

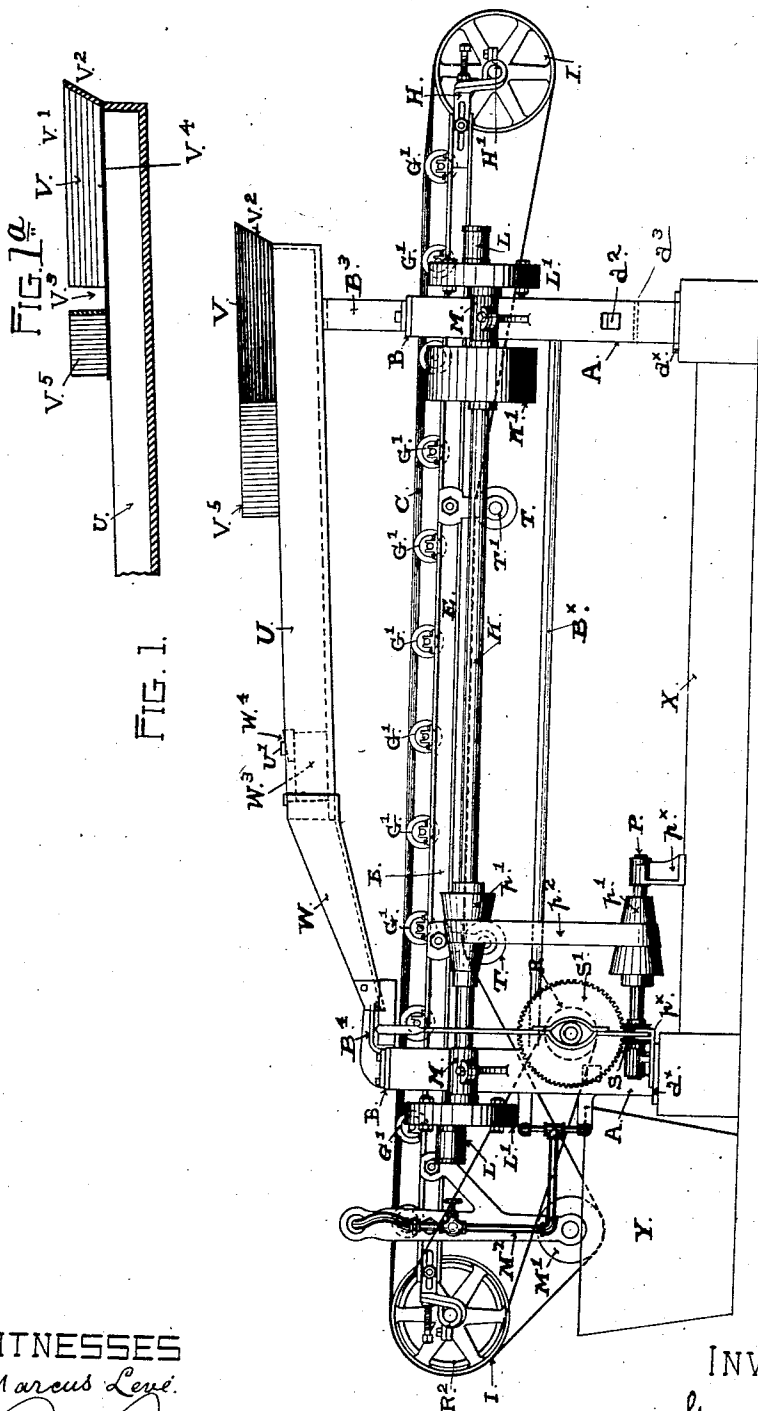
(No Model.)

G. E. WOODBURY.
ORE CONCENTRATOR.

4 Sheets—Sheet 1.

No. 580,030.

Patented Apr. 6, 1897.



WITNESSES

Marcus Levy.

R. L. Chas. L. L.

INVENTOR

George E. Woodbury

By *Wm. H. Woodbury*
his Attorney.

