Jan. 10, 1939. A. J. WEINIG 2,143,669

LIQUID LEVEL REGULATION APPARATUS

Filed March 1, 1935 2 Sheets-Sheet 1

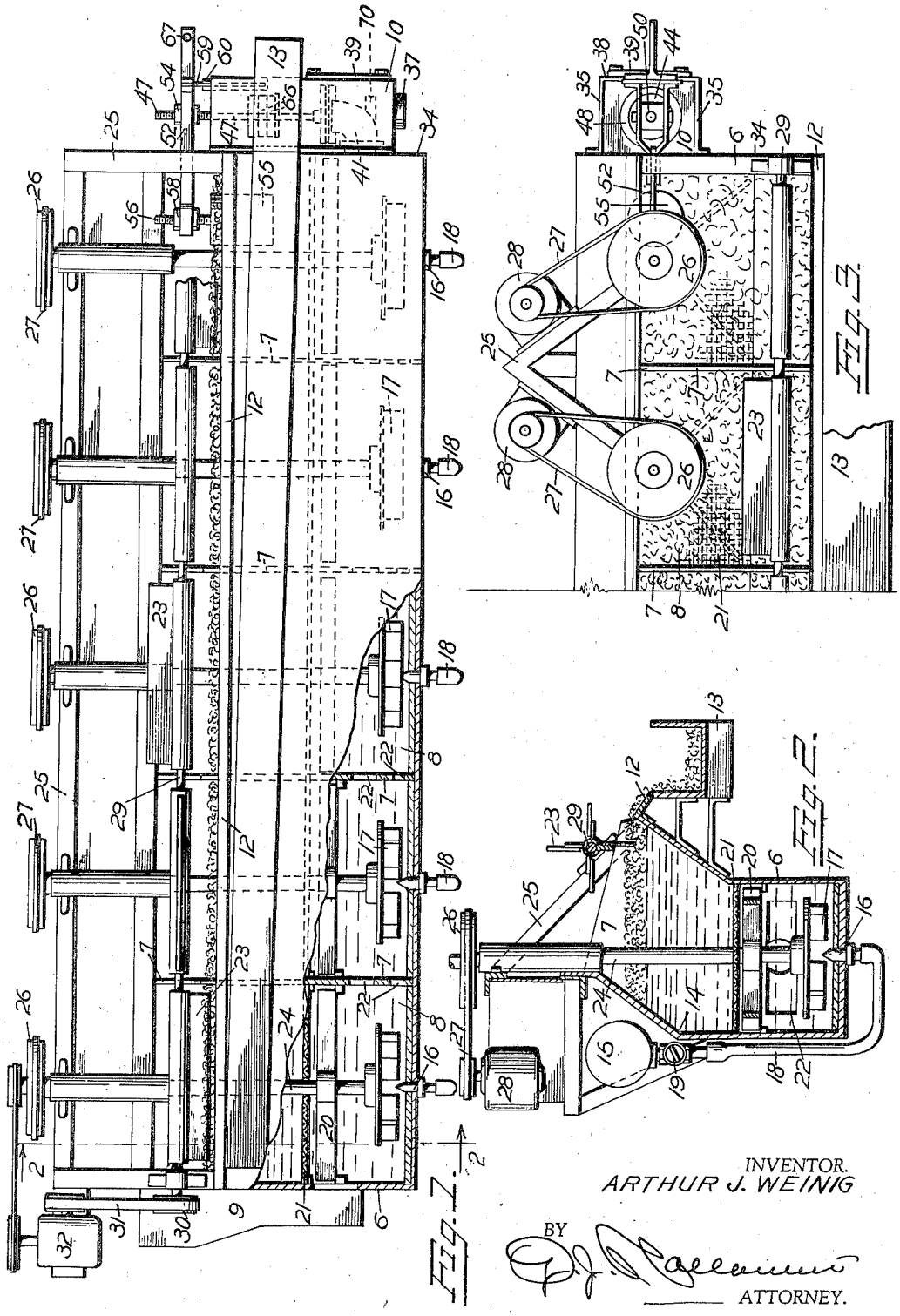


Fig. 3.

Fig. 2.

Fig. 1.

