976,430.

S. H. BOYLAN.

SLIME CONCENTRATOR.

APPLICATION FILED APR. 13, 1910.

Patented Nov. 22, 1910.

4 SHEETS—SHEET 1.

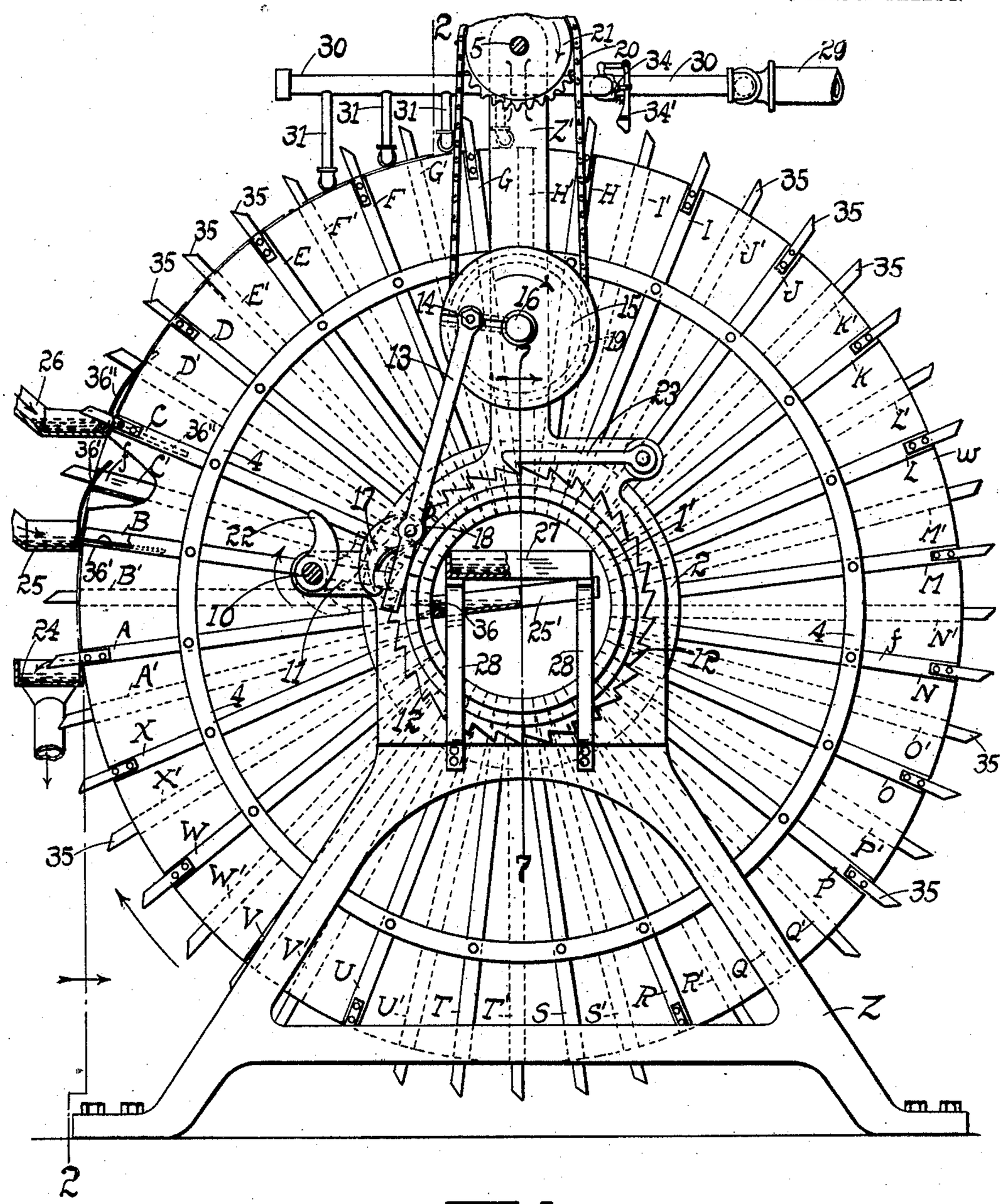

FIG. 1.

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4 SHEETS—SHEET 2.

FIG. 2.

