No. 711,903. Patented Oct. 21, 1902.

L. LOOK.

ORE CONCENTRATOR.

(Application filed Feb. 23, 1898.)

(No Model.) 2 Sheets—Sheet 1.

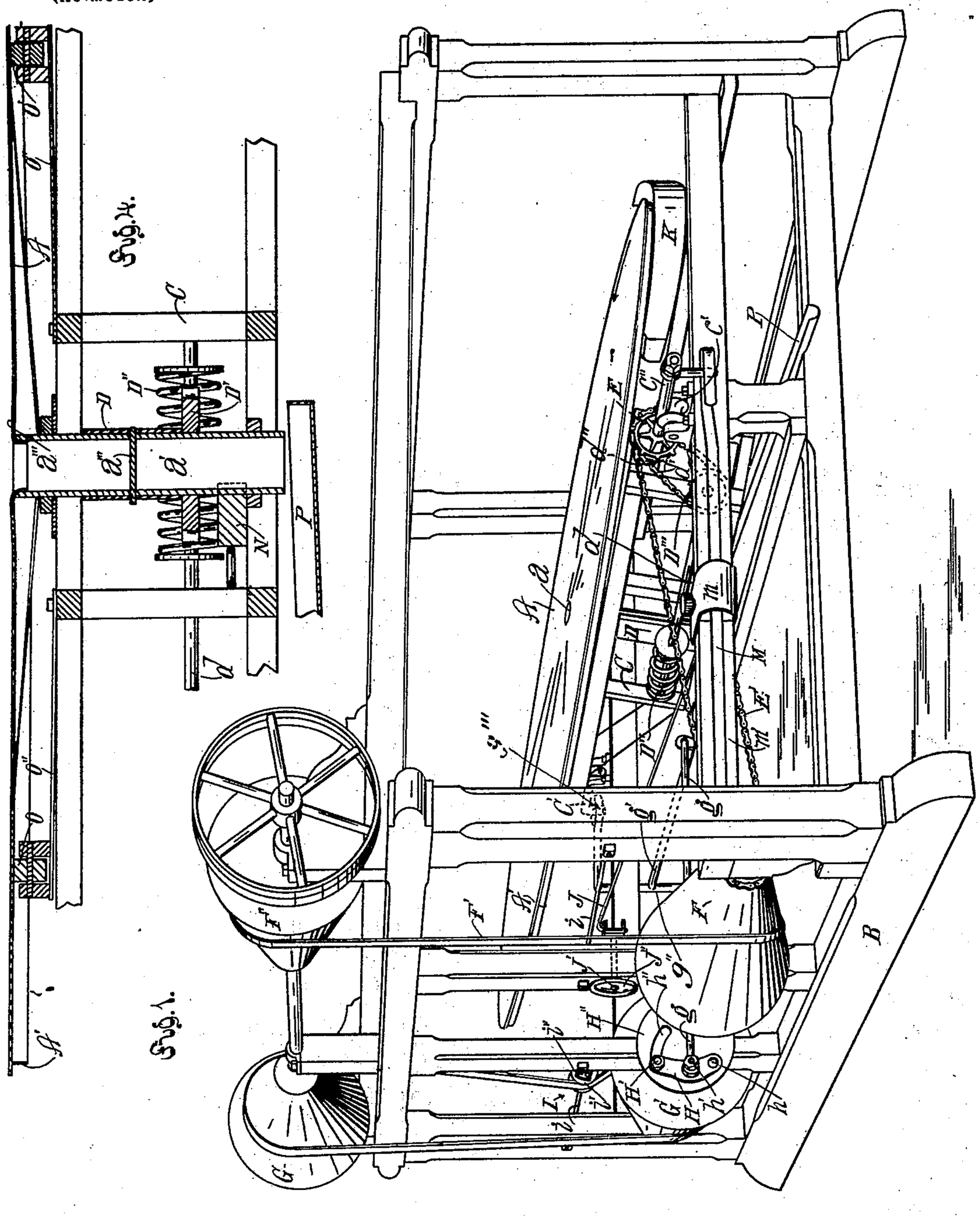

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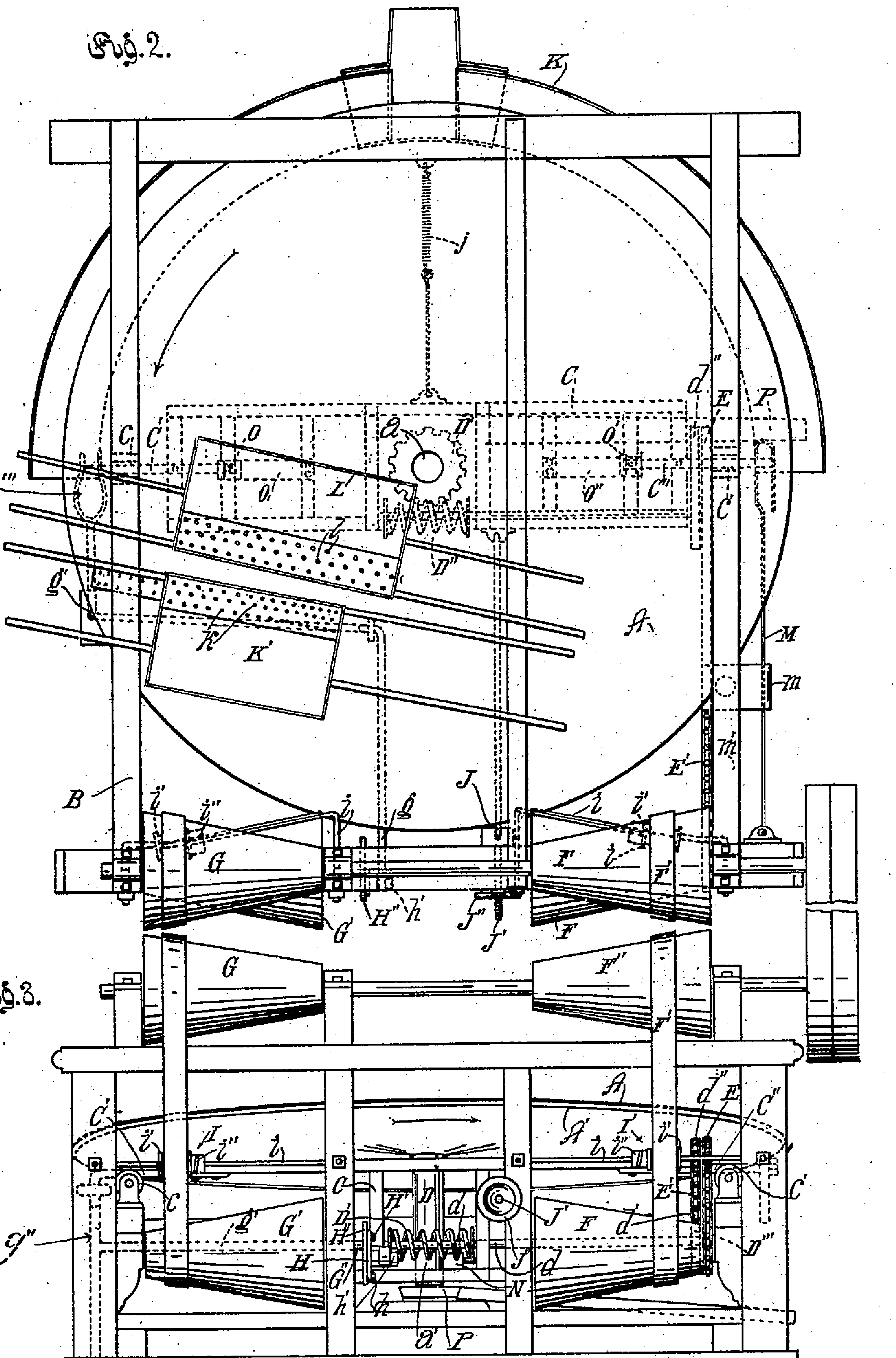
Fig. 2.

Fig. 3.



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UNITED STATES PATENT OFFICE.

LUTHER LOOK, OF LOS ANGELES, CALIFORNIA.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 711,903, dated October 21, 1902.

Application filed February 23, 1898. Serial No. 671,378. (No model.)

To all whom it may concern:

Be it known that I, LUTHER LOOK, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in Ore-Concentrators, of which the following is a specification.