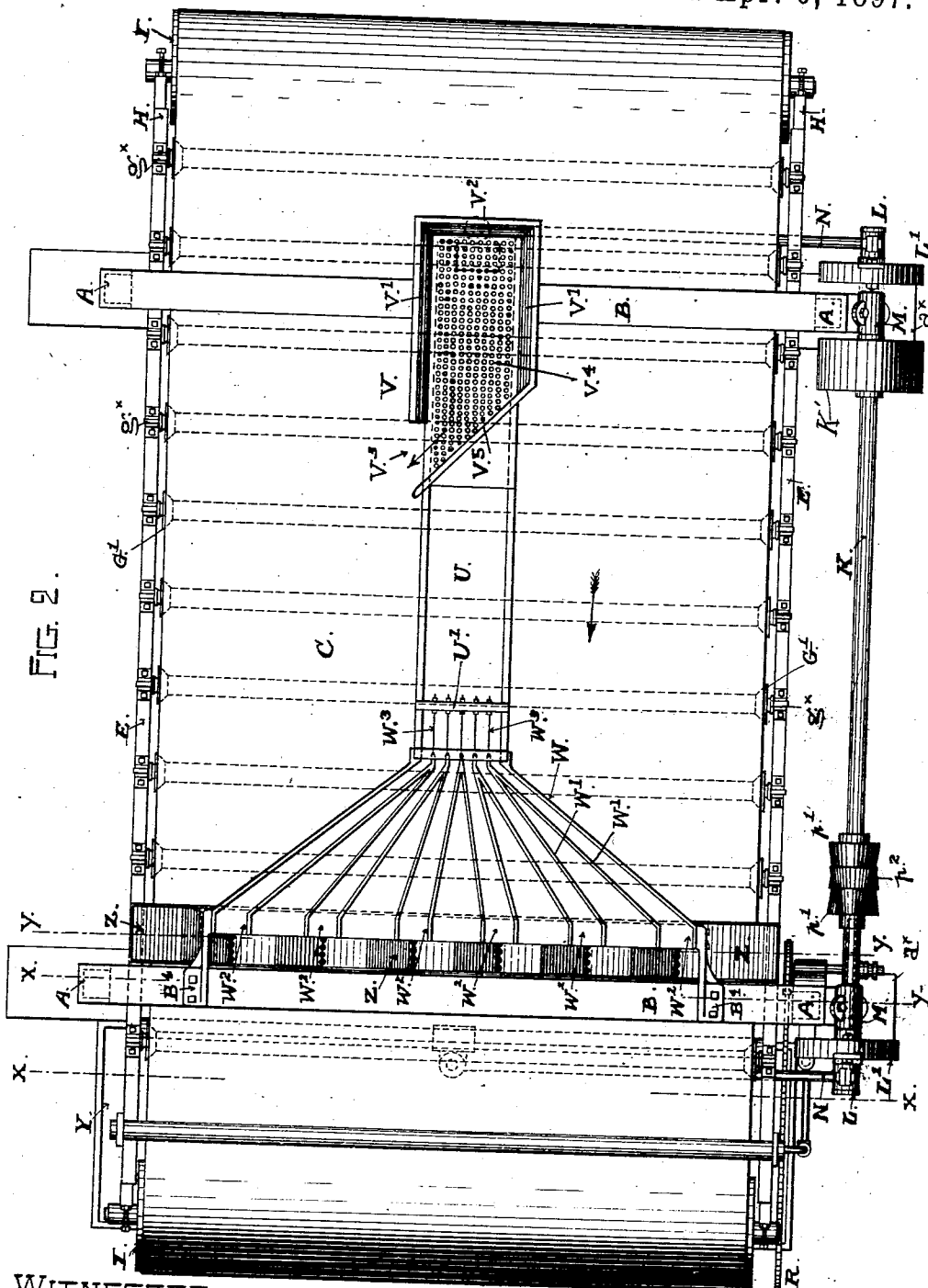
(No Model.)

G. E. WOODBURY.
ORE CONCENTRATOR.

4 Sheets—Sheet 2.

No. 580,030.

Patented Apr. 6, 1897.



