12 suspended therefrom are sequentially advanced along the supporting rail 8 by a suitable advancing mechanism such as a pusher transfer mechanism shown in FIGURE 1 including a pusher bar 14 reciprocably mounted on the underside of the chassis 6 incorporating a series of pivotally mounted pushers 16 at spaced intervals therealong. Reciprocation of the pusher bar 14 effects intermittent advancement of the work hangers 10 along the supporting rail. Immersion and withdrawal of the work racks 12 from the several treating solutions contained in an aligned series of receptacles 18 is achieved by the elevating and lowering movement of the chassis 6.

In a typical process shown in FIGURE 1, a treating receptacle 18*a* is shown which is adapted for subjecting the workpieces on the work rack 12 to an electroplating operation. The treating receptacle 18*a* is provided with a pair of longitudinally extending contact bars 20 from which a series of anodes 22 of the desired metal to be plated are suspended and in electrical contact therewith. Electrification of the workpieces on the work rack 12 may be conveniently achieved by any one of a number of techniques well known in the art, such as by electrifying the supporting rail 8 or selected sections thereof providing a corresponding electrification of the work hanger 10 and work rack 12 supported therefrom.

In accordance with such an automated electroplating operation as shown in FIGURE 1, the work racks 12 having a plurality of workpieces suspended therefrom, are automatically and sequentially conveyed through the series of treating stations receiving an appropriate treatment in each of the treating receptacles. As a result of such treatment, a progressive depletion of the active constitutents in the treating solutions occur necessitating replenishment thereof in order to maintain optimum treating characteristics. Depletion of the treating solution also occurs as a result of "drag-out" of the treating solution by the work racks as they are withdrawn from the treating receptacles.

In order to maintain the treating solution at an optimum concentration and composition during the course of continuous operation, it is necessary to periodically replenish the active constituents in the treating solution. In accordance with the practice of the present invention, this is achieved by the automatic liquid dispenser generally indicated at 24 which can be preset in a manner subsequently to be described, to deliver a controlled quantity of makeup solution from a supply container 26 at preselected time intervals consistent with the depletion rate of the treating solution as determined by such related factors as the production rate, surface area of the workpieces being treated, duration of treatment, time, etc.

The automatic liquid dispenser 24 as is best shown in FIGURES 2–4 comprises a pumping unit including an electric motor 28 supported on a suitable base 30 which in turn is drivingly connected to a dispenser pump 32. The pump 32 is provided with an inlet, or suction port 34 which is connected to a suction tube assembly indicated at 36. An outlet or discharge port 38 of the pump 32 is adapted to be connected to a supply tube 40 for discharging the makeup solution from the supply container 26 into the treating receptacle 18*a*.

By virtue of the compact, light-weight, and portable characteristics of the automatic liquid dispenser comprising the present invention, the entire unit can be simply placed on the top of the supply container 26 which may comprise a conventional 55-gallon drum and the suction tube assembly 36 may be conveniently inserted through a conventional outlet provided in the top of the drum. A contact probe assembly generally indicated at 42, employed for a purpose subsequently to be described, may similarly be inserted through a second port in the top of the supply container 26.

The suction tube assembly 36 as is best shown in FIGURES 2 and 3, comprises a tube 44 connected at its upper end by a coupling 46 to an elbow 48 mounted on the suction port 34 of the pump 32. The lower end of the tube 44 is connected to a suction head 50 of a substantially cylindrical configuration having an axial bore 52 extending therethrough and disposed in communication with the interior of the tube 44. The base of the suction head 50 is provided with a transverse groove or slot 54 which intersects the axial bore 52 to enable makeup solution contained in the supply container to be drawn inwardly therethrough and upwardly through the axial bore 52 and tube 44 into the suction port of the pump. The base of the suction head 50 is adapted to be seated against the bottom surface of the supply container 26.

