

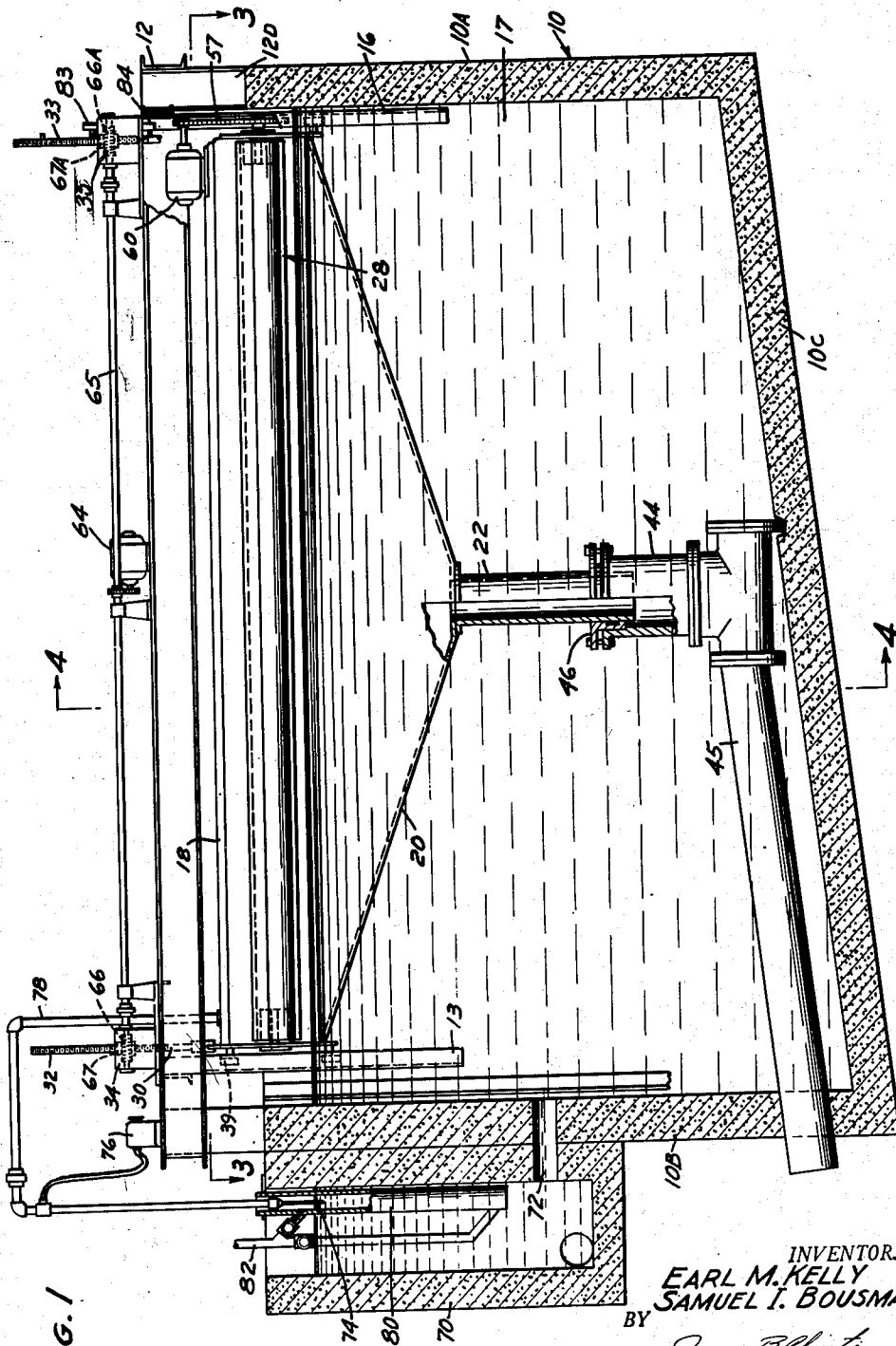
April 7, 1953

E. M. KELLY ET AL
VARIABLE LEVEL SKIMMER

2,633,989

Filed Nov. 3, 1949

2 SHEETS—SHEET 1



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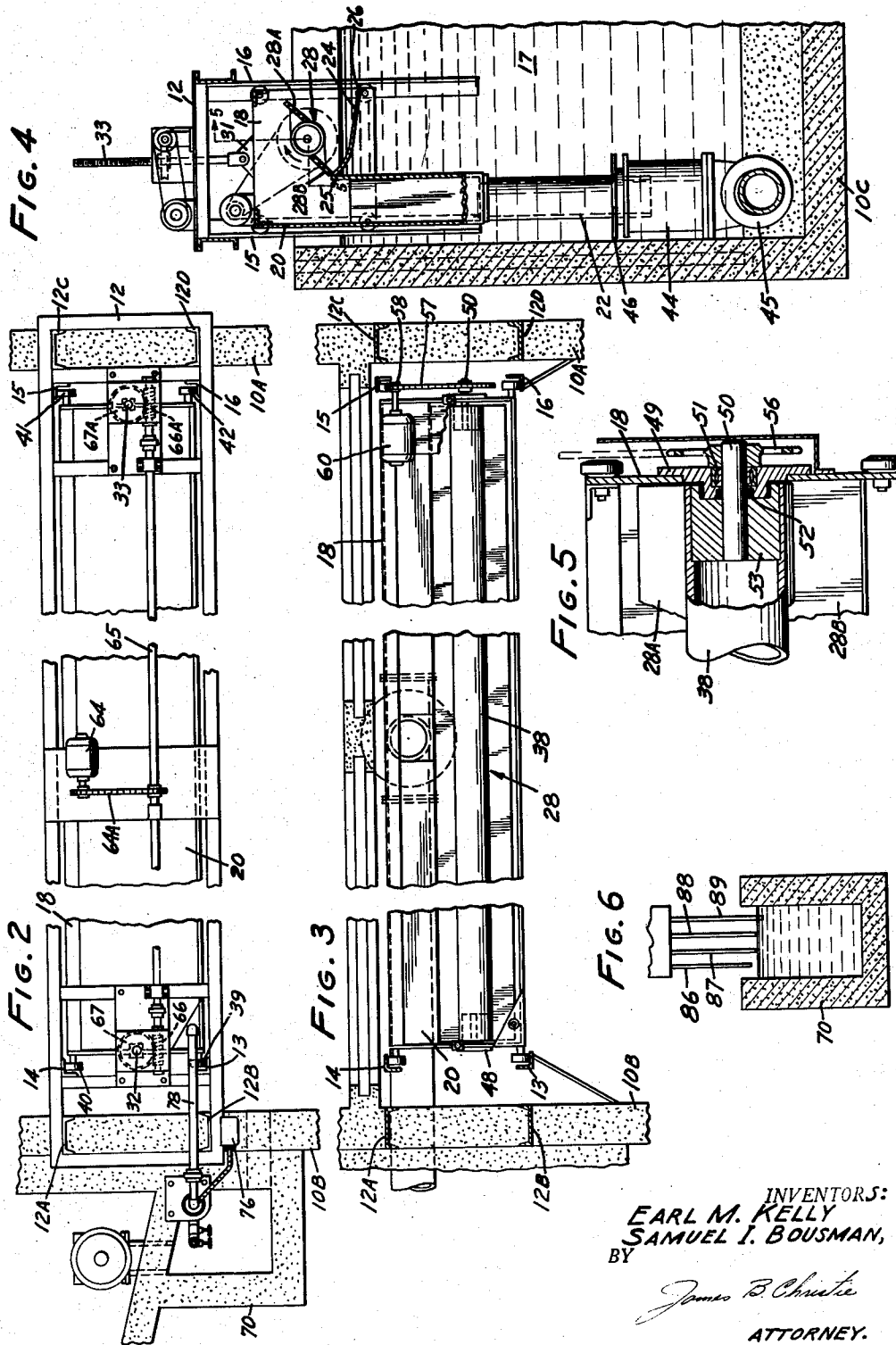
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UNITED STATES PATENT OFFICE

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VARIABLE LEVEL SKIMMER

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This invention relates to skimming apparatus of the type used to remove floating material such as scum, foam, and solid particles from a body of liquid. Usually such skimming apparatus is used on a body of liquid passing through an elongated basin or tank, often referred to as a skimming pond.