INVENTOR.
ARTHUR J. WEINIG

BY

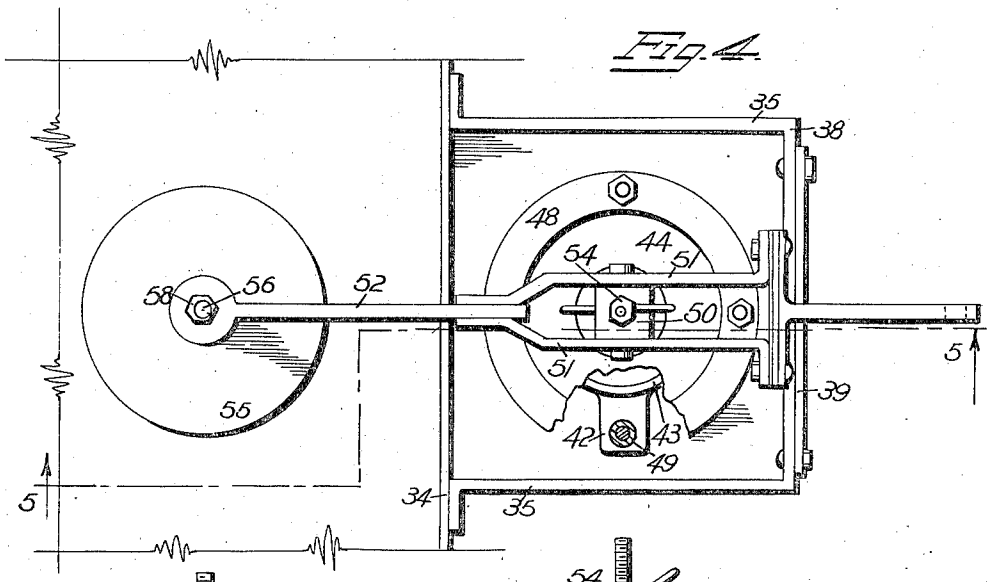
ATTORNEY.

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Filed March 1, 1935 2 Sheets-Sheet 2

Fig. 4



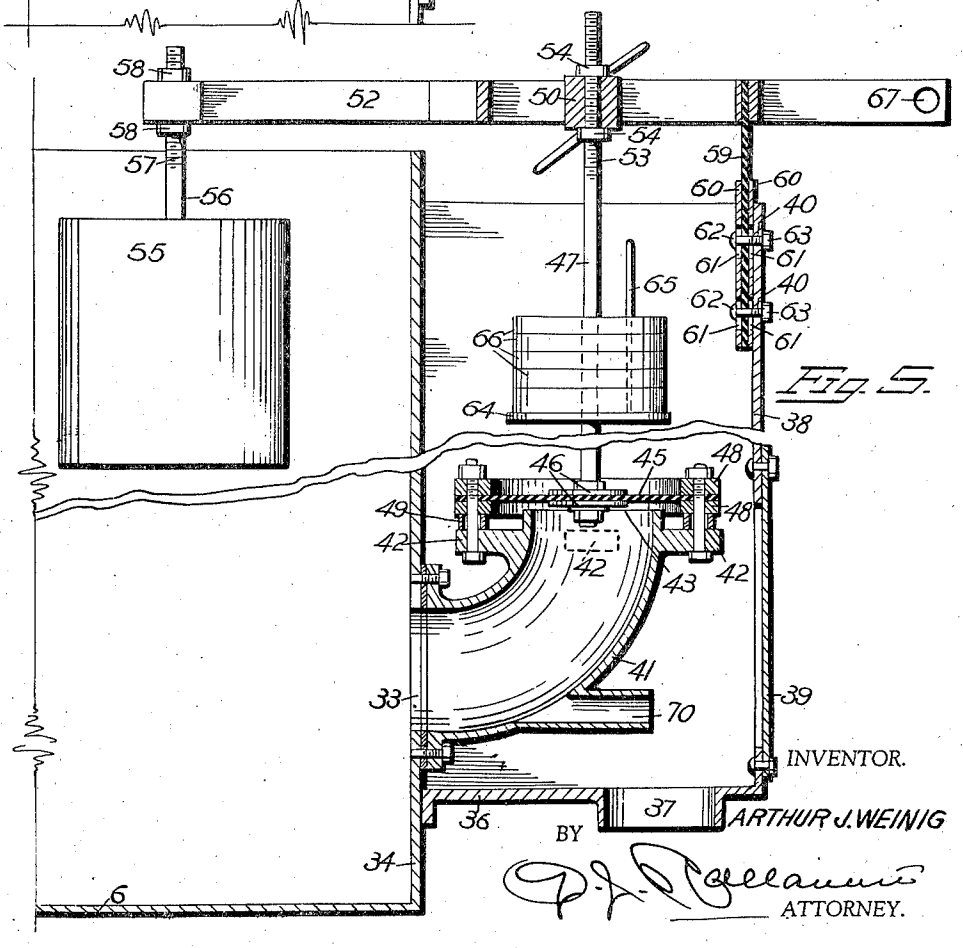


Fig. 5.

