July 4, 1933. J. V. SLADE 1,916,392

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Filed Nov. 18, 1930 2 Sheets-Sheet 1

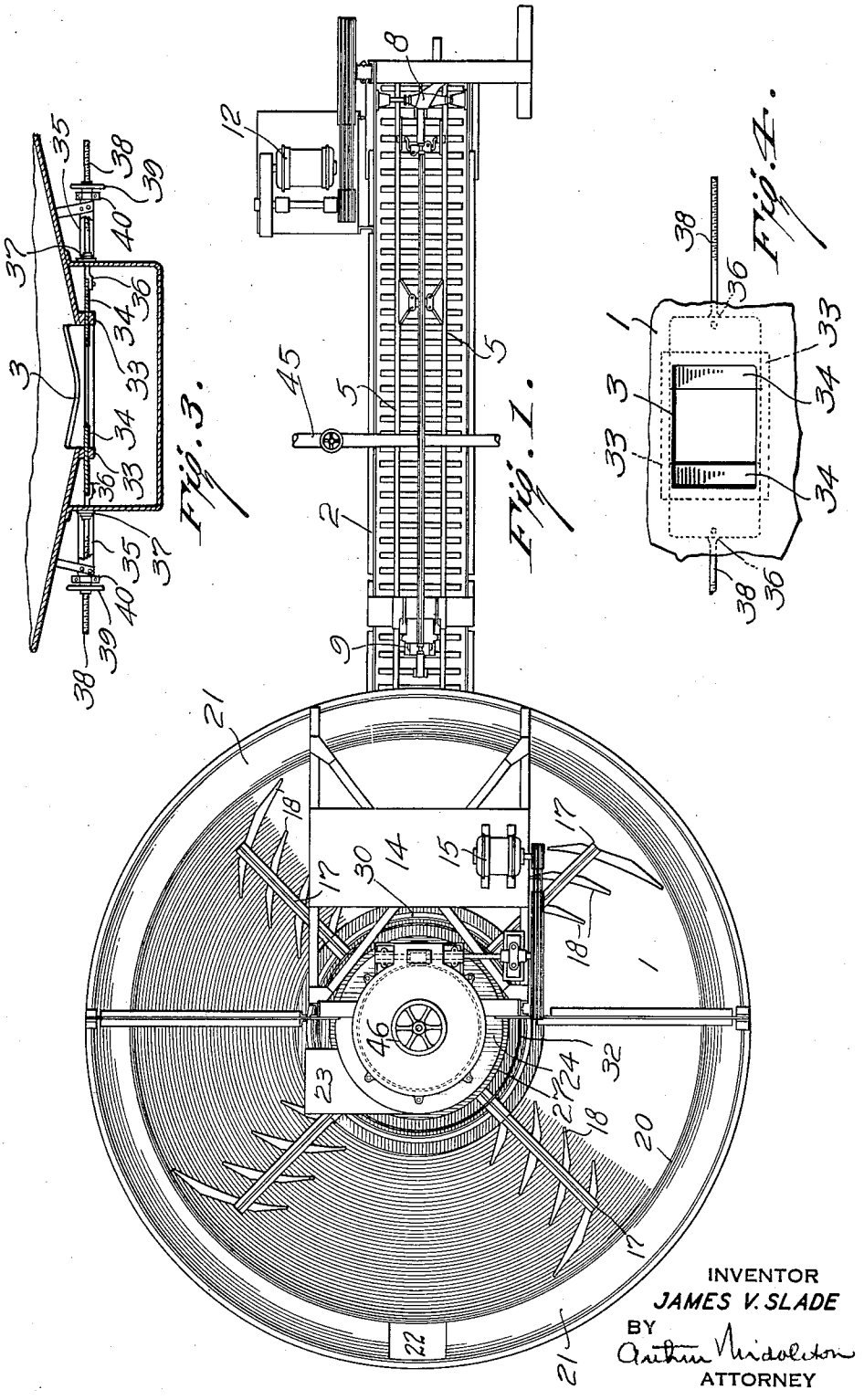


Fig. 1.

