No. 628,105. Patented July 4, 1899.

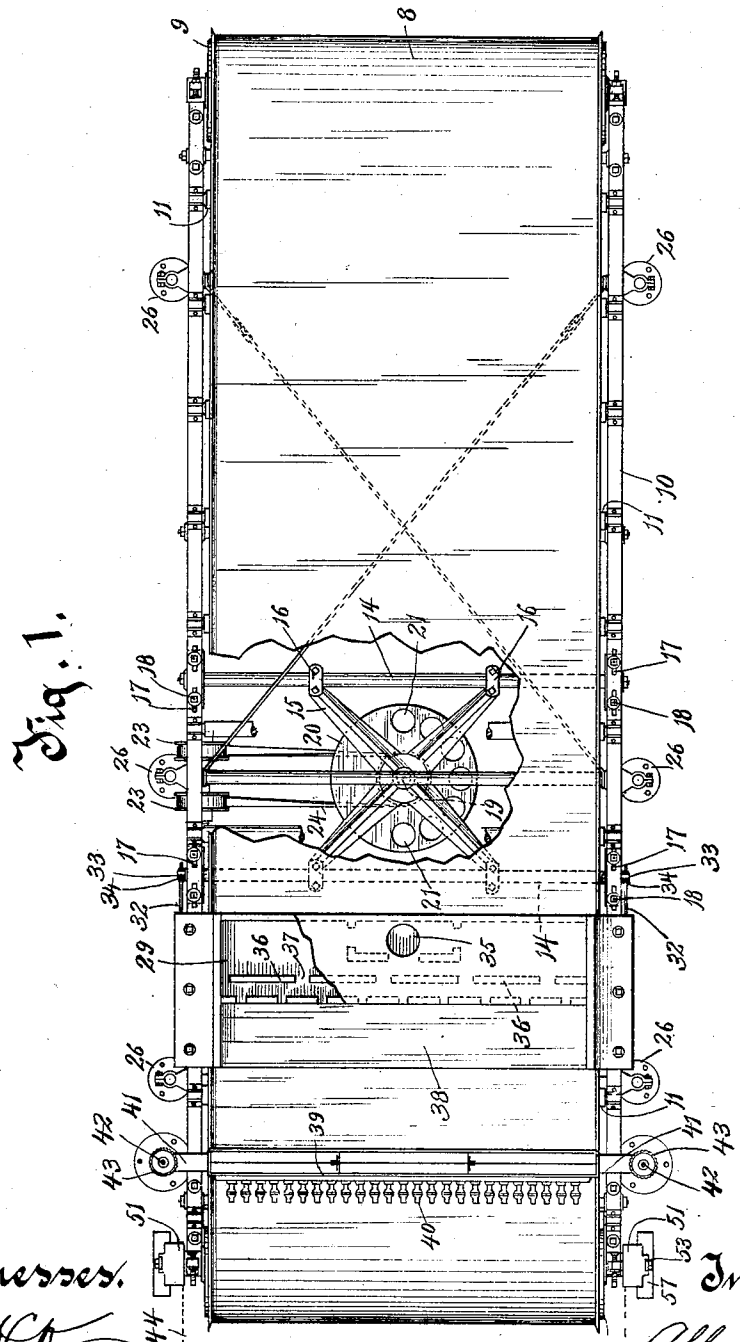
A. G. MATHER & F. T. SNYDER.

ORE CONCENTRATOR.

(Application filed July 22, 1897.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.



Witnesses.

C. N. Keeney.

Anna C. Faust.

Inventors.

Allan G. Mather.

Frederick T. Snyder.

By Benedict & Morsell.

Attorneys.

No. 628,105. Patented July 4, 1899.

A. G. MATHER & F. T. SNYDER.

ORE CONCENTRATOR.

(Application filed July 22, 1897.)

(No Model.) 2 Sheets—Sheet 2.