The particular object of my invention is to provide a device for concentrating mill-tailings or finely-pulverized and slimy ores in an expeditious and effective manner.

In practicing my invention I make use of a rotary concentrating-table. I am aware that this idea is not broadly new; but my invention differs from all those previously produced and of which I am aware in that I provide an inclined rotating rimless table having a central opening surrounded by a slight elevation and provide adjustable means for shaking the table in a horizontal plane, whereby I am enabled to discharge the concentrates at the center of the table and discharge the tailings at the periphery thereof. Other machines collect the concentrates in pockets at the periphery of the table and afterward sluice them to the center of the table, which is annular, the concentrates passing down one half of the annular outlet, while the tailings discharge through the other half thereof. The quantity of tailings is always greatly in excess of the quantity of concentrates, and consequently heretofore the capacity of the machine was determined by the amount of tailings which could pass through one-half of the annular discharge-opening. It is evident that by discharging the tailings at the periphery of the table and the concentrates at the center my invention is greatly increased in capacity over any of those known. Furthermore, in order to make the concentrates collect at the periphery of the table it is necessary to pitch or toss them with considerable violence, and in the case of very slimy ores this violent tossing will prevent the concentrates from separating from the tailings, and either much tailings will pass off with the concentrates or many concentrates will pass off with the tailings.

In placer-mining I have carefully observed the effect of river-currents in depositing gold, and I find that most of the gold is invariably deposited upon the inner side of a bend, never on the outer side thereof. The reason of this is that at a bend the current of water at the surface is by its momentum carried against the bank at the outer side of the bend, where it sinks and is deflected to the bed of the stream, crossing diagonally to the bank at the inner side of the bend, where it rises and is again deflected toward the outer bank, where it again sinks and is deflected to the bed of the stream, crossing diagonally, as before. Thus the current at the bed of the stream at a bend is always toward the inner side of the bend, and the surface current is always toward the outer side thereof. Thus the lighter material which is practically held in suspension by the water rises and crosses the stream with the surface current, while the heavier matter sinks to the bottom and remains at the point where the undercurrent begins to rise to the surface.

My concentrator is designed to follow as closely as possible the natural action of a stream in depositing gold along its bed.

The object of my invention is to so arrange and construct a concentrator having a rotating table that the concentrates will discharge at the center of the table, while the tailings will discharge at the periphery thereof.

My invention comprises the various features of construction and combinations of parts whereby I am enabled to impart to the table and to the gangue those motions which are necessary to separate the concentrates from the non-mineral-bearing material and to cause such concentrates to discharge at the center of the table, while the tailings discharge at the periphery thereof.

Another object of my invention is to provide an ore-concentrator having all the advantages of the traveling-belt concentrator, with none of its disadvantages; also, to provide means whereby the inclination of the table may be readily adjusted and whereby a rotary motion and shaking motion without any rocking or tossing of the table may be imparted to the table by means of very cheap, simple, and effective devices and which will allow the motions to be regulated independent of each other, so that a rapid rotary motion with a slow shaking motion may be im-

parted to the table or any desired combination of movements produced until the other extreme is reached.

It is an especial object of my invention to so arrange the mechanism for shaking the table that the movement will be in a horizontal plane and not a pitching, rocking, tossing, or bumping movement, which has heretofore been employed and which causes the concentrates to be collected at the periphery of the table.

My invention comprises the various features of construction and combinations of parts whereby I accomplish the objects above set forth.

The accompanying drawings illustrate my invention.

Figure 1 is a perspective view showing a concentrator embodying my invention. Fig. 2 is a plan view of the same. Fig. 3 is a fragmental end view of the same. Fig. 4 is a fragmental sectional view.

In the drawings, A represents a concentrating-table which is preferably circular in shape, as shown, and is provided at its center with a discharge-opening *a*. This opening leads into a downwardly-projecting hollow shaft *a'*, which is rigidly secured to the table and forms a journal-support therefor. This table is preferably covered with canvas, rubber, or some composition best adapted to furnish a roughened or frictional surface suitable for concentrating purposes.

