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CONTINUOUS SETTLING DEVICE

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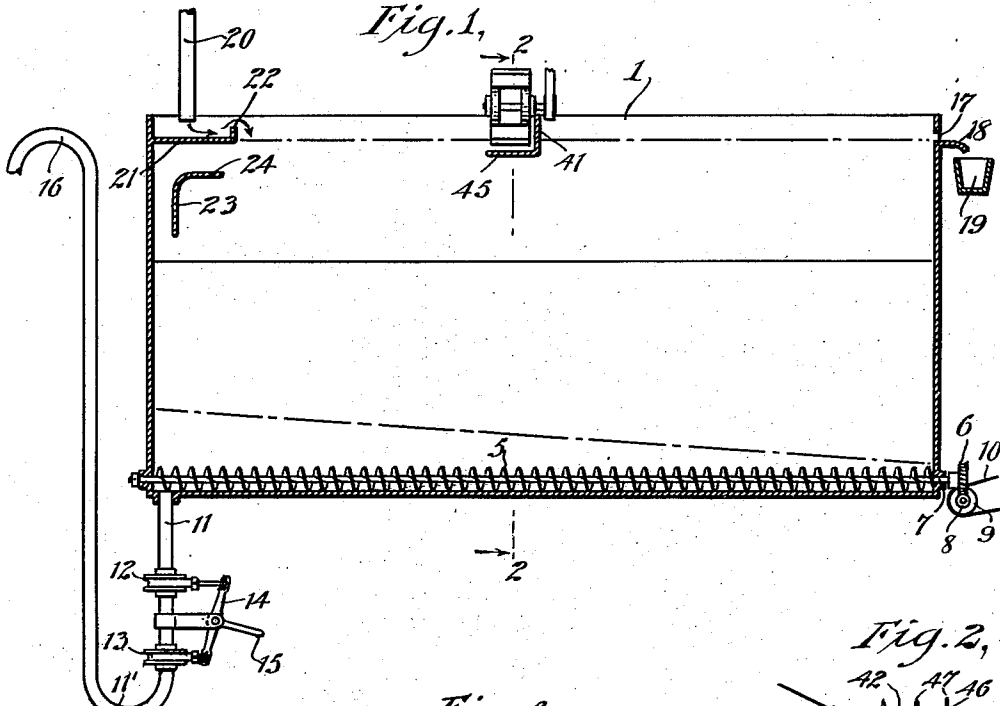


Fig. 1,

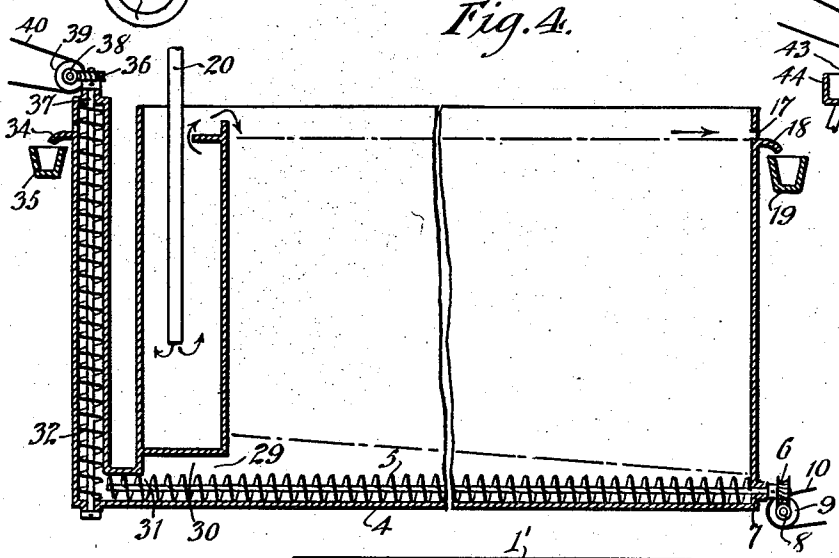


Fig. 4.

