June 9, 1925. 1,541,237

R. S. TROTT

CLOSED CIRCUIT CLASSIFIER

Filed Dec. 24, 1923

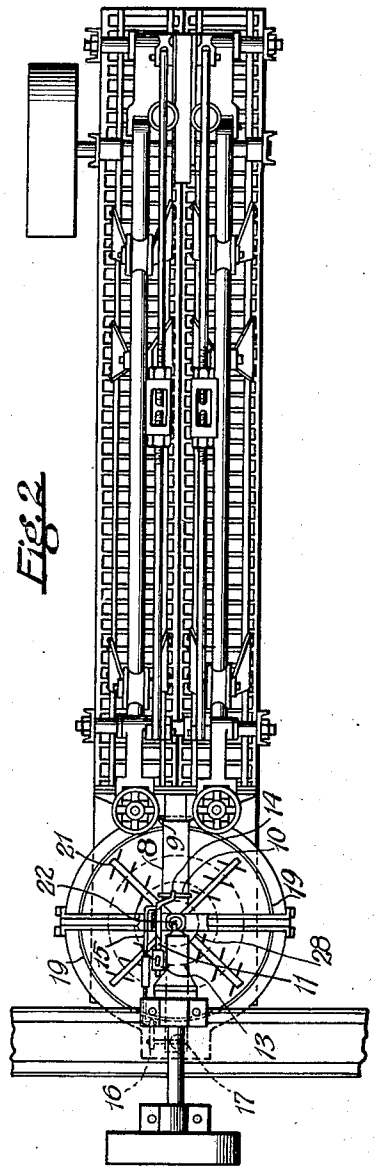

Fig. 2

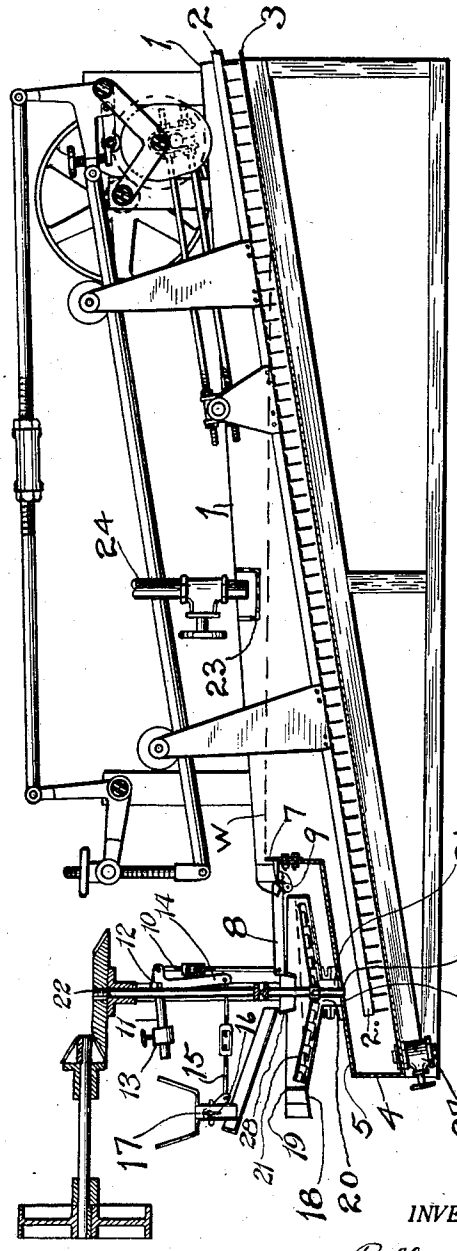

Fig. 1

INVENTOR

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BY

ATTORNEY

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UNITED STATES PATENT OFFICE.

ROLLAND S. TROTT, OF DENVER, COLORADO.

CLOSED-CIRCUIT CLASSIFIER.

Application filed December 24, 1923. Serial No. 682,540.

To all whom it may concern:

Be it known that I, ROLLAND S. TROTT, 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 Closed-Circuit Classifiers, of which the following is a specification.