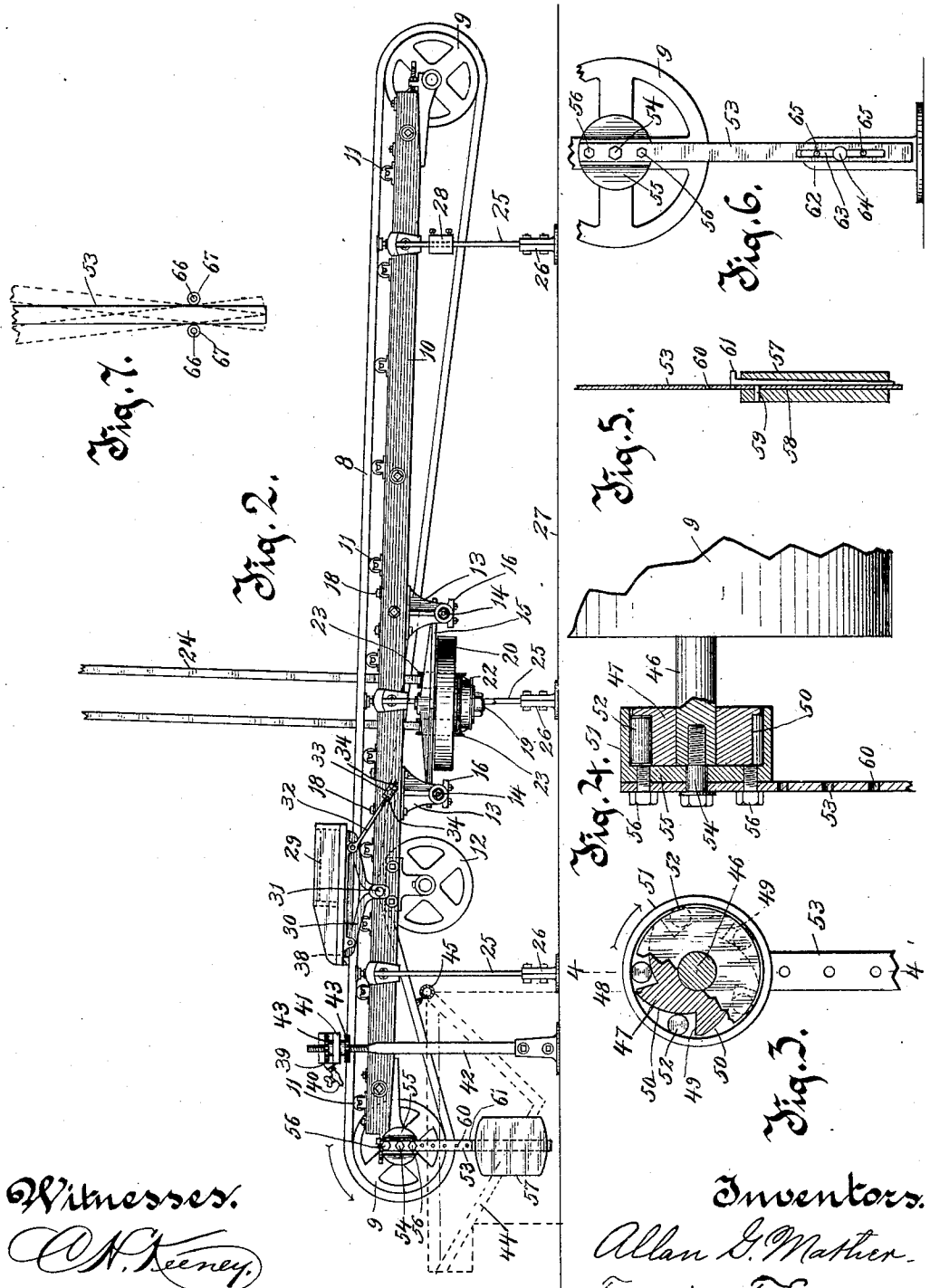


Fig. 2.

Fig. 7.

Fig. 6.

Fig. 5.

Fig. 4.

Fig. 3.

Witnesses.

A. N. Keeney.

Anna V. Faust.

Inventors.

Allan G. Mather.

Frederick T. Snyder.

By Benedict and Morsell.

Attorneys.

UNITED STATES PATENT OFFICE.

ALLAN G. MATHER AND FREDERICK T. SNYDER, OF MILWAUKEE, WISCONSIN.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 628,105, dated July 4, 1899.

Application filed July 22, 1897. Serial No. 645,509. (No model.)