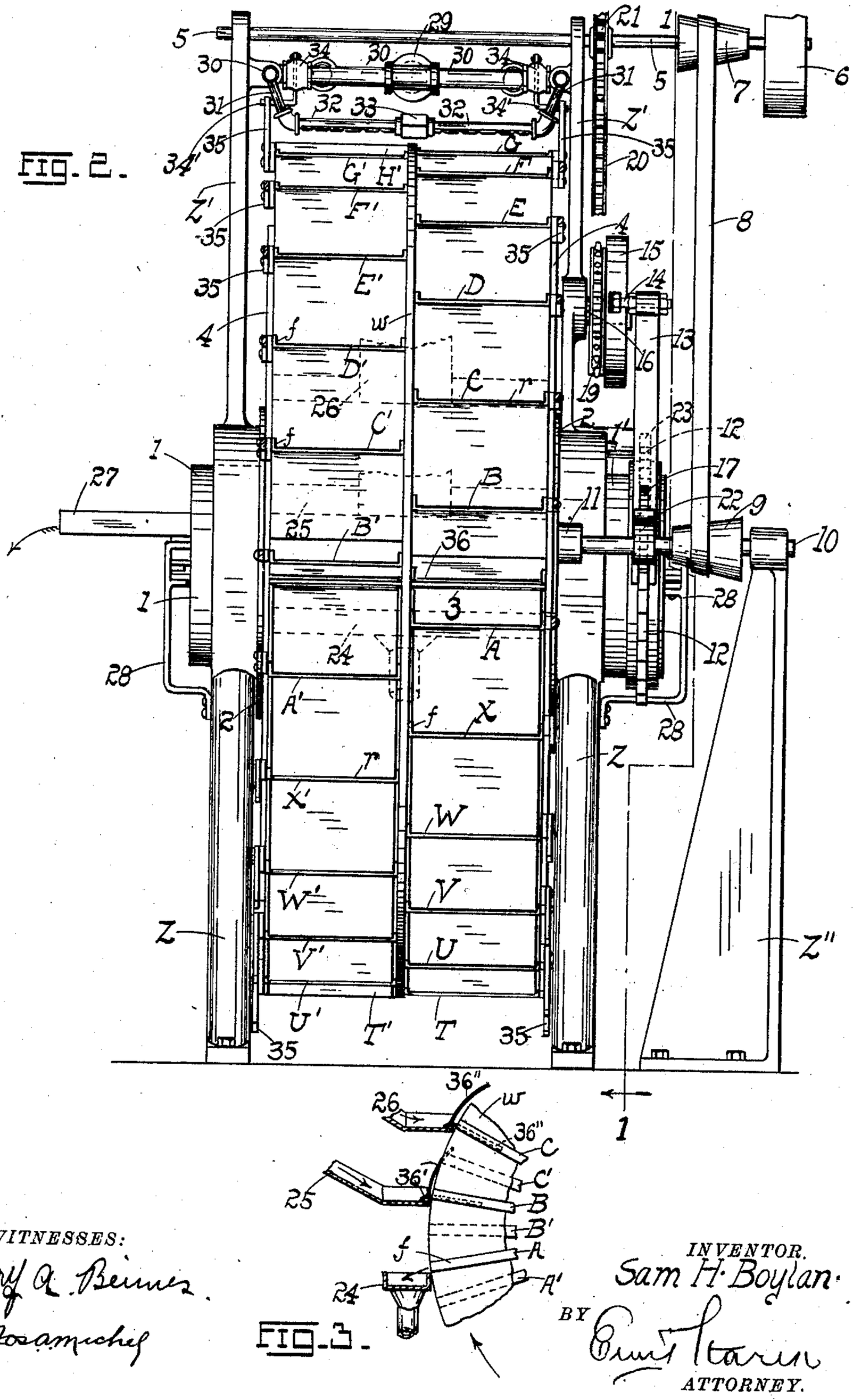

FIG. 3.

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4 SHEETS—SHEET 4.

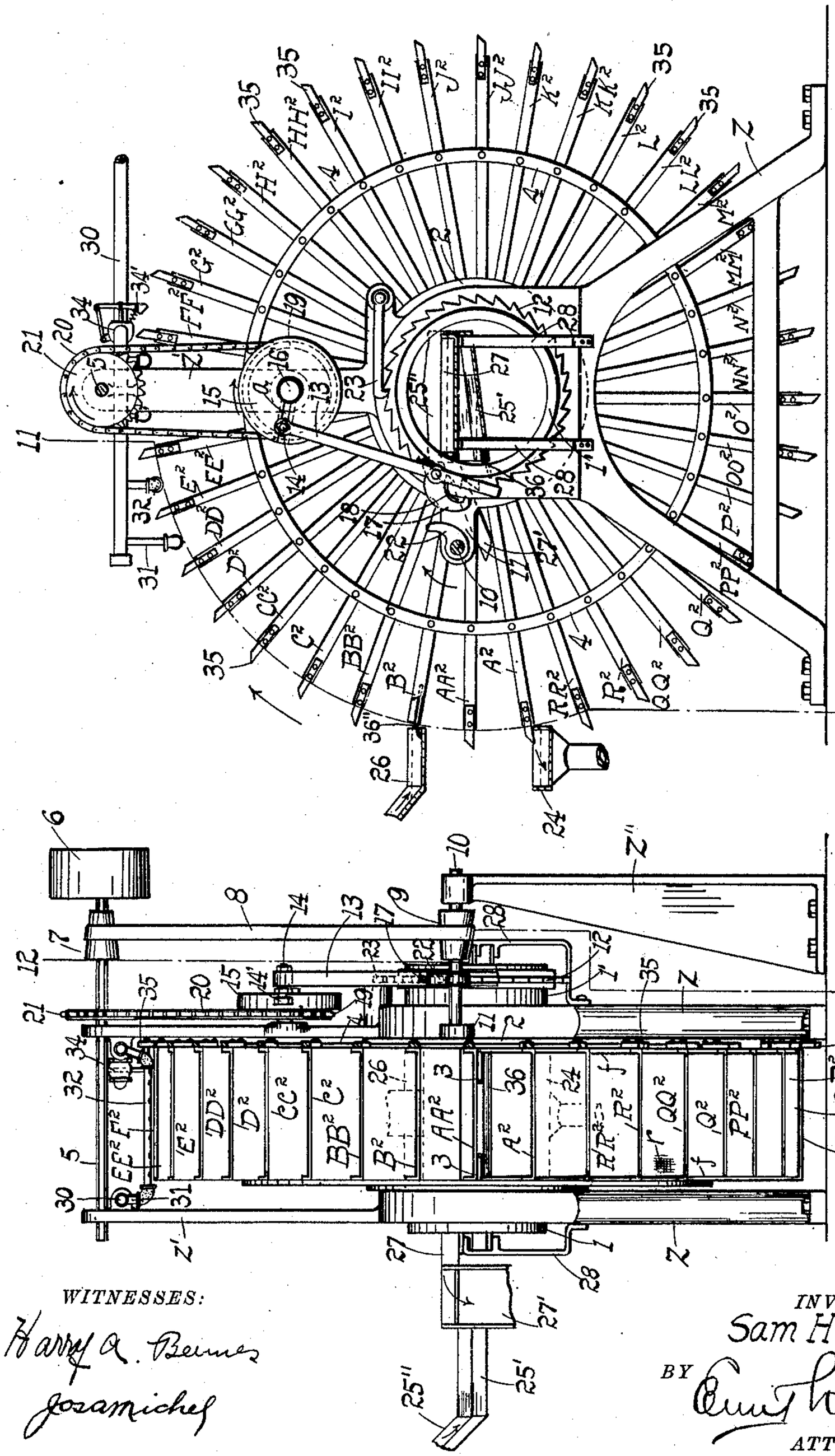

FIG 12.

FIG. 11.

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SLIME CONCENTRATOR.

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4 SHEETS—SHEET 3.