My invention consists of a closed circuit classifier unit formed by the combination of a sloping trough classifier with a pulp thickener, and with certain other parts and novel details of construction.

The object of my invention is to provide a construction whereby the said sloping trough classifier and the said pulp thickener may be operated in closed circuit with each other for the purpose of the resulting benefits in operation and classification.

A further object is to provide a construction whereby a classifier and a thickener, operating as a unit in closed circuit with each other, may be set for a certain result and will thereafter be automatically regulated to maintain that result.

In the drawings, Figure 1 shows a fragmentary vertical section of my closed circuit classifier unit; and Figure 2 shows a plan view of the same. The support of the upper end of the shaft 22 is cut away, and the bevel gear on the shaft 22 is indicated by two dotted circles, for the sake of clearness.

The classifier tank 1, is provided with the extension 4, down along its slope and which has a top or deck 5, provided with the aperture 6.

The rakes 2, are made of sufficient length to rake settled material from the slope of the extended tank and they may be operated by any proper power driven mechanism desired, so long as they rake the settled material up the slope of the tank to the discharge lip 3. A double rake is shown, but a single rake may be used if desired. The rake operating mechanism shown is that covered by my patent issued September 25th, 1923, Number 1,468,844, but any other proper mechanism may be used in its place if desired.

The tank 1, is also provided with the adjustable overflow lip 7, though any other proper method of controlling the height of the liquid level, W, of the classifier by change of the height of the overflow lip may be employed, if desired.

The launder 8, is pivoted at 9 and its other end is supported by the hanger 10, adjustable in length and hanging from an arm of the lever 11. The lever 11 is supported and pivoted at 12 and carries the movable counterweight 13, and the third arm 14.

The control rod 15, adjustable for length, is connected to the arm 14 and to the lever 16 of the pulp valve 17.

I am well aware that various modifications of this launder controlled valve mechanism may be employed, but whatever mechanical equivalent is used, the essential point is that the mechanism should be such that it enables variation in the density in the thickener to control the pulp feed by means of the resulting variation in the overflow from the classifier. And in some classes of work the control of the pulp feed by the launder may be omitted and the launder made stationary, or integral with the tank of the classifier or integral with the thickener, but in any case the result is the same in that the classifier and the thickener are operating in closed circuit with the resulting inherent automatic regulation mentioned before.

I am also aware that the pulp valve 17 may be of any proper form or type desired and may be used to by-pass the pulp feed back to a sump or in any other way as a means of controlling the amount that gets to the thickener.

But, whatever mechanical equivalent is used, the result is the same in that the amount of pulp fed to the thickener is controlled by the valve or other means operated by the launder as determined by the amount of overflow from the classifier.

The thickener tank 18 is provided with the feed box 28, the overflow lip 19 and the discharge orifice 20 and is properly attached to the classifier tank 1 so that the orifice 20 registers with the aperture 6 of the deck 5 of the tank extension 4, forming a passage 26, between the thickener and the classifier.

Any other proper method of attaching the

thickener to the classifier may be employed so long as it allows the thickener to discharge settled material into the classifier below its liquid lever, W, so that by allowing the overflow from the classifier to go to the thickener the two machines will operate in closed circuit.

The sweeps 21, attached to the shaft 22, are supported and slowly revolved by the belt pulley and gearing as shown, or by any other proper power mechanism, so that the settled material will be moved to the discharge orifice 20 and the passage 26.

The sleeve 25 may be secured upon the portion of the shaft 22 which extends below the sweeps 21, if it is desired to reduce the active cross sectional area of the passage 26. By variation of the outside diameter of the sleeve 25 any desired reduction of the passage 26 may be obtained.

I am well aware that there are various other ways to adjust or control the active area of the passage 26, but in any case the result is the same in that the ability to vary the area of the passage 26 will assist in obtaining the proper relations between the amount of pulp fed to the thickener, the density in the thickener, the height of the overflow lip of the classifier, and the amount of wash water or other liquid fed to the classifier.

Wash water, or other liquid is fed to the classifier from the trough 23 which is fed from the valve controlled feed pipe 24, or it may be supplied in any other proper way and from any other proper source.