To all whom it may concern:

Be it known that we, ALLAN G. MATHER and FREDERICK T. SNYDER, of Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a new and useful Improvement in Ore-Concentrators, of which the following is a description, reference being had to the accompanying drawings, which are a part of this specification.

Our invention relates to improvements in ore-concentrators.

It pertains more particularly to that class of ore-concentrators in which a gyratory motion is imparted to the vessel or surface carrying ore to be concentrated for the purpose of assisting the heavier portion of such ore to separate from the lighter and become deposited in said vessel or upon said surface.

The primary object is to improve the general construction of machines of this character.

The invention further comprehends as an object an improved arrangement and construction whereby any appreciable pull on the belt used to drive the machine is prevented and at the same time slack in said belt is automatically taken up.

Incidentally the invention comprehends as an object to provide for adjustments whereby the degree of ellipticity in the paths over which remote portions of the concentrator vessel travel can be regulated and by reversing these adjustments a differentiated action can be obtained, whereby that portion of the concentrating vessel in which the ore is first placed can be shaken strongly to cause the heavier particles to separate and settle and the remaining finer mineral particles allowed to flow with the refuse to the remote portions of the concentrating vessel, at which point they will receive a more gentle shaking to cause such finer particles in turn to separate and settle.

Our invention furthermore, when an endless revolving belt is used as the concentrating surface or vessel, contemplates as an object an improved construction whereby the gyrating movement of the frame is utilized to cause a forward movement of the belt.

With the above and other objects in view the invention consists of the devices and parts or their equivalents, as hereinafter more fully set forth.

The drawings show the invention as applied to an ore-concentrator of the class in which the concentrates are removed after separating and settling by the progressive motion of an endless belt, portions of which successively form the shallow vessel or surface containing the ore. We do not wish to be understood, however, as restricting our invention to its application to a concentrator of this class, as it will be obvious that it may be applied with useful results to concentrators having various other forms of vessels or concentrating-surfaces—as, for instance, to that class in which the concentrates are removed by being shaken across the surface on which they have settled and also to that class from which the concentrates are removed intermittently by hand or by suitable mechanism.

In the accompanying drawings, Figure 1 is a plan view of the complete machine with parts broken away. Fig. 2 is a side elevation. Fig. 3 is a detail of the mechanism for carrying the belt forward, a part being broken away. Fig. 4 is a section on the line 4 4 of Fig. 3, showing a fragment of one of the end belt-carrying drums. Fig. 5 is a sectional view through the feed-weight and its flexible supporting-strap, showing the means for adjusting said weight. Fig. 6 is a view of a modification in the means for carrying the belt forward, and Fig. 7 is a view of another modified form for the same purpose.

Referring to the drawings, the numeral 8 indicates a vessel (here shown as a belt with raised edges) adapted to hold the ore to be concentrated. This vessel, in the form of an endless belt, passes over drums 9 9, mounted in the ends of a frame 10 of suitable form, size, and strength. The upper portion of the belt passes over a series of small supporting-rollers 11, arranged on the upper side of the frame, and the under portion of the belt passes over a drum 12, mounted in hangers on the under side of the frame.

Projecting from the side pieces composing the frame are sets of hangers 13 13, which are arranged opposite each other and are con-

nected by rods 14 14. A spider 15 is provided with a plurality of radiating legs having terminal clamping devices 16, through which the rods 14 pass, whereby the spider is supported adjustably on the frame 10. By loosening these clamping devices it is obvious that the spider may be adjusted laterally with respect to the frame. It is obvious that the particular construction of spider shown—that is to say, a spider provided with a plurality of radiating legs, said legs being adjustably clamped on the rods—is not absolutely necessary, as any suitable or convenient form of bearing adjustably mounted on the rods may be provided in lieu thereof without departing from the spirit and scope of our invention. The hangers 13, which carry the rods 14, are also adjustable longitudinally on the frame. In order to secure this longitudinal adjustment, the side pieces of the frame are provided with elongated slots 17, and bolts 18 pass through these slots and the hangers 13. By loosening the bolts the hangers and the rods connecting the said hangers can be moved longitudinally of the frame in either direction, and necessarily the spider 15 is moved therewith.

