

No. 812,520.

PATENTED FEB. 13, 1906.

J. W. PINDER.
ORE CONCENTRATOR.
APPLICATION FILED NOV. 25, 1904.

2 SHEETS—SHEET 1.

FIG. 1.

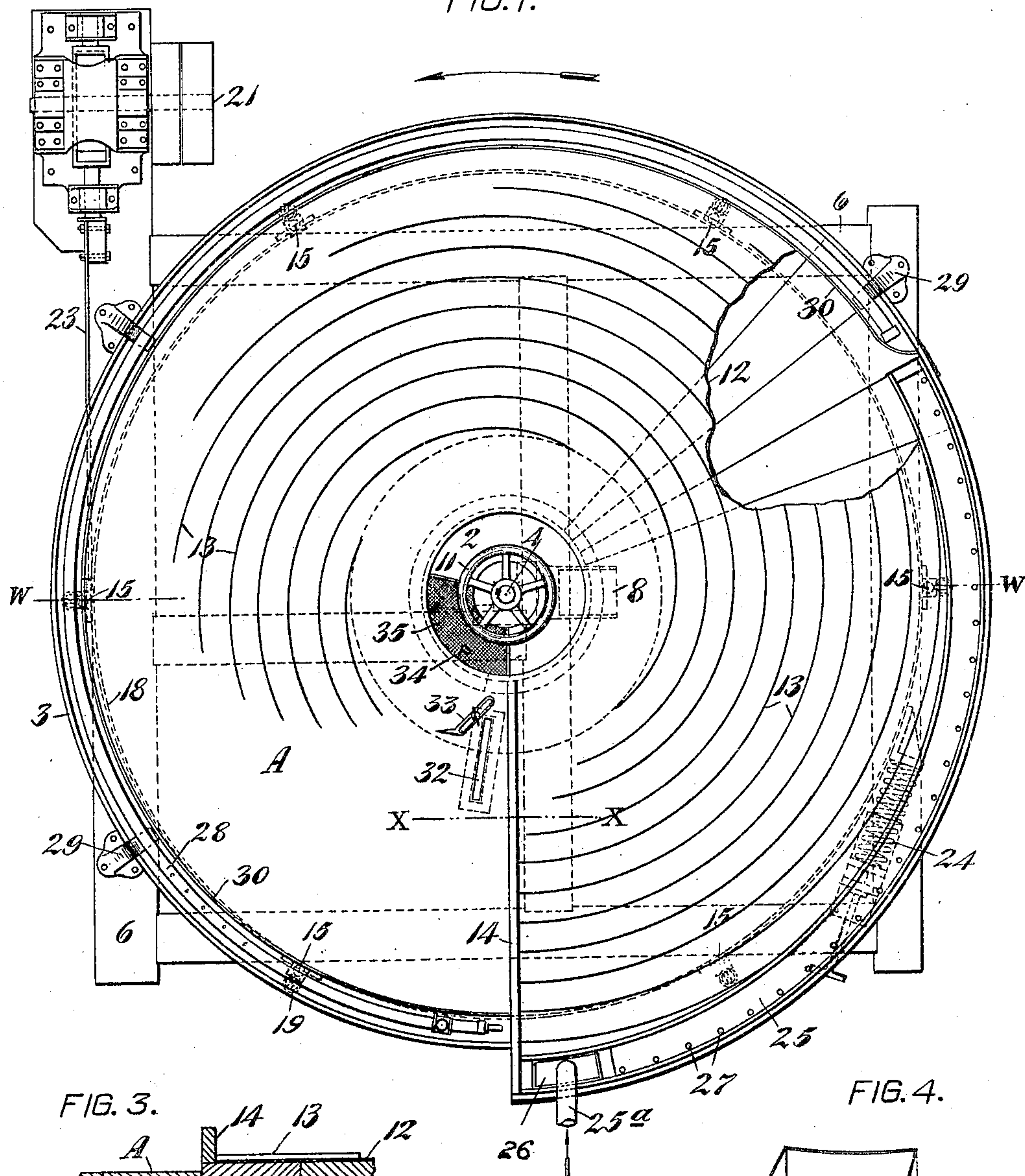
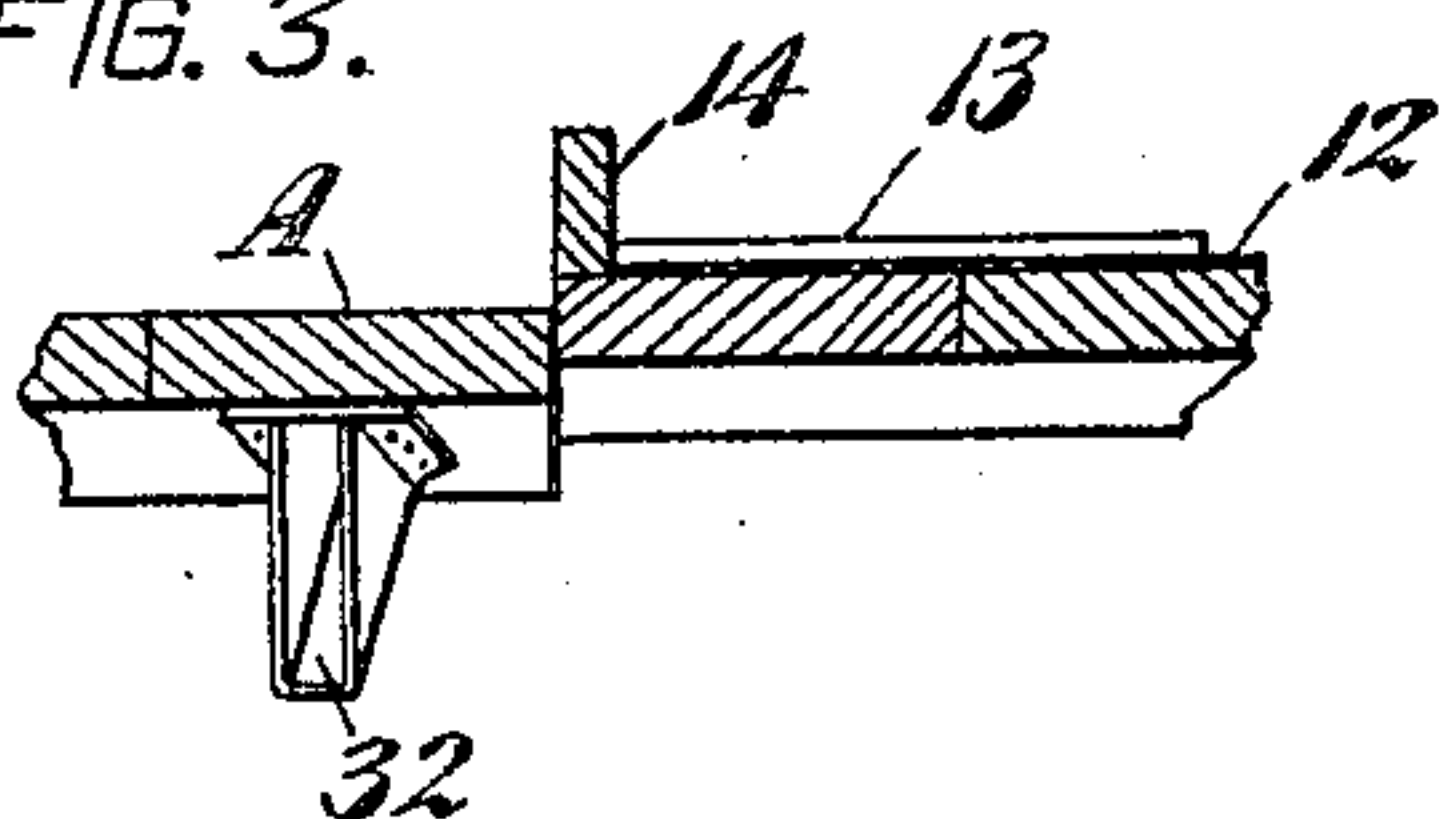


