No. 666,603.

Patented Jan. 22, 1901.

H. H. CRAMER.

ORE CONCENTRATOR.

(Application filed May 2, 1899.)

(No Model.)

3 Sheets—Sheet 1.

FIG. 1.

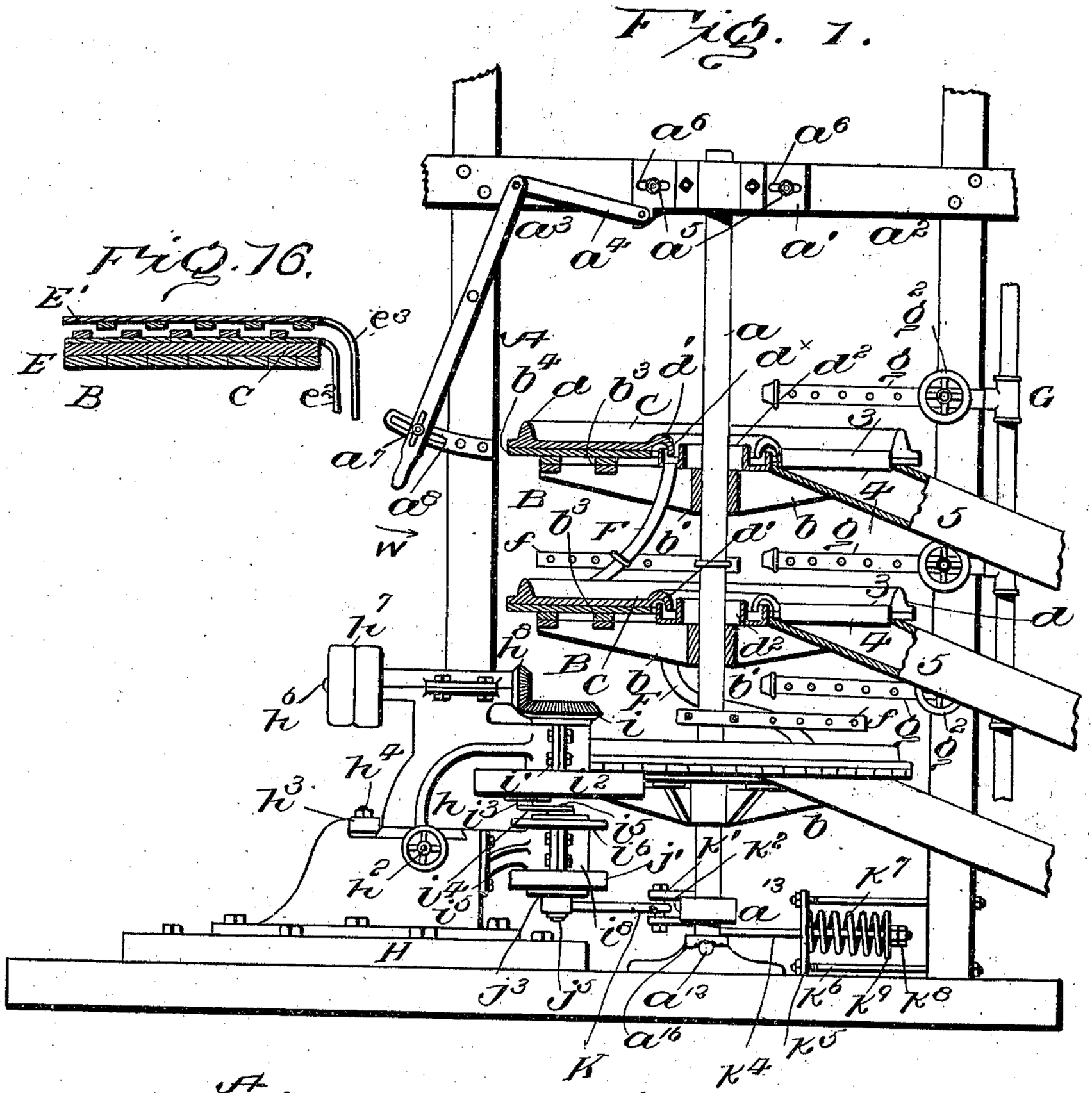
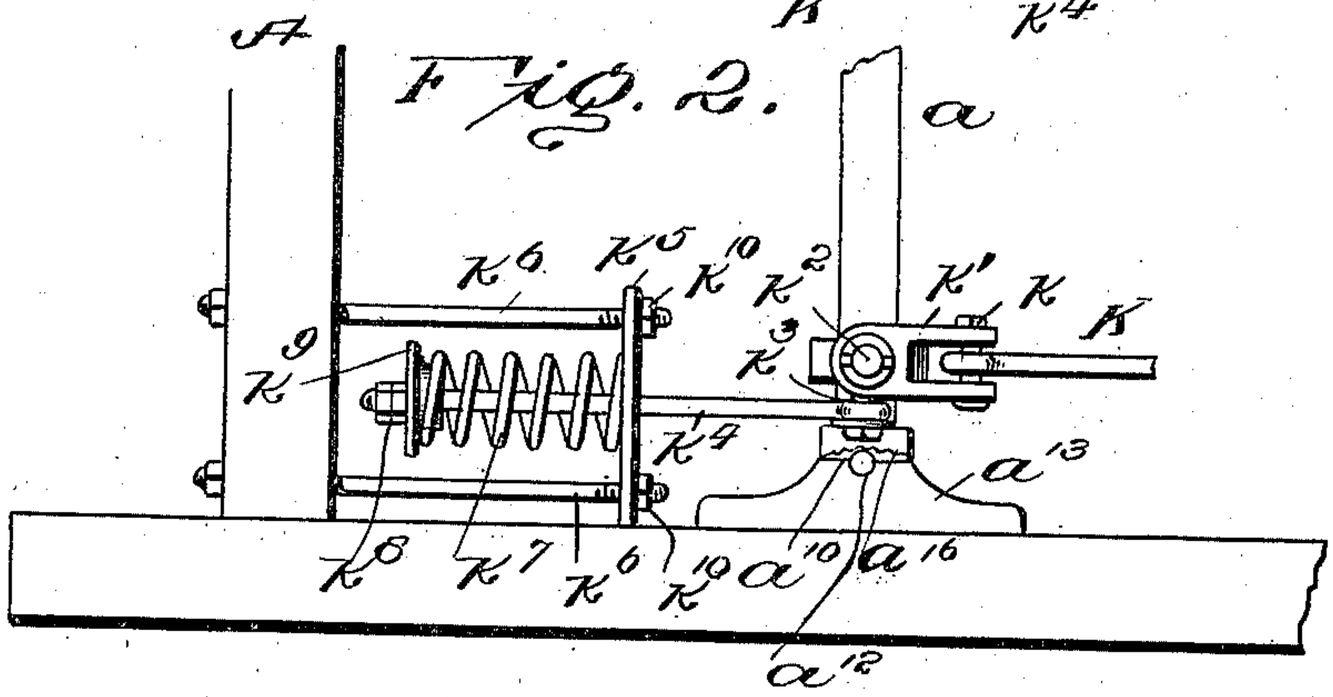


