

- [54] **LIQUID DISPENSING APPARATUS**
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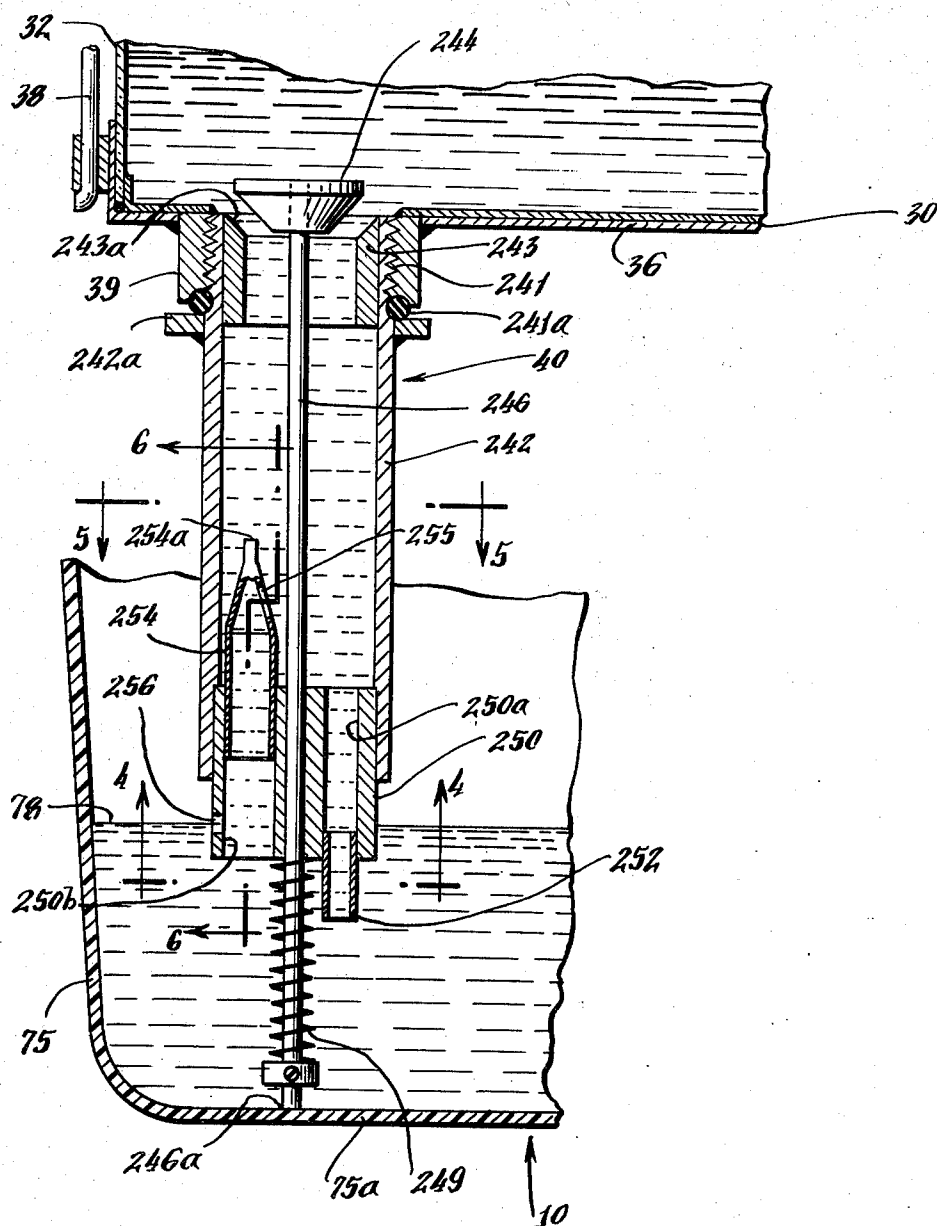
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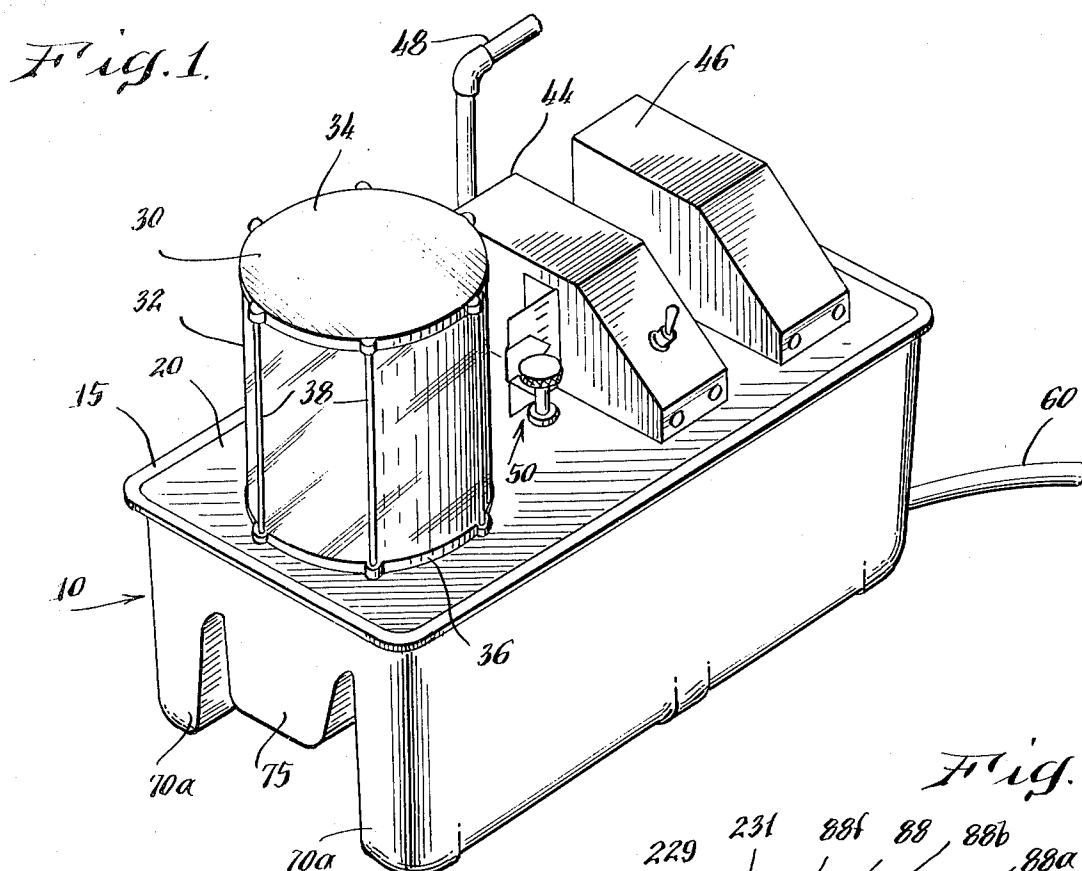
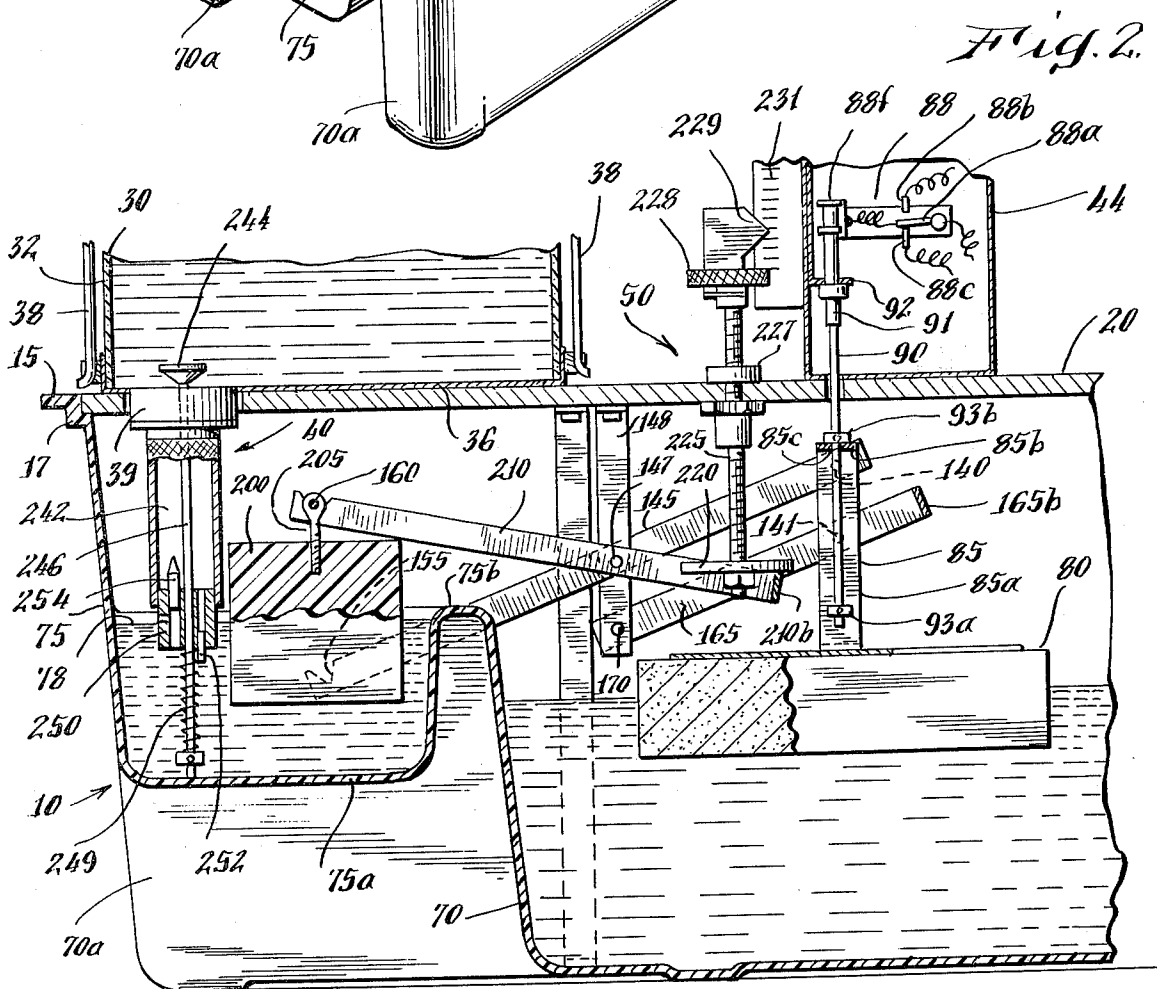
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[51] **Int. Cl.²** **B67D 3/00**
[58] **Field of Search** **137/453, 454, 261;**
222/437, 457, 479; 62/397

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[57] **ABSTRACT**
In apparatus for maintaining in a receiving receptacle a fixed level of liquid introduced by vacuum-restricted gravity flow from a supply reservoir, means are provided for minimizing the disturbance caused by air entry into the vacuum-sustaining space. To this end, a restricted passage for air influx begins at the intended level of liquid in the receptacle and extends with continued restriction to a relatively elevated point of entry into the liquid supply column. Correlation of dimensions of liquid passages and air passages is specified.