An insulated conductor 56 forming a component of the liquid level indicator extends longitudinally and exteriorly of the tube 44 and is retained thereagainst by an overlying tubular sleeve 58. The lower end of the insulated conductor 56 extends into the suction head 50 and is electrically connected to a contact 60 having the head portion thereof disposed in electrical contact with the exterior of the suction head 50 and the makeup solution in the supply container.

The tube 44, coupling 46, elbow 48, suction head 50 and sleeve 58 of the suction tube assembly, are comprised of a suitable nonconductive material which is resistant to attack by acidic or alkaline makeup solutions in which the suction tube assembly may be immersed. Any one of a number of suitable plastic or synthetic resinous materials such as polyvinyl chloride or copolymers of vinylidene chloride, phenolic resins, polyethylene, polypropylene, polymethyl methacrylate, polytetrafluoroethylene, and the like, can be satisfactorily employed consistent with the specific makeup solutions to be pumped. The suction head 50 is preferably comprised of a material of the foregoing type which has extremely low wetting characteristics toward the makeup solution or alternatively may be provided with a non-wetting coating adjacent to the head of the contact 60 to prevent retention of a film of the solution on the exterior thereof after the liquid level in the supply container drops to a point below the level of the contact 60. The existence of such a liquid film provides a path of conductivity of the electricity supplied to the contact 60 providing therewith erratic indication of the liquid level in the supply container.

The contact probe assembly 42 comprises a cylindrical rod 62 which is formed with a slot 64 at the base thereof in which a contact 66 is positioned with the head portion thereof in electrical contact with the exterior of the rod 62. A second insulated conductor 68 extends downwardly along the length of the rod 62 and is retained thereagainst by a tubular sleeve 70 extending to a point contiguous to the slot 64 at the base thereof. The contact 66 as best shown in FIGURE 4, is electrically connected at a point internally of the rod 62 to the insulated conductor 68 to avoid any corrosive attack of the conductor or the electrical junction.

The contact 60 in the suction head 50 and a contact 66 in the contact probe assembly 42 are preferably made of a corrosion resistant conductive alloy such as platinum, for example, and are sealed within the nonconductive mate-

rial of which the contact probe assembly and suction head 50 are comprised so as to avoid seepage of the makeup solution therein which would corrosively attack the conductor wire. The upper ends of the insulated conductors 56 and 68 are connected to the control circuit as shown in FIGURE 5 for indicating the depletion of the makeup solution in the supply container in a manner subsequently to be described. Accordingly, the contacts 60 and 66 are disposed at a position adjacent to the bottom of the supply container so that when the liquid level therein attains a position adjacent to the contacts, the control circuit is signaled and initiates the appropriate corrective action.

It will be apparent from the foregoing that the automatic liquid dispenser 24 comprising the present invention, can be readily mounted on a supply container and be removed therefrom after the supply of makeup solution has been pumped therefrom to a second full supply container to continue its automatic dispensing operation. The control circuit for regulating and providing automatic operation of the liquid dispenser, may be conveniently located at a position remote from the liquid dispenser and treating receptacle and connected thereto by a suitable power supply for energizing the motor and for connecting the insulated conductors 56 and 68.

The operation of the automatic liquid dispenser will now be described for a typical automated electroplating operation and with particular reference to the control circuit as shown in FIGURE 5. The control circuit is electrically connected at terminals T1 and T2 to a suitable electrical power source. To avoid operation of the liquid dispenser at times when no actual liquid treatment of workpieces is being performed, the control circuit is provided with a pair of interlocking contacts SW1 and SW2 which are disposed in series in the conductor connected to terminal T2 and are closed responsive to energization of the control circuit of the principal electroplating machine and a rectifier or generator circuit for supplying current to the anodes of the treating receptacle respectively. By this provision, operation of the machine for test purposes or energization of the rectifier or generator, without actual operation of the machine, will prevent energization of the control circuit of the liquid dispenser. It is also contemplated however, that less than or more than two interlocking contacts can be provided to achieve the desired integrated and coordinated action between the dispensing apparatus and the process equipment with which it is associated. The circuit is also preferably provided with a manually operable on-off switch SW3 which is effective to denergize the liquid dispenser at such times that no dispensing operation is desired.