WITNESSES
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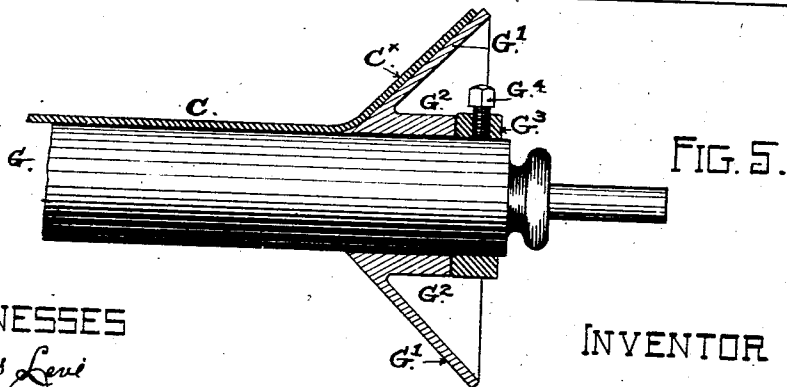
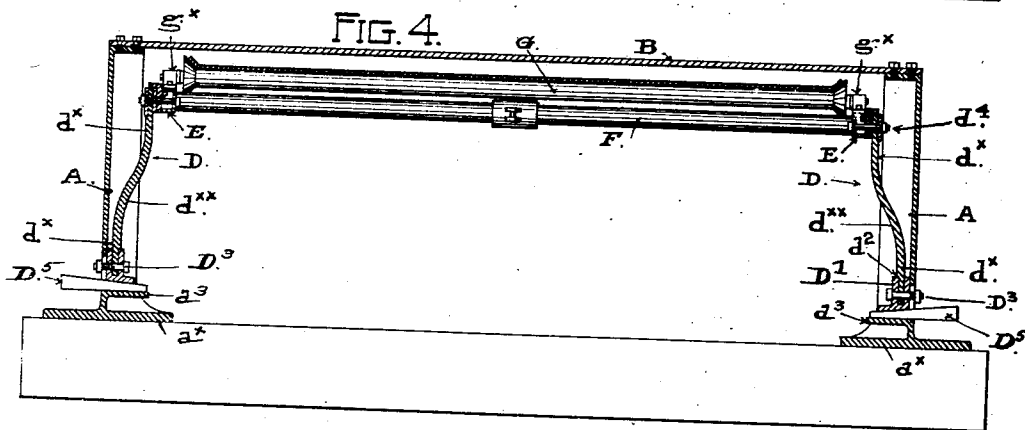
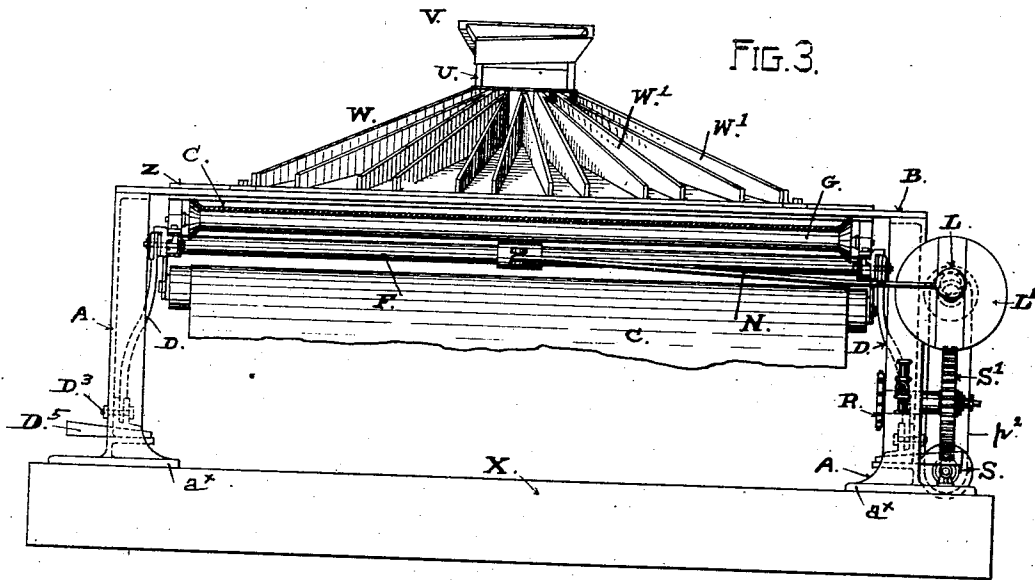
(No Model.)

G. E. WOODBURY.
ORE CONCENTRATOR.

4 Sheets—Sheet 3.

No. 580,030.

Patented Apr. 6, 1897.



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(No Model.)

G. E. WOODBURY.
ORE CONCENTRATOR.

4 Sheets—Sheet 4.

No. 580,030.