3 Claims, 6 Drawing Figures





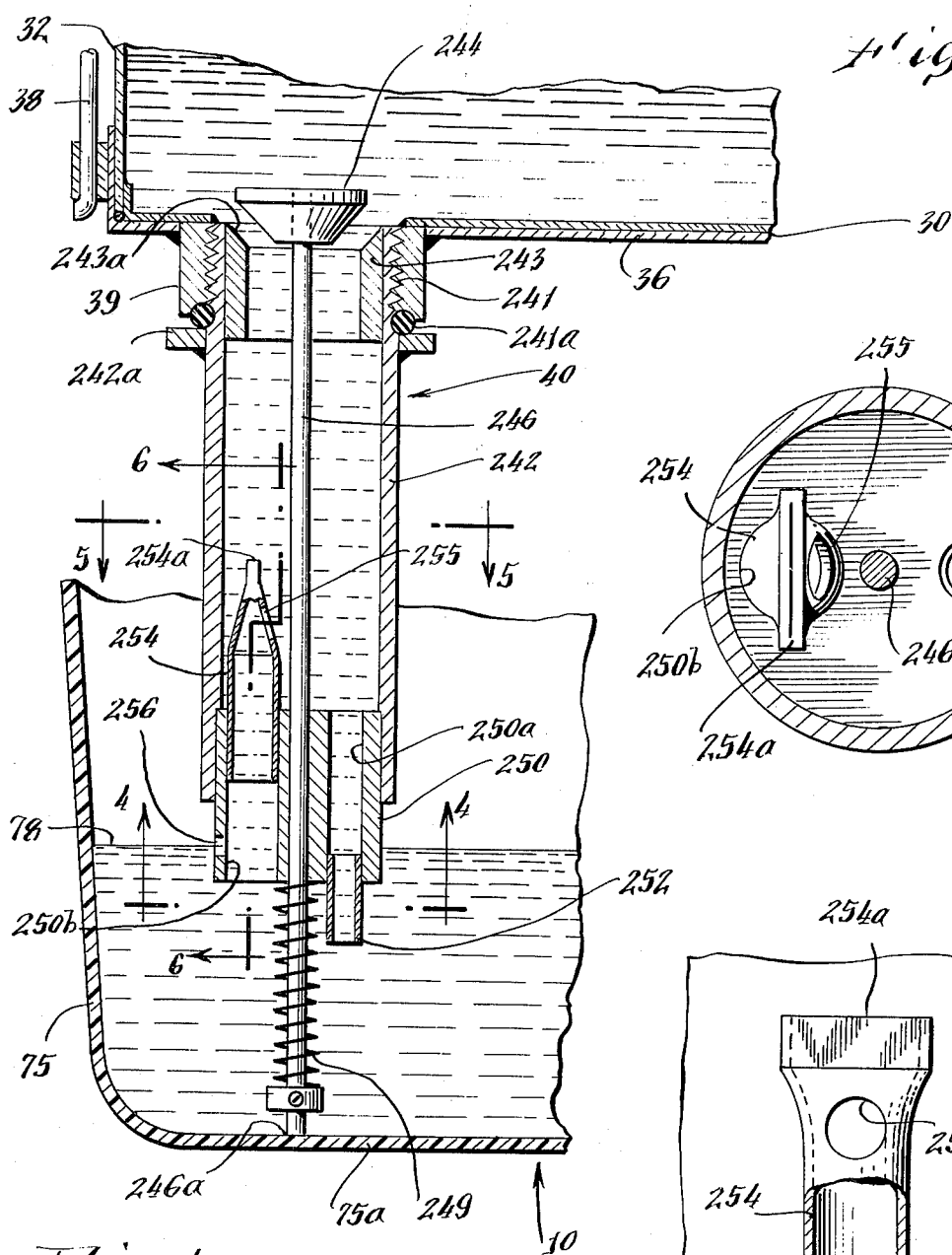
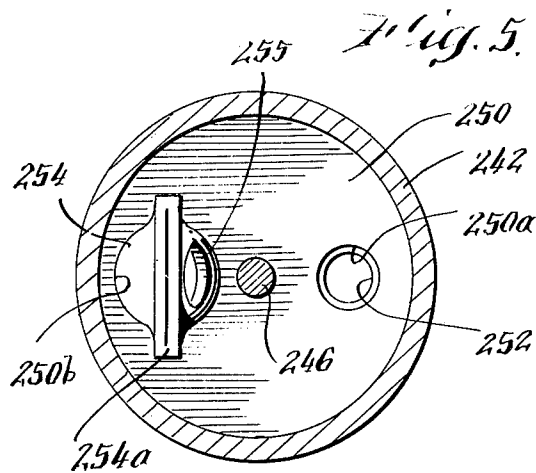
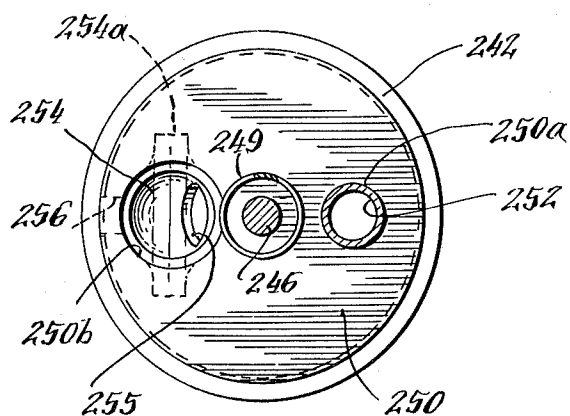
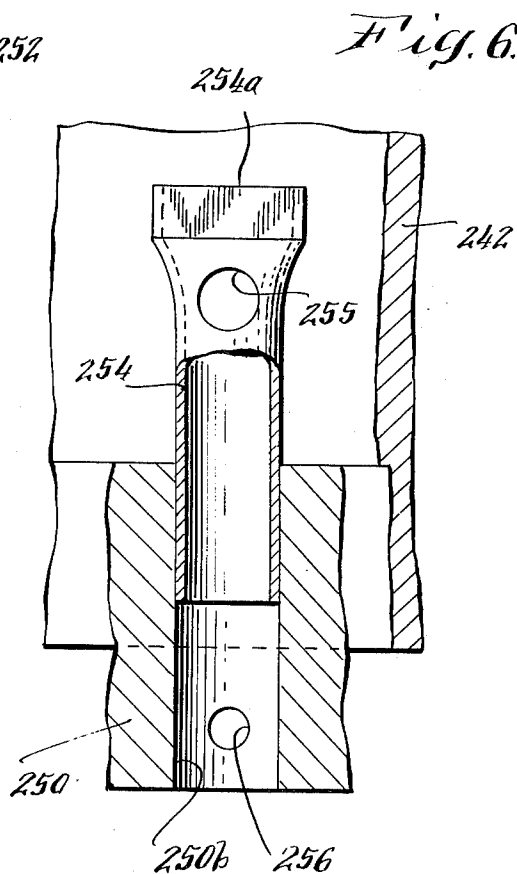