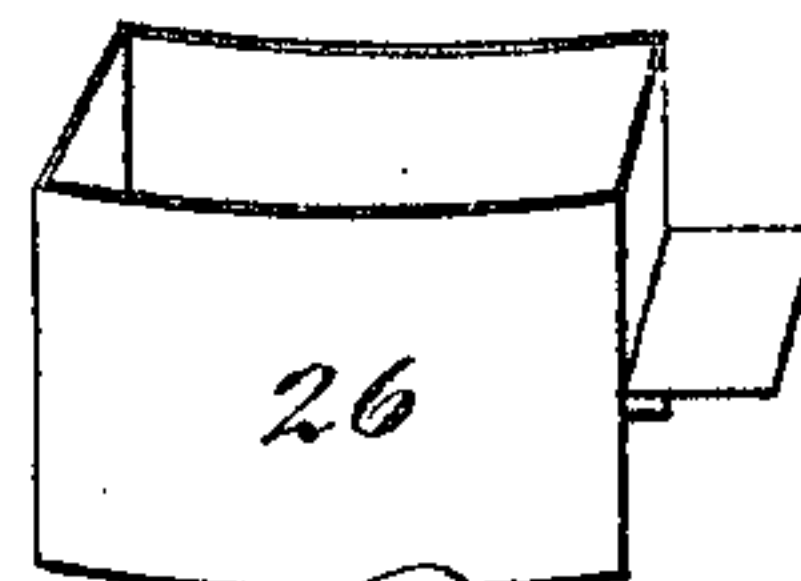
FIG. 3.



