Oct. 6, 1925. 1,556,083

A. C. DAMAN

FLOTATION MACHINE

Filed Oct. 18, 1923 3 Sheets-Sheet 1

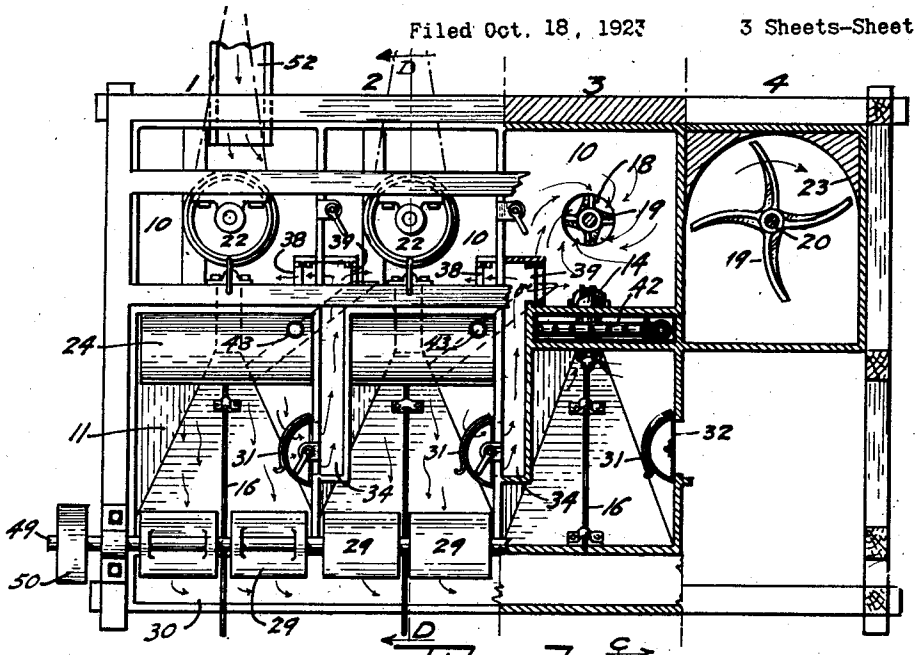


Fig 1

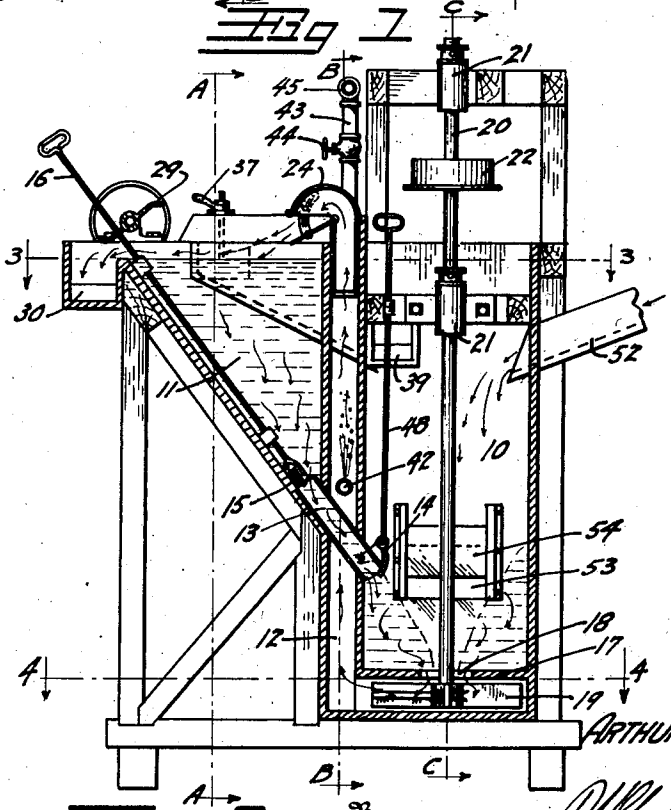


Fig 2

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Filed Oct. 18, 1923 3 Sheets-Sheet 2