Fig. 4.



LIQUID DISPENSING APPARATUS

The present invention relates to improved liquid dispensing apparatus and more particularly to apparatus for maintaining in a receiving compartment a relatively fixed level of liquid introduced by vacuum-restricted gravity flow from a supply reservoir. The invention has been found particularly applicable to use in the printing industry.

BACKGROUND AND BRIEF DESCRIPTION OF THE INVENTION

Offset lithographic printing presses are generally provided with a reservoir (the "water fountain pan") which is filled with a water solution of gum arabic and a slight proportion of chromic or phosphoric acid. The dampening rollers of the press apply this "etch and gum" water solution to the nonprinting portions of the printing plate on the plate cylinder of the press, thus insuring that no ink from the inking rollers will be received on the dampened portions of the plate. The proportions of a particular "etch and gum" solution are dictated by a number of factors, including the type of ink used, the nature of the printed work, the color being printed, and the type of paper to be printed.

It has proven impractical to prepare and store large quantities of etch and gum solution over extended periods of time because of the various kinds of deterioration that can occur in the course of such storage. On the other hand, some conditions of press operation may require that relatively great quantities of solution be supplied in a continuous run. To accommodate both these considerations, apparatus has heretofore been provided which can, under automated control, provide a continuous succession of freshly mixed batches of water and etch and gum concentrate. Such apparatus employs the combination of a reservoir of etch and gum concentrate, a mixing chamber in which metered quantities of the concentrate are to be admixed with water (as a customary solvent) and some sort of intermediate metering chamber in which successive measured batches of concentrate are temporarily stored as part of the metering process.

In this combination, the primary reservoir of concentrate is conveniently provided in the form of an inverted container which supplies liquid to the metering chamber by vacuum-controlled gravity feed. In such a system, as concentrate is withdrawn from the metering tank, replacement liquid is automatically fed in from the reservoir somewhat in the manner of the familiar inverted-bottle water cooler. However, for the application of these principles to printing equipment liquid mixing arrangements, it is important, in order to assure accurate metering of the supplied concentrate, that the liquid in-flow from the reservoir be relatively smooth and free of the "glugging" effect which characterizes many vacuum-controlled gravity feed arrangements. The present invention provides means for assuring this desired result.

In the more general aspect of the invention, this is accomplished by providing between the superposed reservoir and the metering chamber into which it feeds a conduit assembly which includes in the first instance a passage through which liquid from the reservoir is admitted to the tank at a point below the intended normal surface level of the liquid pool to be maintained in the tank. Beyond this, however, the conduit system further

includes a separate restricted passage extending upwardly into the interior of the conduit structure from a point below the said normal liquid level and to a region of the conduit which communicates with the interior of the reservoir. This passage still further communicates with a relatively small laterally directed air-admitting orifice located approximately at the normal liquid level, so that a slight lowering of the level of the liquid will admit air into the conduit only by successive movement through the orifice and the restricted passage. It is found that these arrangements prevent the admitted air from causing the serious perturbation of the liquid maintained in the metering chamber and thus effectively realize the objects of the invention.

