J. W. PINDER.

SPIRAL SLIMER.

APPLICATION FILED SEPT. 28, 1910.

995,089.

Patented June 13, 1911.

3 SHEETS—SHEET 1.

Fig. 1.

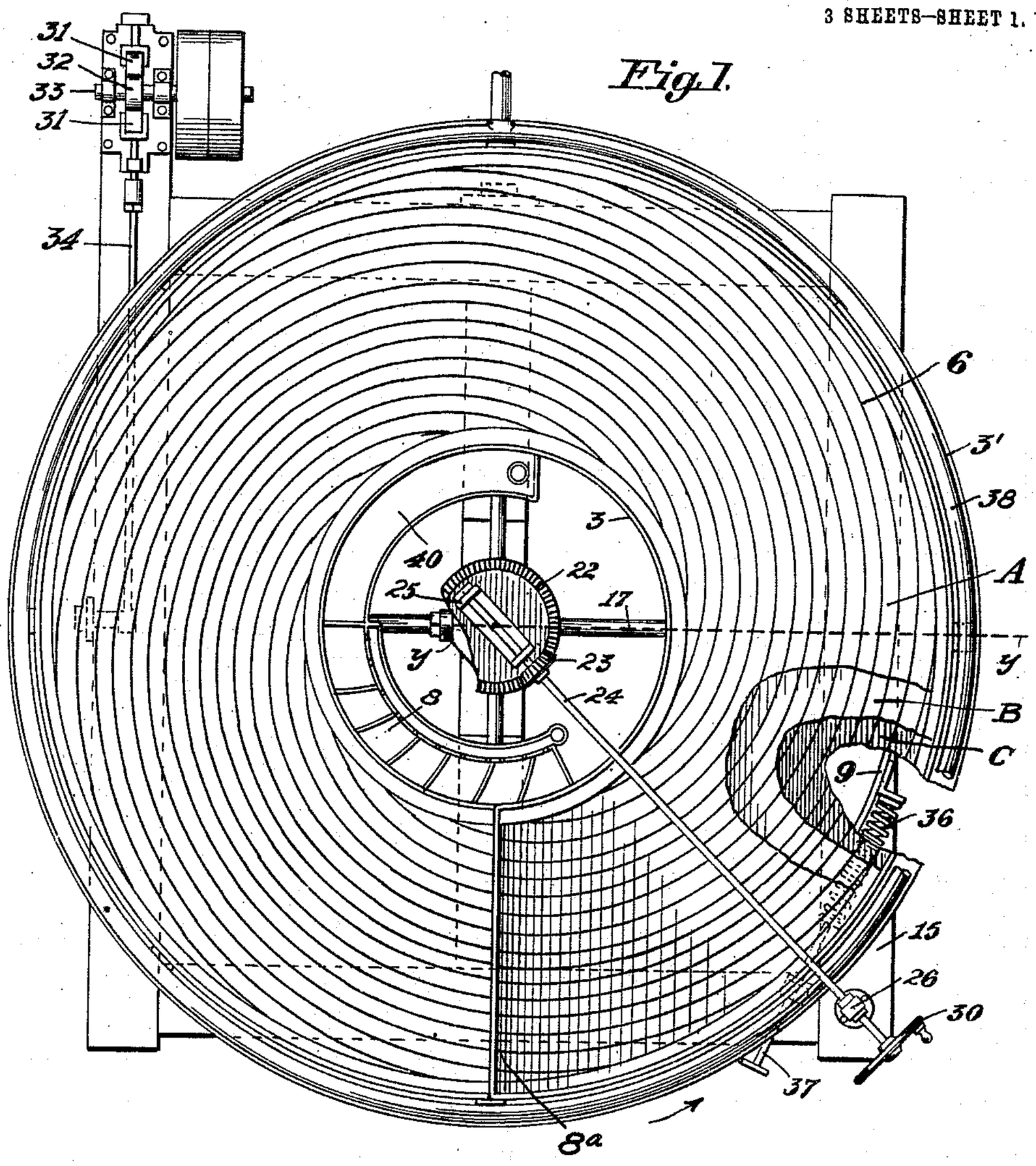
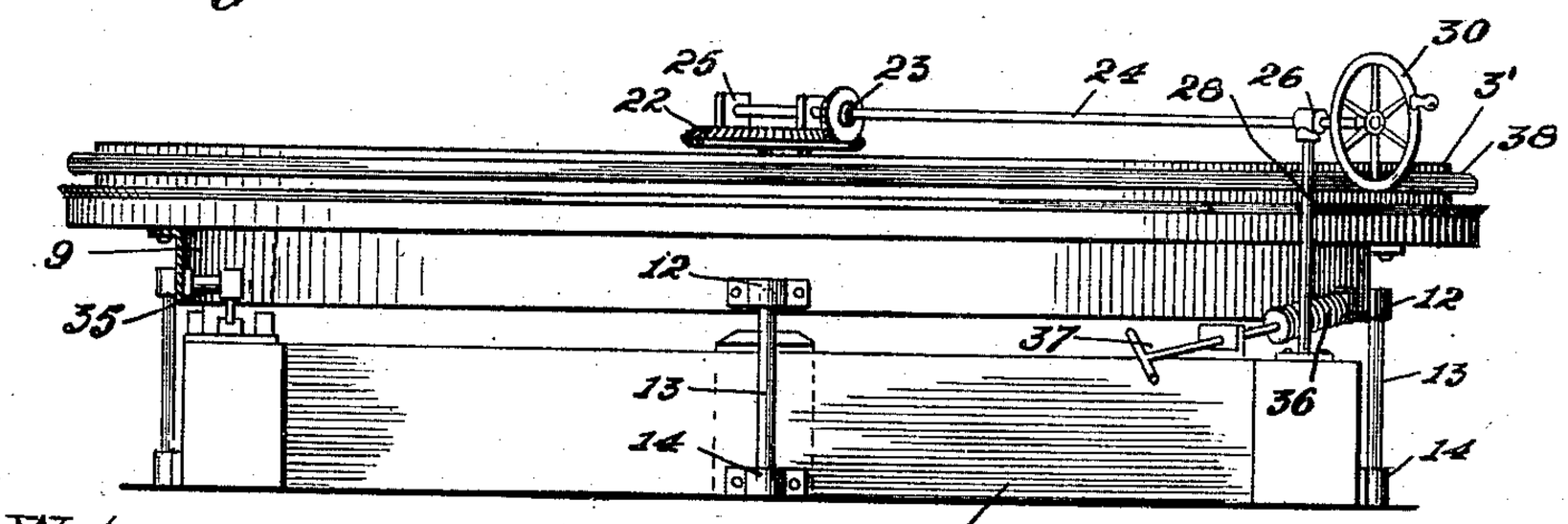