The tank 1 is provided with a drain 27 of any proper construction so that the tank 1 may be drained or washed out.

The product discharged by the rakes 2 may be taken away by a conduit, launder, pipe, conveyor, trough or any other proper means.

The overflow from the classifier may be taken away by a conduit, launder, pipe, trough or any other proper means.

Pulp is fed to the thickener and wash water or other liquid is fed to the classifier in such quantity that there is always an overflow at the overflow lip of the classifier, which overflow mixes with the feed to the thickener either in the thickener itself or before the feed gets to the thickener.

As the level of the overflow lip and of the liquid in the classifier is higher than the overflow lip and the liquid in the thickener, there will be an upward current through the aforesaid adjustable passage from the classifier to the thickener.

The settled material from the thickener will have to pass down into the classifier against the upward current through said passage, the lighter solids and suspensions overflowing from the overflow lip of the thickener.

Some of the lighter solids and suspensions, however, will be carried on down into the classifier and put into suspension and maintained in suspension in the classifier by the washing and agitating action of the rakes.

These re-suspended solids and suspensions will either be carried by the said current up into the thickener again, or they will be moved by the rakes beyond the influence of the said current.

These re-suspended solids and suspensions beyond the influence of the current from the classifier to the thickener, will either settle and be raked out of the classifier, or they will overflow from the overflow lip of the classifier into the launder and flow on into the thickener, from the launder.

The classifier end of the launder is pivotally mounted; the thickener end of the launder being suspended from a pivoted and counterweighted lever which is connected to a valve controlling the pulp feed to the thickener.

The entire launder may be hung from this lever if desired, and a spring instead of the counterweight may be employed to sustain one or both ends of the launder in any proper way, though I prefer to use the construction as stated.

But, regardless of the mechanical equivalent employed, the movement of the launder, due to the variation of the amount of overflow (and of the weight) it carries, operates controls which vary the amount of pulp fed to the thickener.

Thus, when the amount of pulp fed to the thickener increases, the density in the thickener increases and the upward current in the passage between the classifier and the thickener will decrease.

So, the overflow from the classifier, due to wash water or other liquid will increase.

This will increase the weight in the launder and it will be depressed, which movement will operate the controls and reduce the amount of pulp fed to the thickener.

The reduced feed to the thickener, coupled with the increased amount of overflow from the classifier, which flows into the thickener, will reduce the density in the thickener.

This reduction in density will increase the upward flow between the classifier and the thickener, which in turn will decrease the amount of overflow and the weight carried by the launder.

This will cause the launder to rise, which movement will operate the controls to open the feed pulp valve and increase the feed to the thickener.

In other words, by the proper setting of the launder support and of the controls which govern the pulp feed, together with the proper setting of the active area of the passage from the classifier to the thickener,

the height of the classifier overflow lip, and of the amount of wash water or other liquid fed to the classifier, the machine may be set to operate at maximum efficiency for any material being fed and for any desired classification; and the operation of the classifier overflow in closed circuit with the thickener, controlling by the action of the launder the amount of pulp fed, will maintain the machine automatically at this point of greatest efficiency.

In some cases it may be found necessary to cut down the effective settling area of the thickener by shortening the power driven sweeps, but this is a step well understood by those versed in thickeners.

In other classifiers of this type, when the lighter solids and suspensions have been carried beyond the influence of the current from the classifier to the thickener there is no chance for them to get out of the classifier except by settling and being raked out with the heavier settled material.

In my invention, however, since the classifier is in closed circuit with the thickener, these suspensions and lighter solids may overflow and pass back to the thickener eventually or directly, where they have another opportunity to overflow from the overflow lip of the thickener.

It will be seen that this will give a product delivered by the rakes of the classifier which is much cleaner than has hitherto been possible, as it will be much more free from the lighter solids and suspensions.

In some cases it will be found that the classifier and the thickener being in closed circuit will furnish enough automatic regulation without the necessity of controlling the feed to the thickener by the action of the launder.