Further aspects and advantages of the invention will become apparent upon consideration of the following description taken in connection with the accompanying drawings in which

FIG. 1 is a perspective view of a mixing apparatus applicable in the printing industry and in which the present invention has been usefully applied. The apparatus of this Figure is fully described in the U.S. Application for Patent Ser. No. 471,208, filed May 20, 1974, in the names of John MacPhee and Harold W. Gegenheimer, which application is hereby incorporated by reference in the present application.

FIG. 2 is a partial sectional view of the apparatus of FIG. 1 showing a specific application of the invention.

FIG. 3 is a sectionalized view of a particular embodiment of the present invention.

FIG. 4 is an enlarged section taken on line 4-4 of FIG. 3.

FIG. 5 is an enlarged section taken on line 5-5 of FIG. 3.

FIG. 6 is a greatly enlarged irregular section taken on line 6-6 of FIG. 3.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1 there is shown in that Figure the external configuration of an assembly of particular liquid mixing apparatus representing an advantageous application of the invention. This assembly has as its base portion a receptacle or tank 10 which is so formed as to be readily self-supported upon any level surface. This tank consists of a molded enclosure of liquid and etch-resistant plastic material, for example, polyvinyl chloride. It is provided at its upper edge with a surrounding outwardly directed lip 15 which, as appears in FIG. 2, may be slightly offset from the plane of the vertical tank wall to provide an inwardly directed ledge 17 for the support of a cover plate 20.

Supported on cover plate 20 is an inverted container 30 which, as will be further explained at a later point, is adapted to provide storage for from one to several gallons of a concentrated etch and gum solution or other concentrated solution intended, in the operation of the apparatus, to be admixed with water or other appropriate diluent or solvent. For present purposes it is sufficient to note that the container 30 as illustrated comprises a water-tight and air-tight assembly consisting of a cylindrical sidewall 32 of plastic, an imperforate end wall 34, a generally similar wall 36 at its opposite extremity and take-up means or tie rods 38 for maintaining the end walls in firm assembly with the cylindrical sidewall 32. In the inverted position in which it is shown the container 30 has a downwardly directed

outlet system 40 (see FIG. 2) which will be described in detail at a later point.

Also supported on the cover plate 20 are two removable (but normally secured) casings 44 and 46 which enclose electrical and mechanical control devices to which some further reference will be made at a later point. A water supply pipe 48 is also operatively connected to and through the cover plate 20, and there is further supplied a control assembly 50 for controlling the proportions of the liquid mix which it is the function of the over-all assembly to produce. At the right hand extremity of the assembly there is shown a liquid outlet conduit 60.

Referring now to FIG. 2, in which many of the items so far described will be readily identified, it will be seen that the tank 10 as viewed in longitudinal section comprises a first liquid-receiving compartment 70 which occupies the greater portion of the right hand part of the tank structure and has wing portions 70a extending to the left end of the structure. It is the function of this compartment to receive a substantial quantity of a primary liquid (e.g. water) which in the course of operation of the apparatus is to be admixed with a secondary constituent such as an "etch and gum" concentrate. To the left of this first compartment, but in proximity to it, there is provided a second, smaller compartment 75, the wall structure of which is shown as being formed continuously with the wall structure of the compartment 70. It is the function of this compartment to receive from the reservoir 30 the secondary liquid or concentrate. This second liquid is introduced into the compartment 75 from the reservoir 30 by means of the outlet system 40, already referred to. The details of this outlet system comprise the present invention and will therefore be described in detail at a later point. It is sufficient at this point, however, to say that the conduit system has a primary outlet 252 through which down-flowing liquid from the reservoir 30 is supplied to the chamber 75. The combination of the inverted reservoir 30 and the outlet system 40 provides a liquid level maintaining system of the type in which the balance between the partial vacuum existing in the upper portion of the reservoir 30 and the weight of the liquid column seeking egress through the outlet 252 causes a substantially constant level of liquid to be maintained in the chamber 75, as indicated at 78.

As may be recognized by joint consideration of FIGS. 1 and 2, the compartment 75 is an open top receptacle or basin having a bottom wall 75a formed with considerable spacing between it and the supporting foundation of the total tank assembly 10. On three sides of this basin its lateral bounding wall is connected to and merges into the bounding wall of the tank 70 by means of a horizontal bridging part 75b. The narrow extensions 70a of the compartment 70 extend along and in effect enclose the lateral walls of the compartment 75. It will be apparent that by virtue of this arrangement the compartment 75 has a point above which liquid contained in that compartment will overflow the bounding surface 75b and drop into the larger mixing compartment.

The elements at the right of FIG. 2 illustrate means by which the liquid in the tank 70 may be maintained between a predetermined minimum level and a predetermined maximum level and will be described only briefly because they do not bear directly on the substance of the present invention. These means include

float 80, comprising a body of material having a significantly lower specific gravity than water. On its upper surface, there is attached a stainless steel plate bearing an upwardly extending U-shaped bracket 85. This bracket has vertical legs 85a and a transverse part 85b joining these legs. At the central region of the transverse part there is a slot 85c extending at right angles to the axis of the transverse part.