WITNESSES,
Chas. E. Chapin.

John H. Moore

FIG. 4.



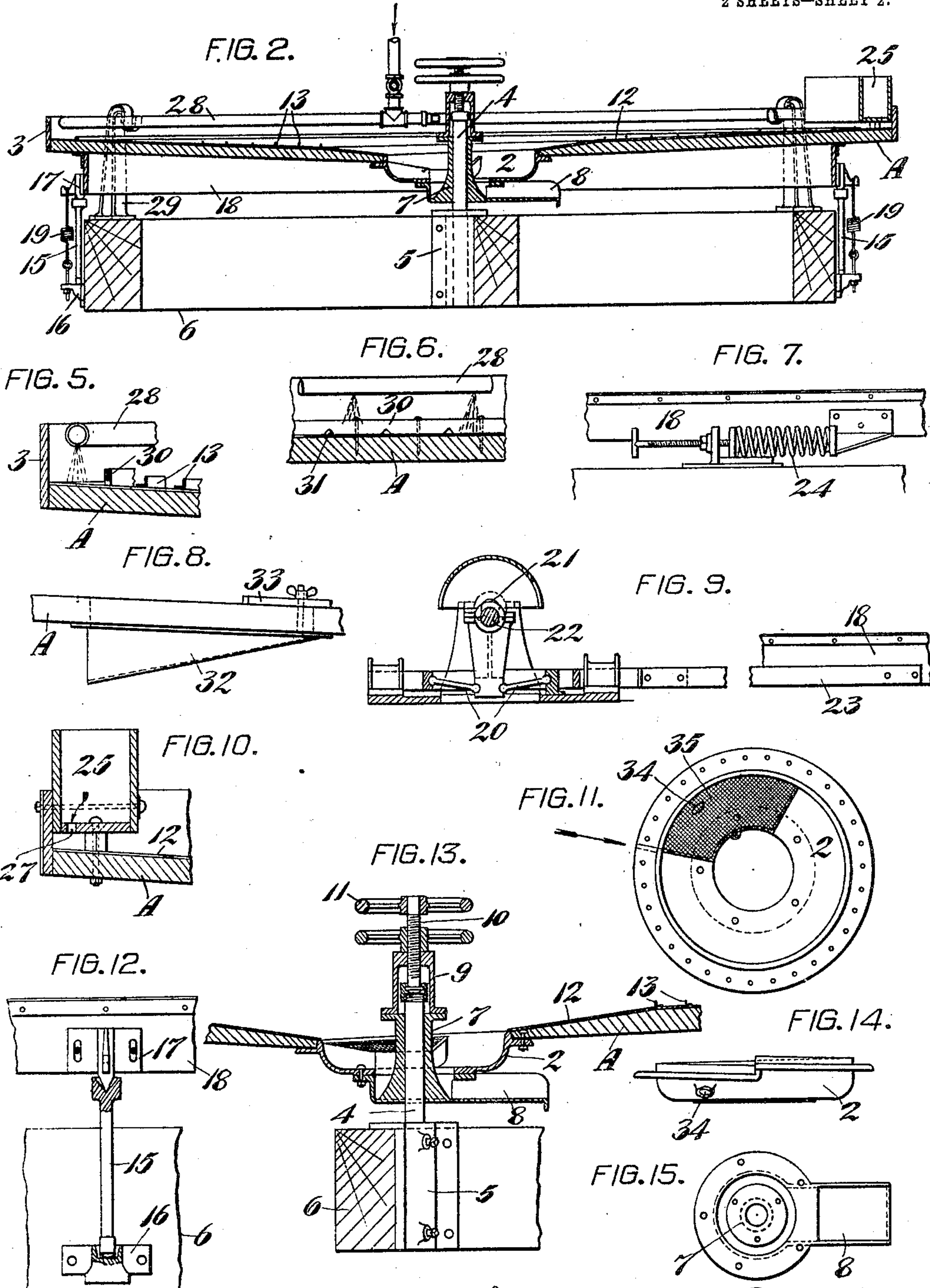
INVENTOR,
Joseph W. Pinder
By *Geo H. Strong* atty