Conventional apparatus of this type generally consists of a trough and means, usually an elongated paddle, to urge the floating material up an inclined tray into the trough. The tray and trough form a so-called "overflow lip" where they meet above the liquid level and over which the skimmed material is discharged into the trough. Means are provided for removing accumulated scum, etc., from the trough. As the material, whatever it may be, is carried up the inclined tray above the level of liquid in the tank, any free liquid has opportunity to drain back into the main body before the material is carried over the overflow lip. In this manner liquid loss into the trough is held to a minimum.

When the character and quantity of floating material is relatively uniform and the liquid level substantially constant, the skimming apparatus may be pre-set to give optimum performance. But once so set, it is not possible in present skimmers to achieve any variation in placement of the overflow lip, based upon changes in quantity or character of floating material, and even more important, on the level of the liquid body. There is a need for an apparatus which will adjust itself responsive to changes in these operation variables. The circumstances giving rise to a need for such apparatus are frequently encountered in sewage treating plants where the volume of throughput varies over a considerable range at different times of year, and even during the course of a twenty-four hour period. In such installations, the design of the settling basins is often such that scum and other floating material accumulates on the surface. When the flow of liquid through these basins is uniform, it is a simple matter to remove the scum, etc., with conventional skimming apparatus. However, when the liquid level in such settling basins varies, such variation being frequently as much as several feet, the presently existing skimming apparatus is inoperative and remains so until the liquid returns to the level for which the apparatus is designed.

We have developed a skimmer, the position of which is adjustable to permit optimum operation even when comparatively large variations in liquid level are encountered. In accordance

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with our invention, we provide a skimmer for removing floating substances from a body of liquid comprising in combination a collecting trough, an inclined tray extending from a point beneath the level of liquid to the edge of a side-wall of the trough and terminating in an overflow lip, means for lifting the floating substances from the surface of the liquid up the inclined tray and discharging them over the overflow lip into the trough, and means for varying the elevation of the trough and inclined tray to maintain the overflow lip a predetermined distance above the liquid level.

In a preferred embodiment of the invention, automatic means are provided operative responsive to changes in liquid level to adjust the position of the trough, etc., to maintain a fixed pre-selected distance between the surface of the liquid and the overflow lip. In this preferred embodiment, the apparatus may operate continuously even while the liquid level is in the process of changing and hence, is not dependent upon steady conditions.

The invention will be more clearly understood from the following detailed description thereof taken in conjunction with the accompanying drawing in which:

Fig. 1 is a sectional elevation through a conventional skimming pond or settling basin with one form of the apparatus of the invention mounted therein;

Fig. 2 is a plan view of the skimming apparatus of Fig. 1;

Fig. 3 is a horizontal section taken on the line 3—3 of Fig. 1;

Fig. 4 is a sectional elevation taken on the line 4—4 of Fig. 1;

Fig. 5 is an enlarged sectional elevation taken on the line 5—5 of Fig. 4; and

Fig. 6 is a partial sectional elevation showing an alternative embodiment of the apparatus of Fig. 1.

In the drawing, the apparatus of the invention is shown installed in a concrete basin or channel 10 having sidewalls 10A, 10B and a bottom 10C inclined from wall to wall. A stationary rectangular supporting framework 12 is rigidly mounted across the basin, being supported above the sidewalls by legs 12A, 12B, 12C and 12D. Guides 13, 14 depend from the framework 12 adjacent one wall 10B and a like pair of guides 15, 16 depend from the framework adjacent the other wall 10A. The several guides 13, 14, etc., extend vertically downwardly from the support-

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ing framework 12 beneath the surface of liquid 17 in the channel.