Fig. 2.



Witnesses,
Charles Pickles
R. S. Berry.

Inventor,
Joseph W. Pinden.
By Geo. H. Strong
Atty

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3 SHEETS—SHEET 2.

Fig. 3.

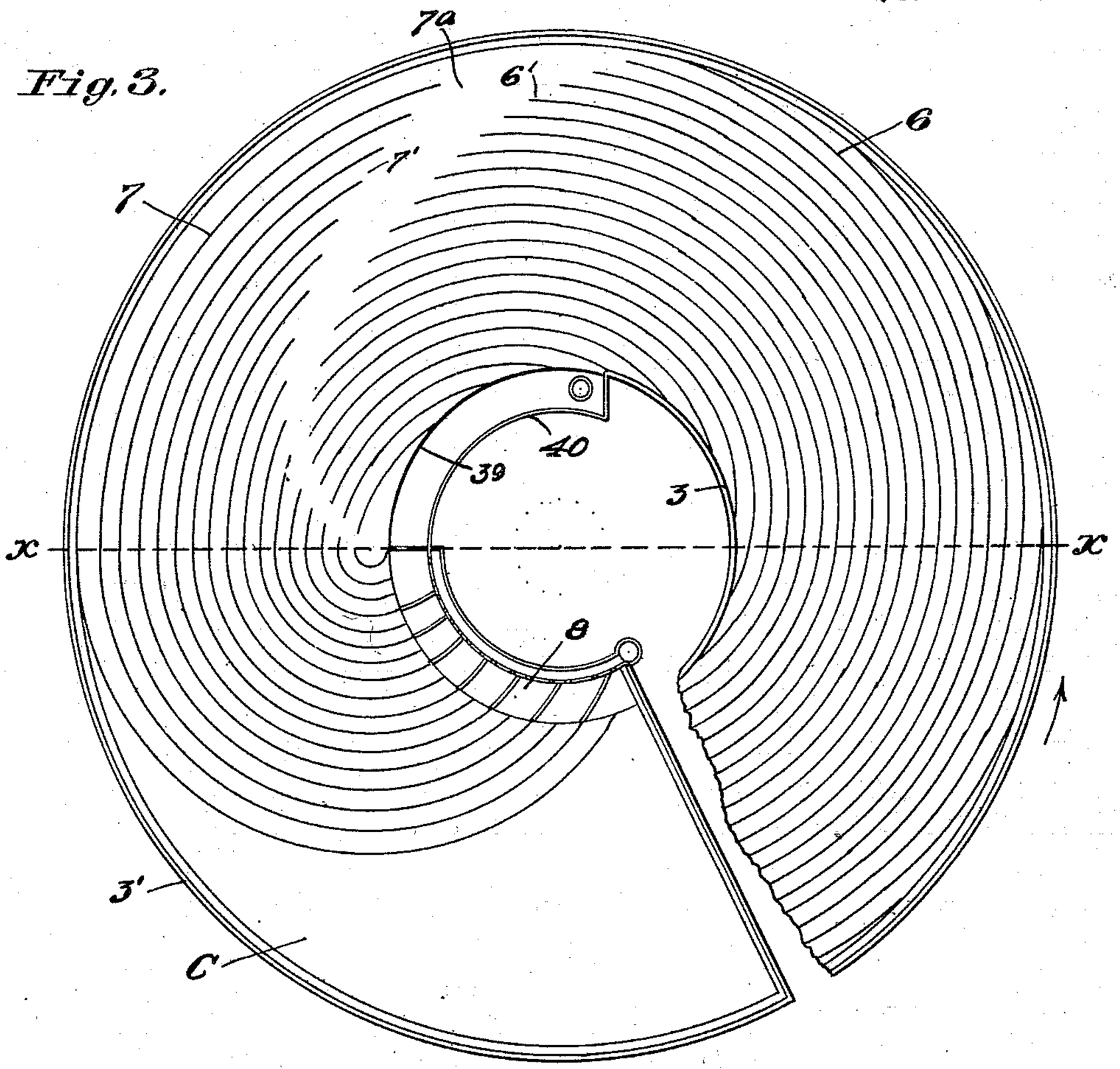


Fig. 4.

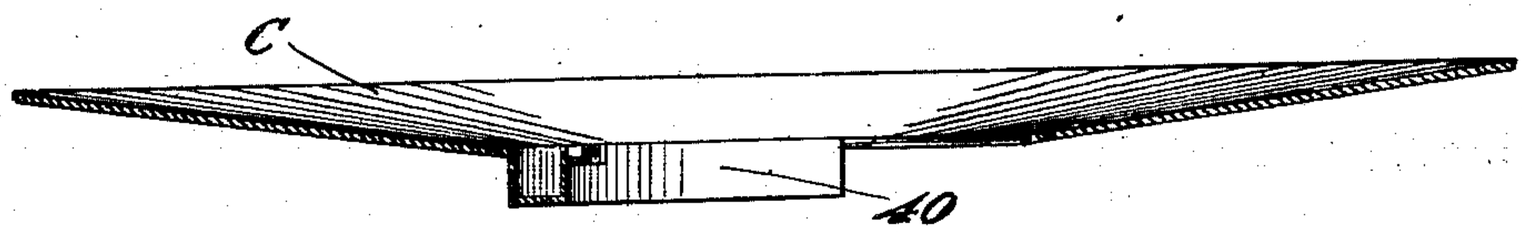
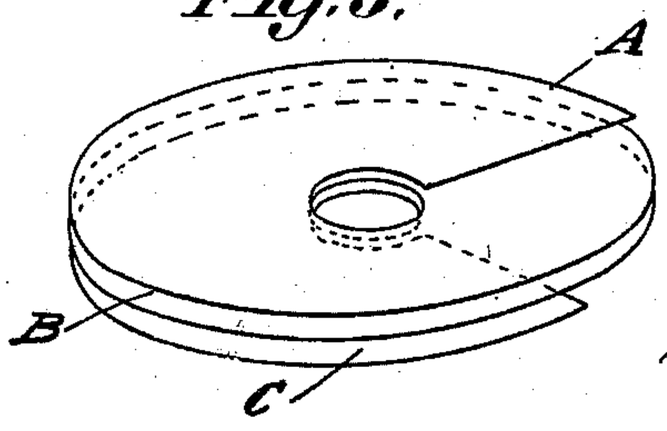


Fig. 5.



Witnesses:
Charles Pickles
R. L. Burns.

Inventor:
Joseph W. Pinder
By Geo. H. Strong.
Atty

J. W. PINDER.

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3 SHEETS—SHEET 3.

