L. E. JONES.

CENTRIFUGAL CONCENTRATOR.

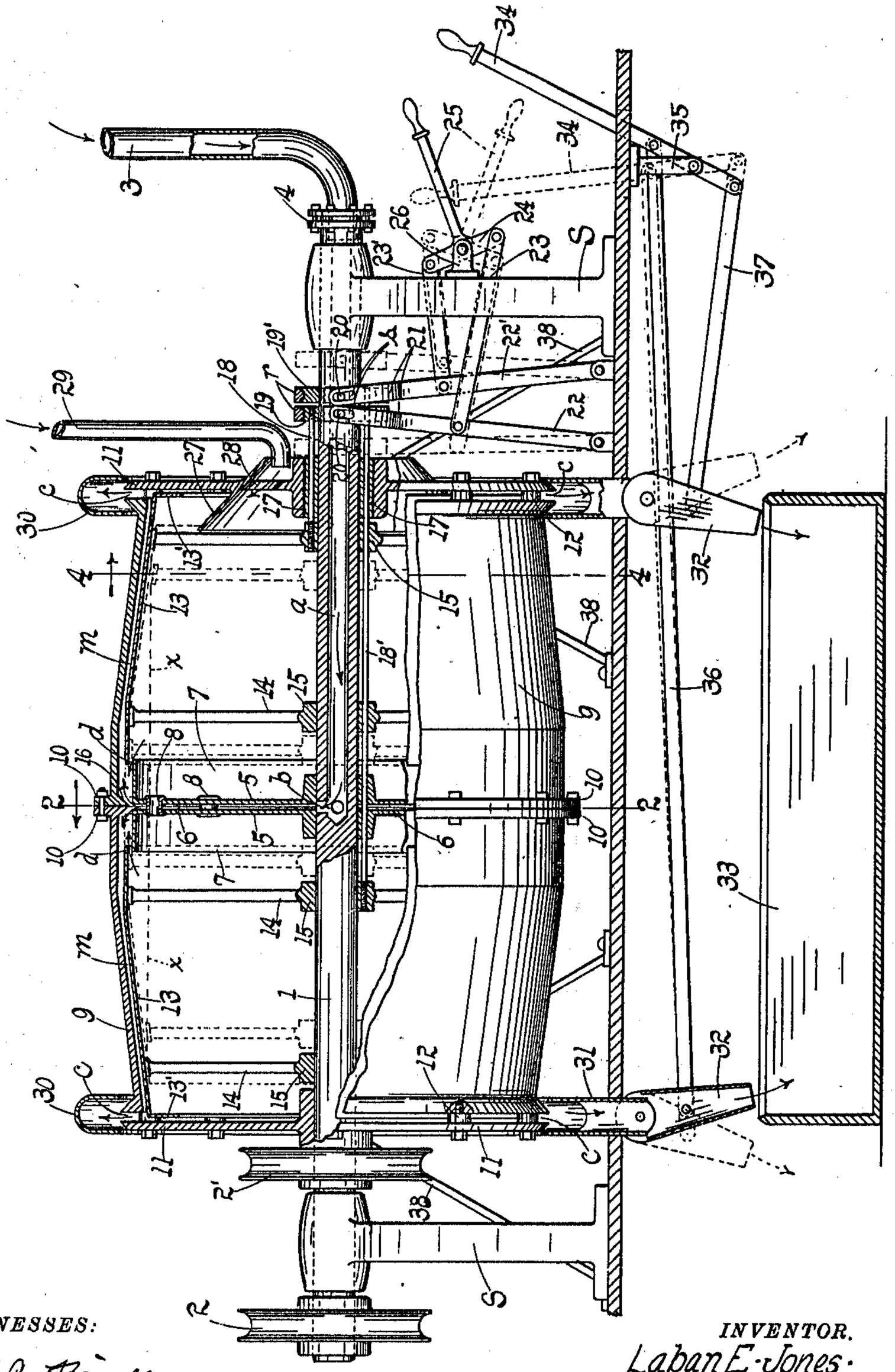
APPLICATION FILED FEB. 20, 1911.