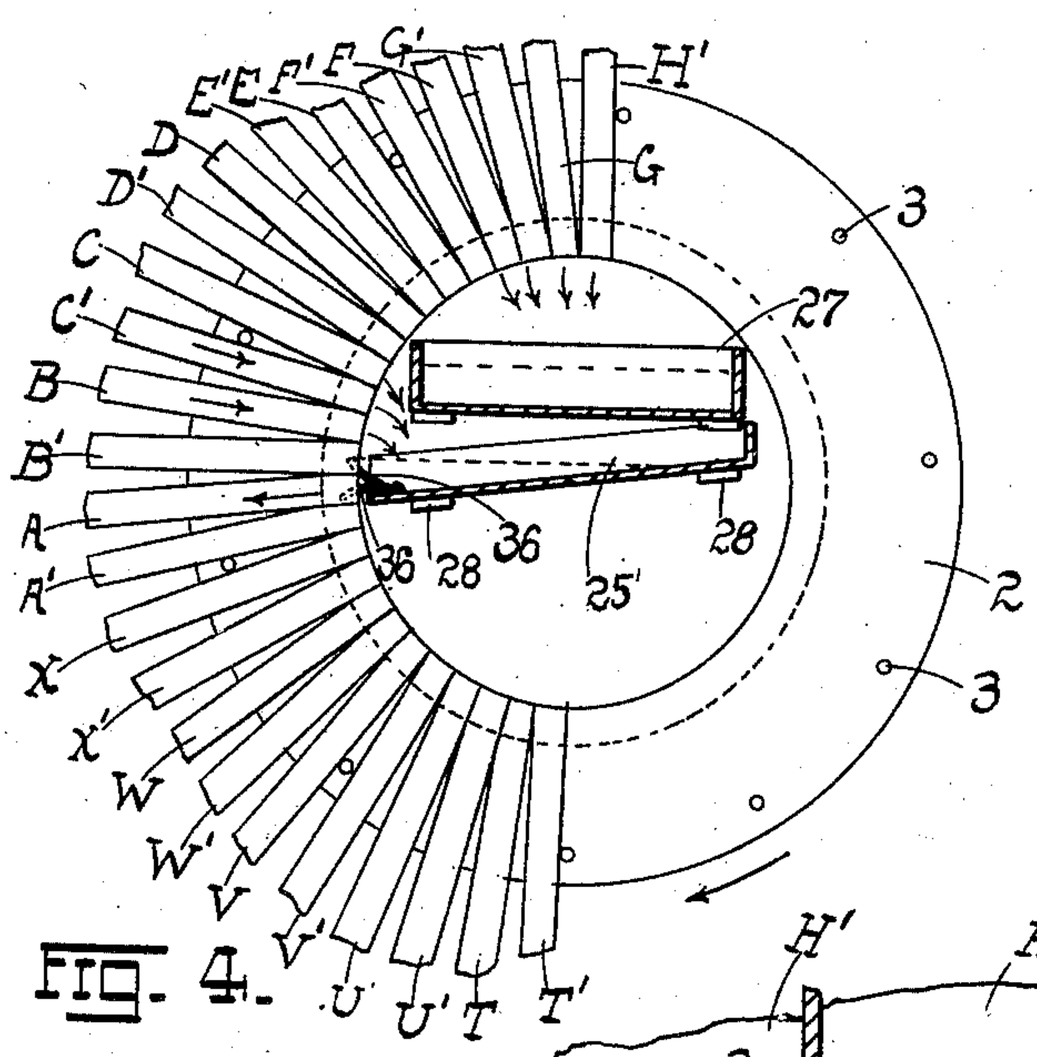

FIG. 4.

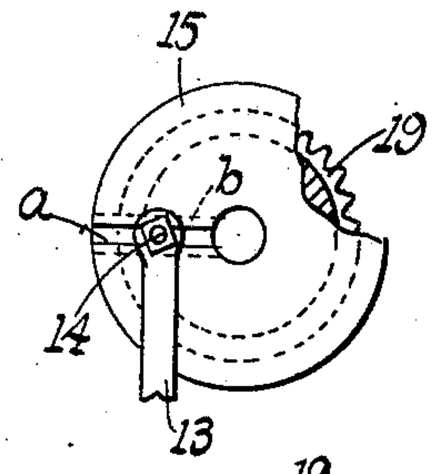

FIG. 5.

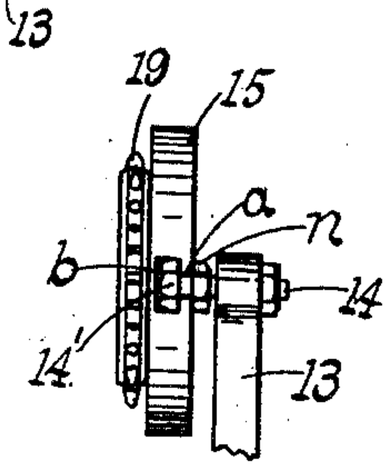

FIG. 6.

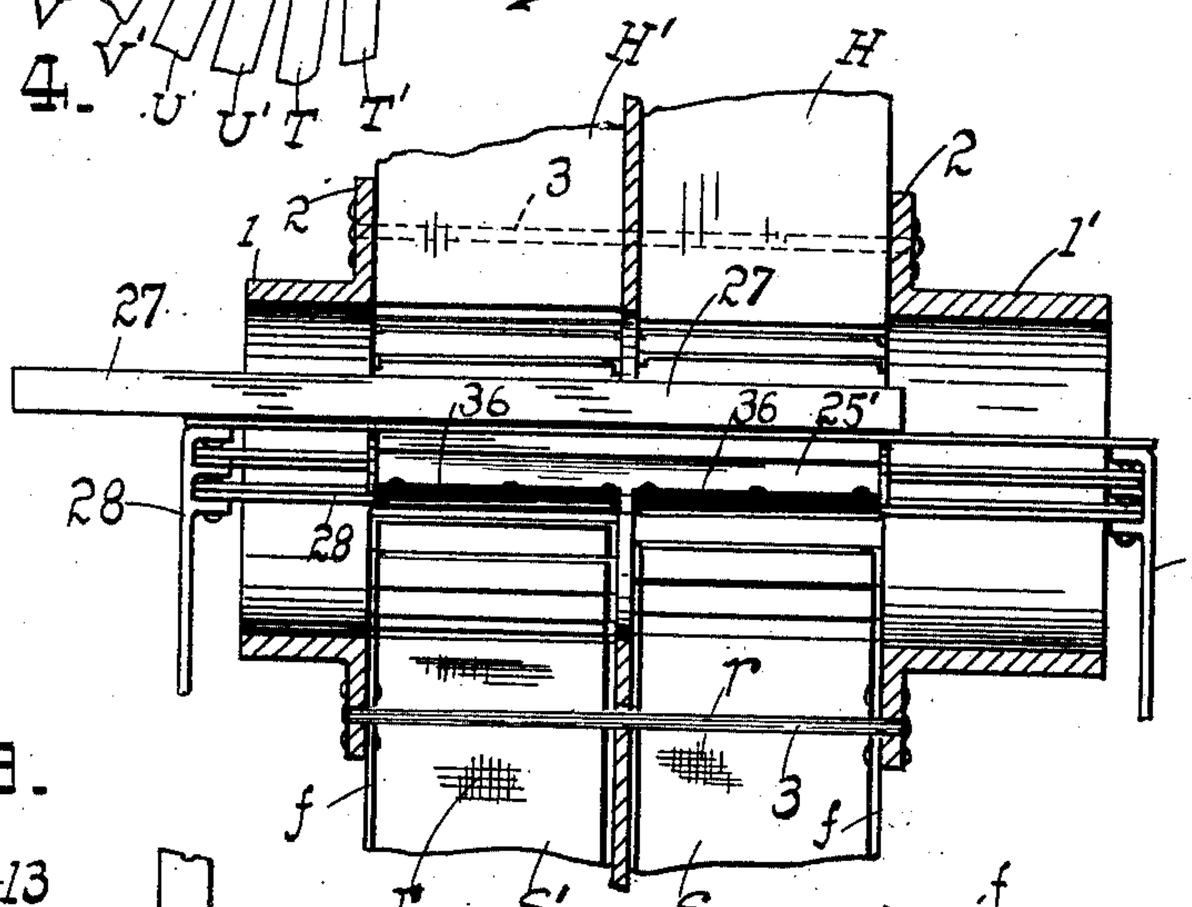

FIG. 7.

FIG. 8.