In the specific circuit shown in FIGURE 5, the closing of switch SW1 and the energization of the control circuit of the principal electroplating machine and the energization of the rectifier or generating circuit for supplying plating current to the treating receptacle, causes energization of suitable relays which in turn close their contacts SW1 and SW2 effecting energization of the liquid dispenser control circuit which is visibly indicated by the illumination of "on" indicator light 72. Upon the closing of contacts SW1 and SW2, the coil 74 of relay RL1 is energized which moves its contact RL1–1 in electrical connection with terminal 76 which in turn effects energization of a coil 78 of a suitable interval timer T1 which commences to time a preselected time period. The interval timer T1 is presettable so as to energize the motor effecting pumping of the makeup solution from the supply container to the treating receptacle upon the expiration of a prescribed time period such as, for example, every 15 minutes, every ½ hour, or every hour. The desired setting of the interval timer T1 is readily established by determining the quantity of liquid delivered at each such time interval and the rate of depletion of the active constituent in the treating receptacle as determined by such factors as the rate of production, surface area of the parts being treated, duration of the treating cycle, and similar considerations. Conventionally, the interval timer is set in combination with the quantity of makeup solution delivered at each interval so that the fluctuation of the treating solution between the point immediately after addition and the point immediately prior to addition of makeup solution, is within acceptable limits. In cases where relatively close limits must be maintained on the concentration of the active constituent in the treating solution, smaller quantities of makeup solution are delivered at relatively short time intervals. When larger fluctuations in the concentration of the treating solution can be tolerated, greater quantities of makeup solution can be delivered at less frequent time intervals.

In view of the foregoing considerations, it is also contemplated that in lieu of employing an interval timer for regulating the times at which makeup solution is supplied to the treating solution, an ampere-hour meter can be employed which is operative to accumulate the ampere hours of electricity consumed in an electroplating operation which can be directly correlated with the quantity of active constituent in the treating solution consumed. By virtue of such an ampere hour meter, the appropriate quantity of makeup solution can be supplied after a predetermined number of ampere hours has been consumed in the treating receptacle so as to maintain the concentration of the treating solution within the desired limit.

In the specific circuit shown in FIGURE 5, at the completion of the preselected timing period, the interval timer T1 closes its contact T1–1 which in turn energizes the motor 28 through the closed contact T2–1 of a volume or delay timer T2. Simultaneously, the motor T2M of volume timer T2 is energized whereby the volume timer commences to time a preselected delay period. At the same time the heater coil 79 of thermal delay timer T3 is energized which commences to heat.

As the volume timer T2 commences to time, makeup solution is pumped by the pump 32 from the supply container to the treating receptacle. At the completion of a preselected delay time, the volume timer T2 opens its contact T2–1 which deenergizes the pump motor 28 and the heater coil 79 of the thermal delay timer T3. The interval timer T1 thereafter opens its contact T1–1 which deenergizes the motor of the volume timer T2 which resets itself.

The foregoing sequence continues in preselected intervals whereby a predetermined quantity of makeup solution is added to the treating receptacle. In the event a malfunction occurs in the volume timer T2 such that it continues to time beyond the preset period or wherein a component thereof is defective so as not to deenergize the pump motor 28, the heater coil 79 of the thermal delay timer T3 attains a temperature at a preselected time period after the selected expiration of the delay period of the volume timer T2 causing it to open its contact T3–1 which deenergizes the coil 74 of control relay RL1 causing its contact RL1–1 to move from terminal 76 to a position in contact with terminal 77 as shown in solid lines in FIGURE 5. The closing of contact RL1–1 with the terminal 77 effects illumination of a warning indicator light 80 on the control panel or other suitable visual or audible signal device signaling the operator of the presence of a malfunction. At the same time, the switching of contact RL1–1 effects a deenergization of the pump motor 28 whereby the pumping of makeup solution is stopped. The provision of this safety feature prevents any circuit malfunction from causing an excessive quantity of makeup solution from being pumped into the treating receptacle and drastically changing its composition.