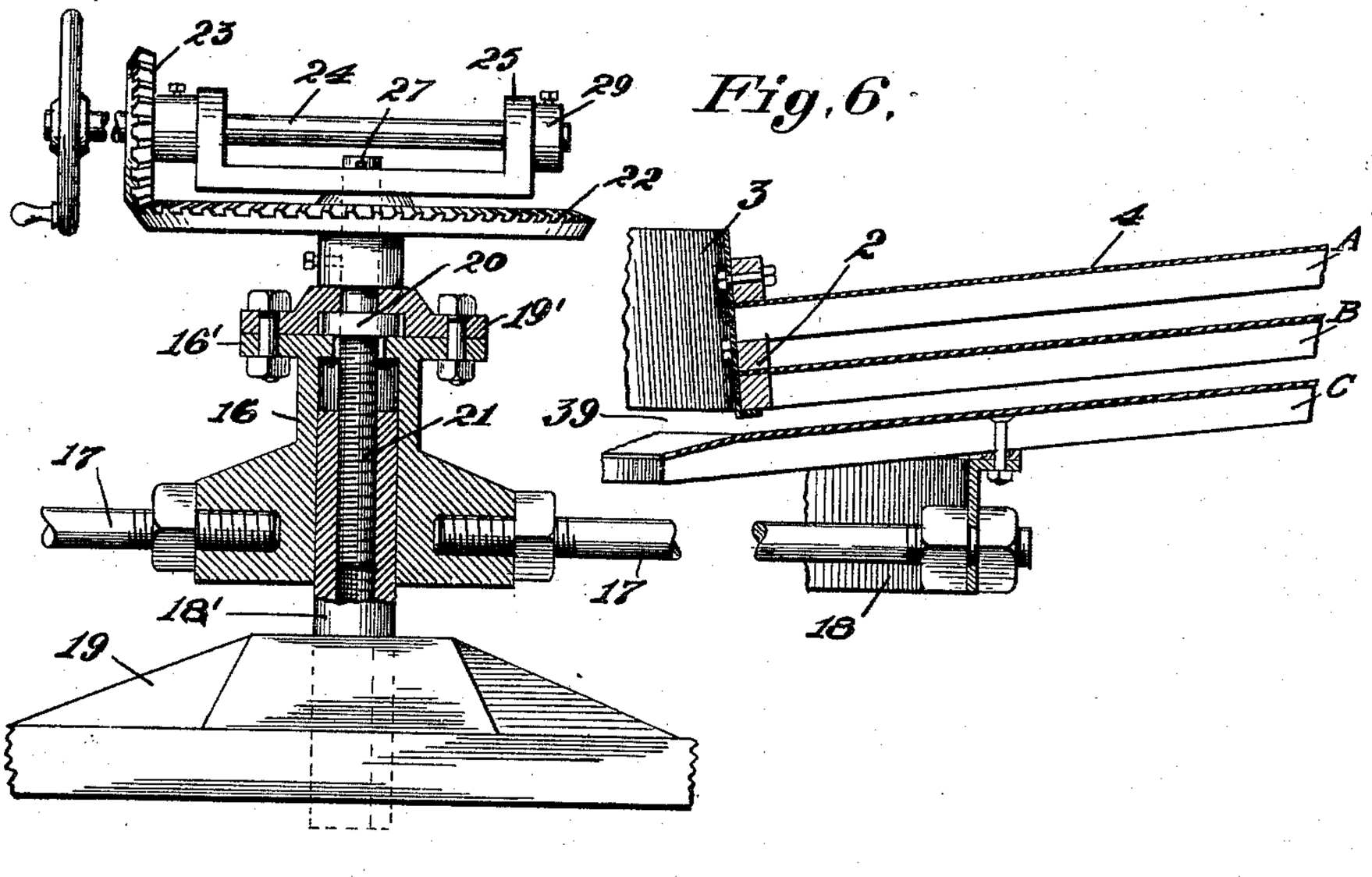

Fig. 6.

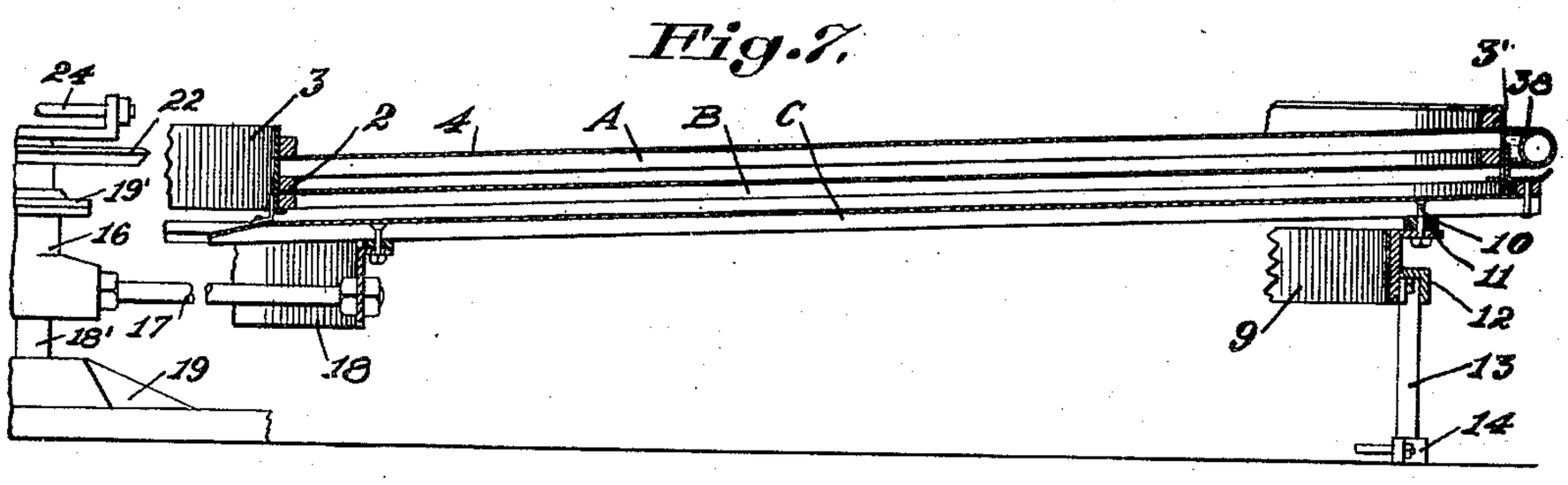

Fig. 7.