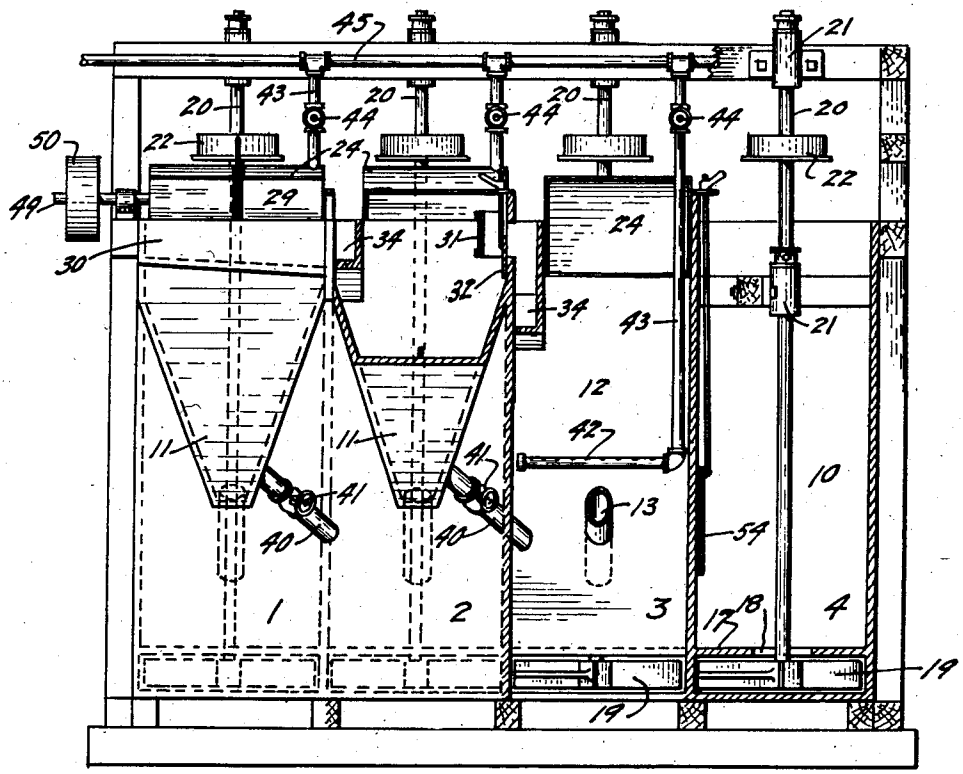


Fig 3

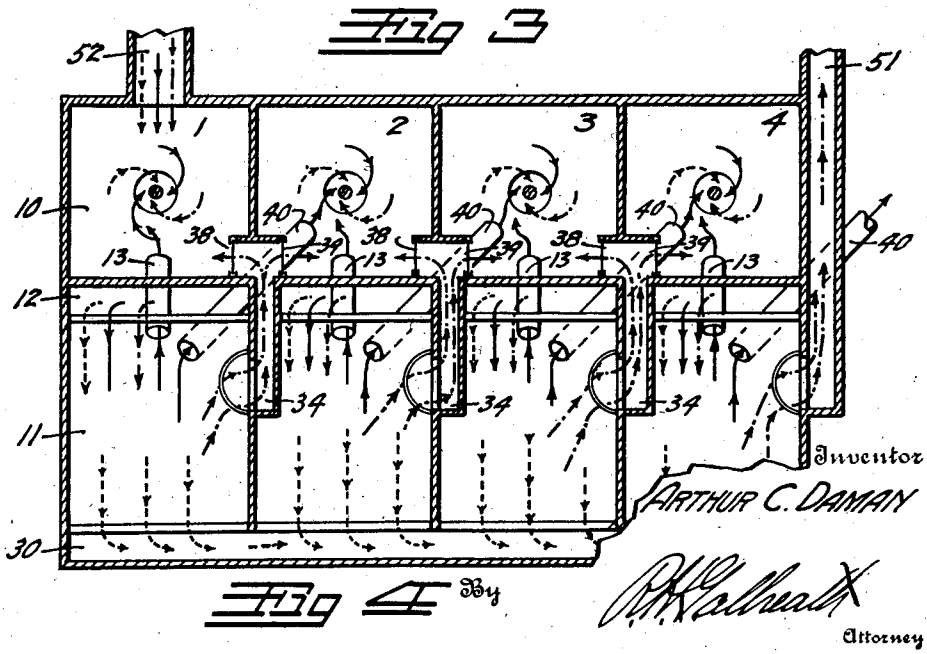


Fig 4

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FLOTATION MACHINE

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3 Sheets-Sheet 3

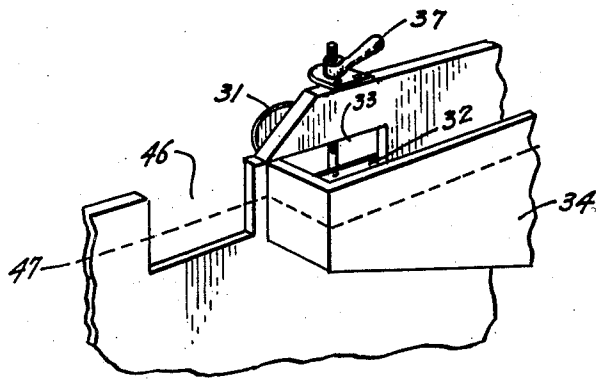


Fig 5

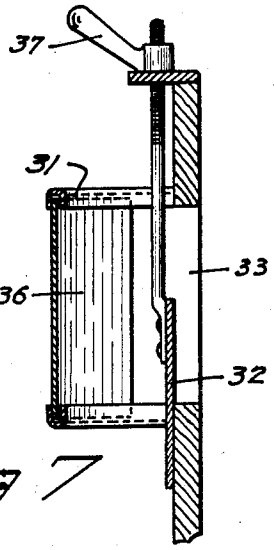


Fig 7

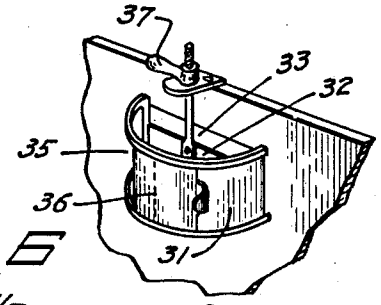


Fig 6

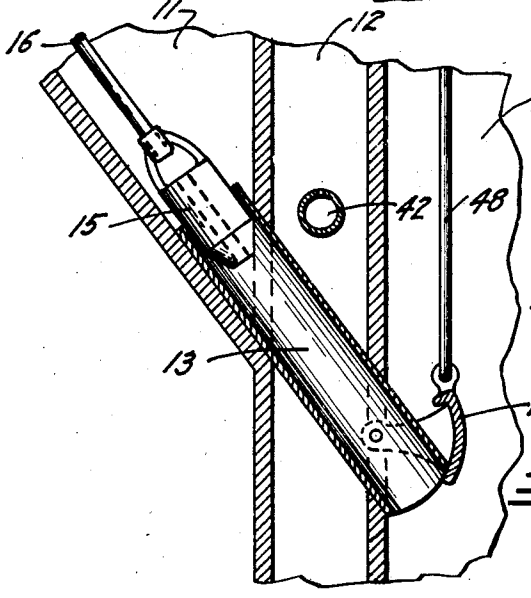


Fig 8

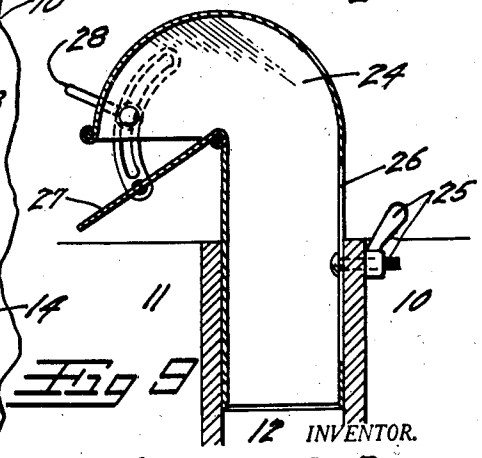


Fig 9

INVENTOR.

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Patented Oct. 6, 1925. 1,556,083

UNITED STATES PATENT OFFICE.

ARTHUR C. DAMAN, OF DENVER, COLORADO.

FLOTATION MACHINE.

Application filed October 18, 1923. Serial No. 669,326.

To all whom it may concern:

Be it known that I, ARTHUR C. DAMAN, a citizen of the United States, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Flotation Machines, of which the following is a specification.