INVENTOR.
ARTHUR J. WEINIG
BY
ATTORNEY.

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UNITED STATES PATENT OFFICE

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LIQUID LEVEL REGULATION APPARATUS

Arthur J. Weinig, Golden, Colo., assignor, by mesne assignments, to Morse Bros. Machinery Company, Denver, Colo., a corporation of Colorado

Application March 1, 1935, Serial No. 8,946

8 Claims. (Cl. 137—68)

My invention relates to a means for regulating the level of a body of liquid, and more particularly to the liquid level regulation of a multi-cell flotation machine, subject to a continuous feed and discharge.

It is an object of the present invention to provide a regulating device which may be initially adjusted to establish a normal liquid level and which operates automatically thereafter to vary the rate of discharge from a liquid body in response to fluctuations in feed, to thereby maintain a substantially constant liquid level.

Heretofore in the art, various regulating means have been employed. An adjustable weir is probably the most common form of level regulating device for flotation machines at present in commercial usage. While weir regulation has worked very well in practice, it has a tendency to promote the deposit and building up of sediment, particularly when treating gritty pulps, which results in clogging the machine.

Also, weir regulation is not responsive to minor fluctuations in the liquid level, and as a consequence, the elevation of the froth layer with respect to the froth overflow is almost constantly changing, and froth of varying quality is discharged across the overflow.

The desideratum in froth flotation operations is to maintain a froth layer of uniform depth in order that a selective percentage only of the froth may be removed and by maintaining the percentage removed constant, a concentrate of uniform quality is obtained.

Another object of my invention is to effect a removal of froth of uniform quality in the flotation treatment by controlling the liquid level.

Still another object of my invention is the provision of a discharge control which is counterbalanced with respect to hydrostatic pressure in the liquid body, and which is actuated by any variation from the balance.

A further object of the invention is to provide a control device which is simple and durable in construction, positive and noiseless in operation, and which is resistant to friction and corrosion.

Other objects of the invention reside in novel details of construction and novel combinations and arrangements of parts as will more fully appear in the course of the following description.

Referring to the drawings in the several views of which similar parts have been similarly designated,

Figure 1 is a front elevation, partially in section of a muti-cell flotation machine to which the present invention has been applied,

Figure 2 is a section taken along the line 2—2, Figure 1,

Figure 3 is a plan view of the last two cells and discharge compartment of the machine illustrated in Figure 1,

Figure 4 is an enlarged plan view of the regulating device of the flotation machine illustrated in Figure 1, with a portion of a diaphragm broken away to show the overflow passage, and

Figure 5 is a section taken along the line 5—5, Figure 4.

As illustrated in Figure 1, a flotation machine comprising a tank 6, divided by partitions 7 into a series of cells 8 is provided at one end, with a feed compartment 9, and at its opposite end with a discharge compartment 10.

A froth overflow lip 12 extends along one side wall of the tank 6, and a launder 13 beneath the lip 12 receives the overflowing froth. The wall of the tank 6 opposite the overflow lip 12 is bent inwardly at 14 below the normal froth level and acts as a froth-crowder.

A header 15 connected with a source of compressed air (not shown) extends along a side of the tank 6.

Each cell 8 is provided with an air inlet 16 beneath an impeller 17, and a flexible conduit 18 delivers air to the inlet from the header 15. If desired, regulating valves 19 may be provided for varying the quantity of air supplied to each cell.

A baffle-element 20 is disposed in each cell above the impeller, and a grid 21 extending across the cell above the baffle-element 20 defines zones of agitation and separation in each cell.

The partitions 7 have openings 22 near their lower ends providing passages which permit the direct flow of material under treatment from cell to cell, and are particularly effective in preventing excessive accumulation of non-floated gangue in the respective cells.

A rotary froth skimmer or paddle 23 is mounted near the overflow lip 12 of each cell and moves the froth toward the overflow lip.

A convenient driving assembly for the moving parts of the machine has been illustrated in Figures 1, 2 and 3.

The impellers 17 are mounted for rotation on shafts 24 depending from a superstructure 25 supported above the tank 6. Pulleys 26 are mounted on the upper ends of shafts 24 and connected by belts 27 or other suitable means with motors 28 on the superstructure.

The skimmers 23 are mounted on a shaft 29 journaled on superstructure 25 and extending lengthwise of the tank 6. One end of shaft 29 extends beyond the tank, and a pulley 30 is mounted on the extended end of the shaft.