That is, increase of the density in the thickener will cause more overflow from the classifier, which will tend to thin down the contents of the thickener and thus lower its density and reduce the classifier overflow. But in any case, it will probably be found that the launder control of the pulp feed at the start of any new set of conditions will assist in the determination of the passage area, of the pulp feed, of the height of the classifier overflow lip, and of the amount of wash water or other liquid fed to the classifier.

And should either the character or the quantity of the pulp to the thickener change for any reason, or a different classification be desired, the overflow launder pulp control will assist the operator in quickly arriving at the new settings for maximum efficiency of the machine.

When proper settings are obtained it may be possible that the launder may be blocked in position or in any other proper way may be made stationary, and the regulation due to the closed circuit connection of the classifier and the thickener may be relied upon alone.

This in some cases will be ample regulation. But where more exact results are required, or the feed and conditions of feed make it necessary, the extra regulation due to the launder controlled pulp feed may be employed.

The operation of my closed circuit classifier is as follows;—Pulp is fed to the thickener and wash water or other liquid is fed to the classifier in the desired quantities, the overflow from the classifier going to the thickener direct as shown, or it may, if desired, go to the pulp feed before it reaches the thickener.

As the density of the material in the thickener is greater than that of the material in the classifier, the overflow lip of the classifier will have to be adjusted to a slightly higher level than the overflow lip of the thickener in order to produce the desired upward current through the connecting passage from the classifier to the thickener.

The settled material from the thickener will have to pass downward against this upward current, which carries the lighter solids and suspensions up to either re-settle in the thickener, or to overflow at its overflow lip.

I have now described my closed circuit classifier unit in the form I prefer, but I do not wish to be limited to the exact constructions described, as I am well aware of various modifications that may be made without departing from the essence of my invention, which is; the combination of the thickener and the classifier with other parts and novel features of construction to the end that they may form a closed circuit classifier unit capable of adjustment for superior classification and practically automatic regulation of such classification.

So, what I claim as new, and desire to protect by Letters Patent is as follows:—

1. A classifier unit, comprising in combination, a thickener and a classifier, each provided with an overflow, the classifier having an outlet above its liquid level, a device for moving settled material to said outlet and an aperture below its liquid level, the thickener having a bottom surface adapted to receive settling material, and being provided with a discharge orifice and with a device for moving settled material toward said orifice, means joining the thickener and the classifier so that said orifice registers with said aperture, means for feeding material to the thickener, means for feeding a liquid to the classifier, and means for conveying the overflow from the classifier to the thickener.

2. A classifier unit comprising a thickener and a classifier, each provided with an over-

flow, the classifier having an outlet above its liquid level and a device for moving settled material to said outlet, the thickener having a bottom surface adapted to receive settling material and being provided with a discharge orifice and a device for moving settled material toward said orifice and means adjacent said orifice joining said thickener to said classifier below the liquid level of the classifier, means for feeding material to the thickener, means for feeding a liquid to the classifier, and means for conveying the overflow from the classifier to the thickener.

3. A classifier unit comprising a thickener and a classifier in closed circuit, each provided with an overflow, the thickener being provided with a discharge for thickened material and with means connecting said discharge to the classifier below its liquid level, and with means to convey settled material to said discharge, the classifier being provided with an outlet above its liquid level and with means to convey its overflow to said thickener, the thickener being provided with means for feeding material and the classifier being provided with means to feed a liquid.

4. A classifier unit comprising in combination a thickener and a classifier in closed circuit, each provided with an overflow and a discharge, the thickener discharge being into the classifier below its liquid level, the classifier discharge being above its liquid level, each being provided with a device to move settled material toward its respective discharge, the classifier being adapted to overflow into the thickener, and being provided with a source of wash liquid, the thickener being provided with a source of feed pulp.

5. A classifier unit comprising in combination a thickener provided with an overflow and a discharge and a device to move settled material toward said discharge, a classifier provided with an overflow, with a feed hole below the liquid level, with a discharge above the liquid level, and with a device to move settled material to said discharge, the classifier adapted to overflow into the thickener, and the thickener adapted to discharge into the classifier through the said feed hole, means for feeding material to the thickener, and means for feeding wash liquid to the classifier.