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2 SHEETS—SHEET 2.



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UNITED STATES PATENT OFFICE.

JOSEPH WILLIAM PINDER, OF SAN FRANCISCO, CALIFORNIA.

ORE-CONCENTRATOR.

No. 812,520.

Specification of Letters Patent.

Patented Feb. 13, 1906.

Application filed November 25, 1904. Serial No. 234,223.

To all whom it may concern:

Be it known that I, JOSEPH WILLIAM PINDER, a citizen of the United States, residing in the city and county of San Francisco and State of California, have invented new and useful Improvements in Ore-Concentrators, of which the following is a specification.

My invention relates to an improved ore-concentrator, and especially to ore-concentrators of the circular type.

The object of my invention is to provide a concentrator which will have a maximum amount of concentrating-surface within a minimum space, which shall be simple and substantial in construction, and which shall provide for a more delicate and complete separation of valuable minerals having different specific gravities than is possible by means of the machines commonly in use.

The invention consists of the parts and the construction and combination of parts as hereinafter more fully described and claimed, having reference to the accompanying drawings, in which—

Figure 1 is a plan view of my improved concentrator-pan with a portion of upper surface covering broken away to show sectional character of the pan. Fig. 2 is a section on line W W of Fig. 1. Fig. 3 is a detail section on line X X of Fig. 1, illustrating the relative levels of the two ends of the pan-spiral. Fig. 4 is a perspective of the splash-box. Figs. 5 and 6 are details in partial section of the wash-water pipe and water-strip. Fig. 7 is a detail of the spring for effecting the return motion of the pan. Fig. 8 is an elevation of the discharge-spout for the concentrates shown in Fig. 3. Fig. 9 is a detail in partial section of the toggle mechanism for operating the pan. Fig. 10 is a detail in section of the pulp-feed box. Fig. 11 is a plan of the central bowl into which the gangue discharges, showing screen-receptacle for separate collection of slime values. Fig. 12 is a detail of the pivotal standards for supporting the pan. Fig. 13 is a detail in partial section of the central support for the pan, showing method of raising and lowering it to vary its depth. Fig. 14 is an elevation of the central bowl of Fig. 11 looking in the direction of the arrow. Fig. 15 is a plan of the gangue-discharge.

A represents a pan which is substantially involute in outline, but whose concentrating-surface lies in the plane of a turn of an in-