Fig. 2.

Fig. 3.

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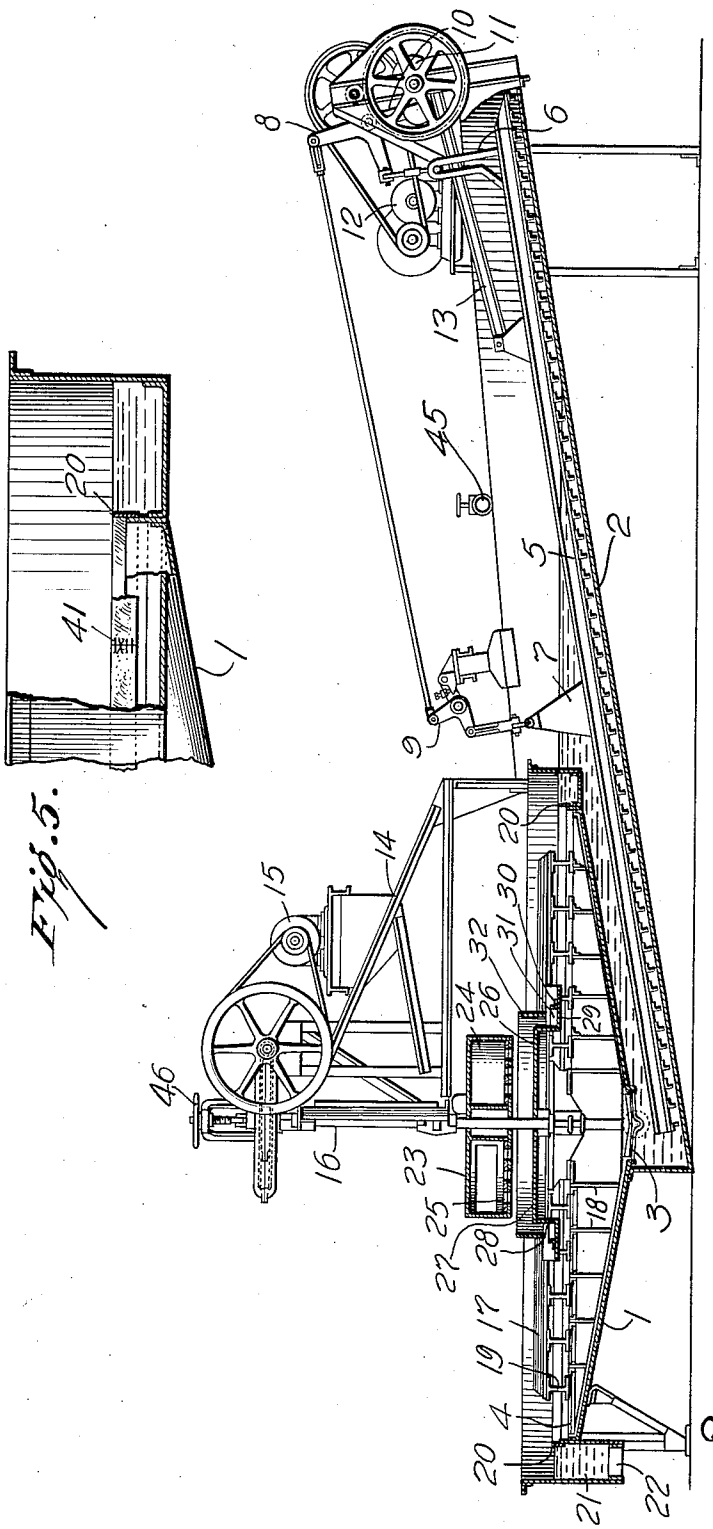


Fig. 2.

Fig. 5.

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UNITED STATES PATENT OFFICE

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CLASSIFIER

Application filed November 18, 1930. Serial No. 496,403.