992,876.

Patented May 23, 1911.

2 SHEETS—SHEET 1.

FIG. 1.



WITNESSES:

Harry A. Baines.

Fannie C. Heber.

INVENTOR.

Laban E. Jones.

BY Church Howard

ATTORNEY.

L. E. JONES.

CENTRIFUGAL CONCENTRATOR.

APPLICATION FILED FEB. 20, 1911.

992,876.

Patented May 23, 1911.

2 SHEETS—SHEET 2.

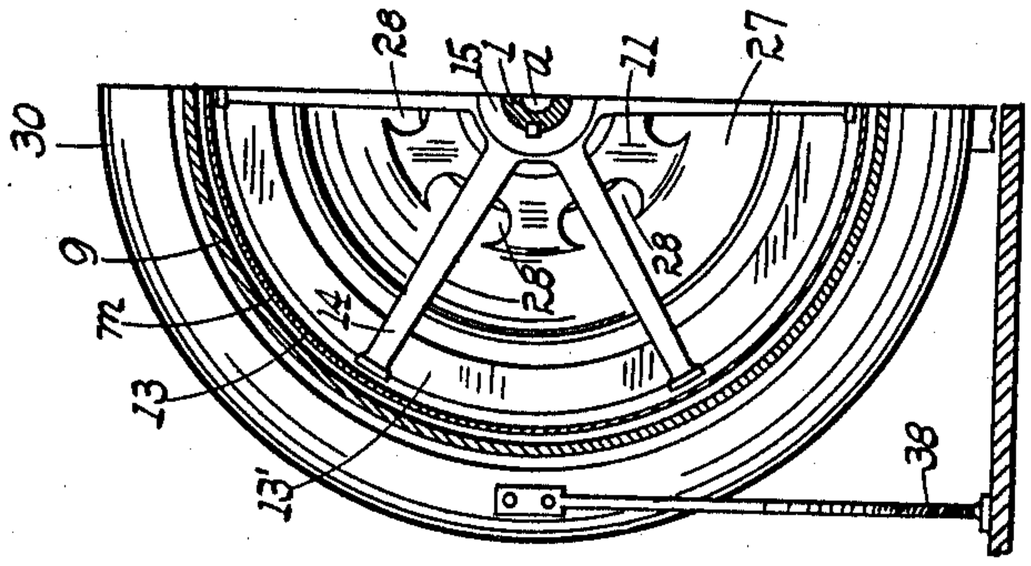


FIG. 4.