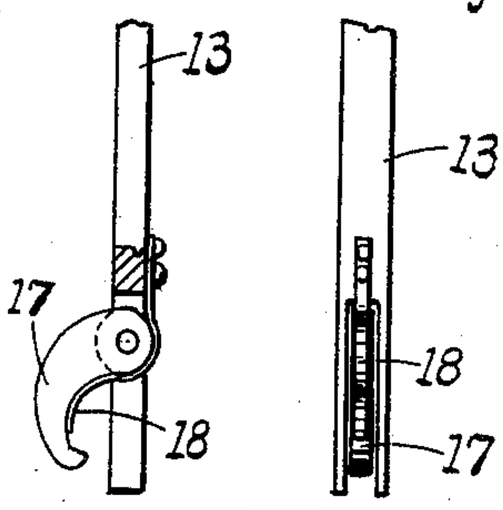

FIG. 9.

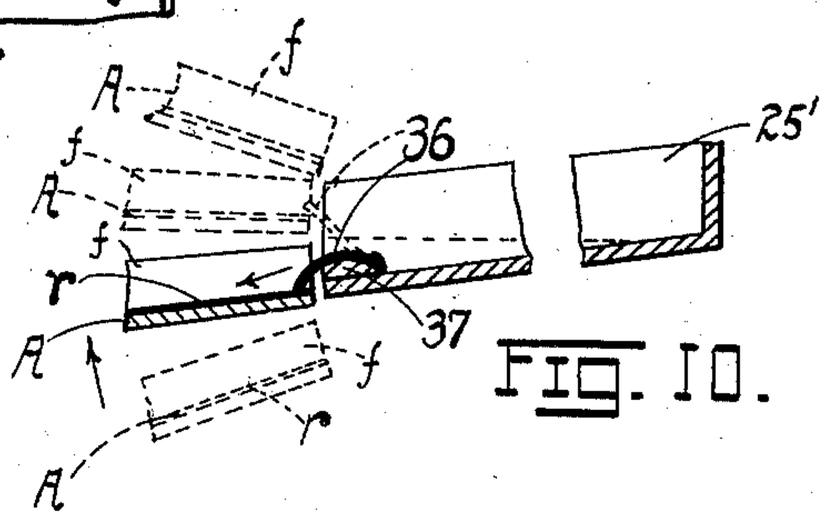

FIG. 10.

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UNITED STATES PATENT OFFICE.

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SLIME-CONCENTRATOR.

976,430. Specification of Letters Patent. **Patented Nov. 22, 1910.**

Application filed April 13, 1910. Serial No. 555,191.

To all whom it may concern:

Be it known that I, SAM H. BOYLAN, citizen of the United States, residing at Colorado Springs, in the county of El Paso and State of Colorado, have invented certain new and useful Improvements in Slime-Concentrators, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

My invention has relation to improvements in slime concentrators; and it consists in the novel construction and arrangement of parts more fully set forth in the specification and pointed out in the claims.

In the drawings, Figure 1 is a combined side or face elevation, and vertical section of the double machine made according to my invention, the section being taken on the line 1—1 of Fig. 2; Fig. 2 is a combined front elevation and section on the line 2—2 of Fig. 1; Fig. 3 is a detail showing the manner in which the cut-off aprons or lips of the wash-box and feed-box engage the outer ends of the trays, and how the lower tray discharges into the tailings box; Fig. 4 is substantially a diagrammatic side view showing the manner of engagement of the cut-off lips or aprons of the central feed or return box with the inner ends of the trays, also showing the flow of the middlings into said box, and the discharge of the concentrates into the concentrate-box; Fig. 5 is a face view of the slotted crank-disk and sprocket wheel carried thereby, by which variable rotation is imparted to the machine; Fig. 6 is an edge view of Fig. 5; Fig. 7 is a vertical transverse section on the line 7—7 of Fig. 1 taken through the hollow hub of the machine, or wheel carrying the concentrating trays, parts being in elevation, and other parts being entirely omitted (notably the ratchet disk carried by the hub); Fig. 8 is a side view of the forked pawl-carrying rod leading from the crank-disk, and the spring-controlled pawl pivoted to said rod between the fork members, one of said members being removed; Fig. 9 is an edge view of Fig. 8; Fig. 10 is a cross sectional detail taken through the center feed-box showing the progressive stages assumed by the cut-off apron or lip as the trays revolve around the axis of the wheel; Fig. 11 is a combined front elevation and section of the single machine taken on the line 11—11 of Fig. 12; and Fig. 12 is a combined side elevation and vertical section of such single machine, the section being on line 12—12 of Fig. 11.

The object of the present invention is to provide a machine for the concentration of the mineral values of slimes, a product now general treated on vanners, in centrifugal separators, and other slime machines.

The principle of construction and operation of the present invention is a radical departure from existing machines in particulars to be specifically pointed out later on. The use of canvas, blankets, and rubber as concentrating surfaces for slimes is well known; and while blankets have been eminently successful they have never, so far as I am aware, been employed on automatic machines on account of their retaining qualities, that is to say, after the mineral and slimes have settled in the meshes, it is impossible to either dress or clean often. Canvas subserves about the same purpose as blankets though to a somewhat less degree as the meshes thereof are very minute and fill rapidly, and once filled they lose their efficiency, necessitating the exposure of a new surface to secure the highest efficiency. The rubber-belt used on vanners has been quite successful, though in the case of vanners, the objection exists in the necessity of passing the mineral settled on the rubber belt, through the feed coming in the table which naturally disturbs the settled product. The canvas belt and tray machines in use to-day are all built on the same lines, being provided with fixed planes for the settling and washing of the concentrates, so that should the slime contain a comparatively large amount of mineral it would be treated on the same plane as a slime the mineral contents of which is small. To meet this condition these machines have been built so as to strike a happy medium, the range of adjustment being exceedingly limited. It must be apparent that if the mineral contents of the slime be very fine and the silica contents be coarse, the dressing plane should not be the same as when the mineral contents is coarse and the silica fine.

It is therefore the object of my invention to provide a machine in which the concentrating or dressing plane may be adjusted to the slimes instead of the slimes adjusting themselves to the plane; it may be instantly changed from a level or horizontal position to a dip of three inches to the foot while the machine is in operation. The washing plane may be handled in the

same way though through a wider range. The possibility of arranging the planes absolutely to the conditions arises from the inherent construction of the present machine, the planes being disposed radially about a horizontal axis around which they are free to revolve at any predetermined speed, such rate of speed determining the time of exposure of the concentrating surface to the flow of the pulp, the time of exposure depending of course, on the character of the pulp.

A further object of the invention, and one necessarily realized from the inherent construction of the machine, is to accomplish the washing and final cleaning of the concentrates at different points of rotation of the several planes of which it is composed, this resulting in a machine of large capacity.

A further object is to provide a machine which occupies a minimum amount of floor space; one which is self-contained and operating automatically and with a minimum amount of attention; one in which the trays furnishing the concentrating surfaces are designed so as to enable them to carry in excess of their regular mill feed all the dressing water and pulp from the tray being dressed, thus giving the middlings a double concentration, and giving the operator the opportunity of making a very high grade concentrate without the excessive losses resulting in the discharge of the pulp direct from the dressing tray into the tail race.