This invention relates to classifiers, and more particularly to that type of classifier intended to perform a classifying or sorting operation of particles of mixed sizes or different specific gravities or both by permitting the particles or part of them to settle in a fluid. The general type of classifier forming the basis of the invention is shown and described in United States Letters Patent 1,292,237 issued January 21, 1919, to Blomfield.

For better comprehension of the invention and realization of the problems involved and solutions presented hereinafter, attention is first invited to several basic principles affecting material classification.

If a mixture of various particles or particles of different specific gravity be introduced in a fluid, the larger or heavier will sink more rapidly than the finer or lighter ones. This action will be referred to as classification under free settling conditions. Agitation of the solution will tend to keep the finer particles in suspension, but where the agitation is not too vigorous the coarser particles will continue to settle. If the settling particles be subjected to an upflow or rising current the settling velocities of the particles will be reduced in proportion to the intensity of the upflow. By regulating the upflow, a very exact division can be made between the finer particles which will not sink because of the upward velocity of the fluid and the coarser particles which do sink. This action is termed classification under hindered settling conditions. In the application of this principle to classifiers of the type shown in said Patent 1,292,237, the upflow of the fluid is produced from a secondary compartment to a primary chamber through a constricted opening. By passing the upflow through the constricted opening, the velocity is greatest at the opening, so that the finer particles are not only carried up into the primary chamber but are retained in suspension therein so as to ultimately pass over a weir provided for exit of the fluid from the primary chamber. The size of the particles overflowed with this outgoing fluid is a function of the settling velocities of such particles. Collaterally, the size, quantity and character of the particles in the overflow are functions of the disturbing influences affecting both the free settling conditions and the hindered settling conditions in the primary chamber or bowl.

One of the problems affecting proper and efficient classification is the irregularity of or spasmodic introduction into the bowl of material to be classified. The present invention seeks to improve the proper and efficient classification by obtaining an equalization of introduction of the materials, that is, attempts to approach as nearly as possible the ideal condition of a steady flow. Again, the invention seeks to obtain a flow of entering material with minimum ripple and disturbing currents and yet with the material introduced at the surface of the fluid so as to have maximum depth for settling purposes.

A further difficulty with the usual hydromechanical classifiers arises from the fact that the primary chamber permits particles of certain intermediate size to settle and pass to the secondary compartment where that size may not be permitted to settle and is returned for reclassification. As a result, the density of the fluid in the vicinity of the constriction builds up, thereby altering the hindered settling condition and the upflow, not only causing oversize particles to escape with the outflow over the weir from the primary chamber, but also tending to clog the rake. The invention looks to the provision of a structure properly balancing the settling conditions of the two chambers and regulating the upflow from the secondary compartment to the primary chamber.

With the specific problems mentioned above in view and with the objects already stated in mind, with other objects and advantages as may more clearly appear in the following description, one embodiment of the invention is illustrated in the accompanying drawings, in which like numerals of reference indicate similar parts throughout the several views and in which;—

Figure 1 is a plan of a classifier constructed in accordance with the present invention;

Figure 2 is a longitudinal central sectional view of the same;

Figure 3 is an enlarged portion of Figure 1 showing the gates and adjusting means;

Figure 4 is a plan of the portion of the bowl shown in Fig. 3, showing the gates partly open.

Figure 5 is an enlarged view partly in section showing the arrangement of the weir.

In the specific embodiment of the inven-

tion illustrated in said drawings, the basic construction shown provides two settling tanks identified as primary settling chamber 1, and secondary settling compartment 2, respectively, the two being connected by a constricted opening 3. Both tanks have mechanical rakes, the rake or sweep 4 in the primary chamber 1 impelling the settled material toward the constricted opening 3, whereas the bladed rake 5 in the secondary compartment 2, impels the settled material therein up the inclined bottom of compartment 2 and into any suitable receiving means. This general assembly just described is old in the art.