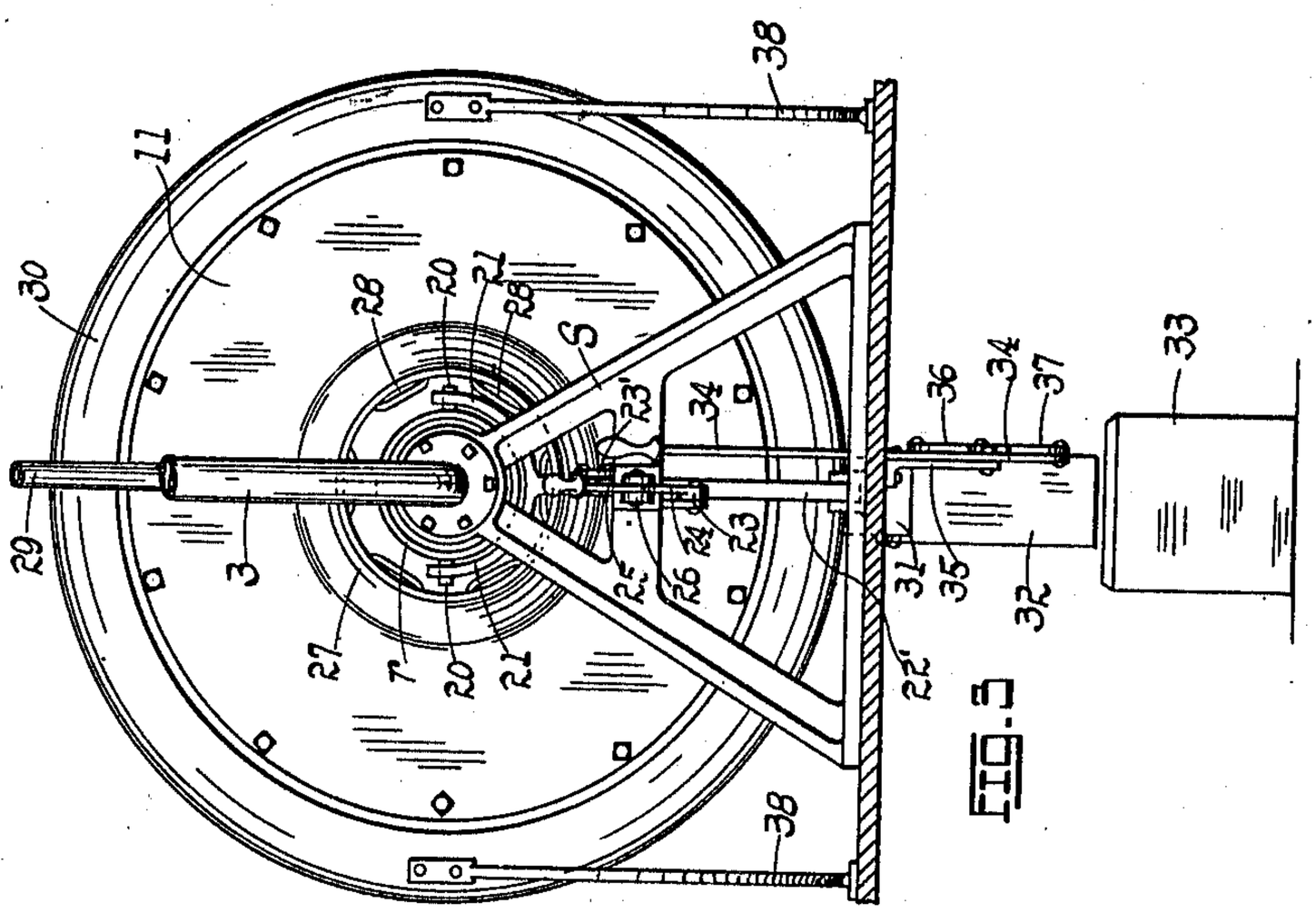


FIG. 3.