FIG. 76.

FIG. 2.



Witnesses
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Grafton L. Mueller.

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No. 666,603.

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3 Sheets—Sheet 2.

Fig. 3.

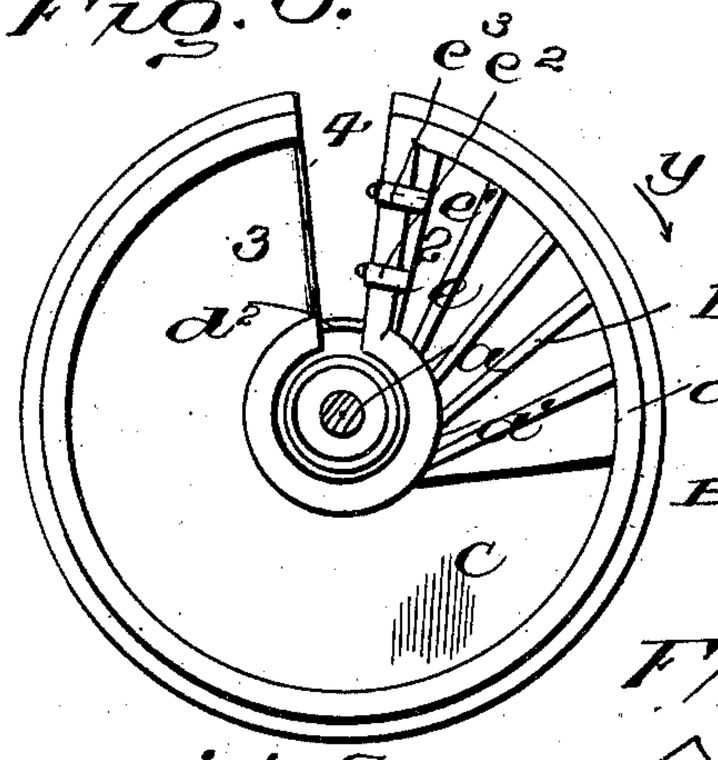

Fig. 4.