A further object is to secure further and other advantages best apparent from a detailed description of the invention which is as follows:—

Referring to the drawings, and for the present to Figs. 1 to 10 inclusive, which represent the double form of machine, Z, Z, represent the standards which serve as supports for the hollow trunnion sections 1, 1′, of the wheel or rotatable member carrying the pans or trays over which the pulp flows and on which the concentration takes place. The flanges 2, 2, of the hub sections are connected by tie-rods 3, the whole forming a hollow hub for the wheel. The spokes of said wheel are in the form of trays or pans, A, B, C, D, E, and so on, and A^1, B^1, C^1, D^1, E^1, and so on, provided with lateral upturned flanges *f*, the bottoms of the trays being provided with a blanket, canvas, or rubber lining *r*, over the surface of which the pulp flows as a sheet and on which the concentration takes place. A circular stiffening band 4 on each face of the wheel connects the trays together, the bases of the latter being secured in any mechanical manner to the flanges 2 of the hub-sections. Any other or equivalent method of building up the wheel and securing a rigid construction therefor would answer the same purpose as the wheel here illustrated. Mounted on top of the standard extensions or brackets Z′, above the wheel is a drive-shaft 5 provided with a belt-pulley 6 to which rotation is imparted from any suitable source of power (not shown). Said shaft carries a cone-pulley 7 from which leads a drive-belt 8 to a similar cone-pulley 9 on a bottom parallel shaft 10, the latter being mounted in bearings at the top of a standard Z″ and a bracket-arm 11 formed on the adjacent main standard Z. Disposed about the projecting peripheral portion of the hub-section 1′ (the part projecting beyond the bearing formed therefor in the standard Z) is a ratchet wheel or disk 12 over which loosely plays a forked pawl-carrying rod 13 depending pivotally from a bolt 14 carried by and projecting from the outer face of a crank-disk 15 rotatably mounted on a stud or short shaft 16 projecting from the standard extension Z′. The disk 15 is provided with a radial slot or groove *a* provided with an under-cut *b* for the reception of the bolt-head 14′ whereby the bolt may be shifted any distance radially from the axis of rotation of the disk 15, and when once adjusted may be held against shifting by a lock-nut *n* or by any other mechanical method. The forked end of the rod 13 has pivotally mounted thereon a pawl 17 which is normally held out of engagement with the teeth of the ratchet disk 12 by a flexed spring 18, the pawl being forced into engagement with the ratchet only at stated intervals as presently to be seen. Before coming however, to the point of how this engagement is effected, it may be best to describe the construction by which rotation is imparted to the crank-disk 15. This is accomplished as follows:— Formed with the crank-disk is a sprocket-wheel 19 from which leads a chain 20, the same passing over a similar sprocket-wheel 21 on the over-head shaft 5, so that as the latter rotates, a corresponding rotation is imparted to the crank-disk, and with the rotation of the latter, a reciprocating movement (to an extent depending on the radial distance of the bolt 14 from the axis of the disk) is accordingly imparted to the pawl-carrying rod 13, and hence to the pawl 17. Of course, the rod 13 has imparted thereto a combined curvilinear and reciprocating rectilinear movement as is obvious, though the free end is practically a mere reciprocating rectilinear one, the lengths of the strokes or reciprocations depending on the size of the circle described by the bolt 14 from which the rod 13 is suspended. Now, on the shaft 10, opposite the pawl 17 is mounted a cam 22, which, when its nose strikes the pawl 17 forces the latter into engagement with the ratchet 12, so that as the disk 15 rotates, the pawl will draw on

the ratchet 12 with its upward reciprocation or stroke and thus advance or rotate the hub 1, 1′, and the entire wheel of which said hub forms a part through an arc depending on the length of upward stroke of the pawl while thus engaged. The frequency of these engagements depends necessarily on the rapidity of rotation of the shaft 10, which may be regulated by shifting the drive-belt 8 over the pulleys 7 and 9 as well understood in the art; and the degree or length of arc (or angular advance) through which the wheel may be rotated depends on the lengths of the strokes imparted to the advancing pawl 17, said strokes depending on the radial distance the bolt 14 has been shifted from the center of the crank-disk 15, it being obvious that this distance determines the size of the circle described by the bolt. So that it follows that the entire concentrating wheel may be periodically advanced at more or less frequent intervals, and the arc of advance may be varied at pleasure, the one adjustment being independent of the other. We may have frequent short rotations, or frequent long rotations; we may have short rotations at long intervals, or we may have long rotations at long intervals. The precise character of rotation or advance imparted to the wheel will depend on the character of the pulp or ore to be concentrated; on whether the mineral values are coarse or fine, heavy or light, the skilled operator being able to judge with very little experimentation precisely how to set the machine for treating any particular pulp or ore. A gravity locking pawl 23 prevents any accidental rotation of the wheel in the wrong direction.

As was stated above, the present is a double machine, there being two series of trays disposed across the wheel, the series A, B, C, D, E, and so on alternating in radial disposition with the trays A^1, B^1, C^1, D^1, E^1, and so on, that is to say, they are relatively staggered (Figs. 1, 2) the two sets being preferably separated by a partition wall *w* which enters as a structural feature into the wheel as a whole. However, a description of one-half of the wheel or one set of trays, and the manner of their operation will suffice for the adjacent set, since the trays are identical, either series (or one tray for that matter) constituting a complete concentrator.

Disposed adjacent to the periphery of the wheel at a point below the horizontal plane intersecting the axis of rotation of the wheel, and at the end of the first downwardly inclined tray, below the tray which had reached a level position, is a tailings box 24. Located similarly at the outer end of the first upwardly inclined tray is a pulp feed-box 25; at the end of the next tray above the one receiving the pulp from the feed-box is a wash-box 26 for delivering washing or dressing water onto the trays as they pass the said box. The pulp from the box 25 flows over the trays as they successively present themselves, whence it discharges into the secondary feed-box 25′ (or return box) positioned within the chamber of the hollow-hub of the wheel, the box 25′ in turn delivering the pulp to the successive downwardly pitching trays leading to the tailings box 24. It follows therefore, that the pulp after leaving the primary feed-box 25 flows over one tray from the periphery to the center of the wheel, and from the center back to the periphery before finally discharging into the tailings box 24, the pulp thereby having the benefit of the concentrating action of the surfaces of two trays. So too, the wash waters and middlings discharged from the tray immediately above that taking the pulp from the feed-box, are likewise caught in the return feed-box 25′, whence they flow with the pulp on to the tray leading to the tailings box. This arrangement thus affords the middlings a double concentration, giving the operator an opportunity of making a very high grade concentrate without the excessive losses which would occur should the pulp from the dressing tray go direct to the tail race as is done in prevailing forms of machines.