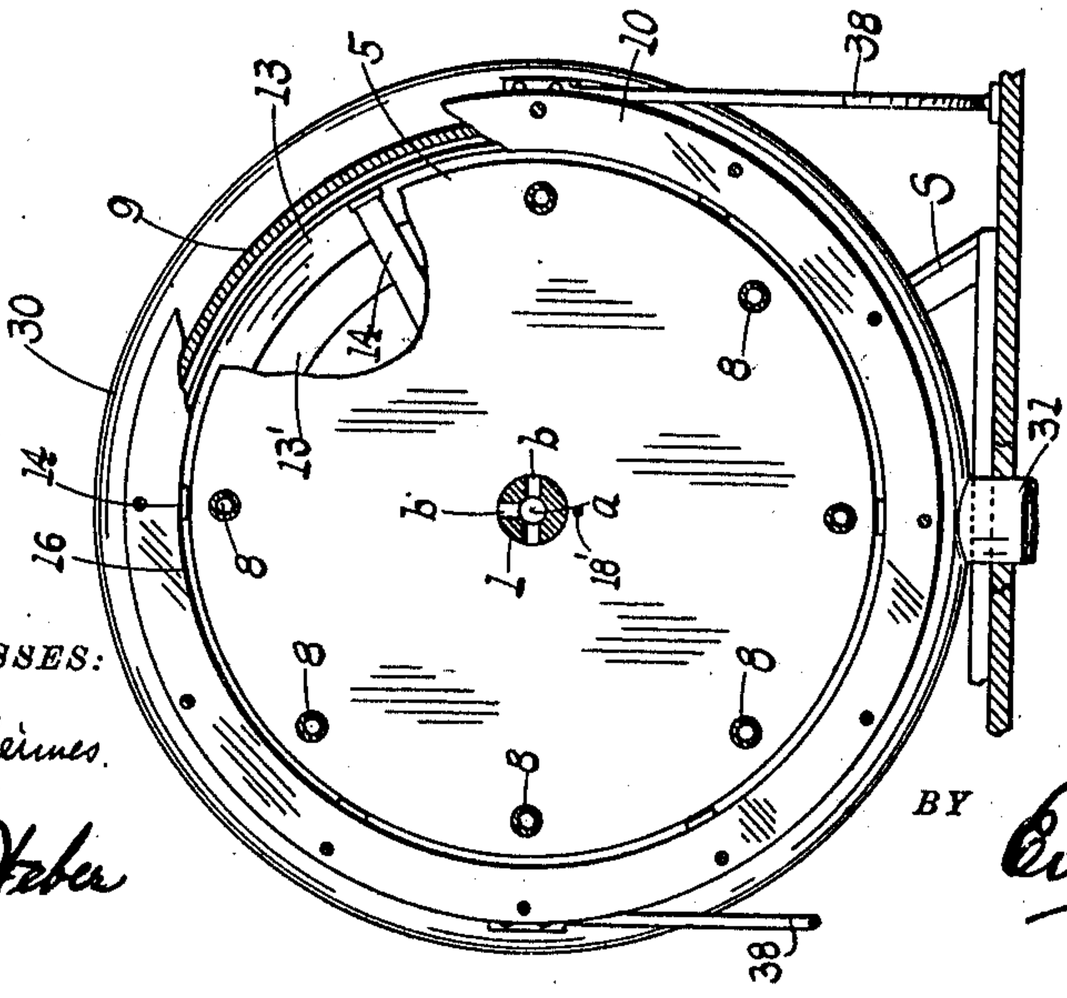


FIG. 2.

WITNESSES:

Harry A. Beines.

Ramie E. Heber

INVENTOR.

Laban E. Jones.

BY Ernst Starck

ATTORNEY.

UNITED STATES PATENT OFFICE.

LABAN ELLSWORTH JONES, OF ANACONDA, MONTANA.

CENTRIFUGAL CONCENTRATOR.

992,876. Specification of Letters Patent. Patented May 23, 1911.

Application filed February 20, 1911. Serial No. 609,783.

To all whom it may concern:

Be it known that I, LABAN E. JONES, citizen of the United States, residing at Anaconda, in the county of Deerlodge and State of Montana, have invented certain new and useful Improvements in Centrifugal 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 centrifugal slime concentrators; and it consists in the novel features of construction more fully set forth in the specification and pointed out in the claims.

In the drawings, Figure 1 is a side elevation of the apparatus, with parts in section; Fig. 2 is a vertical cross-section on the center line 2—2 of Fig. 1; Fig. 3 is an end elevation of the apparatus; and Fig. 4 is a half cross-section on the line 4—4 of Fig. 1.

The object of my invention is to construct an apparatus for subjecting fine ore or slime to the action of centrifugal force, special provision being made to cause the slime-pulp to flow in sheet form over a rotating surface on which the concentration is effected, the tailings being allowed to pass out of the machine to any suitable point where proper disposition thereof may be made. The concentration herein results from the action of centrifugal force operating on the material while flowing in sheet form over the concentrating surface, precipitation of the concentrates on said surface being the direct result of such action.

A further object is to provide means for washing or flushing the concentrates accumulated on the concentrator surface, and causing their discharge from the machine, said washing being herein accomplished by taking advantage of a speed differential between the independently rotatable members entering into the construction of the machine.

A further object is to make provision for regulating the thickness of the sheet flowing over the concentrating surface, and thereby the thickness of the film of concentrates precipitated thereon.