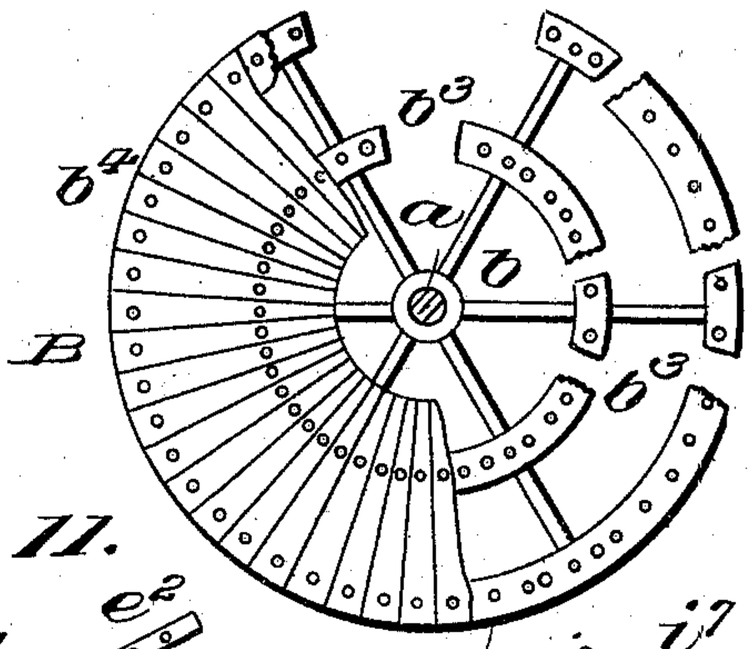

Fig. 11.

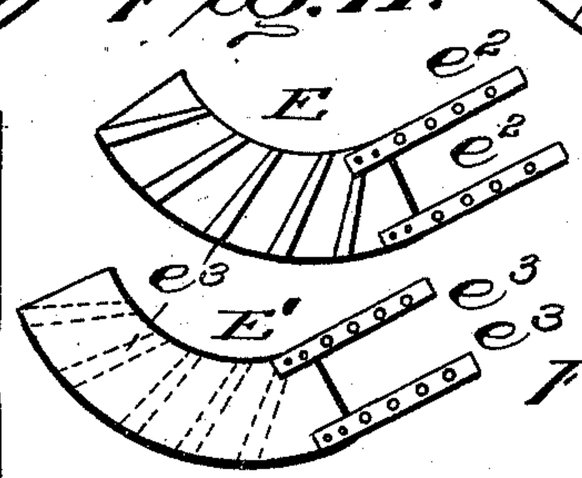

Fig. 7.

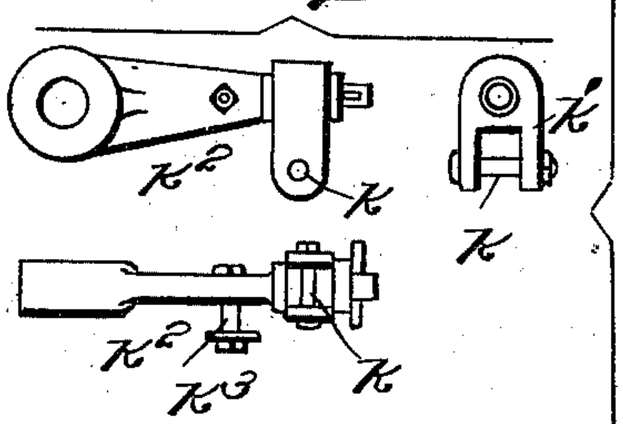

Fig. 8.

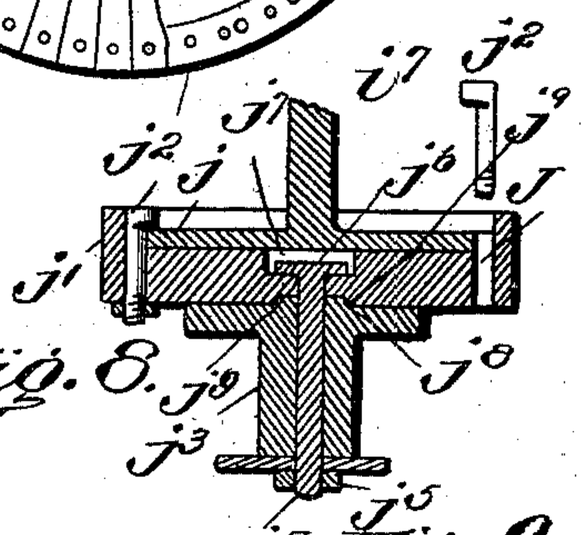

Fig. 14.