There is supported well above the central region of the float block 80 and within the cover-mounted casing 44 a two-way toggle switch 88 having a power-connected contact 88a and two alternatively usable contacts 88b and 88c. It may be assumed that these connect with control means (not shown) for alternatively supplying water to and releasing water from the tank 70. An operative connection between the switch 88 and the float block 80 is provided by means of a push rod 90 which at its upper end is connected to the switch actuator 88f by a member 91 coacting with a fixed mounting bracket 92. The rod 90 extends downwardly through the slot 85c in the transverse bracket part 85b so that its lower end approaches but does not contact the plate 82. Circular collars 93a and 93b are attached to the intermediate region of the rod in such a way (e.g. by set-screws) that their relative positions can be adjusted or preset by the operator of apparatus. With this arrangement of parts it will be seen that as the float 80 moves upward (i.e., during a period in which water is being fed from a supply source into the tank 70) a point will be reached at which the transverse bracket part 85b will engage the collar 93b and cause the push rod to move the switch actuator 88f into its uppermost position. This action will snap the power-connected switch element 88a into contact with switch terminal 88c. In the intended use of the apparatus, this will simultaneously cut off the incoming supply of water to the tank compartment 70 and will initiate an out-flow of water through the conduit 60 (FIG. 1), thus lowering the water level in the tank.

Because, as previously indicated the switch 88 is of an over-center variety, the reduction in water level will not immediately affect the condition of the switch. However, when the float 80 has dropped significantly (i.e., with decreasing water level) a point will be reached at which the transverse bracket part 85b will contact the upper surface of the rod collar 93a, thus drawing the rod in the downward direction. When this happens, the switch 88 will be thrown into its alternate position with the contacts 88a and 88b in engagement. Under these circumstances, the outflow of water from the compartment 70 will be halted and the influx of a fresh supply of water will begin. This cycle will continue indefinitely unless interrupted by the operator of the equipment. It will be understood that the maximum and minimum levels which the water is permitted to attain can be predetermined in advance by up and down adjustment of the rod-borne collars 93a and 93b.

Having now described briefly the system of water level control provided in connection with the primary tank compartment 70, it is in order next to indicate with similar brevity the means by which this system also functions to control the supply of measured quantities of etch and gum solution from the secondary tank compartment 75. For such control, each of the vertical float-attached bracket parts 85a is provided with a pair of spaced pivot pins 140 and 141. Each of the upper ones of these pins has rotatably secured to it a lever

arm 145 which is further rotatably secured to and supported by a fixed fulcrum provided by a pin or bolt 147. Each of these bolts 147 is in turn held in place by a vertical bracket 148 having a secure attachment to the cover plate 20 of the assembly. Each lever arm extends some distance to the left of the fulcrum pin 147, being provided near its left extremity with an upwardly directed notch 155. Each of the notches is adapted to engage (from below) a horizontally extending support bar 160 shown in section in FIG. 2.

Each of the vertical bracket parts 85a has further attached to it a second lever arm 165 pivotally mounted on one of the bolts 141. This lever arm extends between the bracket 85a and the bracket 148, being pivotally attached to the latter by a pin or bolt 170. The two identical level arms 165 are connected at their right hand extremities by a bridging piece 165b with which they jointly form a U-shaped assembly having its open end directed to the left. The combination of the fixed vertical brackets 148, the levering members 145 and 165, and the float-attached brackets 85a provide at each end of two opposed extremities of the float 80 a pantograph arrangement the effect of which is to assure that the bracket parts 85a remain perpendicular to the floor of the tank compartment 70 as the float moves up and down. This in turn maintains the major surfaces of the float parallel with the floor of the tank and prevents the float from assuming an angular position which might cause it to frictionally engage any of the tank wall surfaces.

By action of the lever arm 145, motion of the float 80 is enabled to produce measured transfer of etch and gum concentrate (or other activating liquid) from the secondary tank compartment 75 to the primary compartment 70. This is accomplished by means of a displacement block or piston 200 which is associated with compartment 75 and which may be assumed to be generally cubic in form. The block extends over only a portion of the area of the compartment 75, leaving adequate clearance for the liquid conduit assembly 40, and is constituted of an appropriate liquid resistant material having specific gravity of about 1.4. Because of the latter characteristic it will tend to sink in the liquid 78 contained in the compartment 75 unless it is supported by means other than its buoyancy in the liquid. The supporting means actually employed comprises in the first instance the horizontal bar 160, to which the piston is attached by spaced eye-bolts 205. The openings in these bolts are dimensioned to permit the piston to swing freely on the bar 160.

The bar itself has two separate means of support. The first of these comprises the pair of notched lever arms 145 to which reference has already been made. The second comprises another pair of lever arms 210 (one only being shown) which are joined in a U-shaped assembly by a cross-member 210b extending between them at their right hand extremities. The assembly is provided with oppositely disposed fulcrum points by extensions of the bolts or pins 147 supported in downwardly extending bracket arms 148. By virtue of this arrangement, downward movement of the cross-member 210b will lift the piston-supporting extremities of the lever arms 210. These extremities, in turn, are provided with upwardly directed notches (not apparent in the drawing) which are formed to receive the extremities of the support bar 160.