Patented Apr. 6, 1897.

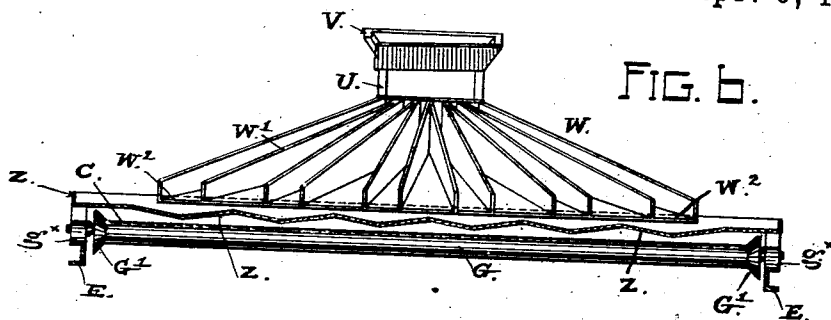


FIG. 6.

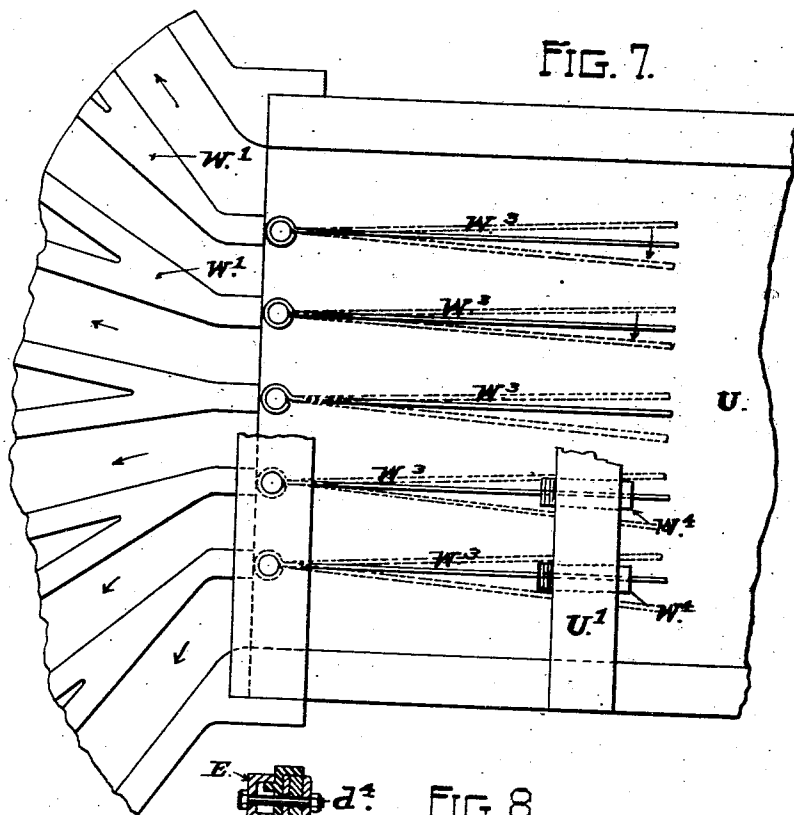


FIG. 7.

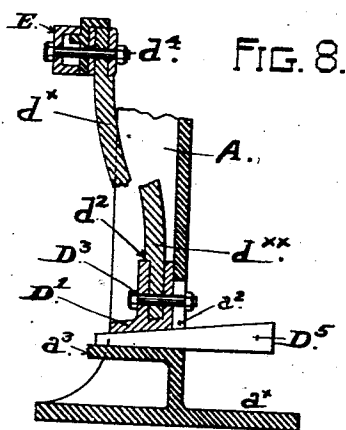


FIG. 8.

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UNITED STATES PATENT OFFICE.

GEORGE E. WOODBURY, OF SAN FRANCISCO, CALIFORNIA.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 580,030, dated April 6, 1897.

Application filed July 19, 1894. Serial No. 518,008. (No model.)

To all whom it may concern:

Be it known that I, GEORGE E. WOODBURY, a citizen of the United States, residing in the city and county of San Francisco and State of California, have invented certain new and useful Improvements in Ore-Concentrators; and I do hereby declare that the following is a full, clear, and exact description of the same.