B is the main frame of the machine, and C is a sliding and swinging supporting-frame which is journaled in the main frame by means of sliding journal-rods C' C''. These two rods form in combination a single rod divided at its mid-length, the hollow shaft *a* being arranged between the rod ends and the rods being journaled in the framing B. The outer end of the rod C' is turned downward to form a crank end, as shown in dotted lines in Fig. 1, the purpose of which will be hereinafter explained. This frame carries the table-rotating mechanism, which, as shown, comprises a sleeve D, which is provided with a worm-gear D', with which meshes a worm-screw D'', which is secured to a shaft *d*, the other end of which is provided with a power-wheel D''', operated by means of a band *d'*, trained around a loose driving-pulley *d''*. The driving-pulley *d''* is secured to a loose power-pulley E, and the two pulleys are journaled upon a shaft C,'' which forms the pivotal and sliding support for the frame C. A belt, band, or sprocket-chain E' is connected with a sprocket-wheel or a pulley which is secured to a cone-pulley F, which is secured upon a counter-shaft and operated by a belt F', trained around a complementary cone-pulley F'', which is arranged to be operated by suitable power. (Not shown.) The hollow sleeve D fits upon the downwardly-projecting hollow shaft *a'*, to which it is secured by any suitable means, such as a pin *a'''* or set-screws. Thus the rotation of the sleeve causes the table to rotate, since, in effect, the worm-wheel is thus secured to the hollow shaft or discharge-tube *a''*, which is fixed to the table.

The frame is supported by means of the journal-rods C' C'', seated in suitable grooved rollers forming supporting-seats *c c'* in the main frame, and such rods are longer than the seats, so that the sliding frame may be shifted back and forth with relation to the main frame, thus to give the table a laterally-reciprocating or shaking motion without any rocking or tossing motion.

g' is a bell-crank lever which is secured to a vertical rock-shaft *g''*, and one end of the lever is provided with a fork *g'''*, which straddles and engages the turndown end or crank-arm of the rod C''. To the other lateral arm or rod of the bell-crank lever is secured a connecting-arm *g''*, which connects such arm with a crank or wrist pin *h'*, which is mounted upon a wheel or face-plate H'', which is fixed upon an auxiliary shaft G'', upon which the pulley G' is fixed and which pulley is driven by a belt trained around the cone-pulley G, which is fixed upon the driving-shaft.

I have provided improved means for regulating the throw of the crank. This means is clearly shown in Fig. 1 of the drawings and comprises the combination of the shaft G'', a crank-pin *h'*, secured to a yoke H, which is pivoted to such shaft by a pivot *h*, arranged at a distance from the center or axis of the shaft, the crank-pin *h'* being arranged upon the yoke H a distance from the pivot *h*, and means, such as the bolt and nut H', for adjusting the yoke with relation to the shaft, so that such yoke may be swung to carry the crank-pin nearer to or farther from the center or axis of the shaft, thus to regulate the throw of the crank.

In the drawings I have shown a face-plate H'', secured to the end of the shaft to furnish a support for the yoke or pin support, and have shown a slot *h''*, formed in the arc of a circle having a pivot *h* for center. The bolt H' slides in the slot to adjust the position of the yoke and to thereby adjust the position of the crank-pin. The pivot *h* is arranged at one end of the yoke, the crank-pin is arranged substantially at the mid-lengh of the yoke, and the bolt *h'* passes through the other end of the yoke, so that thereby the strain applied to the crank-pin is distributed equally between the pivot and the bolt and is not all placed upon the adjusting-bolt, as heretofore proposed. This enables me to grip the outer end of the yoke so tightly as to hold it from slipping without providing corrugations upon the yoke and upon the support, as has heretofore been necessary. This gives a delicacy of adjustment which cannot be secured where corrugations are employed, since in such event the yoke must be shifted the full width of one corrugation when it is adjusted. I

have found in working ores with my improved machine that a very slight adjustment of the yoke will sometimes produce a result which cannot be secured by a greater adjustment.

I I′ represent adjusters for adjusting the belts upon the cone-pulleys, these adjusters each comprising a journal-shaft *i*, arranged between the driving and driven pulley and adjacent to one of the pulleys (preferably the driven pulley) and parallel with that face of the pulley upon which the belt leads. A flanged adjusting and tightening wheel *i′* is journaled to rotate and to slide upon the shaft, and a stop *i″* is arranged upon the shaft at that side of the wheel *i′* which is toward the larger end of the pulley. Suitable means may be provided for adjusting the shaft in and out to take up the slack of the belt.