It is the function of the lever arm 210, coacting with additional means now to be described, to limit the possible downward motion of the displacement block or piston 200 without regard to the maximum upward motion of the float 80, and thus to permit controlled variation of the quantity of secondary liquid which the piston can cause to overflow the compartment 75. This is to be accomplished without concurrently altering the total quantity of primary liquid supplied to compartment 70. These objectives are achieved by providing operator-controlled means for adjusting the degree to which the left hand ends of the lever arms 210 can be drawn down by the weight of the displacement block 200. The particular means provided for this purpose comprises a circular blocking member 220 affixed to the lower end of a vertical adjusting rod 225. This blocking member engages the upper surface of the lever-connected cross-bar 210b when the cross-bar reaches a certain level, that level being variable in accordance with the degree of downward extension of the adjusting rod 225. Upon such engagement of parts, downward motion of the displacement block 200 necessarily ceases regardless of its degree of submersion in the etch and gum solution 78. Assuming that a predetermined quantity of solution has been deposited in the compartment 75 before downward motion of the displacement block begins, it will be apparent that limitation of downward motion of the block automatically determines the fraction of this quantity which will be caused to overflow the boundary surface 75b, and thus effectively meters the amount of concentrate which can flow into intermixing relationship with the liquid in compartment 70.

As further appears in FIG. 2, the adjustment rod 225 is supported from the tank cover plate 20 by a fitting 227, which is internally threaded to engage external threads provided on the adjustment rod. Near its upper end the rod is provided with a knurled knob 228 by which it can be screwed up and down in the fitting 227. A pointer 229, also attached to the upper end of the rod, (although not rotatable with it) coacts with a scale 231, marked with appropriate measurements (e.g. fluid ounces per gallon) so that, after initial calibration of the system, the location of the pointer will indicate how much liquid is to be expelled from compartment 75 during a single cycle of operation of the apparatus. The amount can be increased at any time by turning the knob 228 to raise the blocking plate 220 to a degree indicated by the change of position of the pointer 229. Conversely, the amount can be reduced by effecting downward motion of the blocking plate.

While the lever arms 210 and the blocking plate 220 conjointly fix the limits of motion of the piston 200, the occurrence of such movement in the first instance depends primarily upon action of the earlier described lever arms 145. In this connection, it may be assumed, for example, that the apparatus at the end of a filling and mixing cycle is in the condition in which it is shown in FIG. 2. It will be seen in this Figure that the float 80 is at a high level, corresponding to attainment of the maximum desired level of the primary fluid. Under these conditions, the lever arms 145 have disengaged the piston support bar 160 — as they are free to do because of the open notches 155 by which engagement of the arms and the bar are accomplished. The piston thus remains supported solely by the independent lever arms 210. Consider, however, that the next phase of

operation of the apparatus involves draining liquid from the compartment 70. As such drainage occurs, the float 80 will fall and the left hand extremities of the lever arms 145 will rise. At a certain point, the notches 155 will re-engage the cross-bar 160 and, in effect "take over" from the lever arms 210. In the preferred mode of operation of this system, the piston will be lifted by the lever arms 145 (i.e., as actuated by the falling float 80) until it nearly (but not quite) leaves the surface of the liquid in the compartment 75. As this occurs, the level of liquid in the compartment 75 will tend to fall below its intended "normal level" — this being because part of the liquid required to sustain that level has been displaced into the compartment 70 by the prior downward motion of the piston. Accordingly, replenishment from the supply reservoir 30 will be called for. The way in which this is accomplished by the present invention will now be described.

Referring now more particularly to FIG. 3, it will be seen that the supply connection between the reservoir 30 and the compartment 75 comprises the conduit assembly 40, previously referred to. It should be noted first that to permit occasional refilling of the reservoir, the assembly 40 is removable as a whole from the reservoir's end wall 36 by means of a screw thread 241 formed at the upper end of the hollow conduit or cylinder 242 of relatively large cross-section which forms the enclosure of the assembly. This thread engages a corresponding thread provided internally on a mouth-forming sleeve 39 which is attached to the reservoir end wall and which in use extends downwardly through an appropriately sized opening formed in the tank cover of FIG. 2. A gasket 241a forms a tight seal between the end of the sleeve 39 and an annular flange 242a secured to the outer surface of cylinder 242. The threaded end of the cylinder 242 encloses in tight-fitting engagement a second cylinder or sleeve 243 which has an inwardly tapered or countersunk end surface 243a. This is adapted to receive an interfitting closure member or stopper 244 which in turn is attached to an axially extending push rod 246. This rod is of such length that when the reservoir 30 is put in place on the tank cover (FIG. 2), the lower end of the rod will engage the floor of the tank compartment 70 as indicated at 246a. In consequence, the stopper 244 is pressed away from the tapered opening 243a and liquid is free to flow into the cylinder 242 through a comparatively open connection. On the other hand, when the reservoir is moved away from the tank assembly (for refilling or otherwise), a compression spring 249 appropriately located at the lower end of the rod immediately pulls the stopper into closed position, thus permitting the reservoir to be lifted and turned into an upright position without loss of liquid. This feature is not new in itself and is not described as novel. However, at the lower end of the cylinder 242, there are provided novel means for controlling the release of liquid into the tank compartment 75. These means include in the first instance a cylindrical block 250 interfitted within the bore of the hollow cylinder 242. This block has a central opening for the rod 246 and two additional circular openings or holes 250a and 250b. The first of these receives a tubulation 252 which, in the illustrated orientation of the apparatus, extends downwardly below the intended level of the liquid 78 in the compartment 75 and provides a restricted outlet for liquid from the reservoir 30 into the compartment 75. The opening 250b