As the secondary compartment and associated parts are in most part likewise old in the art, a brief outline thereof will suffice herein. Secondary compartment 2 is in the form of an inclined trough in which a mechanically operated reciprocating bladed rake 5 actuates settled material upwardly with a step by step motion. The rake is carried by two hangers, 6, 7, one, as 6, near the discharge end and the other, 7, toward the lower end, both hangers being supported by interconnected bell cranks 8, 9 respectively, the upper one, 8, of which has a rocker lever 10 depending therefrom for actuation by a cam 11 driven through suitable reduction gears by a motor 12. This structure obtains an offsetting movement of the entire rake toward and away from the bottom of the trough. Reciprocation of the rake is obtained by a crank-operated pitman 13, this reciprocal movement, combined with the offsetting movement, resulting in an orbital movement by which the materials settling on the bottom of the trough will be intermittently dragged up the incline with a step by step motion.

The primary chamber 1 may also include certain parts as heretofore used including a circular bowl construction with a bottom sloping downwardly toward the center wherein is provided the constricted opening 3 to the secondary compartment directly below. Above the bowl or chamber 1, is a superstructure 14, upon which is carried a motor 15 which actuates a longitudinally adjustable vertical shaft 16 through suitable driving connections. This shaft is axially disposed with respect to the bowl and carries the rake 4 at the lower part of the shaft, thereby rotating said rake by virtue of direct connection between said parts.

Heretofore it has been common practice to construct the rakes with the scrapers all of substantially the same height, in other words, with the top of the rake substantially parallel to the bottom of the tank along the line where the rake overlies the tank bottom, and below the surface level of the fluid in the bowl. In the present invention, however, the rake provides rake arms 17, not only perpendicular to the shaft but positioned above the normal surface level of the fluid in the chamber. As is usual with devices of this type, the rake has blades or scrapers 18 at acute angles with respect to radial planes from the shaft, said scrapers having bottom edges closely adjacent to the bottom of the bowl so as to scrape the settled material toward the center of the bowl. In the present showing, the blades or scrapers nearest the middle of the bowl are of greater height than the blades nearest the outer edge of the bowl, the intervening blades from the innermost to the outermost being progressively shorter than the next preceding blade. In other words, blades are proportionate in height to the depth of the fluid in the bowl thereby obtaining greater agitation where the fluid is the deepest and less agitation where the fluid is more shallow. The agitation, thus proportionate to the depth of the fluid, is more evenly distributed as a result of which the finer particles are kept in suspension throughout the content of the bowl and excessive agitation near the periphery of the bowl or surface of the solution is avoided. The construction shown provides blades of such length that all of the upper edges of the blades are in a common plane, and are of such a height that the plane of the upper edges is below the surface level of the solution in the bowl.

The blades 18 are each carried by a bracket 19 depending from the arm 17 of the rake. Preferably there is a separate bracket for each blade, and obviously part of the bracket is above the solution for attachment to the arm of the rake whereas the lower part of each bracket is below the surface of the solution for carrying the blade. The bracket will accordingly obtain a restricted evenly distributed slight surface agitation of the solution, this feature being deemed an important feature of the present invention, and it is for this reason that it is preferable to utilize a separate bracket for each blade. It is to be noted that the brackets are each shown to be a short length of I-beam construction providing upper and lower flanges and a vertical web portion. The length of the I-beam brackets are arranged transverse to the rake arms, each bracket preferably having a length substantially the width of said arm. This construction makes the webbing of the brackets tangential to the circle or orbit of revolution thereof and therefore the surface strata of the solution will be cut only by the edge of the bracket and will not suffer any material lateral displacement. The cutting action is found to obtain a very desirable although relatively slight agitation in the surface strata. By reference to the drawings it will be observed that the solution is permitted to escape or have its outflow around the entire circumference of the bowl over a

circumferential weir 20. The height of this weir is in a plane which intersects the webbing of the several brackets. The escaping solution passing over the weir enters a spillway or launder 21 which slopes downwardly around the bowl toward one end of the same so as to discharge the solution through a single outlet 22 as will be understood by those skilled in the art.