verted conical helix or spiral. The surface of this pan is preferably composed of independent sections or sectors having their inner ends rather loosely connected to the rim of a central bowl 2, as indicated in Fig. 13, while their upper ends are made fast to a steel rim 3. These sectors all converge downwardly to the center, so that the pan is more or less concave, the sectional character of the pan rendering the latter flexible to allow variations in the extent of this concavity and to adapt the pan to ores of different grades and character. By supporting the outer rim of the pan at substantially a fixed level the bowl 2 may be raised or lowered on the central supporting-shaft 4 to change the pitch of the pan. The shaft 4 is secured in a casting 5, fast to the bed-frame 6, and extends upwardly through a sleeve 7, which is fast to or cast integral with the spout 8, the latter being bolted to the bowl 2, as shown. A head or cap 9 is fixed to this sleeve, and a screw 10, passing through the cap, pivots on the top of shaft 4, so that by means of the hand-wheels 11 the screw may be turned to raise and lower the center of the pan, this raising and lowering being permitted by reason of the flexibility of the pan, operating through the pivotal connections of the sectors with the bowl. The surface of the pan is preferably covered with some impermeable and durable but flexible material, such as linoleum, (indicated at 12.) On the surface of this covering are secured the curved or spiral riffles 13, which extend around the pan from a line radial to the pan or from a line running from the widest point of the pan toward the center, and which line is herein designated as the "head" of the pan. In other words, the locus of one terminal of a majority of the riffles is in a line radial or substantially radial to the pan, and the riffles incline gradually upward and outward in the direction of curvature around the pan, so that the material tends to travel by virtue of the centrifugal action of the pan between rather than over the riffles. In the present instance the head of the pan is indicated by the radial partition 14, and the surface on the head side of this partition may be an inch, more or less, higher than the corresponding surface on the other or tail side of the pan, as indicated in Fig. 3. The spiral riffles curve outwardly, the outermost terminating first and the others successively around the surface of the pan. The outer

periphery of the pan is supported by the upright standards 15. The lower ends of these standards rest loose in sockets 16, secured to the timber frame, and the upper ends support adjustable brackets 17, which are bolted to the flange 18 on the under side of the pan. A spiral steel spring 19 is attached to the parts 16 17 to hold the pan securely to its bearings and to reduce or eliminate all the vibration.

The standards 15 allow the pan to have a free oscillating movement about the central pivotal shaft or stud 4. The oscillating movement is imparted to the machine in such a manner as to cause the pulp delivered from the segmental feed-box 25 to travel around the pan in the direction of the latter's incline and to give to the pulp its proper agitation and effect the necessary separation of the values from the worthless matter. Any suitable means may be provided to produce the proper oscillation of the pan. For this purpose I prefer to use the well-known principle of a double toggle, as 20, commonly used on rock-breakers and other machinery. These toggles are operated from a suitable source of power through shaft 21 and eccentric 22 and connect with the rim of the pan by a connecting-rod, as 23. A stiff steel spring 24, having one end secured to the pan and the other abutting against a suitable stop on the stationary part of the timber frame, acts in opposition to the toggles to cause a quick return of the pan and effect the advance step by step of the material around the pan.

It is to be observed that the feed-box is disposed at the widest point of the pan or farthest from the center and extends a substantial distance around the pan.

The pulp and water are delivered through a suitable spout, as 25, into the splash-box 26, whence it distributes over the bottom of the feed-box 25, discharging thence through openings 27 upon the pan.

The operation will then be as follows: The pan being given an oscillatory motion, the pulp from box 25, falling as it does upon the pan nearest its periphery and farthest from the center, is subjected immediately to the greatest agitation, throwing down at once all the heavier minerals and driving the pulp forward on its journey around the pan, while the gangue and lighter portions flowing over the riffles 13 will gravitate toward the center. A water-pipe 28, supported on suitable brackets 29, extends around the periphery of the pan beyond the feed-box and is perforated on its inner side, so as to cast a spray of numerous jets of clear water upon the outer edge of the pan adjacent to the rim. In order to distribute this water so as not to allow any considerable separate streams to flow directly across the pan and interfere with the proper stratifying of the material thereon, I employ a water-strip 30, preferably of rubber and secured to the pan adjacent to the rim 3 and