A pin 19, provided with a gyrator-supporting head, is fixed in the spider at the center and depends therefrom. This gyrator 20 is mounted revolubly on the pin 19 and is so constructed and arranged that its center of gravity does not fall within the axis of the pin 19, but at a greater or less distance from it. In order to effect this, we prefer to construct this gyrator in disk form, having a series of recesses or pockets 21, which necessarily render that portion of the gyrator which is devoid of these recesses the heaviest. The gyrator may be arranged to rotate by power applied in any convenient manner. We here show a pulley 22 fast on the gyrator. Two guide-pulleys 23 23 are mounted in one side of the frame on axes at right angles to the axis of pulley 22. A belt 24 passes around pulley 22 and about pulleys 23 and extends from a line-shaft (not shown) rotated by any suitable source of power. It will thus be seen that the belt leads from a shaft above, so that there is no pull on any part of the frame that will oppose the action of the gyrator.

While we herein show and describe the gyrator 20 provided with the recesses 21, which recesses are adapted to be filled with metal plugs in order to graduate or adjust the degree of eccentricity of the center of gravity of the gyrator with reference to the axis of rotation, yet any other form may be provided which is of such construction that the center of gravity does not fall within the axis of the pin 19, but at a greater or less distance from it. The frame 10 is supported by flexible supports 25, which at their lower ends are secured adjustably in the base-pieces 26, firmly secured to the floor 27. Owing to the eccentricity of the gyrator and to the fact that the flexible supports 25 of the frame 10 allow said frame and the gyrator-supporting pin affixed thereto to move readily in any direction in a plane at right angles to the axis of the pin 19, when said gyrator 20 is rotated the inertia of the gyrator will tend to hold its center of gravity stationary and the rotation will tend to carry the pin around the center of gravity of the gyrator. This will move the frame and the concentrating vessel 8 attached thereto; but the frame, being prevented from rotating by the supports 25, will receive a gyratory or vanning motion.

By adjusting the inertia capability of the gyrator with reference to the weight of the frame 10 and its load the path over which the frame and concentrating vessel travel can be made larger or smaller. The inertia capability can be regulated by inserting or removing plugs from the recesses in the gyrator; but without the provisions hereinbefore stated for adjusting the center of gravity of the frame and its load to coincide with the axis of the pin 19 the motion of every portion of the frame and concentrating vessel would not be parallel and similar. Portions near the bearing of the gyrator would travel in approximately circular paths, while the portions lying on the side of the center of gravity of the frame 10 and its load away from the bearing of the gyrator 20 might move over paths more or less elliptic. By the provision of the several adjustments of the spider on the rods 14 and of the rods on the frame 10, however, any desired degree of ellipticity can be obtained in the paths over which the remote portions of the concentrating vessel travel. Useful and practical results are obtained by these means. Also by reversing these adjustments a differentiated action can be obtained, whereby that portion of the concentrating vessel in which the ore is first placed can be shaken strongly to cause the heavier particles to separate and settle and the remaining finer mineral particles allowed to flow with the refuse to the remote portions of the concentrating vessel, at which point they will receive a more gentle shaking to cause such finer particles in turn to separate and settle.

If there should be any drag on the free motion of the frame, such as would result from attaching a flexible water-supply pipe to the concentrating vessel or any other outside interference, it would result in disturbing the regular gyratory motion and produce abnormal motions of the frame and the concentrating vessel. In order to guard against this, we provide weights 28, which we prefer to mount adjustably on the flexible supports 25. The inertia of weights of this character properly disposed will balance the retarding effect of the aforesaid drag, and the regular vanning motion may be obtained.

Besides other advantages possessed by our machine it will be seen that it prevents any appreciable pull on the belt 24 and at the same time slack in the belt is automatically taken up. This is accomplished by reason of

employing the flexible uprights 25, connected, as described, in connection with the gyrator, the pulley 22, mounted on the axis of the gyrator, and the guide-pulleys 23 23, mounted on one side of the same frame which carries the gyrator. It will be evident that in the movement of the frame in a circular or gyratory path the parts just mentioned and arranged as described will cause no appreciable pull on the belt. It will also be evident that in this movement of the frame in a circular or gyratory path the supports 25 pull downwardly on the frame, and thereby automatically take up the slack which would otherwise occur in the belt.