In practice I find that as the adjusting-wheel is rotated by the traveling belt the tendency of the wheel is to travel toward the larger end of the pulley, and thereby acting upon the belt, if the stop is released, will feed the belt from the small end of the driven pulley toward the larger end thereof. Thus in order to adjust the belt to give a slower rotation of the driven pulley all that is necessary is to loosen the stop *i″* and adjust it to the desired position upon the shaft, the adjusting-wheel automatically traveling in that direction and carrying the belt in that direction.

J is an adjusting-rod which has one end attached to the lower portion of the swinging and sliding frame C and the other end secured to suitable adjusting means, such as the screw-threaded bolt J′, which is provided with the adjusting-nut J″, and *j* is a spring which normally holds the frame against the pull of the adjusting-rod.

K is a trough for receiving the tailings from the machine.

K′ is a trough provided in its bottom with perforations *k* and arranged to discharge the ore or gangue upon the table in a line extending diagonally across the radius of the table. This ore-trough with ordinary ores must be arranged upon that side of the table which is traveling upward and near to the periphery of the table.

L is a trough which is provided with perforations *l* and is adapted to discharge clear water upon the table, near the center thereof, and also preferably in a line extending diagonally across the radius of the table and substantially parallel with the line in which the ore is delivered upon the table. The position of these troughs varies with the character of the ore treated, and such troughs are capable of being adjusted to suit the requirements. With all ordinary ores, however, the operation is very effective when the troughs are arranged in the position shown in the drawings.

P is a trough to carry away the concentrates.

In practice, the device being in readiness, power is applied to operate the cone-pulleys, and thus to rotate the table and to shake it back and forth from side to side. A counterbalancing-spring M is provided at one side of the main frame and is arranged to engage with the downwardly-turned end of the rod C″, which supports the sliding frame and to cushion the shaking movement of the frame—that is to say, when the sliding frame is in its normal position or midway between its limit of motion in each direction the spring is at rest; but when the frame moves to one side or the other the spring is brought into play to overcome the momentum of the table at each end of the stroke and to prevent the sudden jar which would otherwise result and which would prevent the proper operation of the concentrator. The strength of this spring is regulated by means of a sliding tension-adjuster *m*, which is moved back and forth along a support *m′* to lengthen or shorten the spring and to thereby regulate the strength of the spring to suit the varying speed and length of the side shake of the table, whereby I am enabled to dispense with the use of fly-wheels and other balancing devices to prevent too violent stoppage. The table being adjusted to the inclination which is deemed suitable for the ore to be treated, ore mixed with water is discharged upon the table through the perforated trough and falling through the perforations in small streams is spread evenly upon the surface of the table. By reason of the rotation of the table the ore and water is constantly carried upward against its efforts to run downward; but the downward motion of the surface of the gangue and water is in excess of its upward motion, thus acting in the same manner as the surface current at a river bend and carrying the silica and lighter portions of the ore downward toward the tailing-trough, while the heavier portions or the concentrates are settled by the shaking action of the table and cling to the table, the frictional surface of which prevents them from traveling downward as rapidly as the portions held in suspension in the water. By reason of the action of the water the concentrates when carried toward the highest point of the table where the pitch of the table is greatest endeavor to run downward, and thus move slightly toward the center of the table, forming the concentrates into long gradually-diminishing spiral lines terminating at the central discharge. The clear water which is discharged upon the table between the ore and the central opening and slightly above such opening assists in freeing from the concentrates all the light non-mineral-bearing matter and causes it to float away, while the concentrates are assisted in moving toward the center. The mouth of the discharge flares slightly in funnel shape and is arranged in the center of a slight conical elevation *a‴*, which

is provided near the center of the table, and the top of the table slopes slightly from the circumference to the elevation, so that the concentrates are slightly retarded as they near the discharge. This causes the concentrates to bank sufficiently to form a bed, which allows the lighter matter yet remaining to work to the top and be carried off with the tailings. The dish of the table is varied to suit the character of the ore being treated, ranging from a table having its top practically flat to one having a fall of one-half inch to the foot, or even more, according to the heaviness of the concentrates and the speed of rotation of the table.