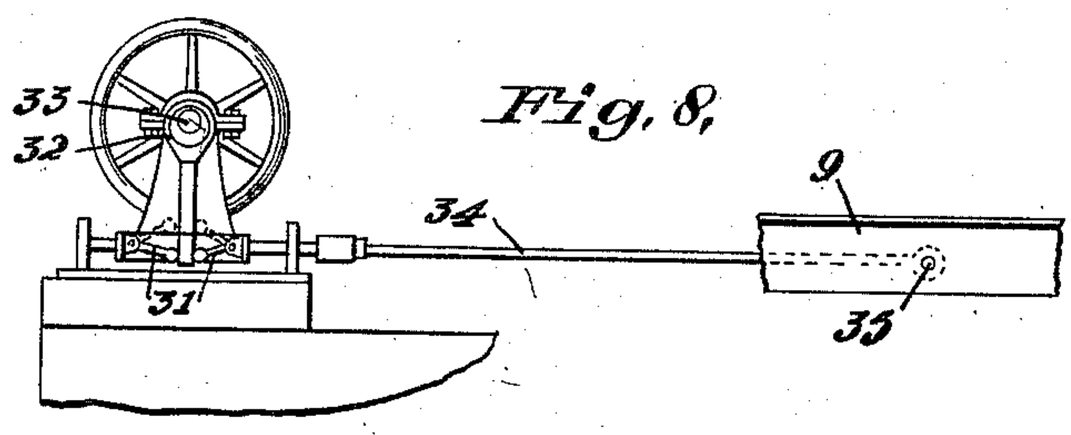

Fig. 8.

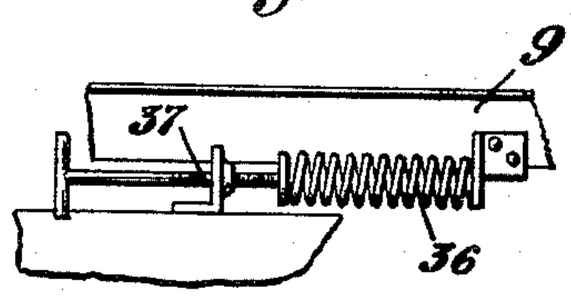

Fig. 9.

Witnesses:
Charles Pickles
R. S. Berry,

Inventor:
Joseph W. Pinder
By Geo. H. Strong.
Atty.

UNITED STATES PATENT OFFICE.

JOSEPH W. PINDER, OF OAKLAND, CALIFORNIA.

SPIRAL SLIMER.

995,089. Specification of Letters Patent. **Patented June 13, 1911.**

Application filed September 28, 1910. Serial No. 584,374.

To all whom it may concern:

Be it known that I, JOSEPH W. PINDER, citizen of the United States, residing at Oakland, in the county of Alameda and State of California, have invented new and useful Improvements in Spiral Slimers, of which the following is a specification.

This invention relates to concentrators for treating the pulp from stamp-mills or the like, and particularly pertains to that class of concentrators known as slimers, in which a separation of precious metals from sand or gangue is obtained by the vibration of riffled surfaces.

The object of this invention is to provide a table with duplex sets of riffles; one set for separating the mineral from gangue and the other for segregating the separated minerals one from the other.

Another object is to provide a table of spiral form with a plurality of superposed decks one above the other and spaced but slightly from one another and inclosed on the sides so that the material and water is in effect forced under a limited head pressure through a shallow spiral conduit or sluice whereby all the float gold and other precious mineral and float values are submerged and saved.

A further object is to provide a concentrator in which the riffled surfaces are formed on a round spiral table having two or more complete turns of the spiral from top to bottom the surface of which is concave or sloping from the outer rim toward the center.

The invention consists of the parts and 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 the spiral concentrating table with parts broken away. Fig. 2 is a side elevation. Fig. 3 is a plan view of the lower coil of the spiral. Fig. 4 is a cross section on the line X X, Fig. 3. Fig. 5 is a diagrammatic view in perspective showing the helical or spiral and the concave form of the table. Fig. 6 is a detail of the mechanism for adjusting the incline of the table; also showing a portion of the table in section. Fig. 7 is a half section of the table on the line *y—y* Fig. 1, showing the close relation of one spiral of the table to another. Fig. 8 is a detail of the vibrative mechanism. Fig. 9 is a detail of the coil spring adjustment.