Within a definite arc of the wheel's rotation, the dressed or washed trays are cleansed of their concentrates, the said concentrates and the cleansing water being discharged into a concentrate box 27 located likewise within the hollow of the hub immediately above the feed-box 25′, the boxes being supported on brackets 28 carried by the standards Z. The mechanism by which the cleaning water is projected onto the trays may be described as follows:—Leading from any suitable source of supply (not shown) is a water-supply pipe 29 which divides into two branches 30, 30, one on each side of the machine, which are supported on the standard extensions Z′, each branch being provided with legs or shunts 31 which communicate with a perforated spray-pipe section 32 positioned transversely to the plane of rotation of the wheel, the adjacent closed ends of each pair of pipes 32 being secured to a common union 33. At a convenient point in each branch 30 is located a valve 34 (preferably of any conventional gate variety) the stem 34′ of which lies in the path of rotation of a series of tappets 35 carried on each side of the wheel. As the wheel comes to a stop at the end of each periodic angular advance, an interval depending on the rapidity of rotation of the cam 22 on the shaft 10) a tappet strikes the valve-stem thereby tripping the valve to open position and allowing the water to flow through the branch 30, shunts 31 and spray

pipes 32 onto the trays which happen to have been advanced up to the pipes, the concentrates being thus removed and conducted to the concentrate box 27 whence they flow to any suitable point of further concentration or treatment. Of course, the box 27 receives the material of both sets of trays of the double machine, the tripping action of the tappets on both sides of the wheel being alike and, as before stated, a description of one side of the machine will answer for the opposite side. After the tappet slips off the valve-stem 34′ the valve closes, thereby cutting off the water during any advance or rotation of the wheel, the water being saved during these intervals. It may be stated in passing that the engagement between the cam 22 and the spring-controlled pawl 17 must necessarily be at some point on the upstroke of the rod 13, but as the rod 13 is reciprocating up and down over the ratchet disk 12 at a uniform rate of speed for any given position of the pivotal bolt 14, there is no difficulty in securing the desired engagement between the parts referred to.

The position at which any tray receives the pulp either from the main feed-box 25 or the return or supplemental box 25′, may be termed its "loading" position; and, in the double machine here described, this position for a given tray is from a horizontal plane to any desired pitch down from said plane, and at a similar pitch or incline upward from said plane. Thus in Fig. 1, the tray A is being loaded at a downward pitch from the center of the machine, such loading continuing as presently to be seen until the tray reaches a horizontal position at which the material is allowed to settle on the concentrating surface. From such horizontal or level position no loading takes place until the tray reaches the position of tray B; but in the illustration, as tray B is passing the feed-box 25, it is being loaded, the pulp discharging into the central box 25′. Thus the loading takes place on tray B while inclining upward toward the feed-box 25, and is also taking place on tray A (from the box 25′) while the latter is rising, from the tailings box 24 to a level position. Of course, while tray A is rising to a level position, tray B is rising to meet the wash-box 26, the feeding or loading on B continuing in a constantly diminishing degree as it approaches the wash-box as will presently be more fully described. What is true regarding trays A and B on one side of the machine is true of trays A^1 and B^1 on the opposite side, for when A reaches a horizontal or level position, A^1 reaches the position previously occupied by A, and B^1 takes the position previously occupied by B, so that we have a feed or loading process followed by a settling process on one side, which is then repeated on the other side, and so on continuously. As each tray in its advance comes opposite the wash-box 26, the same is dressed, the dressing water and middlings flowing into the center feed or return-box 25′ whence they flow onto the "loading" trays dipping downward from the center as described.

The maximum flow over a tray takes place while that tray is at the beginning of the arc of travel which defines the loading interval, and by the time a tray has reached a level position no more loading should take place as in that position it is desirable that the pulp be allowed to settle, the settling continuing until the tray takes on fresh pulp from the main feed-box 25. And it is equally as essential that no loading take place when a tray has reached the wash-box 26. This control of the feed of the pulp is accomplished automatically by the successive trays in conjunction with a cut-off lip or apron disposed along the discharge edges of the feed-boxes (25, 25′) and is best explained by a reference to Figs. 3, 4, and 10. Along the discharge edge of the box 25′ is a rubber or resilient lip or yielding apron 36 (there being two such lips along the length of the box, one for each set of trays) which is secured to a strip 37, said lip when freed springing downwardly and projecting a slight distance beyond the edge of the box (Fig. 10). As a tray (A for example) reaches the beginning of its loading position, (as shown by full drawing of the tray in Fig. 10) the pulp flows freely onto the tray. As the latter continues its rotation the inner edge of the tray picks up the lip thus gradually cutting off the pulp flow until the tray reaches a level position at which the flow is cut off completely, the lip having been raised to prevent any further flow of pulp thereover. The material on the tray has thus a chance to settle, and as the tray continues in its sweep it releases the lip which now drops back to engage the next succeeding tray and supply the proper complement of pulp thereto. From the level position the tray continues to rise until its free outer edge reaches the box 25 which has a similar lip 36′ (at the delivery edge) such lip 36′ engaging the outer edge of each approaching tray as it is released from the tray approaching the wash-box 26. To illustrate (Fig. 1), the lip 36′ is resting on the tray B allowing the pulp to flow freely thereover from the feed-box 25; as the tray keeps on rising it gradually picks up the lip thus progressively cutting off the pulp-flow. When the tray B reaches the wash-box 26, it releases the lip 36′ which then engages the next tray A (on which the settling had been taking place) allowing the lip 36″ of the wash-box (released from tray C) to engage the tray B and deliver the wash-water thereto. Of course the lips 36′, 36″, are split

at the center (as are the lips 36, 36, Fig. 7) thereby forming two independent lip sections, one for each set of trays A, B, C, and so on, and A′, B′, C′, and so on. At the center of the machine likewise, the lips 36, 36, must be in two sections as there is always one loading tray above the level position which is pouring its contents into the center feed-box 25′ (Fig. 4), so that one section of the lip 36 must always be deflected or "open" to allow for the discharge of the pulp and dressing water from the center box onto the tray pitching downwardly therefrom. The other lip section of course, would be raised to cut off any flow onto the tray occupying the settling position (Fig. 4.)