The apparatus presents further and other advantages better apparent from a detailed description of the invention, which is as follows:—

Referring to the drawings, S, S, represent a pair of standards between which is mounted a shaft 1, one end of the shaft being provided with a driving belt pulley 2. Opening from the opposite end of the shaft is a longitudinal passage-way *a* which terminates at the center of the shaft, the terminal of said passage-way having leading therefrom through the shaft the discharge ports *b*. With the intake end of the passage *a* communicates a pulp-supply or slime-pipe 3, a stuffing box 4 of any conventional design permitting of free rotation of the shaft 1 about its axis. On opposite sides of the ports *b* there are secured to the shaft 1 a pair of disks or walls 5, 5, leaving between them a flat circular compartment or pulp-chamber 6, which discharges at the outer edges or peripheries of the disks, the disks being provided with rims or flanges 7 extending in opposite directions. For convenience the compartment 6 with its bounding walls 5, 5, will be referred to as a centrifuge, rotating as it does about the axis of the shaft 1. The disks 5 are connected together at various points by hollow thimbles or tubes 8 to allow free intercommunication between the water compartments on either side of the compartment 6 and which will be presently referred to in detail. Mounted on the shaft 1, and having a rotation about the axis thereof independently of the shaft, and encompassing the centrifuge is an outer drum 9 composed of two substantially truncated cone-sections united together at the basal flanges 10 of the sections, the heads or ends 11 being bolted to the outer terminals of the drum sections, but spaced apart therefrom by spacing thimbles or rings 12 to afford an annular overflow passage *c* for the discharge of the concentrates and tailings as presently to be described. The drum 9 is provided with a driving belt-pulley 2′ adjacent to one of the heads 11. Mounted within the drum 9 opposite each disk 5, and feathered to freely slide along the shaft, and at the same time rotatable with the shaft, are inner drum-sections or shells 13, 13, substantially of the same contour as the outer drum sections, the outer ends of the

shells being provided with inner flanges 13′. The shells are supported on spokes 14 radiating from hubs 15 free to slide along the shaft 1, the diameters of the inner adjacent ends of the shells being such as to circumscribe or encompass the cylindrical surface of the disk-flanges 7, thus leaving annular discharge passages *d* between the flanges 7 and said shells.

At the juncture of the outer drum sections are formed bevel ribs 16 forming a bevel ridge which acts as a spreader for the current of pulp projected from the centrifuge (see arrows Fig. 1). The hub of the drum-head 11 adjacent to the pulp supply-pipe 3 is provided with a bushing 17 through which freely play the connecting rods 18, 18′, respectively, the opposite ends of the rod 18 being secured respectively to the adjacent spoke-hub 15 of the contiguous shell 13 and to the adjacent slip-collar 19 mounted slidingly on the shaft 1, while the rod 18′ has its opposite ends secured respectively to the nearest spoke-hub 15 of the opposite shell 13 and an outer slip-collar 19′, the rod 18′ passing freely through the hub portions of the disks 5, 5, through the spoke-hubs of the first shell and through the bushing 17 as fully shown in the drawings (Fig. 1). Each slip collar is loosely embraced by a ring *r*, each ring being provided with diametrically disposed pins 20 to engage the slots *s* in the forks 21 of the levers 22, 22′, pivoted to the floor. The levers 22, 22′, are connected by means of links 23, 23′ to the ends of the terminal cross-arms 24 of the hand-lever 25 pivoted between the lugs or ears 26 on the adjacent standard S. By swinging the lever 25 in one direction the slip collars 19, 19′, will be driven apart thus drawing the shells 13 toward each other, and by swinging the lever in the opposite direction the slip-collars will be moved toward each other thereby driving the shells 13 apart. In this longitudinal movement of the shells or inner drum sections the thickness of the annular spaces *m* between the shells and inner surfaces of the outer drum sections will be varied, since in such movement the adjacent surfaces of the shells and outer drum sections will be brought closer together or farther apart according as the shells 13 are moved outward or inward. The thickness of the annular space or clearance *d* however, is not affected, since the bases of the shells are substantially cylindrical. Formed with one (or both) of the outer drum-heads 11 is a conical funnel or flange 27 flaring inwardly and projecting on either side of the plane of the head, the head being provided between its hub and the funnel with openings 28 for the inflow of water into the water compartments formed by each shell 13 and its adjacent flanged disk 5, the water level in the two compartments being maintained the same throughout by reason of the intercommunication between the compartments through the hollow disk-spacing thimbles 8. The water is supplied from the water-supply pipe 29 which discharges into the funnel 27. The water is fed at a rate to maintain it during the rotation of the apparatus, at a substantially uniform thickness against the inner surfaces of the shells 13, the inner surface of the hollow cylinder of water hugging the shell walls being represented by the dotted line *x* (Fig. 1), and being substantially on a level with overflow from the outer drum. The overflow passages *c* from the outer drum are surrounded by hollow annular rings 30 having basal necks 31 from which depend pivotally the sluice-pipes or discharge-nozzles or spouts 32. These allow the concentrates to be discharged into a tank 33, or, when swung out of range of the tank discharge the tailings or waste outside the tank, the nozzles being controlled by a hand-lever 34, pivoted to a bracket 35, and provided with links 36, 37 on opposite sides of the fulcrum point, one link 36 leading to the farther spout and the other 37 to the near spout. The dotted position in Fig. 1 shows the manner of manipulating the spouts. The rings 30 may be supported and braced in any way, here shown as braced by struts 38.