forming therewith a channel into which the jets from pipe 28 discharge, letting the water out of this channel through suitable perforations 31 in the strip. The circular form of the pan affords the greatest amount of area for cleaning and concentrating purposes within the smallest space, which in machines of this character is of vital importance. As the finer concentrates approach the center in their line of travel around the pan, the motion imparted to the pulp is varied, the agitation and impulse growing less as it nears the end of the riffle system. This not only affords a suitable agitation for all classes of sulfids, including the very lightest, which require less agitation for settling purposes than do the heavier particles, but these heavier concentrates which are already formed on the outer circumference travel slower and assume a more stratified position as they go onward, thus making the separation more complete. The formation of the strata of the heaviest minerals on the outer edge of the pulp prevents the wash-water washing away the finer and more delicate minerals which lie on the surface of the pan and under the gangue nearest the heavier mineral already developed. These finer values are gradually separated from the baser matter in their progress around the pan, the gangue, being lighter, naturally seeking the center and the heavier matter the outside of the pan, as described, so that in the end we have a thorough and complete separation and stratification from the center to the outside of the pan of all the values according to their specific gravities. Passing beyond the riffles, the values remaining on the pan are worked forward until they finally discharge into a spout 32 and can be collected into any suitable receiver, the adjustable finger 33 serving to direct the material as desired. The gangue passing over the pan discharges into bowl 2 and passes thence out as waste through spout 8. The pan adjacent to the bowl 2 and within the innermost riffle is given an accelerated pitch, as indicated in Fig. 13, to assist in the more rapid passage of the gangue after it is once free of the riffles. Some ores slime more than others—that is, their values become ground into a pulp too fine for ordinary concentration. Ore-pulp of this character fed upon my pan will be worked around the pan in the manner described. The fine slime being heavier will approach the center about two-thirds of the distance around the pan, and unless some means is provided for their collection they will eventually flow off with the rest of the gangue and barren matter through spout 8. Accordingly I construct the bowl 2 with two compartments, one opening into spout 8 and the other having a separate discharge, as 34, this latter compartment being covered with a very-fine-mesh screen; as 35. If the pan

were handling pulp, for instance, which had passed through a forty-mesh screen from the mortar, the screen 35 would be about eighty-mesh, any values larger than eighty-mesh being caught by the riffles 13 and duly stratified. The finer slime values approaching screen 35 will pass therethrough and out at spout 34 to be separately collected, while any lighter barren matter too large to pass through screen 35 will be delivered into the regular gangue-discharge in bowl 2.

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

1. A concentrating-pan having a concaved upper surface and mounted upon a central support, said pan being essentially involute in outline, riffles on the surface of the pan, said pan having a central discharge, means located at the widest portion of the pan for delivering material upon the pan in the field of maximum agitation and means for giving the pan an oscillatory movement.

2. A concentrating-pan having a concaved upper surface and mounted on a central support, said pan being essentially involute in outline, spiral riffles on the pan and a feed-box arranged around the pan at substantially the point farthest removed from the central support, said pan having separate discharges for the values and worthless matter and means for giving the pan an oscillatory movement.

3. In a concentrator, a pan having a central discharge and a concaved riffled surface wherein the riffles commence at a common line which is radial to the pan said riffles terminating at irregular intervals around the pan, means for supporting the perimeter of the pan, means for supplying pulp to the pan at substantially the point farthest removed from the central discharge, and means for raising and lowering the center of the pan to vary its depth.

4. A concentrating-pan having a concaved upper surface essentially involute in outline, and having riffles on said surface commencing at a common line radial to the pan and terminating at irregular intervals around the pan, said pan composed of a series of sections rigidly supported at their outer ends, and flexibly supported at the center, means for raising and lowering the inner ends of said sections to vary the depth of the pan, means for delivering material upon the pan in the field of maximum agitation, and means for oscillating the pan.

5. A concentrating-pan having a concaved upper surface and a central opening, said pan having riffles on its surface commencing at a common line radial to the pan and terminating at irregular intervals around said pan, means for supporting the pan at the center and at its periphery to permit it to oscillate in a horizontal plane, said pan composed of

a plurality of sectors flexibly supported at the center, means for raising the inner ends of these sectors to vary the depth of the pan, a flexible covering supported on these sectors, curved riffles supported on said covering, and means for delivering material upon the pan in the field of maximum agitation.

6. An ore-concentrating pan having a concaved upper riffled surface, with the riffles commencing at a common line which is substantially radial to the pan and terminating at irregular intervals around the pan said pan being essentially involute in outline and the surface of the pan lying in a spirally-descending plane.

7. An ore-concentrating pan having a concaved upper riffled surface, said pan being essentially involute in outline and the surface of the pan lying in a spirally-descending plane.