receives at its upper end, a second tubulation 254 which is crimped and closed at its upper extremity as indicated at 254a and which has in the sidewall of the crimped region a relatively small circular orifice 255. Through the opening thus provided, the liquid within the cylinder 242 is in communication with the main body of fluid in the tank compartment 75 not only through the tubulation 252 and the lower end of the opening 250b but also through a small passage provided by the bounding wall of a lateral orifice 256 which is located with its center line at the intended equilibrium level of the liquid pool 78. The effect of this arrangement is, first of all, that as long as a supply of liquid concentrate remains in the reservoir 30, the level of such liquid maintained in the receiving compartment 75 tends to stabilize at approximately the midpoint of the opening 256. That is to say, as long as the liquid pool 78 is at or above the stated level, the air inlet path provided to the container 30 through the still exposed part of the opening 256 is too restricted (by water surface tension or otherwise) to permit air bubbles to enter the enclosure 242. Accordingly, no air reaches the upper region of the container 30, and the partial vacuum maintained in that region prevents liquid from being released into the compartment 75, either through the tubulation 252 or through the lower end of the opening 250b.

However, once the displacement piston 200 (FIG. 2) has been lowered sufficiently to cause a significant amount of liquid concentrate to overflow into the mixing compartment and has thereafter been re-elevated by the weighted float 80 (i.e., upon the withdrawal of solution from the mixing compartment), the liquid remaining in the compartment 75 will (in the absence of replacement) fall below its original level. Once this begins to occur, the opening 256 will become fully uncovered, and a stream of small air bubbles will flow through the passages formed by and between the opening and the orifice 255 into the upper reaches of the container 30. In this way, the vacuum in the container will be broken, so that liquid may be released through the tubulation 252. This will continue until the liquid level in compartment 75 again reaches the midpoint of the opening 256, at which time air flow will cease and a new condition of stabilization will exist.

The liquid control system just described provides special advantages in avoiding large scale surges of rushing air and out-rushing liquid at any time. That is to say, the succession of small air bubbles which develops in the restricted path formed by the openings 256 and 255, taken in connection with the restricted liquid flow which can occur through tubulation 252, precludes the severe "glugging" effect often encountered in vacuum-controlled liquid feed systems. This in turn prevents the occurrence of perturbation or fluctuations in liquid level in compartment 75 sufficiently violent to cause liquid concentrate to slop over the wall surface 75b (FIG. 2) and thus to produce unpredictable variations in the proportions of the solution formed in compartment 70. It is believed sufficient for operability in this fashion that the openings 255 and 256 and the opening in tubulation 252 be specified as relatively small in proportion to the cross-section of the main passage within the cylinder 242. In a particular case good results have been obtained with a construction in which the cylinder 242 has an internal bore of about 1 inch, and the openings 252, 256, 255 and 250b measure

3/16 inch, 3/16 inch, 1/4 inch and 3/8 inch, respectively.

While the invention has been described by reference to a specific embodiment, it will be understood that numerous variations may be made by those skilled in the art. For example, it is believed that for operation with large liquid handling systems, the dimensions specified in the preceding paragraph can appropriately be scaled up proportionately. Also, while circular passages have been employed for convenience in manufacture, other shapes having comparable cross-sectional areas can alternatively be adopted. It is therefore intended in the appended claims to cover all modifications which fall within the true spirit and scope of the invention.

What is claimed is the following.

1. For use in a vacuum-controlled gravity-feed liquid dispensing system of the type in which a superposed reservoir supplies liquid to an underlying receptacle to maintain a relatively fixed level of liquid in the receptacle, an improved assembly for feeding liquid between the reservoir and the receptacle, said assembly comprising:

A. a main conduit of relatively large cross-section having at one end a comparatively open connection with the supply reservoir for both conducting air to the supply reservoir and for conducting liquid from the supply reservoir; and

B. means partially blocking the other end of said main conduit but providing

1. a first passage by which liquid flowing from the supply reservoir into said main conduit may be admitted to the receptacle at a point below the intended normal surface level of said liquid in the receptacle;

2. a second passage of relatively limited cross-section opening at a point below the intended normal surface level of liquid in the receptacle, said second passage defining

a. a first laterally directed orifice of relatively restricted cross-section communicating between the interior of said second passage and the interior of said main conduit to complete an open connection between a point below the intended normal surface level of liquid in the receptacle and the interior of the main conduit; and

b. a second laterally directed air admitting orifice of relatively restricted cross-section located to have its center line approximately at the normal surface level of the liquid and communicating with the interior of said second passage, so that a slight lowering of the liquid will admit air through the main conduit by successive movement through said second orifice, said second passage and said first orifice.

2. An assembly according to claim 1 in which

A. the main conduit is a hollow tubular member;

B. the said blocking means is a solid body conforming to the interior dimensions of the said tubular member;

C. the first passage comprises a first hole formed lengthwise through the solid body and terminating in a restricted outlet;

D. the second passage comprises a second hole formed lengthwise through the solid body, terminating at its upper end in means providing said first restricted orifice for the flow of air from the second hole into the main conduit.

3. An assembly according to claim 1 in which said means providing said first restricted orifice is a tubulation crimped and closed at its upper extremity having said first orifice in the region of the crimped enclosed upper extremity.

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