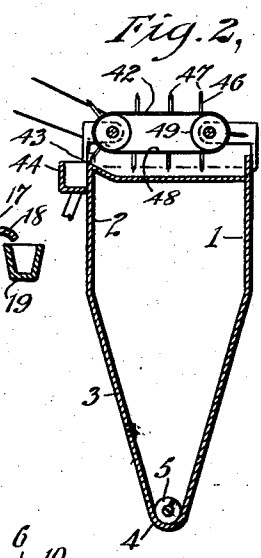


Fig. 2,

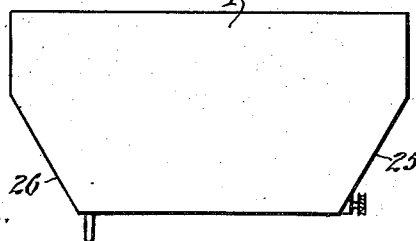


Fig. 3,

WITNESSES

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UNITED STATES PATENT OFFICE.

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CONTINUOUS-SETTLING DEVICE.

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This invention relates to a continuous settling device for continuously settling precipitates and other sedimentary matters from liquids or solutions and has for an object to provide a construction wherein either a large or small volume may be treated in a continuous operation.

Another object of the invention is to provide a method and also an apparatus for continuously treating liquids whereby a rapid treatment may be secured while a thorough separation of the liquids and solids may be attained.

A further object, more specifically, is to provide a continuous settling apparatus which may be used in the paper making industry, in the sugar making industry or other industries where comparatively large volumes of liquid are to be treated and are to have all or most of the solid matter settled or precipitated, the structure being such that comparatively large volumes may be treated in a short time or the precipitate or sediment removed in comparatively small treating tanks or compartments.

In the accompanying drawing—

Figure 1 is a longitudinal vertical sectional view through an apparatus disclosing a preferred embodiment of the invention.

Figure 2 is a transverse sectional view through Figure 1 on line 2—2.

Figure 3 is a side view on a reduced scale of a slightly modified structure to that shown in Figure 1.

Figure 4 is a longitudinal vertical sectional view through an apparatus showing another slight modification of Figure 1.

Heretofore, a number of devices have been designed for continuous settling of precipitates or other sedimentary matters from liquids or solutions but these devices had and have various disadvantages arising from conflicting currents or through the use of an unusually large size apparatus which involves considerable expense in the construction and which presents objectionable conditions when liquid is left in the device for an appreciable time. Well known types of continuous settling apparatus are now in use wherein large volumes of liquid must be under treatment at one time in order to secure satisfactory results, as for instance, twenty thousand to one hundred thousand gallons and over.

In the case of settling or precipitating cane juices in the manufacture of sugar, it

is very objectionable to leave a large volume of juice in the device over Sunday or any holiday as glucose and other objectionable substances are formed that injure the liquid left in the device. Under similar conditions in the paper industry, slime is formed and accumulated which injures the stock being discharged by the continuous settler or "save-all."

In the present invention it has been attempted to overcome these objections and particularly the objection of presenting a device where there is a large volume of liquid under treatment at one time. In treating liquids, as for instance, water stock or white water in paper manufacture or the cane juices in sugar manufacture, a considerable depth must always be maintained in the tank or apparatus treating the liquid and, therefore, in order to reduce the volume in the treating apparatus to a minimum at all times, the same has been designed as a longer and fairly narrow tank, preferably longer and deeper than it is wide, whereby the proper depth of liquid is secured and yet the volume is reduced to a minimum.

In the accompanying drawing an embodiment of the invention is shown wherein 1 indicates a tank or container which is provided preferably with a rectangular section 2 at the upper part and a converging or tapering section 3 at the lower part. The taper of section 3 may vary as occasion demands but at the lower end it is preferably flattened or rounded so as to present what may be termed a guiding chamber 4 in which is arranged a conveyor 5 which is shown as a screw in the drawing. This conveyor may be operated manually or by power and when operated by power, a suitable gear wheel 6 is connected to the shaft 7, said gear wheel being shown as a worm gear meshing with the worm 8 carrying the pulley 9 driven from any suitable source of power through the belt 10. The conveyor 5 may be operated continuously or intermittently and is adapted gradually to move the precipitate or sediment to a position over the discharge pipe 11 into which it moves under the action of gravity and the weight of the liquid in the tank. Preferably, a pair of gate valves 12 and 13 are provided in the pipe 11 and connected to a double acting lever 14 which is in the nature of a walking beam structure whereby whenever

the handle 15 connected with the lever 14 is operated, one of the gates is opened and the other closed.