In order to enable makeup solution to be added to a treating receptacle independently of the automatic timing sequence embodied in the control circuit shown in FIGURE 5, such as may be required at the initiation of an operating cycle or a change in the type or characteristics

of workpieces being plated, the control circuit is provided with a provision for manually energizing the circuit. This is accomplished by providing a resiliently biased push button switch 82 on the control panel which may be depressed temporarily by an operator whereupon energization of a coil 84 of control relay RL2 is accomplished which closes its holding contact RL2–1 and its active normally open contact RL2–2. The closing of holding contact RL2–1 enables the push button 82 to be released while the closing of contact RL2–2 energizes the motor T2M of the volume timer T2 which commences to time a pre-selected delay period and simultaneously energizes the pump motor 28 and the coil 79 of the thermal delay timer T3. At the completion of the timing cycle of the volume timer T2, its contact T2–1 opens deenergizing the pump motor and the thermal delay timer T3 and simultaneously deenergizes the coil 84 of control relay RL2 which opens its contacts RL–1 and RL2–2. Accordingly, additional makeup solution can be added to the treating solution whenever a slight discrepancy exists between the rate of depletion of the treating solution in comparison to the time setting of the interval timer T1 and volume timer T2.

In addition to the foregoing automatic dispensing provisions of the control circuit, an automatic level indicator is also incorporated for visually or audibly signaling the operator that the supply of makeup solution in the supply container is depleted. The level control circuit comprises a transformer including a primary winding 86 and secondary winding 88*a*, 88*b*. Secondary winding 88*a* is electrically connected to a heater 90 of a vacuum tube 92. The secondary winding 88*b* of the transformer is electrically connected through a diode rectifier 94 to a plate 96 of the vacuum tube 92. The plate voltage is also fed to two voltage divider networks incorporating a fixed resistor R1 and a variable resistor R2. The variable resistor R2 is presettable so as to supply a preselected voltage to a cathode 98 of the vacuum tube relative to the voltage of a control grid 100 so that the vacuum tube will be biased at or near cutoff when the liquid level contacts 60 and 66 are immersed in the makeup solution so as to render the vacuum tube more conductive when one of the liquid level contacts is out of the solution as occasioned by a depletion of the makeup solution.

When the makeup solution decreases to a level wherein one of the contacts is exposed above the surface thereof, the control grid 100 is rendered less negative with respect to the cathode making the tube more conductive and thereby increasing the current passing through the screen grid 101 to the plate 96. Such increased current is operative on passing through a coil 102 of a control relay RL3 to cause it to switch its contact RL3–1 from the position shown in solid lines in FIGURE 5 to the position shown in phantom whereby a liquid level indicator lamp 104 is illuminated and a suitable audible buzzer or bell 106 is energized providing visual and audible signals to the operator that the drum is empty. The switching of the contact RL3–1 is also operative to deenergize the coil 74 of relay RL1 which switches its contact RL1–1 from electrical connection with terminal 76 to electrical connection with terminal 77 effecting a deenergization of the interval timer T1 and preventing energization of the pump motor 28.

The liquid level light 104 and the audible buzzer or bell signal 106 remain energized until such time that the suction tube assembly 36, the contact probe assembly 42 and the pump and motor are removed from the empty supply container and installed in a full supply container. Upon immersion of the contacts 60 and 66 in new makeup solution, the tube 92 is again rendered substantially nonconductive whereupon relay RL3 is deenergized causing its contact RL3–1 to switch from the position shown in phantom in FIGURE 5 to the position shown in solid lines extinguishing the warning light 104 and audible signal 106 and reenergizing the control relay RL1. Accordingly, the control circuit thereafter continues to operate commencing with the point at which operation was halted in response to depletion of the makeup solution in the preceding supply container.