A box or casing 29 is arranged transversely above the upper portion of the concentrating vessel, and this box or casing is provided at its ends with converging legs 30 30, which are pivoted at the points 31 to the sides of the frame. Stay-rods 32 32 are pivoted at their upper ends to the legs 30 and at their lower ends pass through pivoted blocks 33 33. These rods are threaded, and adapted to take onto the threaded portions are nuts 34 34. By loosening these nuts the box or casing is permitted to swing on its pivots 31, so as to regulate the tilt of said box or casing, and thereby discharge the material therein with greater or less rapidity. A hole 35 opens into the box or casing, through which the ground ore is poured into the box. Interiorly said box is provided with a series of vertical fixed dams 36, having passages 37 between the adjacent ends thereof, adapted to spread the ground ore preparatory to its being deposited on a projecting shelf 38, from which shelf it is discharged onto the concentrating vessel. In advance of the box or casing 29 is a water-supply box 39, advisably square or rectangular in cross-section and provided with a series of water-discharging nozzles 40. This box is provided with projecting ends 41 41, through which pass the upper threaded ends of standards 42 42. Nuts 43 43 turn on the upper threaded ends of the standards 42 above and below the projections 41. By regulating these nuts the water-box 39 may be raised or lowered.

It will be noticed that the frame and the concentrating vessel carried thereby are arranged at an incline from the front of the machine toward the rear. As the pulp is deposited on the endless belt or concentrating vessel and a gyrating movement is imparted to said parts the heavier particles of the ore will settle down on the belt and by its forward motion will be carried under the spraying-nozzle 40, and the water will wash out and carry the lighter portions of the ore with it rearwardly down and off the belt, while the heavier portions of the ore clinging to the belt will be carried forwardly and deposited in the concentrating-box 44. The rear end of the box 44 is provided with a spray-pipe 45, which sprays water onto the belt and serves to wash any adhering particles into the trough.

At the forward end of the machine we provide means for causing the movement of the belt forwardly. The journals of the front drums are indicated by the numerals 46. On these journals are rigidly mounted disks 47 47. The outer faces of these disks are notched or recessed, forming chambers between the projections 48. One edge of each projection is a practically straight radial wall, forming a shoulder 49, while the other or peripheral surface 50 is curved or tangential. Each surface 50 slopes or inclines inwardly from one projection toward the shoulder 49 of the succeeding projection. The peripheries of the disks are surrounded by rings 51. These rings therefore form a series of spaces between their inner sides and the curved or sloped surfaces of the projections 48, the widest portions of said spaces being adjacent to the shoulders 49, said spaces gradually diminishing in width toward the other projections. In the spaces thus formed balls or rollers 52 are placed, which rollers are normally in the widest portions of the spaces, but are constructed and adapted to roll into the narrow portions of the spaces and wedge between the rings and the disks. The rings 51 are provided with face-plates 55, which plates abut against the ends of the journals of the drum and also against the outer faces of the disks 47. Flexible straps 53 are secured to the face-plate 55 by bolts 56. A bolt 54 passes through the face-plate and turns into the journal 46 and secures the face-plate revolubly to the journal. On the lower free ends of the flexible straps we employ means for retarding and resisting the movement of said lower ends of the straps. In Figs. 1, 2, and 5 we show weights 57 57 on the straps 53 for accomplishing this function. These weights are mounted adjustably, whereby the amount of belt travel is regulated, and in Fig. 5 we show the preferred means for securing such adjustment. The weight is therein shown as provided with a vertical slot 58, into which the lower end of the strap is passed. The slot is approximately twice as wide as the thickness of the strap. Extending inwardly into the slot is a pin 59, which is adapted to engage any of the series of apertures 60 of the strap. A key 61 is adapted to be passed into the slot between one face of the strap and the wall of the slot. It is obvious that when this key is inserted in place the weight is held securely on the lower end of the strap, and even though the key should work loose the pin or projection will still retain the weight in place. When it is desired to adjust the weight, the key is pulled out and the strap is released from the pin. The weight is then readily adjustable to a new position and the pin made to engage another aperture of the series.