When the parts are in the position shown in Figure 1, the sediment will gradually move down and rest on gate 13. The pipe 11 is gradually filled and at a desired time, handle 15 is moved for closing gate 12 and the same movement opens gate 13 whereby the sediment may drop downwardly into the pipe 11'. At a proper time the gates are again reversed and the sediment drops again down on gate 13. This back and forth movement causes an intermittent discharge into pipe 11', which pipe extends upwardly and is provided with a curved section 16 substantially in line with the level of the liquid in tank 1. It is, of course, evident that other forms of valves could be used as well as gate valves or the valves could be entirely eliminated and the discharge regulated by the screw 5 or another screw. Other means of discharge may also be employed. It will be noted that an outlet opening 17 is arranged at one end of the tank 1 whereby the clear liquid may pass out over the discharge member 18 into the trough or chute 19 which directs the same to a desired point. The incoming liquid passes inwardly through the pipe 20 and discharges on the plate or platform 21. The liquid spreads out over this plate and eventually moves over the raised portion or dam 22. The upper edge of this raised portion is above the level of the liquid in tank 1 by reason of the position of the opening 17. This causes a small fall to the liquid as it passes over the dam 22 and this small or low fall gives the liquid and particularly the solid matter therein, a downward movement whereby a precipitation or sedimentation takes place more quickly. Having dam 22 higher than outlet opening 17 causes the incoming liquid to enter container 1 with a considerable downward vector. The idea of dam 22 and its elevation above the water level in container 1, is then to cause the entering liquid to strike downward at first so that when it does assume a horizontal flow, this flow will be distributed more or less equally at all depths of the rectangular section 2 and the upper portions of the tapering section 3. If the cross section of flow is greater, the velocity will be less and the chances for solids to precipitate will be improved. When the water stock or white water in the paper making industry or the cane juices in the sugar making industry is being discharged through the pipe 20, the same overflows dam 22 into the tank 1 when the same is filled. This overflow is continued as long as the device is in operation and as the new liquid is inserted the same will gradually move toward the end of the container having opening 17 and as it moves the solid matter will precipi-

tate or settle, the greater settlement being at the inlet end and above the pipe 11. As the sides of section 3 taper, the sediments will strike these sides and gradually move downwardly into the section 4 and completely cover the conveyor 5 so that usually the conveyor is operating almost completely in a precipitate or sediment so that when this conveyor is operating at a desired speed there will be practically no agitating or stirring action as the principal movement is in a direction longitudinally of the screw. By making the tank 1 comparatively long and narrow, a small cubic content is presented while ample time is given the solids to settle before the liquid reaches the outlet 17 whereby a clear liquid is discharged in a continuous stream. It is, of course, evident that the tank could be made square or of some other shape and a proper action secured if the inlet pipe 20 was a sufficient distance from the outlet opening 17. This is true as far as providing a proper continuous settling apparatus is concerned but it would be objectionable to fill a square tank or tank of some other shape than that shown in the drawing.

Under some circumstances, it might be desired to incline the ends inwardly or towards each other as shown in Figure 3. In this figure the container 1' and associated parts are identical with that shown in Figure 1 except that the end sections 25 and 26 are inclined toward each other whereby the length of the screw or other conveyor is reduced without reducing the settling capacity of the device as the depth of the liquid is maintained where necessary.

Under some circumstances it might be desired to effect the removal of the sediment as shown in Figure 4. In this figure the container 1 and associated parts are identical with those shown in Figure 1, except that the pipe 11 and its fittings are eliminated, as is also the baffle 23 and possibly other parts. The incoming liquid passes inwardly through the pipe 20 and discharges somewhat below the bottom of the rectangular section 2 into the well 27, which occupies the full width of that end of the container and almost its entire depth. The liquid must then travel upward through the well 27, which upward travel is generally conceded to be beneficial for the flocculation of fine precipitates. The liquid in passing the baffle 28 loses its forward horizontal vector of movement and then passes over the dam 22 and so on as described above for Figure 1.