In practical operation the motion of the table appears to be highly eccentric—that is to say, although constantly revolving at a uniform rate of speed the horizontal forward-and-backward shaking movement of the table causes one side of the table to appear to be stationary when the shaking motion is in the opposite direction from the travel of that side of the table and to accelerate its speed when the shaking motion is in the reverse direction. While it is true that the table revolves at a uniform rate of speed, the eccentric motion imparted to it by its rotary and sidewise movement is such that the passage of the concentrates toward the center is greatly facilitated and the rapidity with which the material is concentrated is greatly augmented.

If the table is dished, when the table is inclined the slope of the upper side of the table is comparatively much greater than the slope of the lower side of the table, and therefore the downward passage of the concentrates while upon the upper portion of the table is very rapid and toward the discharge, while by reason of the slight slope of the lower portion of the table there is very little tendency of the concentrates to travel toward the tailings-trough, while the silica and lighter matter which is held in suspension in the water passes freely downward off of the table.

A friction-brake N engages with the hollow shaft a' of the table in order to cause the table to rotate with perfect uniformity and to take up the play of the worm-gear. This brake also holds the shaft firm in its bearings and in case the bearing should wear will prevent any chattering or vibration of the shaft in the bearings.

O O′ are supporting-wheels which are arranged upon the swinging frame and rest beneath and support the table upon opposite sides of the shaft and near the outer circumference of the table. These wheels are carried by suitable elastic spring-supports (indicated by O″) and carry a portion of the weight of the table and its load of material being treated. They also resist the tilting of the table while it is being shaken back and forth and prevent the consequent strain on the bearings.

By covering the top of the rotating table with frictional material, such as canvas or rubber, the concentrates are prevented from washing away with the tailings and I am enabled to cause them to travel toward the center of the table and to discharge through the central opening while the tailings discharge at the periphery of the table. It is to be understood that I do not provide any upwardly-projecting rim to my table, the motions which I produce preventing the material from running off of the edge of the table excepting at the lower side, where the tailings-trough is located. I found in practice, however, that drops of water and tailings would collect upon the under face of the periphery of the table, and when carried to the higher side of the table such drops of water would run down the bottom of the table to the journal-bearing of the table and would soon destroy such bearings by causing them to wear.

In the drawings I have shown the table provided with an annular downwardly-projecting drip-rim A′, which collects the drops of water and causes them to drip from the rim and prevents them from running down the bottom of the table into the bearing.

In practical operation there is an undercurrent at the surface of the table which tends to carry the concentrates toward the center of the table, while the current at the surface of the ore and water is spirally toward the lower edge of the table, crossing the under current at an angle. In practice the rotation of the table produces the same effect as does the running of water around an endless curve in a river and causes the heavy matter to be directed toward the inner side of the bend, which in this instance is the central discharge.

Now, having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A concentrator comprising an inclined rotating table constructed to discharge at its margin and provided with a central discharge-opening and furnished around such opening with a slight elevation over which the material may discharge from the surface of the table; means for rotating the table; means for feeding material onto the top of the table at the upper side of the table and on that side of the table which moves upward; and adjustable means for shaking the table in a horizontal plane.

2. A concentrator comprising an inclined rotating table constructed to discharge at its margin and provided with a central discharge-opening and furnished around such opening with a slight elevation over which material may discharge from the surface of the table; means for shaking the table in a horizontal plane; means for rotating the table; and means for feeding the ore upon the table in a line extending diagonally across the radius of the table.

3. In a concentrator, the combination set forth of a rimless table; a sliding and swinging frame adapted to support and journal such table to rotate; table-rotating mechanism mounted upon such frame; table-shaking mechanism connected with such frame; means for removing the concentrates from the center of the table; means for swinging the frame to adjust the inclination of the table; independent means for operating the table-rotating mechanism; and independent means for operating the table-shaking mechanism.

4. In a concentrator, the combination set forth of a rimless table; a laterally sliding and swinging frame adapted to support and journal such table to rotate; table-rotating mechanism carried by such frame; table-shaking mechanism connected with such frame; cone-pulleys adapted to operate the table-rotating mechanism; cone-pulleys adapted to operate the table-shaking mechanism.