In the drawings, the concentrating surface of the table is shown as circular in plan with three floors or decks A—B—C one above the other in the form of a continuous spiral and slightly separated from each other, the surfaces of which slope downward from the outer edge toward the center. The floors or decks A—B—C are formed of any suitable material and have their outer and inner edges rather loosely mounted on separating rims 2, which are secured to metallic bands 3—3′. The top or working surfaces of the floors A—B—C are covered with a waterproof substance 4, preferably rubber, which is called the mat. Upon this mat 4 are laid two systems or sets of riffles, particularly shown at 6 and 7 in Fig. 3. The riffles 6 of the first set are spirally arranged or evolute radially from the cylindrical plane of the inner edge of the table and taper to nothing at the outer edge in such manner that no smooth channel or zone will be formed between the line of riffle terminals and the rim. These spiral riffles 6 cover the entire surface of the mat on the floors A—B— and until they reach a point about one half the circumference of the table, more or less distant from the bottom or lower end of the spiral table; that is, the riffles 6 continue down to about one half of the lower deck C, when the riffles 6 terminate, and the locus of these terminals is in an irregular curve 6′, Fig. 3, extending from the outer rim of the table, and continues toward the lower edge of the table, as illustrated in Fig. 3.

The second set of riffles 7, is a continuation of the first spiral set 6, but spaced therefrom to include a plain unriffled space 7^a on the deck C. The riffles 7 are laid upon the mat 4 to conform to the general length of the table, running parallel with the circumference thereof. The heads, or upper ends of the riffles 7 on the inner edge of the table, are placed in close proximity with the spiral riffle terminals 6, and continue upward or outward forming a curved line 7′, conforming substantially with the curved line of terminals of the spiral riffles, but widening therefrom more and more as they approach the outer rim, thus forming the smooth or riffleless surface 7^a, in the shape of a curved wedge between the two systems, that is wider at the outer or upper end than at the inner or lower end, as shown in the drawing in Fig. 3. The extreme or lower ends of these second riffles 7 are curved toward the

inner edge of the table in order that the mineral which they deliver may be discharged from the table at that point, and empty into a partitioned receptacle 8 mounted on the inner edge of the table. This duplex arrangement of riffles may be used in any kind of riffle table, having straight, spiral or curved riffles, as explained hereinafter.

The object of the first set of riffles 6 is to separate the mineral from the gangue; the second set 7 is to segregate the separated minerals one from the other and the intervening transverse riffleless zone 7ª is to allow a spreading out of the separated minerals so that the riffles 7 may cut out the different minerals one from the other and grade them. In the primary concentration by riffles 6, two or more different minerals and grades of mineral may be banked up behind a riffle. The open zone 7ª provides for a thinning out and separation so that separating by the riffles 7 will be facilitated.

The pulp and water are fed upon the surface of the table at the highest point or beginning of the spiral turns represented at 8ª, Fig. 1. The impetus given the table by the mechanism to be later described, drives the pulp around and the slight incline of the spiral permits the water to flow slowly along its length. It will be observed from the drawings, that I have designed this spiral table so that the least possible incline in the turns may be had, and in this way bringing the surface of the mat on one deck in close proximity to the bottom of the floor of the next above, so that by adjusting the incline of the table to the center, as later described, the surface of the water flowing on the mat may be brought in contact with the bottom of the floor above it. This is done for the purpose of submerging or saturating these particles of floating sulfids, float gold, and other similar minerals that escape from other sliming machines and are lost. This is one of the principal features of my design of table. These floating minerals, as described, as soon as they are pressed under the surface of the water, in their transit over the table, become deprived of the films of air which surround them, and they at once sink to the bed of the concentrates and are saved.

The various strata of concentrates forming around the outer edge of the mat as the pulp is driven around the table, upon reaching the area 7ª where the first set of riffles end, will gently spread; the outer stratum being the heaviest, that having the least specific gravity being on the inside. As the very heaviest concentrates travel inward the extreme edge of the outer line they are caught by the sharp point of the first riffle in the second set 7, and a very narrow streak of the mineral is shaved off thereby, and that portion is conducted along the line of that riffle to the discharge. The second riffle in this series will shave off another narrow streak of this mineral as did the first, and the third and following riffles will all do likewise so that the original zone of minerals of perhaps three or four inches in width will have been shaved out to a width of two or three feet, each mineral so distinctly separated one from the other that each may be saved in its own receptacle free from the other. Another important principle demonstrated by this system is that the zone of concentrates as they travel along the line of riffle terminals, forms a dam or pressure against the light pulp next below it lying between the riffles. As this pressure is relieved by the shaving away of the concentrates by the second riffles, the impulse of the table will cause the pulp lying at the riffle ends to move forward sending this pulp into the smooth surface, where it becomes exposed to the flow of wash water, and the underlying fine mineral is cleaned and saved thereby. The gain in this way is quite important.

The outer portion of the concentrating table is supported on a ring 9 and is retained thereon by means of carriage bolts 10 resilient washers 11 being interposed between the table and the ring. Socket bearings 12 are secured at intervals around the ring 9, which are adapted to receive the upper ends of standards 13, the lower ends of which are mounted in like manner in socket bearings 14 attached to any suitable frame 15. The standards 13 and bearings 12—14 are so arranged and constructed as to permit of an oscillating motion of the table in a horizontal direction.