The machine thus far described is a double one, that is to say, it has two sets of trays side by side and working independently, and is furthermore provided with two feed-boxes 25, 25′, which allow for a double traverse of the pulp over the concentrating surface, one travel toward the center of the wheel, and a second travel from the center out. I may however, construct a single machine or one having a single system of trays as shown in the modification in Figs. 11 and 12. In that case, the outer feed-box 25 is eliminated, the pulp being directly supplied to, and fed onto the trays from, the center feed-box 25′. In the single machine the pulp has but a single traverse, the loading position of a tray being included in the arc of advance from a suitable pitch below a level position up to a level position only, there being no other loading position. When the pulp reaches the outer edge of a tray (the trays being designated by way of distinction A^2, AA^2, B^2, BB^2, C^2, CC^2, D^2, DD^2, and so on) it discharges into the tailings box 24. After settling, the tray continues on to the wash-box 26, the dressing water and middlings returning to the center-feed box 25′ as already explained, and the subsequent cleaning of the trays of the concentrates and the discharge of the latter into the box 27 being the same as in the double machine. The single machine in other respects is built precisely as the double one, so that the same reference numbers apply to corresponding parts. We thus have for every tray or leaf of the wheel a loading position during which the pulp flows over the concentrating surface *r*, followed by a settling position during which the concentrates have a chance to settle into the meshes of the tray lining; then follows the dressing position, and finally the cleaning position, which as seen from the drawings covers a wide range from a truly vertical position of a tray, to a considerable angle on either side thereof if desired. The rapidity of the periodic advances of the wheel or trays may be varied at pleasure, as also the degree (or arcs) of said advances, making it possible to instantly raise a tray from a loading position to a level or settling position at one single full advance, or by a series of short advances, which in turn may be quick or slow according to the rapidity of rotation of the cam 22, all these various adjustments (effected in the manner previously described) depending on the character of pulp or ore to be handled. It follows from this, that a machine of this character necessarily has a large capacity, a "single" machine of ten foot diameter treating as much as eight tons of pulp in twenty-four hours, requiring one-quarter horse power to propel it. Obviously the concentration need not be restricted specifically to "ores."

In the single machine (Figs. 11, 12) some provision must of course, be made to deliver the pulp to the center-box 25′. As shown in Fig. 11 this is accomplished by a communicating chute or launder 25″ leading to any source of pulp-supply (not shown). In that case the concentrates may be conducted out of the box 27 through a chute 27′. Again, being a single machine, only a single water-pipe 30, and branches 31 and corresponding spray-pipes 32 are used instead of the double arrangement of the double machine. In other respects however, the single type of machine is the same as the double type first described, and corresponding parts have corresponding reference numerals and letters.

Having described my invention, what I claim is:—

1. In a concentrator, a member provided with a concentrating surface radiating from a fixed horizontal axis, over which surface the pulp is free to flow in sheet form, means at the axis for supplying the pulp and means for revolving said member about said axis.

2. In a concentrator, a member provided with a concentrating surface radiating from a fixed horizontal axis, over which surface the pulp is free to flow in sheet form, means at the axis for supplying the pulp and means for periodically revolving said member about said axis.

3. In a concentrator, a member provided with a concentrating surface radiating from, and revoluble about a fixed horizontal axis, and means for discharging the pulp onto said surface at points adjacent to the axis during a depressed position of said surface below a horizontal plane through the axis, whereby the flow of the pulp is away from said axis.

4. In a concentrator, a member provided with a concentrating surface radiating from, and revoluble about a fixed horizontal axis, a feed-box at said axis discharging the pulp onto said surface during a depressed position of said surface below a horizontal plane through the axis, means for delivering a current of dressing or wash water onto said surface upon the elevation of said surface above a horizontal plane through the axis,

the dressing water and pulp being thereby returned to the feed-box.

5. In a concentrator, a member provided with a concentrating surface radiating from, and revoluble about, a fixed horizontal axis, means for rotating said concentrator, means positioned relatively to the concentrating surface to effect a sheet flow of the pulp over said surface from said axis for a downward inclination of said surface from a horizontal plane through the axis, and means positioned to effect a sheet flow over the surface toward said axis for an upward inclination of said surface from a horizontal plane through the axis.

6. In a concentrator, a member provided with a concentrating surface revoluble about a fixed horizontal axis, a chamber at the axis in communication with said surface, means for loading or charging said surface while inclined to an axial horizontal plane, means for rotating said surface to bring the same to an axial horizontal plane or settling position, means for rotating said surface from its settling position and washing the settled ore, and means for rotating the surface beyond its washing position and removing the concentrates therefrom.

7. In a concentrator, a member provided with a concentrating surface revoluble about a fixed horizontal axis, a feed-box at the axis for loading the concentrating surface for a depressed position thereof below a horizontal plane, means for elevating the surface to a horizontal or settling position, means for subsequently elevating said surface above a horizontal and washing the same and returning the wash-water and pulp to the feed-box, and means for rotating the member beyond the washing position and removing the concentrates.

8. In a concentrator, a member provided with a concentrating surface revoluble about a horizontal axis, and assuming in succession a downward inclination from said axis for the loading of the pulp, a horizontal position for the settling of the pulp, and an upward inclination for the dressing of the settled material, means for supplying the dressing fluid, and a chamber at the axis in communication with the concentrating surface aforesaid.

9. In a concentrator, a member provided with a concentrating surface revoluble about a horizontal axis, and assuming in succession a downward inclination from said axis for the loading of the pulp, a horizontal position for the settling thereof, an upward inclination for the dressing of the settled material, and a further inclination for the final cleaning position, means removed a suitable distance from the axis for supplying the dressing and cleaning fluids to the concentrating surface, and a chamber at the axis in communication with said surface.

10. A concentrator comprising a member rotatable about a horizontal axis and provided with trays radiating outward from said axis, in combination with means located at the axis for feeding liquid pulp successively to the trays.

11. A concentrator comprising a member rotatable about a horizontal axis and provided with trays radiating outward from said axis, in combination with a feed-box located at the axis and delivering sheets of pulp successively to the trays in their rotation about the box.

12. A concentrator comprising a rotating wheel having a hollow hub, a series of radiating trays communicating at their inner ends with the chamber of the hub, a stationary pulp feed-box located in the hub chamber and delivering the pulp successively to the several trays as they approach a horizontal position in the course of their upward sweep with the rotation of the wheel, means for discontinuing said feed when a tray reaches a horizontal position, and means for washing or dressing each tray after passing upwardly through a predetermined arc beyond its horizontal position, and directing the wash waters into the feed-box.

13. A concentrator comprising a rotating wheel having a hollow hub, a series of radiating trays communicating at their inner ends with the chamber of the hub, a stationary feed-box located in the hub chamber and delivering the pulp successively to the several trays as they approach a horizontal position in the course of their upward sweep with the rotation of the wheel, means for discontinuing said feed when a tray reaches a horizontal position, means for dressing each tray after passing upwardly through a predetermined arc beyond its horizontal position, and directing the dressing waters to the feed-box, means for removing the concentrates from the trays after the latter have passed their dressing position, and a box in the hub chamber for catching the concentrates thus removed.

14. A concentrator having a member provided with a concentrating surface over which the pulp flows in sheet form, means for rotating the concentrator about a fixed horizontal axis and bringing said surface into different planes for the respective purposes of concentration, settling and dressing, the concentrating surface being provided with a free edge at one end over which the sheet may discharge in the direction of its flow, and means at the end of the member opposite said edge for supplying the pulp.