Another important feature is the vertical adjustment of the rake arm 17 by means of the wheel nut 46 and the threaded end of the vertical shaft 16. This adjustment permits variation of the depth of submergence of the rake blades 18 to a considerable extent. Such adjustment is permissible without bringing the rakes above the liquid level and depends upon the vertical length of the supporting and surface cutting elements 19.

It is further to be noted that the length of the surface cutting elements 19 in the general direction of travel, may be large or small, according to the desired length of the intermittent periods of interruption of outward flow of material near the liquid level.

As shown more clearly in Fig. 5, the weir 20 is rendered adjustable in height by constructing it in the form of a band of rubber belting fitted tightly around the rim of the bowl shaped settling tank 1 and laced at the meeting ends as indicated at 41. The strip of belting is preferably first cut to a size to fit snugly around the rim of the chamber 1, then laced tightly together at its ends to form a continuous band which is stretched over the rim and tapped down to the required elevation. It is thus possible to accurately level the edge of the weir and adjust its height independently of the other parts of the mechanism.

Entry of the material under treatment is obtained substantially at the top middle part of the bowl, the same being shown as introduced through a supply passage 23 to an equalizing or feed well 24. Said equalizing well is shown circular and the supply passage 23 is shown introduced thereinto at one side in a substantially tangential direction so that the entering material will have a swirling action to immediately spread itself entirely around the equalizing well. The bottom of the well is perforated, as at 25, for retarded escape of the material therethrough onto a distributing plate 26 positioned thereunder. This distributing plate is shown as having a middle portion 27 which is at least as large in diameter as the well and shoulders off, as at 28, at its periphery to a lower level providing a peripheral flange or apron 29 in a plane parallel to the said middle portion 27. The specific construction shown is such that the middle portion 27 of the distributing plate is carried upon the upper edges of the radial rake arms and the edge shoulder 28 is a circular band properly cut away to pass the said rake arms and extending downwardly below the said arms and also below the plane of the weir 20, thus positioning the apron 29 below the surface of the solution in the bowl. However, this submersion of said apron 29 is not to any great depth and preferably is only very slightly below the surface. Spaced radially outwardly from the shoulder and extending around the same is an upstanding entry weir 30 secured to the outwardly directed apron and thereby providing in association with the said apron 29 and shoulder 28 of the central plate an annular launder 31 from which the material to be treated can escape around the entire periphery over the entry weir 30.

Above the launder 31 is positioned a baffle ring 32, this ring being opposite the raised or central portion of the plate and depending partway down the shoulder 28 in spaced relation therefrom thus confining the material in its passage from the equalizing well 24 to the launder 31 and preventing escape of said material in any direction except over the entry weir. By this construction the entering material is spread over a considerable area and enters the bowl at a material distance from the center thereof so as not to interfere in any way with the up-flow through the constricted opening 3 in the bottom and center of the bowl. As shown, the apron 29 extends outwardly beyond the position of the weir so that the flow of the entering material will have a direct tendency to move the same radially outward and will avoid down currents from spilling over the weir directly into the bowl. The settling particles from the entering material obviously will come to the bottom of the bowl a distance from the constricted opening 3 and therefore the downflow of particles through the constricted opening will be at the edges of the constricted opening and none in the middle of the opening, thus giving the upflow free passage in the area beneath the distributing plate. This flow is caused mainly by the back wash supplied to the secondary compartment through conduit 45 from a suitable source of supply.

As shown in Figures 2, 3 and 4 more particularly, the constricted opening 3 of the bowl is at the lowermost point of the bowl, it being noted that the bottom of the bowl tapers toward its center as a result of which said constricted opening is both at the middle and lowest part of the bowl. Failure of a classifier to function properly is frequently due to accumulation of material in the secondary compartment below the said constricted opening. This accumulation may be ascribed, possibly to the theory that certain particles are of such a size or specific gravity that they are allowed to settle in the primary chamber, but are kept in suspension in the secondary chamber and therefore will not be raked out.