Each disk 5 and its flange 7, together with its adjacent shell or inner drum section 13 form a water container or compartment, of which the flanged disk rigidly fixed to the shaft 1 may be considered as the relatively fixed or stationary section, and the shell 13 as the movable and adjustable section, its position along the shaft (or its distance from the fixed section) determining the thickness of the annular space *m* between the inner and outer drum sections, and hence determining the thickness of the pulp sheet flowing through said space to the discharge or overflow slot *c*. When a proper working thickness of this sheet has been obtained, (by a proper manipulation of the lever 25) the parts are left in that position during the treatment of the particular pulp. The pulp centrifuge 6, being at the center of the apparatus may be said to be bounded by two intercommunicating water compartments, the water discharged from the latter mingling with the pulp discharges of the former and the conjoint mixture flowing through the spaces *m* to the rings 30, the concentrates being precipitated on the inner (concentrating) surface of the outer drum 9.

The operation of the apparatus is substantially as follows:—Assuming that slime or pulp is flowing from the pipe 3 through the shaft-passage *a* and into the space 6 between the disks 5, 5, and that water is being delivered into the water containers from the pipe 29 through the funnel 27, simultaneous rapid

rotation (in the same direction) is imparted to the shaft 1 and to the outer drum 9 from the belt pulleys 2, 2′, and at the same rate of speed. The operator thereupon manipulates the lever 25 in proper direction to move the two shells or inner drums 13 outward, so as to leave a thin space *m* between said shells and the inner surface of the outer drum. The centrifugal force drives the slime outward against the spreader or parting ridge 16 causing it to flow outwardly in opposite directions through the spaces *m* to the discharge slots *c* and into the rings 30. None of the slime can enter the water compartments or shells 13, because the centrifugal force crowds the water into the form of a hollow cylinder which hugs the walls of the shells, the level (or inner surface of said cylinder of water) corresponding to that of the overflow *c* and represented substantially by the dotted line *x* (Fig. 1). The water thus crowded against the inner surfaces of the shells or inner drum sections 13 prevents the slime from entering them, some of the water however, escaping through the passages *d*, *d*, and mixing with the slime. The slime thus travels in thin sheets toward the overflows *c*, the heavy particles or concentrates being precipitated under the centrifugal action against the inner surfaces of the outer drum sections 9, the waste continuing and discharging into the hollow rings 30, whence it is discharged through the spouts 32, to points outside the tank 33, (see dotted position Fig. 1). The concentrates are flushed or washed out of the outer drum as follows:—As soon as the operation has progressed long enough to cause a precipitation of a sufficient layer of concentrates on the outer drum to fill the spaces *m*, *m*, said drum is quickly slowed down, the settled particles being loosened and driven ahead by their inertia. The speed of the inner drums 13, 13, however, remains constant, the water in them under the greater centrifugal force to which these drums are subjected rushing through the spaces *d*, *d*, and carrying the now loosened concentrates through the spaces *m*, *m*, into the rings 30, whence they are directed into the tank 33 (Fig. 1), thus cleaning the outer drum for another operation. During the washing of the precipitates (under a sudden slowing down or even a complete stoppage of the outer drum) the flow of slime through the pipe 3 may be temporarily discontinued if desired, as it is desirable to use pure water for the washing operation. This may be done by cutting off the pulp from its source of supply by a valve (not shown) or any other suitable means apparent to the skilled mechanic. During the washing process the inner shells or drums 13 should be forced inwardly or toward the disks 5 to increase the thickness of the spaces *m*, and allow for a quick flushing of the concentrates. When ready for another operation, the outer drum is again speeded up, the inner drums 13 are drawn outwardly to thin down the spaces *m*, the spouts 32 are swung out of range of the tank 33, and the concentrating operation is repeated.