This invention relates to flotation machines of the type in which emulsification, aeration, agitation and flotation of the pulp is accomplished within a single unit machine.

In the art of concentrating the mineral values of ore by the process of flotation it has been found that it is much more difficult to separate the fines or slimes than it is the coarser material or sands and that, in order to recover the values from the slimes, the entire pulp content must be subjected to several stages of retreatment.

The principal object of the present invention is to provide a machine in which any portion of the pulp (more particularly the slimes) may be subjected to retreatment without it being necessary to retreat the entire pulp content of the machine. In this machine the slimes may be repeatedly passed through a given cell and given an extended treatment while the sands are independently passed directly after treatment to the next cell or to the tailings.

Another important object of the invention is to so construct the machine that the feed chamber will be materially lower than the frothing and settling chamber so that the tailings from each cell will flow by gravity into the feed chamber of the next succeeding cell—the difference in elevation being made great enough so that the pulp feeding back into the feed chamber will fall or cascade, thereby assisting in the agitation and aeration.

Other objects are:

To provide a machine of this character in which the pulp will be agitated and emulsified and forced in sheet like form upon the surface of the liquid in the frothing chamber by an independent mechanical impeller for each cell, said impellers being so arranged that there will be no stuffing boxes or other wearing surfaces below the pulp line;

To provide means whereby the height from which the pulp is discharged upon the surface of the liquid can be regulated and adjusted;

To construct a machine in which a part or all of either the settling gangue, overflowing tailings, or suspended concentrates, from each flotation chamber may be passed for retreatment through the same cell or bypassed for further treatment to the next cell, and to provide means for making any of these adjustments independently;

To provide means whereby the gangue and tailings from each cell will be efficiently and thoroughly re-emulsified and re-aerated before again being passed to the flotation chamber and in which fresh flotation agents may be added before each re-emulsification;

To provide a machine in which the flotation chambers of each cell can be put into open communication at the froth line to allow a free flow of froth from cell to cell and maintain a uniform liquid level throughout the machine;

To provide means for causing the liquid level in the feed chambers to be lower than that of the flotation chambers so that the surface level in the flotation chambers will not be effected by any variation of level in the feed chambers;

To provide means for adding air to the pulp in addition to that provided by the vortex of the impeller.

Other objects and advantages reside in the detail construction of the invention which result in simplicity, economy and efficiency and which will become more apparent from the following description.

In the following detailed description of the invention reference is had to the accompanying drawings which form a part hereof. Like numerals refer to like parts in all views of the drawings and throughout the description.

In the drawings:

Fig. 1 is a plan view of a four cell embodiment of the invention, the cells being numbered from left to right 1, 2, 3, and 4, respectively,—cell 3 being shown in section taken on the line 3—3, Fig. 2, and cell 4 being shown in section taken on the line 4—4, Fig. 2.

Fig. 2 is a vertical cross section taken on the line D—D, Fig. 1.

Fig. 3 is an elevation of the froth dis-

charge side of the invention, partly in section, the sections being taken as follows: Cell 2, line A—A, Fig. 2; cell 3, line B—B, Fig. 2; cell 4, line C—C, Fig. 2.

Fig. 4 is a flow diagram of the machine, the direction of flow being shown by the arrows. The dotted arrows indicate the mineral or concentrate, the dash-dot arrows the fines or slimes; and the solid line arrows the coarse or sands.

Fig. 5 is a detail view of one of the cell partitions showing how it might be cut away to allow free passage between flotation chambers at the froth line.

Fig. 6 is a detail view of the weir guard used in the invention.

Fig. 7 is a vertical section through the weir guard shown in Fig. 6.

Fig. 8 is a detail cross section of the gangue return passage.

Fig. 9 is a detail cross section through the froth deflector.

The machine may comprise any desired number of cells, four being shown. Each cell comprises a feed chamber 10 separated from a froth chamber 11 by means of a lift chamber 12. The sides and bottom of the froth chamber 11 depend inward to a semi-pointed bottom against the wall of the lift chamber 12. An oblique sand discharge pipe 13 connects the bottom of the froth chamber with the feed chamber 10. A hinged gate valve 14 provided with an operating rod 48 controls the opening of the pipe 13 in the chamber 10, and a plug 15 controls the opening thereof in the chamber 11. The plug 15 is operated by means of an operating rod 16, by means of which the plug may be forced entirely through the pipe 13 to clear it, should it become clogged.