The sediment is carried by the conveyor 5 through the sump 29 formed past the bottom plate 30 of the well 27 and the adjacent part of the conveying trough 4. The conveyor 5 pushes the sediment through the opening 31 in the end of the container 1 and delivers it to another conveyor here pictured

as a screw 32 which lifts the sediment either vertically or along an incline to the desired height, preferably level with or slightly lower than the clear liquid outlet opening 17 where it overflows through a suitable sediment outlet opening 33 over the discharge member 34 into the trough or chute 35 which directs it to a desired point. This conveyor also may be operated manually or by power and as shown in the drawing when operated by power a suitable gear wheel 36 is connected to the shaft 37 of the screw 32, said gear wheel being shown as a worm gear meshing with the worm 38 carrying the pulley 39 driven from any suitable source of power through the belt 40.

Under some circumstances, it might be found desirable to remove the sediment from the end opposite to the inlet end, in which case, of course, it would be a simple matter to construct the settler having the sediment outlet assembly, parts 31 to 40 inclusive, or similar parts, at the end of the container opposite to that shown in Figure 4.

In order to remove such scum as is apt to rise to the surface of sugar solutions, tannery liquors, sewage and other liquids, a baffle 41 extending from a few inches above to a few inches below the liquid level may be placed across the entire width of the tank at a suitable point, preferably nearer the inlet than the outlet. This prevents the scum from reaching the clear liquor outlet, while a mechanically operated scraper 42 about a foot wide traversing the tank surface crosswise, serves to brush the scum over a suitable lip 43 at the side of the tank into a receptacle like a gutter 44, leading to the mud line. So as not to disturb the settling of the liquid below the brushing device, a shelf-like plate 45 a little wider than the brushes extends across the entire width of the tank on the side of the cross baffle toward the inlet and about two inches beneath the surface. At the outlet end of this shelf, where the scum leaves the tank, the end of the shelf rises gradually to the level of the overflow lip that leads the scum into the scum gutter. Above the shelf 45 and extending across the full width of the tank is the brushing mechanism 42 consisting mainly of a number of slat-like elements 46, preferably tipped with rubber 47 and set on driving links or cables 48 passing over

pulleys 49 and driven continuously, mechanically, so as to sweep the scum from the neighborhood of the baffle across the tank and over the lip 43 into the scum gutter 44.

The apparatus has been described in respect to continuous precipitating or settling of cane juices and water stock or white water but it will be evident that it will function in the same manner for continuously precipitating any solids in connection with any form of liquid. It is also evident that if one settling apparatus is not of sufficient capacity, two or more could be used in parallel or in series or could operate independently and thereby take care of any desired volume.

What I claim is:

1. An apparatus for separating solids from a liquid by continuous sedimentation, comprising a tank longer than it is wide formed with four straight vertical walls and a substantially V-shaped bottom, means forming an outlet at one end of the tank, means forming an inlet at the opposite end of the tank, said inlet including a horizontal plate having a raised edge over which the liquid must flow, said raised edge being above said outlet only far enough to cause said liquid to take a downward movement without producing a splash, and means for removing the sediment from the lower portion of said bottom.

2. In an apparatus for separating solids from a liquid by continuous sedimentation, a settling tank having an outlet and means presenting an inlet, said means including a member for guiding liquid into the tank, a flat plate for receiving said liquid, said plate being position in a horizontal plane, and a dam at the edge of the plate whereby the liquid must move in a downward direction as it enters the tank thus giving the solids a settling momentum, the upper edge of said dam being sufficiently above said outlet to cause the liquid flowing thereover to have a downward motion without splashing.

3. In an apparatus for separating solids from a liquid by a continuous sedimentation, a tank having an outlet, means presenting an inlet at the opposite end to said outlet, and baffle means arranged in the tank for giving direction to currents produced in the liquid in the tank.

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