8. An ore-concentrating pan having a concaved upper riffled surface, said pan being essentially involute in outline and the surface of the pan lying in a spirally-descending plane, the pan having a central discharge, and means for delivering pulp at one or more points on said pan most remote from the center and in the field of maximum agitation of said pan.

9. An ore-concentrating apparatus comprising a shallow inverted conical pan having a central and movable peripheral supports, means by which said pan is abruptly oscillated about its center, means for discharging pulp and wash-water near the periphery of the pan, a series of spirally-disposed riffles fixed upon the surface of the pan, and each commencing at a common line which is substantially radial to the pan, said riffles terminating at irregular intervals around the pan, said surface declining in a curve from the commencement to the termination of the riffles, and separate discharge-openings for the concentrated mineral and the gangue.

10. An ore-concentrating apparatus comprising a shallow inverted conical pan having a central and movable peripheral supports, means by which said pan is abruptly oscillated about its center, means for discharging pulp and wash-water near the periphery of the pan in the field of maximum agitation, a series of spirally-disposed riffles fixed upon the surface of the pan, said riffles and each commencing at a common line which is substantially radial to the pan, said riffles terminating at irregular intervals around the pan, declining in a curve from the commencement to the termination of the riffles, said pan having a separate discharge for the gangue and radially-extending openings in the body of the pan in the path of the values for the separate discharge and collection of the latter.

11. In a concentrator, a shallow horizontally-supported concaved pan having a flexi-

ble bottom said pan being essentially involute in outline, vertical standards upon which the periphery of the pan is supported and movable, a central post with socket-sleeve cap and screw whereby the center of the pan may be raised or lowered, spirally-disposed riffles upon the surface of the pan, means for delivering pulp and wash-water at the outer periphery thereof in the field of maximum agitation, and mechanism by which a circular oscillatory movement of the pan is effected.

12. In an ore-concentrator, a circular pan having a concaved upper riffled surface with the riffles commencing at a common point substantially radial to the pan and terminating at irregular points around the pan, and a flexible bottom, means for supporting the outer periphery of the pan, said means including standards loosely pivoting in sockets in the bed-frame and pivotally engaging corresponding parts on the pan, springs relative to said standards and operating to hold the pan to its seat, a central support for the pan and means for raising and lowering the center of the pan to vary its depth.

13. An ore-concentrating pan having essentially the outline of an involute and arranged with its upper surface in a spirally-descending plane, a partition extending from the center of the pan outwardly at the highest point of the surface of the same, and curved riffles extending around the pan in the direction of the decline of curvature, means for delivering pulp and wash-water on the pan in substantially the field of maximum agitation and separate discharges for the gangue and values.

14. An ore-concentrating pan having essentially the outline of an involute and arranged with its upper surface in the plane of a turn of a conical helix, a radial partition extending from the center of the pan outwardly at the highest point of the surface of the same and curved riffles extending around the pan in the direction of the decline of curvature, means for delivering material onto

the pan at the widest part thereof, and separate discharges for the gangue and values.

15. An ore-concentrating pan having essentially the outline of an involute and arranged with its upper surface in the plane of a turn of a conical helix, a radial partition extending from the center of the pan outwardly at the highest point of the surface of the same and curved riffles extending around the pan in the direction of the decline of curvature, a curved segmental feed-trough disposed at the outer edge of the pan at its widest part, said pan having a central discharge for the gangue and having discharge-passages intermediate of its center and periphery for the values.

16. In a concentrator, a circular concaved pan having an upper riffled surface arranged in a spirally-descending plane and a central discharge, means for delivering material upon the pan, said pan having a discharge-passage for the values intermediate of its center and periphery, said passage extending transverse to the general direction of movement of the values.

17. In a concentrator, a circular pan having a concaved upper riffled surface and a central opening, a bowl in said opening having a discharge for the gangue and a separate screen-covered receptacle for the finer slimes passing over the pan, means for supporting the bowl, means for supporting the outer periphery of the pan, means for delivering material and wash-water upon the pan, said pan having a discharge for the concentrated values intermediate of its center and periphery and means for giving the pan an oscillatory movement.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

JOSEPH WILLIAM PINDER.

Witnesses:

FRANCIS G. SMITH,
L. J. FONTENROSE.