It will also be appreciated that it is also contemplated that a suitable transistorized amplifier can be satisfactorily employed in lieu of the vacuum tube 92 for selectively operating the control relay RL3 in a manner and purpose equivalent to that hereinabove described.

While it will be apparent that the preferred embodiments herein illustrated are well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. An automatic liquid dispenser comprising pumping means including a suction tube assembly connected to the inlet of said pumping means and adapted to be disposed in a supply container containing makeup solution and a discharge tube for discharging the makeup solution into a treating receptacle, said suction tube assembly comprising conduit means formed with an inlet port at the base thereof for withdrawing makeup solution contiguous to the bottom of the supply container, control means including presettable means for energizing said pumping means after a preselected depletion of the treating solution has occurred, timing means for maintaining said pumping means energized for a preselected time period, and sensing means associated with suction tube assembly and a point within the supply container spaced therefrom and electrically connected to said control circuit for signaling the depletion of makeup solution therein to said control circuit effecting deenergization of said presettable means and signaling the occurrence of such event.

2. An automatic liquid dispenser comprising pumping means including a suction tube connected to the inlet thereof and adapted to be disposed in a supply container containing makeup solution and a discharge tube for discharging the makeup solution into a treating receptacle, control means including presettable means for energizing said pumping means after a preselected depletion of the treating solution has occurred, timing means for maintaining said pumping means energized for a preselected time period, and sensing means for sensing the depletion of makeup solution in the supply container, said sensing means including first contact means on said suction tube and disposed at a position contiguous to the bottom of the supply container, a contact probe disposed within the interior of the supply container and including second contact means thereon positioned adjacent to the lower end portion thereof and spaced from said first contact means, and means in said control means for imposing a current between said first and said second contacts and for sensing the interruption of such a current flow as occasioned by the depletion of the makeup solution therein and for deenergizing said presettable means and signaling the occurrence of such event.

3. An automatic liquid dispenser comprising pumping means including a suction tube connected to the inlet thereof and adapted to be disposed in a supply container containing makeup solution and a discharge tube for discharging the makeup solution into a treating receptacle, control means including presettable means for energizing said pumping means after a preselected depletion of the treating solution has occurred, first timing means for maintaining said pumping means energized for a preselected time period, second timing means operative responsive to the expiration of a preselected time period beyond that of said first timing means for deenergizing said pumping means in the event said first timing means continues to time beyond said preselected time period, overriding means manually operable for energizing said first timing means and said pumping means independently of said presettable means, and sensing means associated with the

supply container and electrically connected to said control circuit for signaling the depletion of makeup solution therein to said control circuit effecting deenergization of said presettable means and signaling the occurrence of such event.

4. In a treating apparatus including a machine for transferring a plurality of workpieces to a series of treating receptacles, the improvement comprising an automatic liquid dispenser for adding controlled quantities of makeup solution to a treating receptacle at preselected periodic time intervals, said dispenser apparatus comprising pumping means including a suction tube connected to the inlet thereof and adapted to be disposed in a supply container containing makeup solution and a discharge tube for discharging the makeup solution into a treating receptacle, control means including presettable means for energizing said pumping means after a preselected depletion of the

treating solution has occurred, timing means for maintaining said pumping means energized for a preselected time period, interlocking means for energizing and deenergizing said control circuit in accordance with the energization and deenergization respectively, of the machine, and sensing means associated with the supply container and electrically connected to said control circuit for signaling the depletion of makeup solution therein to said control circuit effecting deenergization of said presettable means and signaling the occurrence of such event.

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