The feed chamber 10 is provided with a false bottom 17, having a concentric opening 18, and beneath which is arranged an impeller 19. Impeller 19 is carried on the extremity of a shaft 20, which is supported in the feed chamber in bearings 21, and which is provided with a belt pulley 22 by means of which it is driven. It will be noted that all bearings on the impeller shaft 20 are above the flow of the pulp so that they will not be injured by sand and grit.

That part of the feed chamber below the false bottom 17, is in open communication with the lift chamber 12 at one side and is rounded at the opposite side as shown at 23, Fig. 1, to conform to the throw of the impeller 19. The lift chamber 12, terminates at its upper extremity in a froth deflector 24, shown in detail in Fig. 9, which telescopes into the upper opening of the lift chamber 12. The froth deflector may be raised or lowered as desired, by sliding it in and out of the lift chamber, and is held at any desired height by means of a thumb nut and bolt 25 which travels in a slot 26 in the froth shield 24. The froth deflector 24 is provided with a hinged apron 27 which may be adjusted, by means of a thumb screw 28, to regulate the angle of incidence between the pulp and the surface of the liquid.

Revolving froth scrapers 29, secured to a common shaft 49, driven by means of a belt pulley 50, are provided along the outer edge of the froth chamber 11 for scraping the floating froth into a launder 30, which carries the concentrates from the machine.

The overflow from each cell passes under a weir guard 31, over an adjustable gate 32, through a weir opening 33 in the intercell partition and into a return trough 34. The weir guard 31 is of special construction having an opening 35 which may be adjusted by means of a sliding gate 36, so as to allow a portion of the surface flow to pass thru the weir opening 33. The height of the weir gate 32 may be adjusted by means of thumb nut 37 so as to maintain the pulp level at any desired point.

The weir overflow from the final cell in the series is carried away in a tailings launder 51. The return trough 34 grades downward to the feed chambers 10, and is provided with two gate controlled outlets, one outlet 38, for returning the pulp to the previous feed chamber and one outlet 39, for passing the pulp to the feed chamber of the next succeeding cell.

Connecting the lower part of each froth chamber 11 with feed chamber 10 of the next succeeding cell, is a diagonal bypass pipe 40, controlled by a valve 41, which serves to pass a portion of the sand directly to the next succeeding cell. The pipe 40 from the last cell of the series carries the sand away to the tailing dump.

A perforated air pipe 42 is positioned in each lift chamber 12, and fed from a riser 43, which is controlled by a valve 44. The risers 43 are fed from a common air main 45 above the machine.

In some installations of the machine it is preferred to have an open cell to cell flow at the froth line in the froth chambers 11, thereby allowing the suspended material to flow directly from one frothing chamber to the next, without being again agitated and aerated, and serving to maintain an even liquid level throughout the entire machine. To accomplish this an opening 46, (see Fig. 5) is formed in the intercell partition between each froth chamber extending below the liquid level (shown in broken line at 47) of the cells.

In operation the pulp is fed into the feed chamber of the first cell through a launder 52. The necessary reagents are also fed into the feed chamber. The impeller 19 immediately sets the mass to whirling around the shaft 20, and forms a vortex, as shown in

broken lines in Fig. 2, into which the whirling pulp and air is sucked through the opening 18 into the impeller chamber below the false bottom 17. It will be noted that the feed chambers are rectangular, the whirling mass of pulp being violently and constantly brought against the flat sides of the chamber causing a very violent agitating and mixing action, which results in bringing the mineral particles into intimate contact with the reagents, and the suspended air particles, making an efficient emulsion of the entire mass.

The pulp is forced from the impeller by centrifugal force up the lift chamber 12, where additional air may be added, if necessary, by the perforated pipe 42. Practically no pressure need be maintained in the pipe 42, since the air does no lifting of the pulp. The pulp in rapidly moving past the pipe creates a partial vacuum above the pipe that will draw out the air. This feature results in a great saving in power since a high air pressure is unnecessary.

The pulp with its entrapped air flows into the deflector 24, and is deflected onto the surface of the liquid in the froth chamber in a wide sheet.