Having described my invention, what I claim is:—

1. In combination with a rotatable shaft provided with a longitudinal passage-way having an intake for the pulp and discharging through the shaft, walls secured to the shaft on opposite sides of the discharges thereby forming a chamber for the traverse of the material thus discharged, an outer drum revolving independently of the shaft and walls aforesaid, against the inner surface of which the material ejected from the chamber impinges, an inner rotatable water-holding drum or shell on the shaft located contiguous and opposite to, and spaced from, one of the chamber walls, and having imperforate walls spaced from the inner walls of the outer drum, whereby the material impinging against the outer drum is caused to flow between the outer drum and shell, and the concentrates are precipitated on the inner surface of the outer drum.

2. In combination with a rotatable shaft provided with a longitudinal passage-way having an intake for the pulp and discharging through the shaft, walls secured to the shaft on opposite sides of the discharges thereby forming a chamber for the traverse of the material thus discharged, an outer drum revolving independently of the shaft and walls aforesaid, against the inner surface of which the material ejected from the chamber impinges, an inner rotatable water-holding drum or shell on the shaft opposite to, and adjustable to and from the adjacent chamber wall, and having its walls spaced from the inner walls of the outer drum whereby the material impinging against the outer drum is caused to flow between the outer drum and shell, and the concentrates are precipitated on the inner surface of the outer drum.

3. In combination with a rotatable shaft provided with a longitudinal passage-way having an intake end for the pulp and discharging through the shaft, disks secured to the shaft on opposite sides of the discharges thereby forming a circular chamber for the traverse of the material thus discharged, an outer drum revolving independently of the shaft and disks, against the inner surface of which the material ejected from the chamber impinges, and inner rotatable water-holding drum sections or shells on the shaft opposite to and removed from each disk and having their walls spaced from the inner walls of the drum but in near proximity thereto, whereby the material impinging against the

outer drum is caused to flow in sheet form between the inner surface of said drum and the outer surfaces of the shells, and the concentrates precipitated on the inner surface of the outer drum.

4. In combination with a rotatable shaft provided with a longitudinal passage-way having an intake for the pulp and discharging through the shaft, disks secured to the shaft and bounding the discharge openings from said passage-way, flanges formed on the outer edges of the disks and pointing in opposite directions, an outer drum revolving independently of the shaft and disks against the inner surface of which the material ejected from the space between the disks is projected, inner drum sections or shells rotatable with, and having a sliding movement along the shaft, the adjacent ends of the shells forming passage-ways with the disk-flanges, means for introducing water into the shells through the head of the outer drum, the water being free to flow through the passage-ways formed between the shell walls and the disk flanges into, and against the inner walls of, the outer drum and mingle with the pulp, the mixture flowing as a sheet between the outer drum and inner shells, the ends of the drum being provided with overflow openings, annular hollow rings for receiving said overflows, and means for effecting the discharge of the contents of said rings.