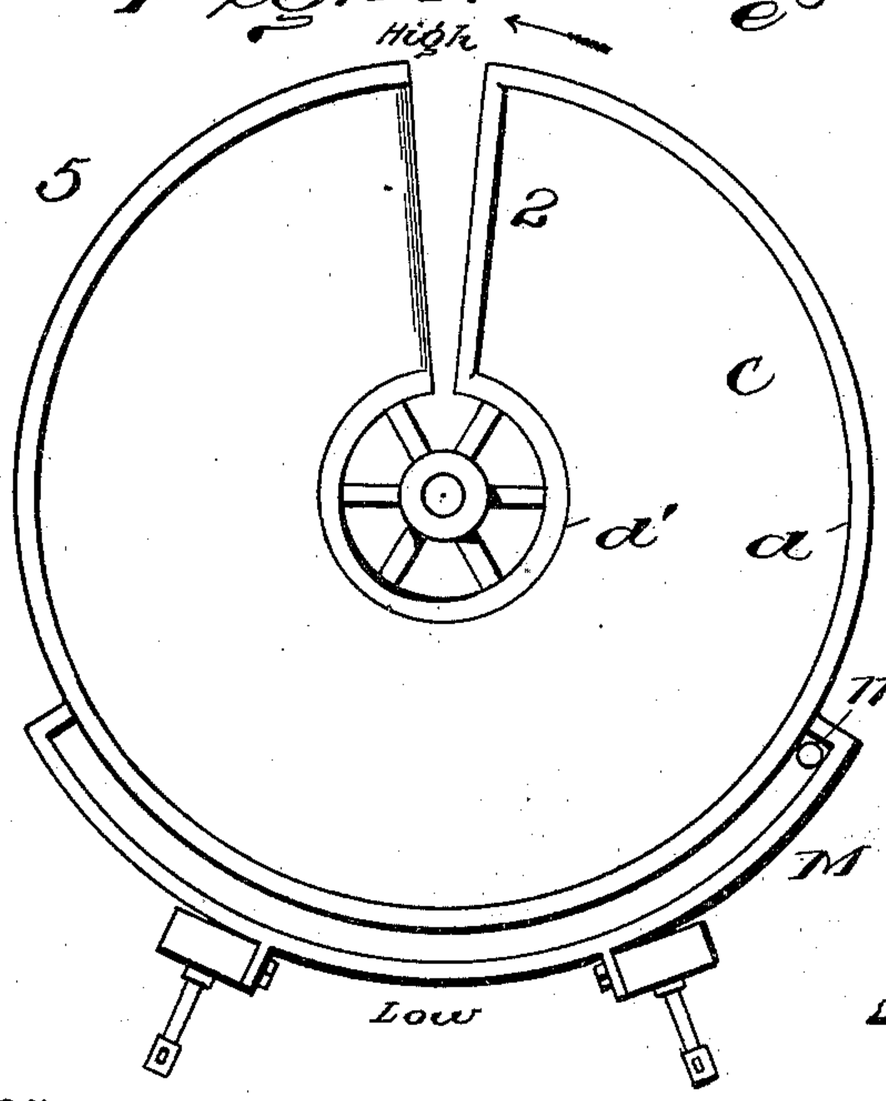

Fig. 15.

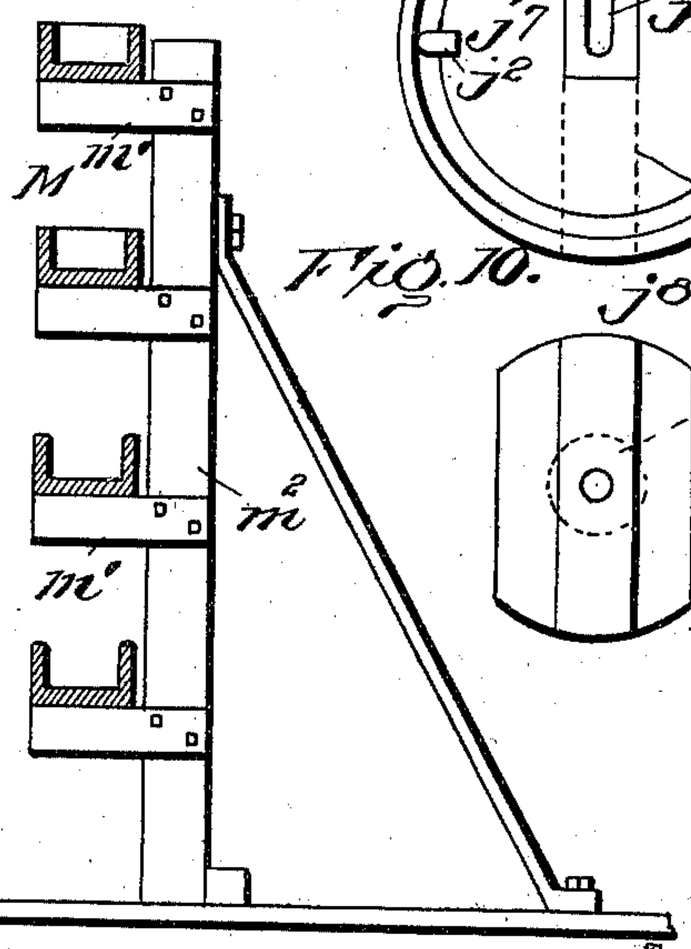

Fig. 9.

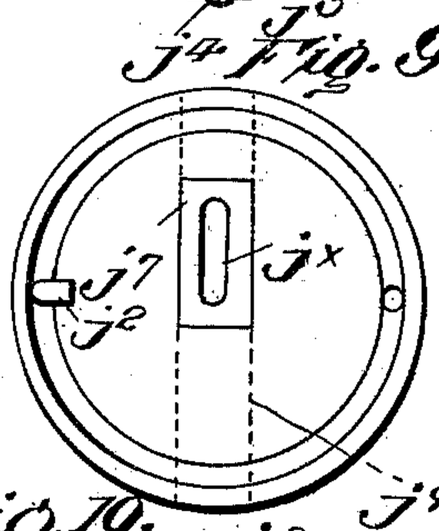

Fig. 10.