The pulley 30 is driven by a motor 28, through the intermediary of a belt 31, or any other suitable means, and reduction gearing contained in a housing 32 on superstructure 25 in operative connection with one of the motors. Since the driving assembly is of conventional construction, detailed description of its component parts appears unnecessary. It will also be understood that while the machine illustrated is a motor-driven type, the invention is operative regardless of what sort of driving mechanism is employed.

The only tailings outlet for the machine illustrated in Figure 1 is provided by an orifice 33 in an end wall 34 of the tank 6 opening into the discharge compartment 10.

The compartment 10 which is open at its upper end, preferably consists of side walls 35 fitted on the end wall 34 of tank 6, a bottom 36 having an outlet 37, and an end wall 38.

In its lower portion, end wall 38 is apertured to provide a service entrance, which is normally covered by a removable plate 39, and bolt-holes 40 are provided in its upper surface for a purpose hereinafter explained.

An elbow 41 fitted over the orifice 33 serves as an upwardly ranging conduit for tailings discharging through the orifice. A series of radial ears 42 extend from the upper wall of elbow 41, and the upper end of the conduit is smoothed to provide a valve seat 43.

A valve 44 movable relative to seat 43 controls the discharge from the conduit 41. This valve comprises a flexible diaphragm 45 held between plates 46 mounted on a rod 47. At its circumferential edge, the diaphragm 45 is clamped between a pair of rings 48, fastened on ears 42. One or more spacer rings 49 may be mounted on ears 42 to elevate the clamping rings 48 and thereby the diaphragm 45 relative to valve seat 43, which is the tailings overflow of the machine.

The rod 47 depends from a block 50 pivotally carried between bifurcations 51 of a lever 52. The rod 47 is threaded at 53 and adjusting nuts 54 bearing against block 50 permit adjustments of the rod relative to the block.

One end of lever 52 overhangs the tank and a float 55 mounted on a rod 56 depending from the overhanging end of the lever 52 is disposed within the tank 6. The rod 56 is also threaded at 57 and nuts 58 bearing against lever 52 permit its lengthwise adjustment for predetermining the liquid level in the tank.

The lever is flexibly supported on end wall 38 of the discharge compartment by means of a strip 59 of flexible material, preferably rubber, which is held between two plates 60 bolted on end wall 38.

Slots 61 in plates 60 are disposed to register with bolt-holes 40, and bolts 62 inserted through bolt-holes 40 and slots 61 serve to hold the strip against movement relative to the plates by tightening of nuts 63.

The slots 61 permit movement of the plates 60 relative to the end-wall 38, and by this means, the degree of flexibility of strip 59 may be varied, as an increase in the distance between the ends of plates 60 and lever 52 will increase the flexibility of strip 59, and a decrease in the distance between the plates and the lever will decrease its flexibility.

A seat 64 on rod 47 supports an upright pin 65 and provides a rest for removable weights 66. The discharge end of conduit 41 is at an elevation considerably lower than the normal liquid level as determined by the position of the float 55, and as a result, the diaphragm 45 is subjected to considerable hydrostatic pressure.

The combined weight of the lever 52, rod 47 and weights 66 is directed against the diaphragm 45 to counterbalance the hydrostatic pressure in the conduit 41, so that the volme of liquid discharging therefrom is equivalent to the volume of feed entering the tank at the inlet 9.

Once this balance has been established by placing the proper amount of weight on seat 64, and by minor adjustment of rod 47, the control will operate automatically thereafter. The lever 52 is also apertured at 67 to permit suspension of an additional weight, if such an arrangement is required to facilitate balancing of the control.

Variations in feed, however slight, are communicated to the float 55 and thence to the diaphragm 45 through the lever 52 and rod 47. If more than a normal amount of feed enters the tank, float 55 rises, causing rod 47 to move diaphragm 45 farther away from the seat 43, and if the feed is subnormal, the float descends in the tank and rod 47 moves diaphragm 45 toward or against seat 43.

In Figures 1 and 5, the elbow 41 has been illustrated as having a tailings discharge spout 70 in its lower portion. Whenever the coarse sands do not rise and discharge freely across valve seat 43, it is advisable to maintain this spout open, to prevent any excessive accumulation of tailings at the discharge outlet.

With many pulps, however, the coarse sands will readily pass through the valve, and under such conditions the spout 70 may be plugged in any convenient manner, a screw cap for example, and all tailings will be discharged across valve seat 43.

It will be understood that the machine will operate substantially the same whatever arrangement is employed. When spout 70 is open, the valve 45 is not opened as wide as it would be with the spout closed, but when the initial regulation is effected, the operation is automatic thereafter.

From the foregoing it is apparent that a normal liquid level having once been established, the control will vary the effective size of the discharge orifice so that no more liquid can escape from the tank than is fed into the same, and when the spout 70 is closed, this condition exists even though the feed to the machine is entirely stopped.