By the construction just described we util-

ize a portion of the gyrating motion of the frame to impart a forward motion to the endless belt. This forward movement of the belt is accomplished by that component of the gyrating movement which thrusts the frame forwardly. When this forward thrust occurs, the weights at the lower ends of the straps effect a retarding influence on said lower ends, so that said ends are momentarily held from forward movement with the frame. The forward thrust of the frame therefore initially acts to cause a turning of the upper ends of the straps on their pivots 54, and as said upper ends of the straps are connected to the rings 51 through the face-plate 55 said rings are necessarily turned in the direction of the arrow on Fig. 2. The turning of the rings causes the rollers 52 to wedge in the narrower portions of the spaces between the inner sides of the rings and curved or sloped surfaces 50 of the projections 48. This wedging action locks the disks 47 temporarily to the rings 51. Further rotation of the strap 53, due to the forward component of the gyrating motion of the frame 10, causes the drum 9 to rotate with it, which in turn causes the forward movement of the belt 8. On the return rearward thrust of the frame of the machine the straps are turned on their pivots in the reverse direction, and this causes a partial rotation of the rings in the opposite direction to that first explained, so that the wedging action on the rollers is at once removed and no reverse rotation is imparted to the drum. It will thereby be seen that the drum is always rotated forwardly.

The metallic straps 53, as before stated, are of a flexible character, and the flat sides of said straps are coincident with the sides of the frame. When, therefore, in the gyrations of the frame said frame is moved sidewise or laterally, the flexible character of the straps permit said straps to bend and give with said lateral movements.

In Fig. 6 we show a form in which the weight is dispensed with. The lower end of the flexible strap is adjacent to a standard or upright 62, and said flexible strap is provided with an elongated slot 63, through which a set-screw 64 passes and enters the standard or upright. The set-screw is put into one of the holes 65 in the standard or upright, whereby a longer or shorter movement is obtained. It will be apparent that this arrangement effects the same function as the weight 57—that is to say, the set-screw acts to initially retard the movement of the lower end of the flexible strap on the forward thrust of the frame. Fig. 7 also shows another form of construction for accomplishing the same function. In this instance the lower end of the flexible strap is passed between two pins 66 66, upon which are advisably mounted antifriction-rollers 67 67. The width of the strap does not quite fill up the space between the pins or between the antifriction-rollers mounted thereon. When, therefore, the frame is thrust forwardly, the movement of the lower end of the strap is retarded by contact of one edge of the strap with one of the antifriction-rollers, while as soon as the strap has been turned on its pivot 54 to either of the dotted-line positions of Fig. 7 the other edge of said strap will then contact with the other roller and will thus be temporarily retarded or held.

What we claim as our invention is—

1. The combination, of a frame, flexible supports connected at their upper ends to the frame, and at their lower ends to the flooring, and capable of yielding in all directions parallel to the frame, a concentrator vessel or surface mounted in the frame, mechanism for shaking the frame and concentrator vessel, said shaking mechanism consisting of a gyrator mounted so as to move about an axis not passing through its center of gravity, a driving-belt pulley mounted on the axis of the gyrator, guide-pulleys mounted on one side of the same frame which carries the gyrator, whereby the distance between the centers of the pulleys does not change, and an endless belt passing around the driving-pulley, thence engaging the guide-pulleys, and extending to any suitable source of power.

2. The combination, with a frame, having opposite side pieces, rods connecting said side pieces, a spider adjustably mounted on the rods, a pin fixed in said spider, a shaking mechanism consisting of a gyrator mounted on the pin, so that the axis of the pin does not pass through the center of gravity of the gyrator, and an ore-concentrating vessel or surface mounted on the frame.

3. The combination, of a frame, hangers on said frame, and longitudinally adjustable along the frame, rods connecting said hangers, a spider connected to the rods, a pin mounted in the spider, a shaking mechanism, consisting of the gyrator mounted on the pin, so that the axis of the pin does not pass through the center of gravity of the gyrator, and an ore-concentrating vessel or surface mounted on the frame.

4. The combination, with a frame, rods extending transversely across said frame, and longitudinally adjustable thereon, a bearing mounted on the rods, so that said bearing may be adjustable transversely of the frame, a pin in the bearing, a shaking mechanism consisting of a gyrator mounted on the pin so that the axis of the pin does not pass through the center of gravity of the gyrator, and an ore-concentrating vessel or surface mounted on the frame.