Witnesses

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ORE CONCENTRATOR.

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(No Model.)

3 Sheets—Sheet 3.

Fig. 12

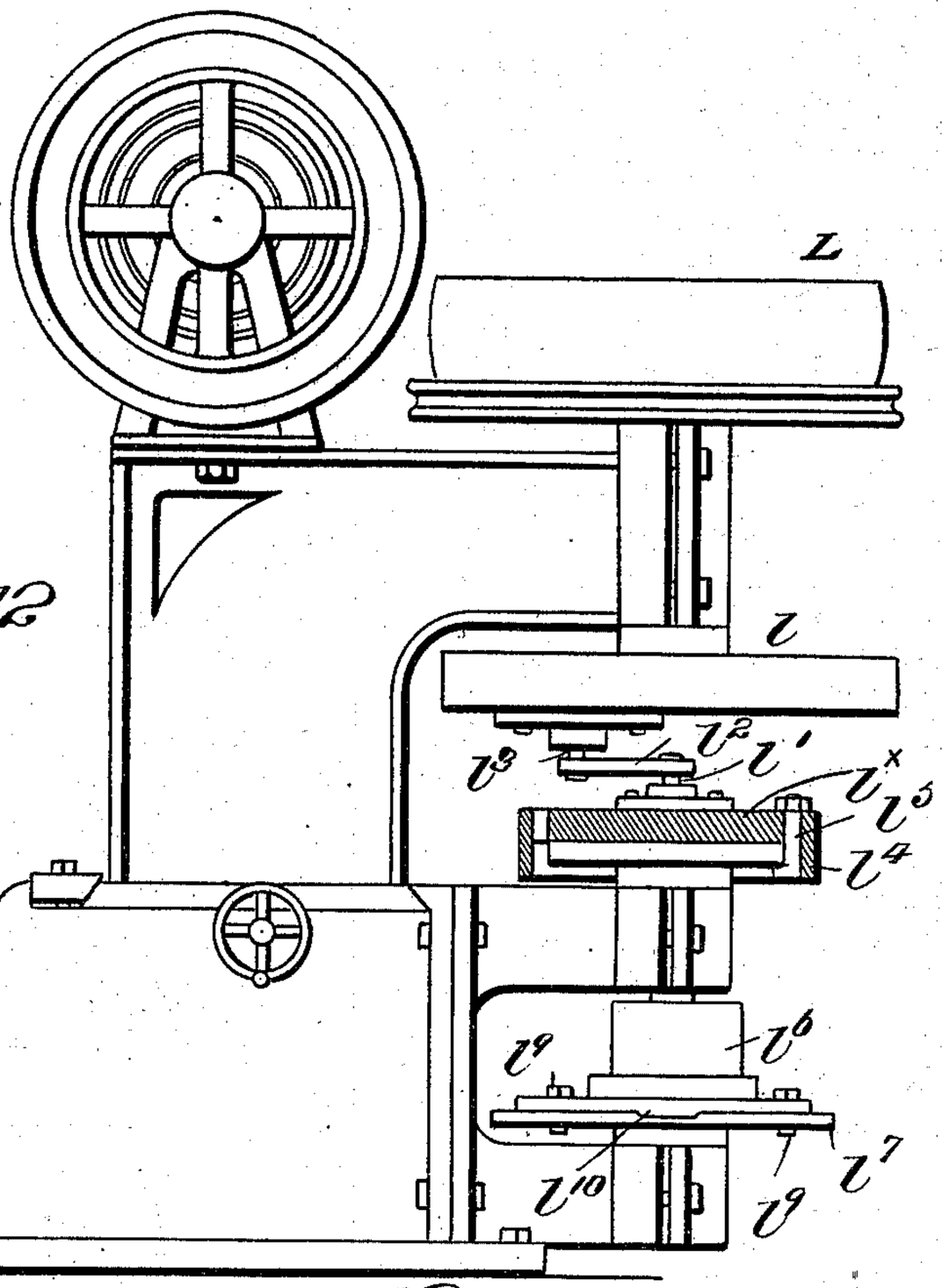


Fig. 13.