The outer rim of the table always remains in the same horizontal plane while the inner rim may be raised and lowered so as to vary the transverse slope or concavity of the table. This is accomplished by means of the device shown in Fig. 6, which consists of a tubular hub 16 having radially disposed arms or spokes 17 which are rigidly attached to a ring 18 upon which the inner edge of the table is fastened and supported, in the same manner as that of the outer edge. The hub 16 is adapted to slide up and down on an internally threaded standard 18′ mounted in a base 19 on the supporting frame 15. A flange 16′ on the upper part of the hub 16 is removably attached to a chambered cap 19′ supported on a fixed collar 20 on a threaded shaft 21, which screws into the threaded standard 18′. The upper portion of the shaft 21 carries a miter gear 22 which meshes with a pinion 23 secured on a horizontal crank shaft 24, supported in a yoke 25 and a bearing 26, Figs. 1–2–6. The yoke 25 is loosely mounted on the shaft 21 and is retained thereon by means of a pin 27, while the bearing 26 is rigidly secured to a

standard 28, Fig. 2, located outside the periphery of the table and mounted on the supporting frame 15. A collar 29 is attached to the inner end of the shaft 24 as a means of retaining the shaft in its bearings. A hand wheel 30 is provided on the outer end of the shaft 24 by means of which the shaft 24 and the pinion 23 may be rotated and thereby revolve the miter gear 22 and the threaded shaft 21, so as to raise or lower the hub 16 and its connections, thus adjusting the incline of the table.

The oscillating or vibrating motion may be given the table by any suitable means, but I prefer to use the mechanism shown in Fig. 8, which consists of toggles 31 actuated by an eccentric 32 on a shaft 33 driven by any suitable power. The toggles 31 operate a connecting rod 34 connected to the ring 9 of the concentrating table, as shown at 35. A stiff coil spring 36 having one end secured to the ring 9 and the other abutting against a suitable stop on the frame 15, acts in opposition to the toggles 31 to cause a quick return. Suitable means are provided whereby the tension of the spring 36 may be regulated, as at 37.

The pulp or slimes may be delivered to the concentrating surface in any suitable manner, the point of feed distributers being located at the highest termination of the spiral surfaces.

Clean water is supplied to the concentrating surface of the lowermost coil by means of a circular pipe 38 having perforations on its under side, and disposed around the outer portion of the table in such manner that the water will be distributed on the surface of the lowermost coil inside the band 3.

An outlet or discharge for waste is provided in the inner band 3 as shown at 39 in Fig. 3, the rim or spacer 2 not continuing across this opening. The materials discharged at this point are received in a trough 40 from which they are drained off in any suitable manner.

Among the important features of the invention to which particular attention is directed are the following:

First:—The plural sets of riffles, the one set for separating the mineral from the gangue, and one or more succeeding sets for segregating the separated minerals one from the other.

Second:—These sets of riffles curved and tapering, one set drifting toward one side of the table and the other set drifting toward the opposite side of the table. In a table of spiral form as here shown, I prefer that one set of riffles hereinbefore represented as 6, be substantially evolute, that is, drifting from the inside of the table downwardly; the other set 7, substantially involute, or drifting toward the inside of the table.

Third:—The spiral movement of the table with a plurality of superposed decks slightly spaced one from the other, the spaces between decks being substantially closed at the edges so as to form a spiral sluice of considerable width, and of almost negligible depth, usually not over $\frac{5}{8}$ of an inch between decks through which the water and material flows in solid column whereby the recovery of the float gold and other values is assured, as previously described.

One great advantage of the spiral arrangement of the table is that a maximum concentrating surface is obtained in a minimum amount of floor space. This is a valuable desideratum in milling machinery.

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

1. A concentrator having a surface in the form of a spiral with more than one complete turn described about a vertical axis, and having one convolution adapted to contact with the surface of the pulp on the next lower convolution to submerge floating values, said table having successive sets of riffles alternately drifting in opposite directions, and means for giving a shake to the table in the direction of the length of the riffles.

2. A concentrating table having a surface in the form of a spiral with more than one complete turn described about a vertical axis, and forming a plurality of decks disposed one above the other and inclosed on the sides and constituting a spiral conduit in which the precious material and float values are submerged and saved, a set of spiral formed riffles drifting toward one side of the table and a succeeding set of spiral formed riffles drifting toward the other side of the table, the first set of riffles tapering to nothing on the table and the terminals of that set operated from the adjacent ends of the succeeding set by an unriffled space which extends crosswise of the table, and means for giving the table a shake substantially in the direction of the length of the riffles.

3. A concentrator table whose surface is in the form of an inclined plane wrapped about a cylinder, the surface of said table having a duplex set of riffles, one succeeding the other, one set adapted to separate the mineral from the gangue and the other adapted to segregate the separated minerals one from the other, said set of riffles drifting in opposite directions, and means for vibrating the table.