5. The combination of a frame, flexible supports connected at their upper ends to the frame and at their lower ends to the flooring, and capable of yielding in all directions parallel to the plane of the frame, said supports forming the sole means for supporting the frame, mechanism for shaking the frame, said shaking mechanism consisting of a gyrator mounted so as to move about an axis not

passing through its center of gravity, drums mounted in opposite ends of the frame, an endless belt passing around the drums, means for imparting a gyratory movement to the frame, a strap, adapted to follow the longitudinal movement of the frame, and to bend laterally with the sidewise movement of said frame, a retarding and resisting device at the lower end of the strap, and clutch mechanism between the upper end of the strap and the journal of the drum, whereby on the thrust of the frame in one direction the clutch mechanism is set so as to clutch the upper end of the strap to the journal of the drum and thereby cause a rotation of said drum in one direction, and on the reverse thrust of the frame to cause a disengagement of the clutch mechanism, whereby a reverse rotation of the drum is prevented.

6. The combination, of a frame, flexible supports connected at their upper ends to the frame and at their lower ends to the flooring, and capable of yielding in all directions parallel to the plane of the frame, said supports forming the sole means for supporting the frame, mechanism for shaking the frame, said shaking mechanism consisting of a gyrator mounted so as to move about an axis not passing through its center of gravity, drums mounted in the opposite ends of the frame, an endless belt passing around the drums, means for imparting a gyratory movement to the frame, a strap, adapted to follow the longitudinal movement of the frame, and to bend laterally with the sidewise movement of said frame, an adjustable retarding and resisting device at the lower end of the strap, and clutch mechanism between the upper end of the strap and the journal of the drum, whereby on the thrust of the frame in one direction the clutch mechanism is set so as to clutch the upper end of the strap to the journal of the drum and thereby cause a rotation of said drum in one direction, and on the reverse thrust of the frame to cause a disengagement of the clutch mechanism, whereby a reverse rotation of the drum is prevented.

7. The combination, of a frame, yielding flexible supports for said frame, drums mounted in opposite ends of the frame, an endless belt passing around the drums, means for imparting a gyratory movement to the frame, a flexible strap, adapted to follow the longitudinal movement of the frame, and to bend laterally with the sidewise movement of said frame, a retarding and resisting device at the lower end of the strap, and clutch mechanism between the upper end of the strap and the journal of one of the drums, whereby on the forward thrust of the frame in one direction the clutch mechanism is set so as to clutch the upper end of the strap to the journal of the drum, and thereby cause a rotation of said drum in one direction, and on the rearward thrust of the frame, to cause the clutch mechanism to be disengaged, whereby a reverse rotation of the drum is prevented.

8. The combination, of a frame, flexible supports for said frame, drums mounted in opposite ends of the frame, an endless belt passing around the drum, means for imparting gyratory movement to the frame, a disk mounted fast on the journal of one of the drums, said disk provided with a series of projections, each projection having a curved or sloped peripheral surface which inclines inwardly toward the shoulder of the succeeding projection, a ring fitting around the disk, rollers in the spaces between the inner side of the ring and the inclined surfaces of the projections of the disks, a flexible strap adapted to follow the longitudinal movement of the frame, and to bend laterally with the sidewise movement of the frame, said strap connected at its upper end to the ring and also adapted to turn at said upper end on a pivot extending from the journal of the drum, and a retarding and resisting device at the lower end of the strap.

9. The combination, of a frame, flexible supports for said frame, drums mounted in opposite ends of the frame, an endless belt passing around the drums, means for imparting a gyratory movement to the frame, a flexible strap adapted to follow the longitudinal movement of the frame, and to bend laterally with the sidewise movement of the frame, said strap provided at its lower end with an elongated slot, a standard adjacent to the lower slotted end of the strap, a pin passing through the elongated slot and entering the standard, and clutch mechanism between the upper end of the strap and the journal of one of the drums, whereby on the thrust of the frame in one direction, said clutch mechanism is set so as to clutch the upper end of the strap to the journal of the drum and thereby cause a rotation of said drum in one direction, and on the reverse thrust of the frame, to cause the clutch mechanism to be disengaged, whereby a reverse rotation of the frame is prevented.

In testimony whereof we affix our signatures in presence of two witnesses.

ALLAN G. MATHER,
FREDERICK T. SNYDER.

Witnesses:
ANNA V. FAUST,
C. T. BENEDICT.