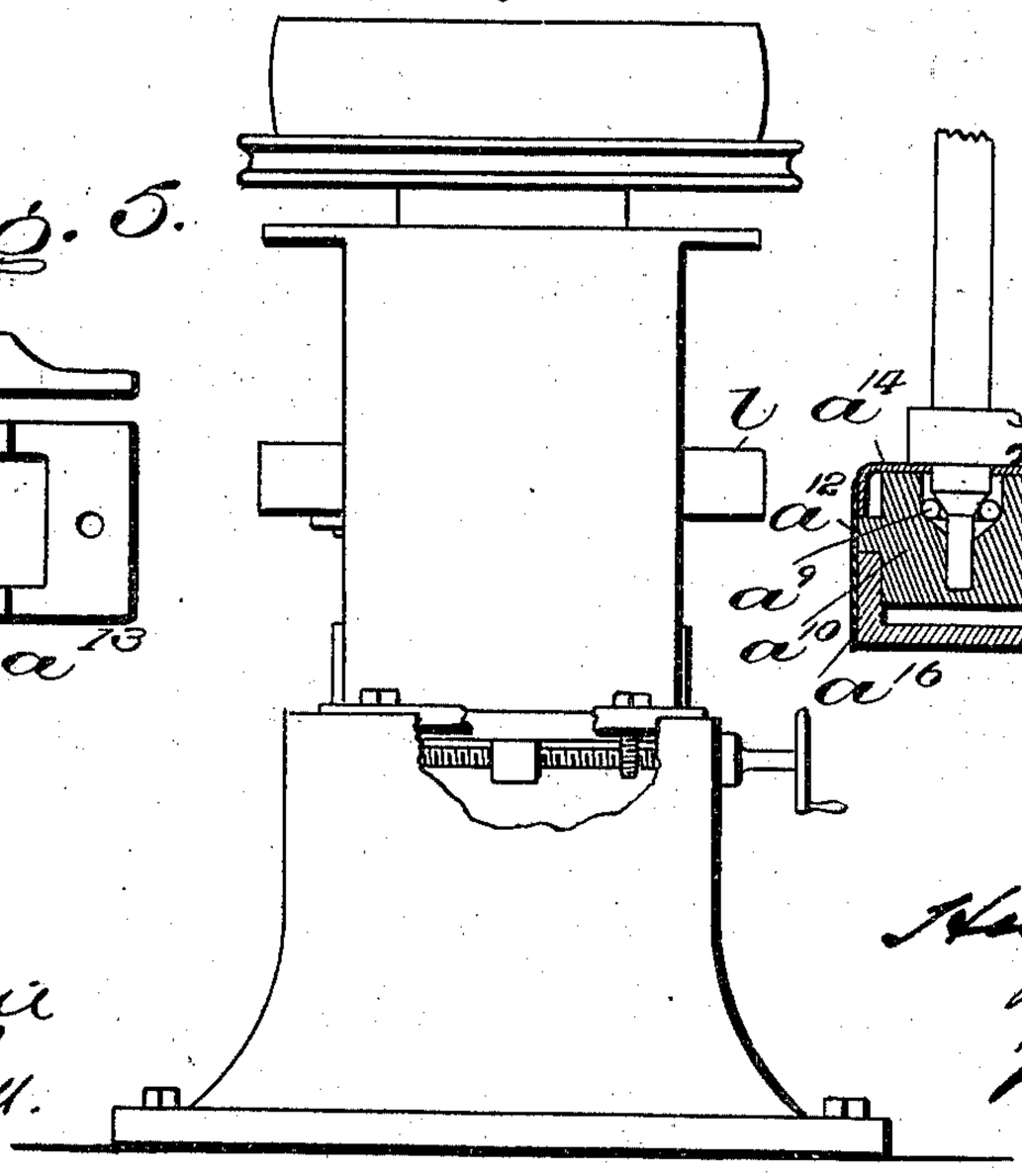


Fig. 5.

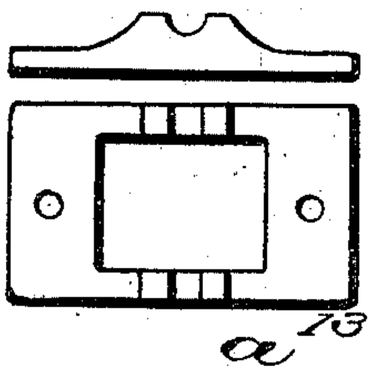
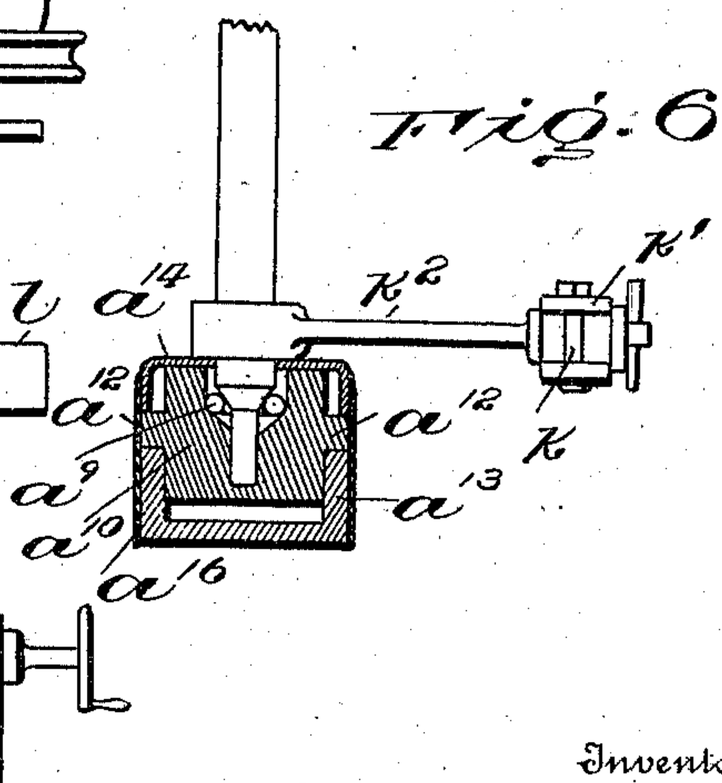


Fig. 6.