5. In combination with a centrifuge for the pulp, a drum encompassing the centrifuge and intercepting the discharges therefrom at a medial point of the drum, shells or drum sections rotatable with the shaft and having adjacent open ends coöperating with the centrifuge and forming interior water compartments discharging into the outer drum around the centrifuge, said discharges commingling with the pulp, said drum-sections forming with the outer drum annular passages through which the material flows in sheet form toward the ends of the outer drum, the latter being provided with overflows at such ends.

6. In combination with a pair of intercommunicating water compartments spaced a suitable distance apart and rotating about a common axis, and provided with means for peripheral discharge of the water, means for conducting the pulp along said axis into the space between the compartments and discharging the same at a point between the water discharges, an outer drum rotating about the axis aforesaid and having its walls spaced a suitable distance from the walls of the water compartments whereby the water mixed with pulp flows in sheet form between the respective walls, and the concentrates settle on the inner surface of the drum.

7. In combination with a pair of intercommunicating water compartments comprising each a fixed section and a movable section adjustable relatively to and from the fixed section conjointly rotating about a horizontal axis, the fixed sections being in contiguous relation and spaced apart, means for conducting the pulp along said axis into the space between the fixed sections and discharging the same at the periphery of the sections, the movable sections forming peripheral water-discharge passage-ways with the fixed sections, an outer drum having terminal overflows and rotatable independently about the horizontal axis aforesaid; the inner surfaces of the drum walls receiving the combined pulp and water discharges, said surfaces being spaced a suitable distance apart from the walls of the water compartments whereby the flow of the discharges is in sheet form, and whereby the concentrates are precipitated on the inner surface of the drum under centrifugal action.

8. A slime concentrator comprising a central horizontal rotating shaft having a passage-way leading from one end of the shaft to the center thereof and provided with discharge ports for the pulp at the inner end of said passage-way, an outer drum tapering toward its ends and rotatable independently of said shaft and provided with terminal overflow passage-ways, flanged disks secured to the shaft on opposite sides of the shaft ports, said space receiving the pulp discharged from the shaft, inner open-ended drum sections or shells slidingly feathered to the shaft opposite each disk and encompassing the flanges of said disks to form annular passage-ways for the escape of water, an open funnel formed with one of the heads of the outer drum, means for feeding water into the inner shells through said funnel, means for conducting pulp into the shaft passage-way, annular hollow rings at the ends of the outer drum for receiving the overflows therefrom, hinged discharge spouts depending from the rings, a controlling lever located outside the outer drum, and intermediate connections between said lever and the inner shells for simultaneously actuating the latter to or from one another, whereby the height or thickness of the space between said shells and the walls of the outer drum may be regulated.

9. In combination with a rotatable shaft provided with a longitudinal passage-way having an intake for the pulp and discharging through the shaft, walls disposed on opposite sides of the discharge openings from the shaft and forming a compartment for the pulp, said compartment having a peripheral discharge, an outer drum revolving independently of the shaft and walls aforesaid, against the inner surface of which the pulp ejected from said compartment is projected, a water-holding shell mounted in the drum and rotatable with the shaft, and hav-

ing a sliding movement along the shaft, a marginal flange on the compartment wall opposite the shell, projecting within the shell and forming therewith an annular water-discharge opening, whereby the water discharged therethrough mingles with the pulp flowing from the compartment aforesaid, the mixture flowing through the space between the outer drum and inner shell, the drum being provided with a terminal overflow for the pulp.

10. In a centrifugal concentrator, a centrifuge having a peripheral discharge for the pulp, an outer drum rotatable about the axis of the centrifuge, an inner water container comprising a fixed section rotatable about said axis, and a combined rotatable and sliding section adjustable along said axis to and from the fixed section, and having one end in telescopic relation to the fixed section and spaced therefrom, whereby a passage-way is formed for the discharge of the water, the pulp and water flowing in sheet form between the outer drum and the sliding section of the water container, and an outlet for the flowing sheet.

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

LABAN ELLSWORTH JONES.

Witnesses:

L. M. SHERIDAN,

T. J. KERLIN.