6. A classifier unit comprising in combination a thickener provided with an overflow and a discharge and a device to move settled material toward said discharge, a classifier provided with an overflow, with a feed hole below the liquid level, with a discharge above the liquid level, and with a device to move settled material to said discharge, the thickener adapted to discharge into the classifier through the said feed hole, means for feeding a liquid to the classifier, means for feeding material to the thickener, means to vary the amount of material fed to the thickener, a launder adapted to carry the overflow from the classifier to the thickener, and adjustable means connecting said launder to said last named means to vary the feed to the thickener in inverse proportion to the amount of overflow carried by the launder.

7. A classifier unit comprising in combination a thickener and a classifier, each provided with an overflow, and with a discharge for settled material and with a device for moving settled material to said discharge, the thickener discharge being below its overflow level and discharging material from the thickener into the classifier, and the classifier discharge being above its overflow level, a launder for conveying the classifier overflow to the thickener, and adjustable means operated by said launder to control the amount of material fed to the thickener inversely to the amount of overflow carried by the launder.

8. A classifier unit comprising in combination a thickener and a classifier, each provided with an overflow, and with a discharge for settled material and with a device for moving settled material to said discharge, the thickener discharge being below the overflow levels of both thickener and classifier and discharging material from the thickener into the classifier, and the classifier discharge being above its overflow level, means to feed material to the thickener, a launder to convey the classifier overflow to the thickener, a control governing the amount of material fed to the thickener, and adjustable means connecting said control and said launder such that an increase of overflow carried by the launder will act to operate the said control and decrease the feed to the thickener, and a decrease of said overflow will increase the feed to the thickener.

9. A classifier unit comprising in combination a classifier or secondary settling chamber provided with a liquid overflow and means to adjust the height thereof, and a thickener or primary settling chamber provided with an overflow and adapted to receive the overflow from the secondary chamber, the secondary chamber having an outlet above the level of its overflow, and the primary chamber having a bottom surface adapted to cause the congregation of settling matter to a semi-solid condition, and in connection with said surface means joining the primary chamber to the secondary chamber and forming a passage between them beneath the liquid level of the secondary chamber, a device for moving material settling upon the bottom of the primary chamber toward said passage, means for feeding ma-

terial into the primary chamber, and a device for moving material settling in the secondary chamber along a sloping surface to said outlet.

10. A classifier unit comprising in combination a thickener provided with an overflow and with a discharge and with a device to move settled material toward said discharge, a classifier provided with an overflow adjustable in height, a feed hole below the level of said overflow, a discharge above the level of said overflow, and a device to move settled material to said discharge, the thickener adapted to discharge into the classifier through said feed hole, means for feeding material to the thickener, control means to govern the amount of material fed to the classifier, and means conveying the overflow from the classifier to the thickener and adjustably connected to said control means to vary the feed to the thickener inversely with the amount of said overflow.

11. A classifier unit comprising in combination a classifier or secondary chamber provided with a liquid overflow adjustable n height, and a thickener or primary settling chamber provided with an overflow, the secondary chamber having an outlet above the level of its adjustable overflow, and the primary chamber having a bottom surface adapted to cause the congregation of settling matter to a semi-solid condition, and in connection with said surface means joining the primary chamber to the secondary chamber and forming a passage between them beneath the said overflow of the secondary chamber, a device for moving material settling upon the bottom of the primary chamber toward said passage, a device for moving material settling in the secondary chamber along a sloping surface to said outlet means for feeding material into the primary chamber, control means to vary the amount of material fed to the primary chamber, and means conveying the overflow from the secondary chamber to the primary chamber and adjustably connected to said control means to vary the feed to the thickener inversely with the amount of said overflow.