Witnesses

Jno. Donnie

G. L. Ducker.

Inventor

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UNITED STATES PATENT OFFICE.

HERBERT H. CRAMER, OF ASPEN, COLORADO.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 666,603, dated January 22, 1901.

Application filed May 2, 1899. Serial No. 715,338. (No model.)

To all whom it may concern:

Be it known that I, HERBERT H. CRAMER, of Aspen, in the county of Pitkin and State of Colorado, have invented certain new and useful Improvements in Ore-Concentrators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention contemplates certain new and useful improvements in ore-concentrators.

The objects of the invention are, first, to provide an improved form of concentrating-table capable of being set at any desired pitch; secondly, to insure the complete separation of all minerals having different specific gravity by centrifugal motion coupled with gravitation, and, thirdly, to provide driving mechanism capable of extensive adjustment for regulating the operation of the concentrating-tables.

The invention will be hereinafter fully set forth, and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a side elevation with parts of the framework omitted, two of the concentrating-tables being shown in cross-section. Fig. 2 is an enlarged detail view showing the connection between the driving mechanism and the table-shaft. Fig. 3 is a plan view of one of the tables. Fig. 4 is a similar view showing the framework of the table with parts omitted and other parts broken away. Fig. 5 shows in different views the bearing-plate for the table-shaft. Fig. 6 is a sectional view showing the boxing and bearing for the lower end of the shaft. Fig. 7 shows plan and side views and a detail of the shaft-arm to which the operating mechanism is connected. Fig. 8 is a vertical sectional view of part of the speed-regulating mechanism. Fig. 9 is a plan view of one of these parts. Fig. 10 is a similar view of another part. Fig. 11 shows two plan views and one edge view of the riffles. Fig. 12 shows a modification of the driving mechanism, the same being in side elevation. Fig. 13 is an end view thereof. Figs. 14 and 15 show a modified arrangement of the troughs for the tailings. Fig. 16 is a sectional view showing the riffles on one of the tables.

Referring to the drawings, A designates a main frame, a portion only of which is shown; a, a vertically-disposed shaft, and a' a boxing for the upper end of said shaft, said boxing being adjustable longitudinally on a cross-bar a^2 of frame A by means of a lever a^3 and a pitman a^4. The boxing is held by bolts a^5, passed through slots a^6 in each end. The lever may be held at any point by a set-screw a^7 working in a slotted curved bar a^8, projecting outwardly from the frame. By moving this lever in the direction of the arrow w the shaft a may be moved out of a perpendicular to the base of frame A and held at the desired pitch or inclination. At its lower end this shaft rests on ball-bearings a^9 within boxing a^{10}, said boxing having trunnions a^{12}, which fit in grooves of a base-plate a^{13}. A collar a^{14} on shaft a and a covering a^{16}, of canvas or the like, secured thereto surround the boxing, preventing mud, dirty water, and other substances from entering.

B designates a series of tables. I have shown but three, although any desired number may be employed. Each table is in circular form and being fixedly mounted upon shaft a may be set at any desired pitch by the adjustment of the position of the shaft. It is made up of a central hub b', keyed on the shaft, a series of spider-like arms b, to which straight or curved bars b^3 may be secured, and a series of tapered bars b^4, secured upon the bars b^3. Upon the bars b^4 is secured the cover C, which is formed at its outer edge with a raised concentric rib d, and around its central opening is a second concentric rib d', the latter being of hooked form—that is, it is formed with a lip $d^\times$. This lip overlaps the outer wall of a circular trough d^2, surrounding the shaft and secured to the hub b'. The rib d' is of less height than the outer rib d, so that even when the tables are set at a pitch the upper edge of rib d at the lower side of the table will be on a plane above the upper edge of the inner rib d'. These inner and outer ribs of the table-cover form a circular passage-way through which the ore is designed to travel—that is, in the reciprocating rotary motion imparted to the table the ore is caused to travel through this passage-way. The cover C may