10 This invention relates to ore-concentrating machines of that class in which the concentrating-surface is an endless belt or apron having a vibratory movement in connection or combination with a longitudinal movement
15 of progression.

One description of machine in the class mentioned has the vibratory movement imparted in a longitudinal direction, or with the progression, and is commonly known as an
20 "end-shake" machine, while another description has the vibratory motion or "shake" across the machine, and is known as a "side-shake" machine. It is to the latter description of machine in this class that my improved concentrator belongs and to which
25 its novel points and features of construction specially relate.

The said improvements comprise certain novel construction of stationary frame, a
30 novel means of supporting and operating the shaking-frame, and a novel means for turning up the sides of the concentrator-belt; also certain novel construction of feeder and distributor for the pulp, and, finally, certain
35 details of construction, all as hereinafter fully described, and pointed out in the claims.

The following description explains at length the nature of my said improvements and the manner in which the same are combined and
40 applied in the production of an improved machine, reference being had to the accompanying drawings, forming part of this specification.

Figure 1 of the drawings is a side elevation
45 of a concentrating-machine containing and constructed according to my said improvements. Fig. 1^a is a longitudinal section, on an enlarged scale, of the hopper and a portion of the sluice-box. Fig. 2 is a plan or top view
50 of the machine. Fig. 3 is a vertical transverse section on the line $x x$, Fig. 2. Fig. 4 is a transverse section on the line $x x$, Fig. 2. Fig. 5 is a detail of one of the belt-carrying rollers and its loosely-revolving head

at one end, the belt and the revolving head 55 being shown in section. Fig. 6 is a transverse section taken on the line $y y$, Fig. 2. Fig. 7 is a plan, on an enlarged scale, of the distributing-tray. Fig. 8 is a view in section, on an enlarged scale, of the ends of the
60 spring-legs and their fastenings.

The present machine is built on the general plan of a concentrator of the same type that was patented to me on the 29th day of December, 1891, Letters Patent No. 465,979, 65 but differing from that machine materially, both in simplicity of construction, weight of parts, cost of building and setting up, and particularly in the work required in handling and running. It also contains several im-
70 proved features of construction over that machine, especially as regards the stationary frame, the belt carrying and driving mechanism, and the pulp-feeding apparatus.

The stationary frame is composed of the 75 four posts or standards A, set one at each corner, and the top rails B B and side rails or tie-rods B^x, that join the four posts together in a light and stiff frame, in and upon which all the working parts are supported. 80 This frame is easily taken apart and packed in small compass, the pieces separated being of convenient size and weight to be transported over rough roads and into localities ordinarily inaccessible where large heavy pieces 85 could not be carried.

Each one of the four posts is cast hollow and square in cross-section, with one side open, and on the bottom a broad foot-flange a^x to fasten the post down to the bed-timbers 90 X, on which the frame is set. The open sides of these four posts face inward, and within the recess of each post is fixed a spring D, having straight top and bottom portions d^x and a curved middle portion d^{xx} , similar in shape 95 to an "ogee" curve, uniting the straight ends. On these four springs is mounted the shaking-frame that carries and gives motion to the concentrator-belt, and each spring is rigidly fixed at the lower end in the recess of 100 the post and at the upper end is secured in the same rigid manner to the side bar of the sliding frame.

A block D^y, with a perpendicular slot d^y in the top to receive the end of the spring-leg, 105 is fixed within the recess of the post by a bolt D^z, passing through the block and through the inserted end of the leg and also through

a slot in the front of the post, so that the same bolt serves to secure the end of the leg in the block and to hold the block in the post. This constitutes the means of holding and
 5 fixing the lower end of the leg, while its upper end is directly secured to the side bar of the shaking-frame by a bolt and nut d^4 . The curved portion of the leg springs inwardly from the straight bottom portion on a regular
 10 curve to the center and thence reversely with an equal curve into the straight top portion, so that the top end of the leg is brought inward and at a sufficient distance away from the back of the recess in the post to allow the
 15 upper end of the leg and the side bar of the frame to clear the post in the sidewise vibration of the frame. This is one object secured by this double-curve center, but the main object or purpose of the construction is to
 20 bring the "spring" or lateral movement of the leg from the ends and confine it to or cause it to take place at the middle portion only, whereby the fastenings at the ends and also the stiff ends of the leg itself are relieved
 25 from the strains and vibrations of the lateral movement. Where these spring-supports are made of wood, as in the present machine and also in my former patent, it is important to relieve the fastenings at the ends and also to
 30 prevent the leg itself at the fastenings from sustaining the vibrations, and in my former patent that object is attained by reducing the thickness of the leg at the middle portion to increase the resilience in that part over the
 35 ends.