15. A concentrator having a member provided with a concentrating surface over which the pulp flows in sheet form, means for rotating the concentrator about a fixed horizontal axis, and bringing said surface

into different planes for the respective purposes of concentration, settling, dressing and final cleaning, the concentrating surface being provided with a free edge at one end over which the sheet may discharge in the direction of its flow, and means at the end of the member opposite said edge for automatically supplying the pulp thereto as the surface reaches the concentrating plane.

16. A concentrator having a member provided with a concentrating surface revolving about a horizontal axis, means for maintaining the flow of the pulp in sheet form over said surface during the revolving movement thereof, and means for varying the speed of rotation of said member and thereby regulating the time of exposure of said surface to the flow of the pulp.

17. A concentrator having a member provided with a surface for the flow of pulp in sheet form thereover, means for periodically rotating said member about a horizontal axis through a predetermined arc, and maintaining the sheet flow over said surface throughout said arc, and means for varying the intervals between two successive rotations.

18. A concentrator having a member provided with a surface for the sheet flow of pulp, means for periodically rotating said member about a horizontal axis through a given arc and maintaining the sheet flow over said surface throughout said arc, and means for varying the degree of said arc.

19. A concentrator having a member provided with a surface for the sheet flow of pulp, means for periodically rotating said member about a horizontal axis through a given arc, and maintaining the sheet flow over said surface throughout said arc, and means for varying the frequency of said periodic rotations and of the degrees of the arc of rotation.

20. A concentrator comprising a rotating wheel composed of a series of radially disposed trays or leaves, a hollow central hub, a stationary feed-box and a concentrate box within the hub, means for permitting the discharge of the pulp from the feed-box consecutively onto the several trays for a given angular upward advance of each tray until it reaches a horizontal position, means for arresting the wheel with the advance of each tray to allow the concentrates to settle on the horizontal trays, means for dressing the several trays after passing the horizontal position and discharging the dressing water into the feed-box, means for directing streams of water against the trays after the dressing operation, and discharging the concentrates into the concentrate box within the chamber of the hub.

21. In combination with a rotating wheel having a hollow hub and provided with a series of radially disposed concentrating leaves or trays terminating at the hub, a stationary feed box for the pulp located in the hub chamber and provided with a yielding lip over which the pulp flows onto the leaves, the ends of the latter engaging and raising the lip to cut off the flow at the end of a given angular traverse of each leaf, the lip being released at the end of such traverse to permit the flow onto the next succeeding leaf of the series.

22. In combination with a rotating wheel having a hollow hub and provided with a series of radially disposed concentrating leaves or trays discharging into the hub chamber, a feed-box located in the hub chamber, a box containing pulp located outside the wheel and having a marginal flexible lip normally deflected downward to allow the pulp to flow onto the leaves and into the feed-box within the hub, the leaves engaging the lip of the outer box in their rotation and raising it to cut off the flow at the end of a given angular traverse of each leaf, and releasing the lip subsequently thereto to permit the flow of the pulp onto the next leaf of the series.

23. In combination with a wheel rotating about a horizontal axis, and provided with concentrating trays radiating from said axis, a box disposed at the axis of rotation and receiving the product of said trays, a water-pipe provided with discharge openings delivering cleaning water onto the trays, a valve in said pipe, and a series of tappets on the wheel for periodically opening said valve and releasing the cleaning water onto the trays.

24. In combination with a series of concentrating trays revolving about a common horizontal axis, means at the axis for delivering liquid pulp in sheet form, successively onto the trays in the course of said rotation, and a tailings box located at the periphery of the series of trays for receiving the tailings discharged from the successive trays.

25. In combination with a wheel having a hollow hub rotating about a horizontal axis, a box in the hub chamber, a series of radiating trays, means for discharging pulp from the box onto the successive trays in the course of the wheel's rotation, an annular ratchet coupled to the hub, a rotatable disk, a rod leading from a point on the disk removed from the center thereof, a pawl on said rod normally disengaged from the ratchet, a cam rotating at a predetermined speed opposite the pawl and adapted to momentarily engage the same in the course of a rotation and force the pawl into engagement with the ratchet, whereby the wheel is periodically advanced through a definite angle or arc of rotation, means located at the outer ends of the trays for washing the same, the wash waters discharging into the box aforesaid, and mingling with the pulp in said box, a concentrate box in the hub cham-

ber, and means at the outer ends of the trays for directing cleaning water onto the trays during the intervals of rest of the wheel and causing a discharge of the cleaned material into the concentrate box.

26. In a concentrator, a member provided with a plane concentrating surface over which the pulp flows in sheet form, means for rotating said concentrator and member about a horizontal axis disposed adjacent to one end of said member, a source of pulp-supply located adjacent to the axis and delivering the pulp to the concentrating surface, the latter having imparted thereto a variable inclination in such rotation to a horizontal plane through said axis during the flow of the pump over the surface.

27. A concentrating member provided with a concentrating surface over which the pulp flows during a downward dip of said surface relatively to a horizontal plane, means at one end of the member for discharging the pulp onto said surface at the vertex of the angle defining the dip, means for elevating said member to bring the surface on a level to permit settling, means for elevating the member to incline the surface upwardly for purposes of dressing, and means for cleaning the surface of the concentrates at points beyond the dressing inclination.

28. In combination with a concentrator having a plane concentrating surface radiating from a fixed horizontal axis, means for rotating said concentrator about said axis whereby said surface assumes different planes of angular disposition relative to a horizontal plane through said axis, means for delivering pulp onto said surface while depressed below the horizontal plane aforesaid, the flow of the pulp being maintained thereover in sheet form until the surface reaches a horizontal or settling plane.

29. In a concentrator, a member provided with a concentrating surface revoluble about a fixed horizontal axis, means for discharging the pulp onto said surface at points adjacent to the axis for a depressed position of said surface below a horizontal whereby the flow of the pulp is away from said axis, the material settling on said surface as the latter reaches the horizontal, and means for discharging pulp onto said surface upon reaching a given upward inclination whereby the flow of the pulp is toward said axis.

30. A concentrator comprising a vertically rotating wheel provided with a hollow hub, and trays radiating outwardly therefrom, a pulp feed-box adjacent the periphery of the wheel for feeding pulp to the upwardly inclined trays, a box in the chamber of the hub for catching the overflow from said trays, and discharging said overflow onto the downwardly inclined trays, whereby the material is subjected to a double traverse and concentration.

31. A concentrator composed of a wheel rotatable about an axis and provided with two juxtaposed sets of trays radiating from said axis, the trays of one set alternating with those of the adjacent set, and means for maintaining a sheet flow of pulp over the trays of each set from a common supply source.

32. In a concentrator, a member provided with a concentrating surface radiating from a fixed horizontal axis and revoluble about said axis, means for feeding liquid pulp onto said surface, the inner and outer bounding edges of the member allowing for the free escape of the pulp, whereby the pulp is permanently maintained in the form of a sheet on the concentrating surface over which it flows.

In testimony whereof I affix my signature, in presence of two witnesses.

SAM H. BOYLAN.

Witnesses:

B. F. CAFFEY,

JOHN R. SMITH.