A second or travelling framework 18 is suspended from the stationary framework in vertically adjustable relationship by lift screws 32, 33 affixed to hangers 30, 31, respectively. The lift screws are suspended from the stationary framework in vertically slideable relationship. The travelling framework is provided with a plurality of rollers 39, 40, 41, 42, etc., there being a total of eight such rollers placed at the eight corners of the framework and engaging in the guides 13, 14, 15, 16. The travelling framework may be raised or lowered with respect to the stationary framework by the lift screws. A trough 20 is fastened to the framework 18 extending substantially from side to side of the channel. The trough has a funnel-shaped bottom opening into a discharge line 22 (see Fig. 1). An inclined feeder tray 24 is fastened to the travelling framework and extends from end to end of the trough. One edge of the tray (which may be formed integrally with the trough) forms an overflow lip 25 with an edge of the trough (Fig. 4). The tray slopes outwardly and downwardly from the trough so that its opposite longitudinal edge 26 lies below the surface of the liquid in the basin (Fig. 4).

A skimmer structure 28 is rotatably mounted between end supports forming a part of the travelling framework and includes two elongated blades 28A, 28B, the outer edges of which slide along the tray 24 when the scraper is rotated to lift scum or other floating material from the surface of the liquid over the overflow lip 25 into the trough 20. The skimmer is rotatably journaled at either end in pillow blocks 48, 49 supported at the ends of the travelling framework. The arrangement is shown in detail in the enlarged sectional elevation of Fig. 5, wherein the pillow block 49 is fastened to the end member of the framework 18. A spindle 50 is journaled through a roller bearing 51 and a sealing gasket 52 in the pillow block. A bushing 53 is mounted on the inner end of a spindle 50 and a tubular hub 38 of the scraper 28 is mounted over the bushing 53. A sprocket 56 is affixed on the outer end of spindle 58 and is connected by a chain 57 to a sprocket 53 mounted on the drive shaft of motor 60. The motor 60 is mounted on the travelling framework so that operation of the skimmer is independent of the position of the travelling framework and may be carried on even though the travelling framework is in the process of adjustment.

The discharge pipe 22 of the scum trough 20 extends into a standpipe 44 connected to a drain pipe 45. The discharge pipe 22 is slideable in the standpipe through a packing gland 46, the depth of insertion of the pipe 22 in the standpipe being dependent upon the vertical position of the scum trough 20 (Figs. 1 and 4).

Preferably, the adjustment of the scum trough is made automatically responsive to the level of liquid in the basin so as to eliminate the error inevitably attendant upon manual control and to reduce the cost of operation. One means of automatic adjustment is shown in Figs. 1 and 2. A reversible motor 64 is mounted on the stationary framework and its drive shaft is connected by a conventional belt and pulley or chain and sprocket arrangement 64A to an elongated shaft 65. The shaft 65 is connected at its opposite ends through suitable gear means, as for example, the worm and worm gear combinations 66, 67 and 66A, 67A to raise or lower the lift screws 32, 33.

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One means of accomplishing this is shown in the drawing. The screws 32, 33 are threaded through the worm gears 67, 67A which are rotatably mounted in brackets 34, 35. Rotation of the worm gears responsive to rotation of the shaft 65 thus causes the lift screws to travel in one direction or the other with respect to the longitudinal axis of the gear. The threads on the two lift screws and associated worm gears are arranged so that rotation of shaft 65 will result in displacement of both lift screws in the same direction and by the same amount.

A stilling well 70 is provided adjacent a side of the channel 10 and is connected to the main body of liquid in the channel through a port 72 in the side of the channel. The liquid in the stilling well 70 will be at the same level as the liquid in the tank 10 but will be free of turbulence because of its relative isolation from the main body of liquid.

The operation of the motor 64 may be controlled responsive to the liquid level in the stilling well 70 in a number of ways. One such control means is shown in Figs. 1 and 2 and comprises a commercially available level controller 74 which is, in effect, a variable capacitor, the capacity of which varies as a function of the depth of immersion of the controller. As the liquid level in the stilling well varies, the capacity of the controller 74 varies proportionately and this variation in capacity is used to operate a relay or other electronic switch means (not shown) located in a control box 76 and connected to control the motor 64. The level controller 74 is mounted to travel with the travelling framework, for example, on the bracket arrangement 78. The arrangement is such that any desired position of the overflow lip with respect to the surface of the liquid in the basin may be maintained. The apparatus is set so that the capacity of the level controller at this pre-selected position renders the motor 64 inoperative. If the capacity of the level controller either increases or decreases from the pre-selected or steady-state capacity responsive to rise or fall of liquid level, the motor 64 will be energized to rotate the shaft 65 in the proper direction to raise or lower the travelling framework 38. The motor will continue to run until the system attains a position at which the steady-state capacity of the level control is again achieved.