However, much of this material if returned to the primary chamber will pass over the overflow or discharge weir. It is therefore a feature of the present invention to obtain means for adjustably regulating the upflow of material or the velocity of the upflow. By such a regulation, much material will be kept in the primary chamber which belongs there but which is so near the critical size or specific gravity as to be influenced by the down current. In the present invention it is preferred to provide means to regulate the upflow velocity by adjusting the size of this constricted opening. For this purpose suitable guides 33 are used at opposite sides of the said opening for receiving horizontal gates 34 slidably mounted in said guides. Any suitable operating means may be provided to both slide the gates and to hold them in adjusted position. Illustrative of this feature of the invention, is shown a slide bar 35 for each gate connected at its inner end, as at 36, to the gate and passing outwardly through the side of the secondary compartment 2 through an appropriate stuffing box 37. This arrangement enables the slide bar 35 to be reciprocated without loss of any of the fluid contents of the compartment. The outer end of the slide bar 35 is screw threaded as at 38, and a hand-wheel 39 is carried upon this threaded end of the slide bar. By suitably anchoring the hand-wheel 39 against movement in a direction longitudinally of the slide bar, but permitting said wheel to be rotated, the said rotation will obviously actuate the slide bar longitudinally depending which way the hand-wheel is turned. Any desired means may be employed for thus anchoring the hand-wheel, as by providing a peripheral groove in its hub and providing an inwardly projecting part from the bar support 40 to engage in the groove as will be understood by those skilled in the art.

Obviously detail changes and modifications may be made in the construction and use of the classifier, and it is not to be understood that the invention is restricted to the exact details of construction or modes of operation herein described except as set forth in the following claims when construed in the light of the prior art.

Having thus described the invention, I claim:—

1. In a classifier, means for equalizing flow of material to the classifier, a distributing plate for receiving the materials, said plate having an edge over which the materials may fall into the classifier, a baffle opposite the said edge of the plate and spaced therefrom and an apron below said edge of the plate for receiving the material and preventing the falling material from setting up a downward current in the classifier.

2. In a classifier, means for equalizing flow of material to the classifier, a distributing plate for receiving the materials, said plate having an edge over which the materials may fall into the classifier, a baffle opposite the said edge of the plate and spaced therefrom, an apron below said edge of the plate for receiving the material and preventing the falling material from setting up a downward current in the classifier, and a weir on said apron over which the material may flow in a direction toward the periphery of the classifier.

3. In a classifier, means for equalizing flow of material to the classifier, a distributing plate for receiving the materials, said plate having an edge over which the materials may fall into the classifier, a baffle opposite the said edge of the plate and spaced therefrom, an apron below said edge of the plate for receiving the material and preventing the falling material from setting up a downward current in the classifier, and a weir on said apron over which the material may flow in a direction toward the periphery of the classifier, said plate and apron having a shoulder connection for preventing flow of material in any direction except over the weir.

4. In a classifier, means for equalizing flow of material to the classifier, a distributing plate for receiving the materials, said plate having an edge over which the materials may fall into the classifier, a baffle opposite the said edge of the plate and spaced therefrom, an apron below said edge of the plate for receiving the material and preventing the falling material from setting up a downward current in the classifier, and a weir on said apron over which the material may flow in a direction toward the periphery of the classifier, said apron extending beyond the weir so as to prevent down currents by the material passing over the weir.

5. Classifying apparatus provided with substantially circular feed well, a feed inlet conduit arranged tangentially thereto whereby feed issuing from said conduit is caused to swirl circumferentially in said feedwell, and a plurality of outlets from said feedwell arranged at right angles to the plane of the swirling feed.

6. Classifying apparatus having a secondary raking classifier compartment, a primary sedimentation chamber superposed thereon and communicating therewith, rakes for conveying solids settling in said chamber to said compartment, and means for rendering uniform the mixture overflowing from said chamber comprising a combined weir partly rigid and partly flexible.

7. Apparatus according to claim 6 in which the flexible part of said combined weir is adjustably held to said rigid part by tension.

In testimony whereof I affix my signature.

JAMES V. SLADE.