5. In a concentrator, the combination set forth of the main frame; a sliding and swinging frame pivoted in such main frame; a sleeve arranged in the swinging and sliding frame and provided with a worm-wheel; a worm adapted to operate the worm-wheel; means for rotating the worm; means for swinging the frame; a table provided with a tubular shaft adapted to fit within the sleeve; means securing the shaft and sleeve together; means arranged at the pivotal point of the swinging frame to shake the table back and forth in a horizontal plane; and means for rotating the table.

6. In a concentrator, the combination set forth of a main frame; a frame adapted to slide and swing in the main frame; a rotating table journaled in the sliding and swinging frame; means for rotating the table; an adjusting-rod secured to the sliding and swinging frame; means for shaking the sliding frame and table back and forth; a counterbalancing-spring arranged to counterbalance the shaking of the table; and a spring arranged to normally hold the swinging frame against the pull of the adjusting-rod.

7. In a concentrator, the combination set forth of a main frame; a sliding and swinging frame arranged in the main frame; a rotatable table journaled in the sliding and swinging frame; means for rotating the table; means for shaking the table back and forth; and yielding supporting-wheels secured to the swinging and sliding frame and arranged to support the table upon each side of its center.

8. In a concentrator, the combination set forth of a main frame; a swinging and sliding frame arranged in the main frame; a rotatable table journaled in the swinging and sliding frame; means for rotating the table; supporting-wheels arranged upon the swinging and sliding frame to support the table upon opposite sides of its center; and a cushioned spring adapted to counterbalance the momentum of the table as it shakes back and forth.

9. In a concentrator, an inclined rimless revolving concentrator-table set forth provided in its center with a slight conical elevation having a discharge-outlet opening therethrough, and having its top sloping from its periphery to the elevation and means for feeding material to the table at the upper portion thereof on the side which travels upward, substantially as set forth.

10. A concentrator provided with a rotating table having a centrally-arranged supporting-shaft; a sliding frame arranged to journal the table and to allow the table to slide back and forth; a friction-brake arranged to engage the shaft of the table; and yielding supporting-wheels secured to the sliding frame and arranged to engage and support the table upon opposite sides of its center.

11. The inclined rimless concentrating-table set forth provided with a central outlet or discharge having its mouth slightly dished; and a slight conical elevation surrounding the dished mouth of the outlet, the top of the table sloping from its circumference to the elevation, and means for feeding material to the table at the upper portion thereof on the side which travels upward.

12. In a concentrator, the combination with a rotating table, of a block frictionally engaging a portion of the rotating device to steady the same.

13. In a concentrator, the combination of a rotating table; a shaft arranged centrally of said table to support the same; driving mechanism for the table; and a block frictionally engaging the shaft and adapted to steady the movement of the table and take up wear.

14. In a concentrator, the combination set forth of the main frame; a sliding frame provided with journal-rods sliding in bearings in the main frame; a rotatable table journaled in the sliding frame; means carried by the sliding frame for rotating the table; a pulley for operating such table-rotating means; a double pulley journaled on one of the journal-rods of the sliding frame; a belt connecting the two pulleys; a belt to rotate the pulley which is journaled upon the journal-rod; and means for sliding the frame back and forth to shake the table.

15. An ore-concentrator comprising a suitable framing, a swinging frame, a divided rod journaled on the framing, the supporting-frame mounted on the inner ends of the divided rod having a crank and whereby the swinging frame is suspended, the loose pulley mounted on the rod, the table mounted on the supporting-frame, having a discharge-tube provided with a worm-wheel within the swinging frame, the shaft journaled in the swinging frame and carrying a worm meshing with

the worm-wheel, a pulley fixed to the worm-shaft and connected with the rod-pulley, the vertical rock-shaft having a fork engaging the crank on the rod, and provided with a lateral rod, an auxiliary shaft provided with a fixed pulley and a wheel having a wrist-pin, an arm connecting the wrist-pin with the lateral rod, a counter-shaft having a fixed pulley connected with the rod-pulley, and the driving-shaft having fixed pulleys connected with the pulleys of the auxiliary and counter shafts: substantially as described.

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