In the particular embodiment shown in Fig. 1, the level control 74 is enclosed in a tubular jacket 80 extending into the stilling well 70, further protecting the level controller from minor fluctuations of liquid level which might result from wind or other factors tending to produce turbulence in the main body of liquid. A pipe manifold 82 is connected to the well 80 so that scum or other undesired accumulations may be flushed periodically out of the well.

The maximum travel of the scum trough, up or down, is established in the original design and limit switches 83 (Fig. 1) are provided to keep the movement within the design limits. The limit switches are connected to render the motor 64 inoperative so long as either is closed.

An alternative automatic control mechanism is shown in Fig. 6, which is a sectional elevation through the stilling well 70. This mechanism comprises a group of four electrodes 86, 87, 88, 89, arranged in pairs to control the raising or lowering of the travelling framework through operation of the motor 64. The electrodes 86, 87, when a circuit is closed therebetween operate the motor

to raise the travelling framework. To accomplish this, the electrode 86 terminates just above the liquid and the electrode 87 terminates in contact with the liquid. Any rise in the liquid level to contact electrode 86 closes a circuit between the electrodes 86, 87, energizing the motor 64 to raise the travelling framework and the electrode assembly to the point where the electrodes 86, 87 assume the same relative position to the liquid level as shown in the drawing. The electrode pair 88, 89 is arranged with the electrode 88 just contacting the surface of the liquid and the electrode 87 extending a short distance into the liquid. Any lowering of the liquid level breaks the circuit between these electrodes which circuit break is used to energize the motor 64 in the opposite direction to lower the travelling framework 38 and the electrode assembly to return electrodes 88, 89 to the relative position with respect to the new liquid level.

The automatic control system shown in Figs. 1 and 2 is preferred over that shown in Fig. 6 because of the simplicity, and it is not limited to use with conductive liquids as is the arrangement shown in Fig. 6.

Float switches or other liquid level responsive means may be used to initiate, through a suitable circuit, the operation of motor 64. The motor 64 may be operated automatically responsive to changes in liquid level as described, or may be operated from manually controlled switches. Automatic control is preferred because more sensitive and rapid response is obtained and the apparatus requires less attention. In either case, the motor 60, which drives the skimmer or scraper, is completely independent in its operation and if energized continuously, will continue to cause scum, etc., to be discharged into the trough 20 even while the trough and feeder tray are being raised or lowered to compensate for changes in liquid level.

In many instances, accumulation of scum, etc., is at such a rate that it is not necessary to operate the skimmer continuously. In one commercial installation, the operator has found that operation of the skimmer for a few minutes out of every hour or two is sufficient to remove the scum. However, between times, the trough, feeder tray, and skimmer move up and down as a single unit responsive to changes in liquid level and act as a scum dam. When scum accumulation again warrants operation of the skimmer, it will be in the correct position. Under these circumstances, a single operator will suffice for a number of installations since his only concern is with starting the scraper motor 60 when an accumulation of floating material develops.

To summarize, the trough is raised and lowered with the liquid level. It carries a sloping tray and a rotating skimmer which dips into the liquid level and pushes scum and other floating material up the sloping tray above the liquid level and over a lip into the trough. As the scum is pushed up the inclined tray, it has an opportunity to drain. The drained scum which is carried into the trough drains out through the standpipe connected with the bottom of the trough.

The trough-tray-skimmer assembly may be employed as a dam to collect scum in a channel until there is sufficient to warrant the rotation of the skimmer, which is driven by a motor mounted on the assembly.

The raising and lowering of the trough may be manual, for example, by substituting a hand wheel for the motor 64. Thus the lift screws

may be turned simultaneously in one direction to bring about raising or lowering of the trough. However, it is preferable to drive the lift screws with the motor and to control it automatically by means responsive to changes in the liquid level.