12. A classifier unit comprising in combination, a thickener provided with an overflow and with a discharge and with a device to move settled material toward said discharge, a classifier provided with an overflow, with a feed hole below the liquid level, a discharge above the liquid level, and with a device to move settled material to said discharge, the thickener adapted to discharge into the classifier through the said feed hole, means for feeding water or other liquid to the classifier, means for feeding material to the thickener, means to vary the amount of material fed to the thickener, a launder adapted to carry the overflow from the classifier to the thickener, and means connecting said launder to said last named means to vary the feed to the thickener by the variation of the amount of overflow carried by the launder.

13. A classifier unit comprising in combination, a thickener and a classifier, each provided with an overflow, and with a discharge for settled material and with a device for moving settled material to said discharge, the thickener discharge being below its liquid level and discharging material from the thickener into the classifier, and the classifier discharge being above its liquid level, means for mixing the classifier overflow with the thickener feed, and means operated by said first means to control the amount of material fed to the thickener by the variation of the amount of overflow carried by said first means.

14. In a classifier, primary and secondary settling chambers, the primary chamber having an overflow for suspended fines, and at a lower point, having a restricted opening for the passage of material to and from the secondary chamber, and the secondary chamber having an outlet for the coarse product, means for feeding pulp into the primary chamber, a mechanical device for dragging settled material along a sloping surface to the outlet of the secondary chamber, means for feeding a liquid to the secondary chamber, the secondary chamber having an overflow for suspended fines, and means conveying said overflow to mix with the feed to the thickener.

15. In a classifier, primary and secondary settling chambers, each chamber having an overflow for the suspended fines, the primary chamber having at a point lower than its overflow, a restricted opening for the passage of material to and from the secondary chamber, and the secondary chamber having an outlet for the coarse product, means for feeding pulp into the primary chamber, means for feeding a liquid to the secondary chamber, means mixing the overflow from the classifier with the feed to the thickener and means to control the amount of said feed by the variation in the amount of said overflow, and a mechanical device for dragging material along a sloping surface to the outlet of the secondary chamber.

16. In a classifier, primary and secondary chambers, the primary chamber having an overflow for the suspended fines and, at a lower point, having a restricted opening for the passage of material to and from the secondary chamber, and the secondary chamber having an outlet for the coarse product, means for feeding pulp into the primary chamber, a mechanical device for dragging settled material along a sloping surface to the outlet of the secondary chamber, means for feeding a liquid to the secondary cham-

ber, a mechanical device to impel settled matter along the bottom of the primary chamber to the opening thereof, the secondary chamber having an overflow for the suspended fines, and means conveying the classifier overflow to mix with the feed to the thickener.

17. In a classifier, primary and secondary settling chambers, each chamber having an overflow for the suspended fines, the primary chamber having at a point lower than its overflow, a restricted opening for the passage of material to and from the secondary chamber, and the secondary chamber having an outlet for the coarse product, means for feeding pulp into the primary chamber, means for feeding a liquid to the secondary chamber, means for mixing the overflow from the classifier with the feed to the thickener and means to control the amount of said feed by the variation in the amount of said overflow, a mechanical device for dragging settled material along a sloping surface to the outlet of the secondary chamber, and a mechanical device to impel matter along the bottom of the primary chamber to the opening thereof.

18. In a classifier, primary and secondary settling chambers, the secondary chamber having an overflow and an outlet for the coarse product, and the primary chamber having an overflow and comprising a shallow vessel with a substantially level bottom, provided with an opening for the flow of material to and from the secondary chamber, means for feeding pulp into the primary chamber, a mechanical device to impel settled matter to the opening of the primary chamber, a mechanical device for dragging settled material along a sloping surface to the outlet of the secondary chamber, and means to mix the overflow from the secondary chamber with the feed to the primary chamber.

19. In a classifier, primary and secondary settling chambers, the secondary chamber having an overflow, and an outlet for the coarse product, and the primary chamber having an overflow and comprising a shallow vessel with a substantially level bottom, provided with an opening for the flow of material to and from the secondary chamber, means for feeding pulp into the primary chamber, a mechanical device to impel settled material along a sloping surface to the outlet of the secondary chamber, and means to mix the overflow from the secondary chamber with the feed to the primary chamber and means to control the amount of said feed by the variation in the amount of said overflow.