This results in maintaining a uniform liquid level in the tank, and as a consequence, the froth layer is not subject to variations in elevation relative to the overflow lip 12. In this way it is possible to retain in the machine, froth at a selective depth below the top of the layer and to discharge across the overflow only concentrate of uniform quality.

The provision of a flexible mounting for the lever 52 insures noiseless operation, as well as resistance to friction and corrosion due to inherent qualities of the material from which the strip 59 is made.

In this connection however, it will be understood that the diaphragm valve of the present invention is readily applicable to flotation ma-

chines of all types, and may be used to regulate the level in one or more cells of the machine.

For example, in most machines the pulp is not passed directly from cell to cell, but it is directed into a conduit or passage as it leaves a cell, by which it is directed to the impeller of the next cell in the series. Where construction of this type is employed, the diaphragm valve structure may be applied to the conduit outlet from any selective cell to control the level in such cell.

In the flotation of ores, it is frequently desirable to employ a number of cells for "roughing" and the remaining cells of the same machine for a cleaning operation. In such an operation it may be necessary to have the liquid level in one series of cells at a different elevation than the level in the remaining cells of the machine. For such requirements, one diaphragm valve may be used to regulate the level of the "rougher" cells, and another diaphragm valve may be used to control the level in the cleaning cells.

These applications of the invention will be readily understood by anyone skilled in the art, and detailed description and illustration of the same appears unnecessary.

Features described but not claimed herein have been made the subject matter of claims in my copending application, Serial No. 105,280, filed October 12, 1936, for Flotation process.

Changes and modifications may be availed of within the spirit and scope of the invention as defined in the hereunto appended claims.

What I claim and desire to secure by Letters Patent is:

1. The combination with a tank having a discharge compartment and a discharge outlet in said compartment providing a valve seat, of a discharge control device comprising a lever, a float depending from the lever in the tank, a flexible fulcrum for the lever on a wall of the compartment, a rod on the lever, a diaphragm on the rod, and means for holding the diaphragm against lateral movement relative to the valve seat.

2. The combination with a tank having a discharge compartment and a discharge outlet in said compartment providing a valve seat, of a discharge control device comprising a lever, a float depending from the lever in the tank, clamping plates on a wall of the compartment, a flexible fulcrum for the lever held between the clamping plates, a rod on the lever, a diaphragm on the rod, and means for holding the diaphragm against lateral movement relative to the valve seat.

3. The combination with a tank having a discharge compartment and a discharge outlet in said compartment providing a valve seat, of a discharge control device comprising a lever, a float depending from the lever in the tank, clamping plates on a wall of the compartment, a flexible fulcrum for the lever held between the clamping plates, a rod on the lever, a diaphragm on the rod, and means for holding the diaphragm against lateral movement relative to the valve seat, the clamping plates being adjustable relative to the lever for varying the degree of flexibility of the lever.

4. The combination with a tank having a discharge compartment and a discharge outlet in said compartment providing a valve seat, of a discharge control device comprising a lever, a float depending from the lever in the tank, complementary clamping plates having alined slots, a flexible fulcrum for the lever held between the clamping plates, adjustable means extending through the slots for fastening the plates in selective positions on a wall of the compartment, a rod on the lever, a diaphragm on the rod, and means for holding the diaphragm against lateral movement relative to the valve seat.

5. Flotation apparatus comprising a tank having a feed inlet and having a discharge outlet providing a valve seat, and a control device for regulating the discharge of material from the tank, comprising a lever, a float carried by the lever and disposed within the tank, a flexible fulcrum for the lever, a rod on the lever, a diaphragm on the rod, and means holding the diaphragm in operative connection with the discharge outlet.

6. Flotation apparatus comprising a tank having a feed inlet and having a discharge outlet providing a valve seat, and a control device for regulating the discharge of material from the tank, comprising a lever, a float carried by the lever and disposed within the tank, a flexible fulcrum for the lever, means for varying the degree of flexibility of the fulcrum, a rod on the lever, a diaphragm on the rod, and means holding the diaphragm in operative connection with the discharge outlet.

7. In level-regulating apparatus, the combination with a diaphragm valve, of lever-mechanism for flexing the diaphragm, including a lever, and a flexible fulcrum held on a rigid support in supporting relation to the lever.

8. In level-regulating apparatus, the combination with a diaphragm valve, of lever-mechanism for flexing the diaphragm, including a lever, rigid clamping plates supported adjacent the lever, and a flexible fulcrum held between the clamping plates in supporting relation to the lever.

ARTHUR J. WEINIG.