We claim:

1. Apparatus for removing floating materials from a body of liquid in a basin comprising a first framework stationarily mounted across and above the basin, a second framework suspended from and vertically adjustable with respect to the first framework, a trough affixed to the second framework for collection of said floating materials, an inclined tray extending from an edge of the trough downwardly and outwardly therefrom, an elongated paddle rotatably mounted on said second framework and positioned to engage against the upper surface of said tray during rotation, means mounted on said second framework for rotating the paddle, and means including a prime mover for raising and lowering the second framework with respect to the first framework.

2. Apparatus for removing floating materials from a body of liquid in a basin comprising a first framework stationarily mounted across and above the basin, a second framework suspended from and vertically adjustable with respect to the first framework, a trough affixed to the second framework for collection of said floating materials, an inclined tray extending from an edge of the trough downwardly and outwardly therefrom, an elongated paddle rotatably mounted on said second framework and positioned to engage against the upper surface of said tray during rotation, means mounted on said second framework for rotating the paddle, and means including a prime mover for raising and lowering the second framework with respect to the first framework to maintain the upper edge of the tray a fixed distance above the surface of said body of liquid.

3. Apparatus for removing floating materials from a body of liquid in a basin comprising a first framework stationarily mounted across and above the basin, a second framework suspended from and vertically adjustable with respect to the first framework, a trough affixed to the second framework for collection of said floating materials, an inclined tray extending from an edge of the trough downwardly and outwardly therefrom, an elongated paddle rotatably mounted to said second framework and positioned to engage against the upper surface of said tray during rotation, a motor mounted to said second framework for rotating the paddle, means including a prime mover for raising and lowering the second framework with respect to the first framework and means including a liquid level follower for controlling said prime mover responsive to variations in liquid level to maintain the upper edge of the tray a fixed distance above the surface of said body of liquid.

4. Apparatus for removing floating materials from a body of liquid in a basin comprising a first framework stationarily mounted across and above the basin, a second framework suspended from the first framework by lift screws and vertically adjustable with respect to the first framework, a trough affixed to the second framework and opening into a vertically adjustable discharge manifold, an inclined tray extending from an edge of the trough downwardly and outwardly therefrom and forming an overflow lip with the

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trough, an elongated paddle rotatably mounted to said second framework and positioned to engage against the upper surface of said tray during rotation to scrape floating materials up the tray into the trough, means mounted to said second framework for rotating the paddle, and means including a prime mover and a liquid level follower for raising and lowering the second framework with respect to the first framework to maintain the overflow lip a fixed distance above the surface of said body of liquid.

5. Apparatus according to claim 4, wherein the prime mover comprises a reversible motor, and means connecting the motor to said lift screws so that rotation of the motor shaft is translated into simultaneous raising or lowering of said lift screws.

6. Apparatus for removing floating materials from a body of liquid in a basin comprising a first framework stationarily mounted across and above the basin, a second framework suspended from the first framework by lift screws and vertically adjustable with respect to the first framework, a trough affixed to the second framework, a drain pipe in the bottom of the basin, a discharge pipe opening into said trough and into said drain pipe, the discharge pipe being affixed to the trough and vertically slideable in the drain pipe, an inclined tray extending from an edge of the trough downwardly and outwardly therefrom and forming an overflow lip with the trough, an elongated paddle rotatably mounted to said second framework and positioned to engage against the upper surface of said tray during rotation, means mounted to said second framework for rotating the paddle, a reversible motor mounted on said first framework and mechanically connected to raise and lower said lift screws in unison, and control means including a liquid level follower for controlling said motor responsive to variations in the level of liquid in the

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basin to maintain the overflow lip a fixed distance above the surface of the liquid.

7. Apparatus according to claim 6, wherein said liquid level follower comprises a stilling well adjacent the basin and connected to the basin below the surface of the liquid in the basin, and electrical means disposed in contact with the liquid in the stilling well for actuating said motor responsive to variation in liquid level in the stilling well.

8. Apparatus according to claim 7, wherein said electrical means is mounted to said second framework to move vertically in the stilling well responsive to vertical motion of said second framework.

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