Successful flotation depends upon a delicate balance of small forces. The angle at which the mineral particles are presented to the surface of the water must be just right in order to insure maximum flotation. In this invention not only the angle of the presented froth may be changed, but the height from which the pulp is dropped, may be adjusted in order to obtain just the proper balance to separate the class of ore being treated.

The froth with its suspended mineral flows across the froth chamber and is scraped into the launder 30 by the scrapers 39.

The sand settles to the bottom and may be all returned to the feed chamber of cell No. 1, for retreatment, through the pipe 13, or a portion by-passed to the feed chamber of cell No. 2 through the pipe 40.

The slimes remaining suspended in the solution pass into the trough 34, and may be all returned to the feed chamber of cell No. 1 for retreatment, through the outlet 38, or a portion may be allowed to pass to cell 2, thru the outlet 39.

The action in the remaining cells is of course similar to that of cell 1 described.

If a test discloses the slime tailings to still contain an appreciable amount of values, the gates 38 are opened and the gates 39 closed until the proper recovery from the slimes is obtained.

If a test discloses the sands in the earlier cells to be practically barren, the pipes 13 are closed by the plugs 15 and the values 41 opened, to speed up the passage of the sands through the machine. This results in a decided increase in efficiency since it rapidly removes the gangue, and worthless material and leaves the machine free to operate only on the mineral bearing pulp.

Openings 53, provided with gates 54, are formed in the inter cell partitions, between the feed chambers 10. Should it be desired to shut down any cell, the valve 14 is closed, and impeller 19 stopped, and the gates 54 opened. The feed chamber will now fill to the openings 53, and the material from the preceding cell will flow through the feed chamber to the next succeeding cell without disturbing the action of the remaining cells.

Should it be found in certain ores that the concentrates are not clear, the slides 36 of the weir guards 31, may be opened slightly to allow a percentage of the concentrate in each cell to flow back to the feed chambers and be subjected to retreatment. This will result in an increase in the value of the concentrate.

While a specific form of the improvement has been described and illustrated herein, it is desired to be understood that the same may be varied, within the scope of the appended claims, without departing from the spirit of the invention.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent is:—

1. A flotation machine comprising in combination a feed chamber; a froth chamber, said feed chamber extending below said froth chamber; a lift chamber, said lift chamber being interposed between said feed chamber and said froth chamber, and feeding onto the top of the latter; a passage feeding back by gravity from the bottom of said froth chamber to said feed chamber; a false bottom in said feed chamber having a concentric opening, said feed chamber being open to said lift chamber below said false bottom; a shaft supported above said feed chamber and extending vertically through said opening and an impeller secured on said shaft below said false bottom for forcing pulp into said lift chamber.

2. A flotation machine comprising in combination a feed chamber; a froth chamber, said feed chamber extending below said froth chamber; a lift chamber, said lift chamber being interposed between said feed chamber, and said froth chamber, and feeding onto the top of the latter; a false bottom in said feed chamber having a concentric opening, said feed chamber being open to said lift chamber below said false bottom; a shaft supported above said feed chamber and extending vertically through said opening and an impeller secured on said shaft below said false bottom for forcing pulp into said lift chamber.

3. In a flotation machine comprising a series of cells each consisting of a feed chamber, a lift chamber and a froth chamber, the

combination of a passage in each cell communicating with the froth chamber near the solution level and opening to the feed chamber of that cell and to the feed chamber of next adjacent cell and having gates controlling the feed chamber openings.

4. In a flotation machine comprising a series of cells each consisting of a feed chamber, a lift chamber, and a froth chamber, the combination of a trough in each cell communicating with the froth chamber near the solution level and opening to the feed chamber of that cell and to the feed chamber of next adjacent cell and having gates controlling the feed chamber openings; a passage in each cell connecting the bottom of the froth chamber with the feed of that cell and a second passage connecting the bottom of said froth chamber with the feed chamber of next adjacent cell, said passages having gates controlling their openings.

5. In a flotation machine, a froth chamber; a weir in the wall of said chamber; an open bottomed weir guard arranged in front of said weir and extending below the liquid surface in said chamber there being an adjustable opening in said guard arranged to control the surface flow to said weir.

In testimony whereof I affix my signature.

ARTHUR C. DAMAN.