4. A concentrator table whose surface is in the form of an inclined plane wrapped about a cylinder, the surface of said table having a duplex set of riffles, one succeeding the other, one set adapted to separate the mineral from the gangue and the other adapted to segregate the separated minerals

one from the other, said set of riffles drifting in opposite directions being separated one set from the other by a limited zone of unriffled surface, which unriffled surface extends spirally across the table, and means for vibrating the table.

5. A concentrator table whose surface is in the form of an inclined plane wrapped about a cylinder, the surface of said table having a duplex set of riffles, one succeeding the other, one set adapted to separate the mineral from the gangue and the other adapted to segregate the separated minerals one from the other, the first set of riffles being substantially evolute and the succeeding set being substantially involute, and means for vibrating the table.

6. A concentrator table whose surface is in the form of an inclined plane wrapped about a cylinder, the surface of said table having a duplex set of riffles, one succeeding the other, one set adapted to separate the mineral from the gangue and the other adapted to segregate the separated minerals one from the other, the first set of riffles being substantially evolute and the succeeding set being substantially involute, said sets of riffles slightly separated from each other by an unriffled space on the table which unriffled space extends wedge-shaped crosswise of the table, and means for vibrating the table.

7. A concentrator comprising a table whose surface is in the form of a spiral with one or more complete turns described about a vertical axis, the surface of said table having a set of spiral riffles extending from the inside of the table downwardly toward the outside, and a succeeding set of riffles drifting from the outside of the table toward the inner edge, and means for giving the spiral an oscillating motion about its axis.

8. A concentrator comprising a table whose surface is in the form of an inclined plane wrapped about a cylinder to form a surface having more than one complete turn described about the cylinder, the turns or decks of the table being spaced only slightly from each other and inclosed at the sides whereby the several turns of the table inclose a spiral sluice which is comparatively shallow in respect to its width whereby the water and material flowing through this sluice is brought in contact with the underside of an upper deck to effect the submergence of the float gold and values carried in suspension, spiral riffles in the table, and means for giving the spiral an oscillating motion about its axis.

9. A concentrator comprising a table whose surface is in the form of an inclined plane wrapped about a cylinder with a plurality of complete turns described about the cylinder, the turns or decks of the table being spaced only slightly from each other and inclosed at the sides whereby the several turns of the table inclose a spiral sluice which is comparatively shallow in respect to its width whereby the water and material flowing through this sluice is brought in contact with the underside of an upper deck to effect the submergence of the float gold and values carried in suspension, spiral riffles in the table, and means for giving the spiral an oscillating motion about its axis, said spiral riffles arranged in successive sets, one set of spiral riffles being substantially evolute and the other set being substantially involute.

10. A concentrator table comprising a spiral having one or more complete turns wound about the axis, means for giving the table an oscillating motion about its axis, said table having one edge higher than the opposite edge of the table, a duplex set of spiral riffles on the table, one set extending from one side of the table downwardly toward the other, the other set succeeding the first set and spaced therefrom and extending from the opposite side of the table downwardly toward the other side of the table, and said table having outer and inner rim flanges.

11. A concentrator table comprising a spiral having one or more complete turns wound about the axis, means for giving the table an oscillating motion about its axis, said table having one edge higher than the opposite edge of the table, a duplex set of spiral riffles on the table, one set extending from one side of the table downwardly toward the other, the other set succeeding the first set and spaced therefrom and extending from the opposite side of the table downwardly toward the other side of the table, said table having outer and inner rim flanges, the first set of said riffles tapering to nothing and terminating against the outer rim flange and the other set of riffles discharging over the inner edge of the table, and with means for collecting the segregated values thereof.

12. A concentrator table comprising a spiral having one or more complete turns wound about a vertical axis, means for giving the table an oscillating motion about its axis, said table having its inner edges at different elevations than the corresponding portions of its outer edge, spiral riffles on the table, said riffles extending in the direction of the length of the table, the table having outer and inner rim flanges, said table having adjacent to its lower end an outlet for the waste material through one flange separate from the outlet for the separated values, and means for raising or lowering the inner edge of the table to vary its transverse pitch.

13. A concentrating table whose surface

is in the form of a spiral having a plurality of complete turns of coils wound about a vertical axis, peripheral rims separating and supporting the outer edges of the coils of the table, inner rims to which the inner edges of the coils are connected, means for supporting the outer rims, means for raising and lowering the inner rims simultaneously to vary the transverse pitch of the table, and means for giving the table an oscillating motion about its axis.

14. A concentrating table whose surface is in the form of a spiral having a plurality of complete turns of coils wound about a vertical axis, peripheral rims separating and supporting the outer edges of the coils of the table, inner rims to which the inner edges of the coils are connected, means for supporting the outer rims, means for raising and lowering the inner rims simultaneously to vary the transverse pitch of the table, and means for giving the table an oscillating motion about its axis, said table having a surface provided with riffles, the upper ends of said riffles being at different distances from the axis of the table than the lower ends of the corresponding riffles.

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

JOSEPH W. PINDER.

Witnesses:
CHARLES A. PENFIELD,
W. E. STANFORD.