In the present construction the desired objects are secured without weakening the leg and the lateral motion or spring of the leg is confined entirely to the middle portion. These
 40 legs are made of flat bars of hard wood, such as hickory, of the same thickness for the whole length, steamed and bent to shape. Beneath the block D' , I set a wedge D^5 through an opening made in the post at a^2 , with the
 45 head of the wedge standing outside the post and the point resting on a rib or shelf a^3 , cast in the recess of the post. By loosening the bolt D^3 that holds the block and driving in the wedge the lower end of the spring-leg is
 50 set up and the frame $E E$ is raised at one side or the other for the purpose of adjusting it to a level position. When the legs are thus properly set, the bolts D^3 are tightened and the blocks D' clamped in the post.

55 In setting up the stationary frame the flat top rail at each end joins the two posts and is fastened down to the tops of the posts by lag-screws, while the two sets of posts are joined along the sides of the frame by the tie-
 60 rods. Within this frame is set the belt-carrying frame, composed of the side rails $E E$ and cross-bars $F F$ at the ends.

Suitable strength and stiffness with a minimum amount of weight are secured by using
 65 channel-iron for the side rails and tubing for the cross-bars. Boxes $g^x g^x$ are fixed along the tops of the side rails for the spindles of

rollers G that carry the concentrating-belt, and adjustable brackets or hangers H , carrying boxes H' on the ends, are secured to the
 70 ends of both side rails for the axles of the drums or larger rollers I , over which the belt passes at the ends of the shaking-frame. These hangers are held and adjusted longitudinally to regulate the tension of the belt
 75 by means of bolts and nuts and screws.

The lateral shake or vibratory motion is given to the frame by two cranks $L L$ on the ends of a horizontal shaft K , for which boxes
 80 M are provided on the end posts on the same side of the stationary frame, and this shaft, extending from one post to the other along one side of the frame, has the cranks fixed on the ends outside the posts, and also a belt-pulley K' set at some point between the ends
 85 to take a driving-belt from a power-shaft. A pitman N from each crank is connected to the middle of the cross-bar, and the two cranks are set in line, so that the motion produced is equal at both ends of the frame.
 90

Provision is made for varying the length of throw of the cranks by fixing the crank-pin on a slide setting in a groove across the face of a disk L' , fast on the end of the shaft; the
 95 slide being held by a screw working through a slot in the slide. The length of throw generally used is about two inches, but some conditions or character of ores that are found to require greater or less degree of shake in the frame sometimes call for a change in the
 100 throw of the cranks, and for that purpose this adjustable crank is employed.

The longitudinal movement or progression, commonly termed the "feed," of the belt is produced from the crank-shaft by a
 105 system of counter-shafts, pulleys, and belts, the arrangement of which will be better understood by referring to Figs. 1 and 3 of the drawings. A short counter-shaft P , in bearing-blocks p^x on the timbers of the stationary
 110 frame at the head of the machine, is driven from the crank-shaft by pulleys p' and a belt p^2 . Cone-pulleys are used for the purpose of varying the speed of the counter-shaft. This counter-shaft gives a continuous but slower
 115 motion to a sprocket-pulley R , mounted on a stud or short shaft on the post, and a link belt from this pulley is carried up to a sprocket-wheel R^2 , fast on the axle of the drum I at the
 120 head of the machine. Motion is given to the sprocket-pulley by a worm S on the counter-shaft and a worm-wheel S' on the axle or hub of the sprocket-wheel, the worm-wheel being connected to the sprocket-wheel by a
 125 clutch of any suitable construction with a clutch-lever for moving it, so that the feed or longitudinal movement of the belt may be stopped and started at pleasure without interfering with the shaking motion.

The loosely-rotating rollers that support the
 130 acting portion of the concentrating-belt in the shaking-frame are of peculiar construction, the novel point or feature therein consisting of a loosely and independently revolving

conical head G' on each end of the roller for turning up and holding in raised position a portion of the belt along each side from the edge inward a suitable distance to produce a standing side along the top or acting portion of the belt.