20. The combination with a classifier including a trough having an overflow and a sloping bottom, an outlet at the upper end thereof, and a reciprocating rake for dragging material along said bottom to said outlet, of a settling chamber disposed above the lower portion of said sloping bottom and having an overflow for liquid and suspensions, and at a lower point having an opening for the passage of material to and from said trough, means for feeding pulp into said settling chamber, means for the supply of a liquid to the trough, and means to mix the overflow from the trough with the feed to the settling chamber.

21. The combination with a classifier including a trough having an overflow, a sloping bottom, an outlet at the upper end thereof, and a reciprocating rake for dragging material along said bottom to said outlet, of a settling chamber disposed above the lower portion of the sloping bottom of said trough and having an overflow for liquid and suspensions, and in its bottom having an opening for the passage of material to and from the trough, means for feeding pulp into said settling chambers, means for the supply of a liquid to the trough, a mechanical device to impel settled matter along the bottom of said settling chamber, to the opening thereof, and means to convey the overflow from the trough to mix with the feed to the settling chamber.

22. The combination with a classifier including a trough having an overflow and means to adjust the height thereof, a sloping bottom, an outlet at the upper end thereof, and a reciprocating rake for dragging material along said bottom to said outlet, of a settling chamber disposed above the lower portion of said trough and having an overflow for liquid and suspensions, and in its bottom having an opening for the passage of material to and from the trough, means for feeding pulp into said settling chamber, means for the supply of a liquid to the trough, a mechanical device to impel settled matter along the bottom of said settling chamber to the opening thereof, and means to convey the overflow from said trough.

23. In a classifier, primary and secondary settling chambers, the primary chamber having an overflow for suspended fines, and at a lower point having an opening for the passage of material to and from the secondary chamber, and the secondary chamber having an overflow for liquid and suspensions and means to adjust the height thereof and an outlet for the coarse product, means for feeding pulp to the primary chamber and means for the supply of a liquid to the secondary chamber.

24. In a classifier, primary and secondary settling chambers, the primary chamber having an overflow for suspended fines, and at a lower point having an opening for the passage of material to and from the secondary chamber, and the secondary

chamber having an overflow for liquid and suspensions and an outlet for the coarse product, means for feeding pulp to the primary chamber, means for the supply of a liquid to the secondary chamber, and means to convey the overflow from the secondary chamber to mix with the feed to the primary chamber.

25. In a classifier, primary and secondary settling chambers, the primary chamber having an overflow for suspended fines, and in its bottom having an opening for the passage of material to and from the secondary chamber, and the secondary chamber having an overflow for liquid and suspensions and means to adjust the height thereof and an outlet for the coarse product, means for feeding pulp into the primary chamber, a mechanical device for dragging settled matter along a sloping surface to the outlet of the secondary chamber, and a mechanical device to impel settled matter along the bottom of the primary chamber to the opening thereof.

26. In a classifier, primary and secondary settling chambers, the primary chamber having an overflow for suspended fines, and in its bottom having an opening for the passage of material to and from the secondary chamber, and the secondary chamber having an overflow for liquid and suspensions and means to adjust the height thereof and an outlet for the coarse product, means for feeding pulp into the primary chamber, a mechanical device for dragging settled matter along a sloping surface to the outlet of the secondary chamber, a mechanical device to impel settled matter along the bottom of the primary chamber to the opening thereof, and means to convey the overflow from the secondary chamber.

27. In a classifier, primary and secondary settling chambers, the primary chamber having an overflow for suspended fines and in its bottom having an opening for the passage of material to and from the secondary chamber, and the secondary chamber having an overflow for liquid and suspensions and an outlet for the coarse product, means for feeding pulp into the primary chamber, a mechanical device for dragging settled matter along a sloping surface to the outlet of the secondary chamber, a mechanical device to impel settled matter along the bottom of the primary chamber to the opening thereof, and means to convey the overflow from the secondary chamber and to vary the amount of feed to the primary chamber by the variation in the amount of said overflow.