The object of my present construction is mainly to prevent the wear of the belt along that portion of the edge which is turned up by the head and such excessive wear as is produced where the conical head is fast on or is an integral part of the roller, for in that form of roller the surface of the conical head at the portion of the greatest circumference necessarily travels at greater speed than the surface of the roller, and the result of this is to make a rubbing contact instead of a rolling contact with that portion of the belt which travels on the rim or outer end of the conical head.

In the present construction, by which I remove the rubbing contact and materially increase the life and durability of the belt, I make a conical head, either of wood or metal, with a hub G², fitted over the end of the roller to turn smoothly and easily, and a conical body, formed of a continuous flange G', extending from the inner end of the hub and from the circumference of the roller upward and outward over the hub, so that when the head is set upon the roller it forms a flaring conical head. Over the end of the roller and against the outer end of the hub, which is finished flat and smooth, a collar G³, held by a set-screw G⁴, is fitted after the head is slipped on to keep the head from running back under the lateral pressure of the belt; but while acting to confine it against moving longitudinally on the roller this collar does not prevent the head from revolving, so that it turns freely on the roller under the contact of the belt with the surface at the outer or larger end of the cone. The height of this raised side C^x, or the amount of the belt C turned up by the conical head, is regulated by shifting the position of the head outward or inward on the roller, which is readily done by loosening the screw in the collar and then moving the head on the roller a greater or less amount to produce the desired height of raised side.

The concentrating-belt C travels over these rollers and around the drums at the ends of the shaking-frame, returning under the frame, where it is guided by three sets of rollers, one of which, M', commonly termed the "depression-roller," is located near the head of the machine and at suitable distance below the shaking-frame to bring the surface of the belt into a washing-tank Y, containing water, while the other rollers T, placed at intervals between the depression-roller and the drum at the tail of the machine, are arranged to keep the belt under sufficient tension to prevent slip and consequent irregular feed of the belt.

The depression-roller M' is mounted in

hangers M², bolted to the side bars E, and the tension-rollers T are journaled in shorter hangers T', capable of being shifted along the side bars into positions nearer to or farther from the drums at the ends of the frame.

The belt is formed without permanently-raised or standing sides, as the loosely-revolving heads of the rollers turn up the edges of the belt along the entire working length thereof and hold them at proper angle to the flat concentrating-surface, and consequently the entire surface of the belt from one side to the other will be flat and run evenly over the drums at the ends and the carrying-rollers under the frame without any difference in the tension or in pulling strain upon the edges or side portions over the main body of the belt.

In this machine, the pulp is distributed across the belt below the head or upper end of the frame by means of a stationary feeding-in hopper V, which is mounted over the belt and upon the lower end of the stationary frame, a distributing box or tray W, supported from the stationary frame at the opposite end, and a sluice-box U, connecting the hopper and distributor together. These parts have a pitch or inclination downward from the lower toward the higher end of the concentrating-belt and may be supported from the top rails of the stationary frame, as shown in Fig. 1, for example, in which the hopper is held at the required height above the belt by legs B³ on the top rail, and the outer end of the distributing-tray is supported from the top rail at that end by the arms B⁴, bolted to the sides of the tray and to the rail.

In the hopper V, which is box shape with flaring sides V' and end V², I set a screen V⁴ on a level with the top of the sluice-box U and at the same inclination, and across the open end V³ of the hopper and upon the sides of the sluice I fix a shear-box V⁵ from one side V' of the hopper across the opening and projecting over the side of the sluice-box, the board standing at such an angle that all the matter retained by the screen will be deflected and thrown to one side from the sluice-box and discharged upon the lower end of the concentrator-belt, where it will be carried off with the tailings. This screen and shear-board will be found very useful in removing and casting out of the stream of pulp such foreign matter and articles and rubbish as commonly find their way into the pulp from the mill and are often a source of annoyance and a cause of interruption in running the machine and oftentimes productive of injury to the feeding apparatus and the belt.

The sluice-box U connects the distributing-tray with the hopper. This tray W, at the lower end, is constructed with a number of narrow partitions W', arranged in divergent manner from the outlet end of the sluice regularly outward and downward to the end of the tray, dividing the tray into several separate channels or conducting-passages. The outlet or

discharging ends W^2 of these channels are considerably greater in width than the mouths or receiving ends at the sluice, and they are so arranged that the pulp as it comes from the sluice is divided as nearly as practicable into streams or portions of equal quantity, and these streams are distributed across the surface of the belt at uniform distances apart.

The quantity of pulp entering any one of these channels is, however, regulated by a swinging gate W^3 , pivoted to and forming the inner end of each partition, the construction of which is shown in Figs. 1, 2, and 7.

A strip of sheet metal or of thin wood is hinged at the lower end to the end of the partition to swing at the upper free end sidewise or across the flow of the pulp to set at a greater or less angle to the stream, so that the approach to the inlet of the channel can be enlarged or contracted by moving these gates accordingly. These different angular positions of the hinged gates are maintained by suitable catches or holding means at the upper end. In the present construction I hold them by introducing a wedge W^4 between the top edge of the gate and a stationary bridge or strip U' , fixed across the top of the sluice. I have found this both a simple and an effective means of fixing the gates in any position. Under the lower end of the channels in this distributor, close to the surface of the belt C , I set an equalizing-tray Z , having separate compartments with sloping bottoms equal in number to the channels in the distributor and so fixed on the shaking-frame that it has vibratory motion with the concentrator-belt under the mouths of the distributing-channels. The form of this tray Z is shown in the plan Fig. 2 and in vertical longitudinal section in Fig. 6.

In the bottom of each compartment or depression in the tray a row of outlet-holes are made lengthwise of the concentrator-belt, through which the pulp is discharged in a thin stream upon the belt.

In the longitudinal section it will be seen that the bottom of the tray is formed with alternating ridges and depressions with plane surfaces sloping from the ridge to the depression, so that each compartment is a V-shaped shell or trough with outlet-apertures in the angle at the bottom, and each compartment, when the shaking-frame is on the center or midway between the two extremes of the vibratory motion, is under and in line with the mouth of a distributing-channel above. The distance between the ridges of the compartment is also somewhat greater than the lateral movement of the tray beneath the mouth of the channel, and consequently each compartment will receive and deposit equally upon the belt the pulp which is discharged from the channel above it. Thus the pulp as divided and distributed by the channel is discharged and spread upon the surface of the belt in the same equal manner by these

compartments. This mode of depositing the pulp in separate parallel streams at intervals apart and lengthwise of the belt is productive of much better results than where the pulp is distributed in a continuous stream across the belt and at right angle to the movement of progression, for in the practical operation of the machine it is found that the intervals of space on the face of the belt, where the descending streams of pulp do not impinge, afford a quiet passage for the ascending sulfurets that rest in and are carried upward by the progressive movement to the head of the machine, whereas in the other mode of feeding in a single stream across the face of the belt without such intervals being left it is found that the sulfurets are liable to be washed back, and their passage to and over the head of the machine is obstructed.

Having thus fully described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. In an ore-concentrator, the combination of the stationary frame, the shaking-frame, the concentrating-belt therein, mechanism for giving lateral vibrating movement to said shaking-frame, and for giving the said belt progressive movement in its frame, and spring-legs each having a straight top and a straight bottom member and a bent middle portion uniting said members and formed of an inwardly-set and an outwardly-set curve in the same vertical plane as described, said legs being rigidly secured at their upper ends to the shaking-frame and rigidly fastened to the stationary frame at their lower ends, and the legs carrying one side of the frame being oppositely set to those on the opposite side of the frame.

2. In an ore-concentrator, the stationary frame composed of the recessed corner-posts, the top cross-bars, and the side bars; in combination with the shaking-frame, spring-legs fixed at their lower ends in said recessed posts, the adjustable blocks having sockets to receive the ends of said legs and the bolts adapted to secure said legs in the socket and to fasten said block to the post, and the wedge fitted between a fixed bearing on the recessed post and the bottom of the said blocks for operation as described.

3. The combination, with the concentrating-belt, of the carrying-roller and the conical heads, each having a central hub fitting over the end of the roller and adjustable longitudinally thereon, an outwardly-extending flange and a collar and set-screw fitted to the end of the roller as a means of securing the conical head in place.

In testimony that I claim the foregoing I have hereunto set my hand and seal.

GEORGE E. WOODBURY. [L. S.]

Witnesses:

EDWARD E. OSBORN,
M. REGNER.