28. In a classifier, primary and secondary settling chambers, each chamber having an overflow for the suspended fines, the primary chamber having at a point lower than its overflow an opening for the passage of material to and from the secondary chamber, and the secondary chamber having an outlet for the coarse product, means for feeding pulp into the primary chamber, means for feeding a liquid to the secondary chamber, means to convey the overflow from the secondary chamber and to control the amount of feed to the primary chamber by the variation in the amount of said overflow, a mechanical device for dragging settled material along a sloping surface to the outlet of the secondary chamber, and a mechanical device to impel matter along the bottom of the primary chamber to the opening thereof.

29. In a classifier, primary and secondary settling chambers, the secondary chamber having an overflow and means to adjust the height thereof, and an outlet for the coarse product, and the primary chamber comprising a shallow vessel with a substantially level bottom, having an opening for the flow of material to and from the secondary chamber, means for feeding pulp into the primary chamber, a mechanical device to impel settled material along a sloping surface to the outlet of the secondary chamber, and means to convey the overflow from the secondary chamber.

30. In a classifier, primary and secondary settling chambers, the secondary chamber having an overflow, and an outlet for the coarse product, and the primary chamber comprising a shallow vessel with a substantially level bottom, and with an opening for the flow of material to and from the secondary chamber, means for feeding pulp into the primary chamber, a mechanical device to impel settled matter to the opening of the primary chamber, a mechanical device for dragging settled material along a sloping surface to the outlet of the secondary chamber, and means to convey the overflow from the secondary chamber, and means to control the amount of feed to the primary chamber by the variation in the amount of said overflow.

31. The combination with a classifier including a trough having an overflow and means to adjust the height thereof and a sloping bottom, and having an outlet at the upper end thereof, and a reciprocating rake for dragging material along said bottom to said outlet, of a settling chamber disposed above the lower portion of said trough and having an overflow for liquid and suspensions, and at a lower point having an opening for the passage of material to and from said trough, means for feeding pulp into said settling chamber, means for the supply of a liquid to the trough, and means to convey the overflow from said trough.

32. A classifier unit comprising in combination a thickener provided with an over-

flow and a discharge and a device to move settled material toward said discharge, a classifier provided with an overflow, with a feed hole below the liquid level, with a discharge above the liquid level, and with a device to move settled material to said discharge, the thickener adapted to discharge into the classifier through the said feed hole, means for feeding a liquid to the classifier, means for feeding material to the thickener, means to vary the amount of material fed to the thickener, a launder adapted to carry the overflow from the classifier, and means connecting said launder to said last named means to vary the feed to the thickener by the variation of the amount of overflow carried by the launder.

33. A classifier unit comprising in combination a thickener and a classifier, each provided with an overflow and with a discharge for settled material and with a device for moving settled material to said discharge, the thickener discharge being below its liquid level and discharging material from the thickener into the classifier, and the classifier discharge being above its liquid level, means conveying the classifier overflow from the classifier, and means operated by said first means to control the amount of material fed to the thickener by the variation of the amount of overflow carried by said first means.

34. In a classifier, primary and secondary settling chambers, the primary chamber having an overflow for the suspended fines, and at a lower point having an opening for the passage of material to and from the secondary chamber, and the secondary chamber having an outlet for the coarse product, means for feeding pulp into the primary chamber, a mechanical device for dragging settled material along a sloping surface to the outlet of the secondary chamber, means for feeding a liquid to the secondary chamber, the secondary chamber having an overflow for suspended fines and means to adjust the height thereof.

35. In a classifier, primary and secondary settling chambers, each chamber having an overflow for the suspended fines, the primary chamber having at a lower point than its overflow an opening for the passage of material to and from the secondary, and the secondary chamber having an outlet for the coarse product, means for feeding pulp into the primary chamber, means for feeding a liquid to the secondary chamber, means to convey the secondary chamber overflow from the secondary chamber, means to control the amount of said pulp fed to the primary chamber by the variation in the amount of said overflow, and a mechanical device for dragging settled material along a sloping surface to the outlet of the secondary chamber.

In testimony whereof I affix my signature.

ROLLAND S. TROTT.