be made of rubber or of lead or any other suitable material. Rubber is more lasting and better adapted for coarse material; but lead is preferable in some instances, since it has a greater affinity for slimes of great fineness. Each table has a segmental portion omitted to form an opening extending transversely through the passage-way and through both the inner and outer ribs. At the side 2 of this opening the ores are received—that is, deposited on the table—while at the other side 3 of this opening they are discharged free of the tailings. The inner and outer ribs *d* and *d'* are connected at the receiving end 2 by a transverse rib *e*. To the discharge end 3 is secured an apron 4, which extends into a launder 5, by which the concentrates are carried off. Adjacent the rib *e* are two buttons *e'* or other suitable devices, with which are designed to engage straps e^2 e^3 of riffles E E'. Each of these riffles is composed of flexible material, such as canvas or rubber, curved so as to fit between the ribs of the table-cover, and a series of transverse diagonally-arranged strips $e^\times$ of rubber, leather, or wood, those of the riffle E being faced upwardly and those of the riffle E' downwardly. The latter are located intermediate the strips of the riffle E. The riffle E' is shorter in length than the riffle E—that is, it does not extend to the rib *e*, leaving a portion of the lower riffle exposed at the receiving end of the table. The ore to be treated is thus placed on the riffle E, and through the variant rotary motion of the table such ores are caused to travel between the two riffles, the riffle-strips serving to force the ore toward the outer rib *d*. These riffle-strips are arranged tangentially—that is, with their inner ends closer together than their outer ends—so as to aid in forcing the ores in the direction stated. They extend around the table only a short distance—that is, they terminate at what in practice is the lower side of the table when the latter is pitched. The riffles are not always used together, as different ores require different treatment. For instance, when ore contains clay or talc and is gummy or sticky more washing is required to clean the mineral. In such case the two riffles will act advantageously if the ore is not too finely ground. In the concentrating of slimes, sometimes exceedingly fine, the lower riffle E should be removed, so that these minute particles may unite and become visible in the form of a bright streak on the table. The upper or inverted riffle causes the floating particles to be forced down without disturbing the bright streak, which if broken will result in thousands of these small particles floating away, especially if the disturbance is near where the waste is discharged.

From the circular trough d^2 of the several tables—that is, those above the lowermost table—extends a hose F, by which the tailings from one trough are conveyed to the next lower table, being emptied onto the latter between the two riffles. Each hose is held in proper position by being adjustably secured to an arm *f*, attached at its inner end to shaft *a*.

G designates a water-supply pipe having a series of lateral branches *g*, each provided with a valve g^2 and a series of perforations for supplying water for washing the tailings from the minerals on all the tables.

H designates a stationary bed-plate mounted on the base of frame A, and *h* a bracket adjustable on the bed-plate by means of a screw-rod h^2. The clamp-bar h^3, held by bolt h^4, will firmly hold this bracket at any point to which adjusted. Mounted in bearings in bracket *h* is a main operating-shaft h^6, having fast and loose pulleys h^7 and a beveled gear-pinion h^8, which meshes with a beveled gear-wheel *i*, fast on the upper end of a second operating-shaft mounted vertically in a boxing *i'* of bracket *h*, and upon the lower end of this shaft is a fly-wheel i^2, carrying a crank-pin i^3, on which is secured one end of a pitman i^4. The other end of this pitman is held to a crank-pin i^5, carried by a disk i^6 of a shaft i^7, fitted in a bearing i^8 of frame H. The shaft i^7 is on the same vertical line with the second operating-shaft. The disk i^6 is of considerably less diameter than the fly-wheel i^2. The shaft i^7 carries at its lower end a disk *j*, which fits within a counterbored recess of a circular head *j'*. The disks i^6 and *j* are preferably formed integral with shaft i^7. The head *j'* is adjustably secured to disk *j* by means of nutted bolts j^2 passed downwardly through vertical openings J in the head *j'*, adjacent the counterbore, said bolts having upper flanged heads which hug the disk *j*. These bolts are prevented from turning when the nuts are being tightened by their heads engaging the peripheral flange of the head. By loosening these bolts j^2 the head *j'* may be axially adjusted on the disk *j*. A crank-pin j^3 is adjustably secured to the under side of head *j'* by means of a bolt j^4 passed through a slot $j^\times$ in the head and centrally through the crank-pin, being held by a nut and washer j^5 on its lower end. This bolt has its head j^6 fitted within an oblong recess j^7 in the upper face of the head *j'*, and from the upper end of the crank-pin projects a rib j^8, which extends into a recess j^9 in the under side of head *j'*, said rib taking all strain on the crank-pin. By loosening the nut j^5 the crank-pin may be adjusted diametrically of the head *j'* and held at any desired point, and this, together with the adjustability of the head relative to the disk i^6, enables me to procure any desired adjustment, according to the length of the stroke it is desired to impart to the several concentrating-tables.

To the crank-pin j^3 is secured one end of a pitman K, the other end of which is in engagement with a bolt *k*, mounted in the prong end of a clip *k'*, loosely held on an arm k^2, extending at right angles from and carried by shaft *a*. To a pin k^3, depending from arm k^2,

is secured one end of a rod k^4, extended in opposite direction to the pitman K. This rod k^4 is passed through a plate k^5, held by horizontally-disposed bolts k^6, extended through one of the posts of frame A. A spring k^7 encircles this rod k^4 and is held thereon by a nut k^8 and a washer k^9, having a flange fitting in the spring. The tension of the spring is regulated by the nuts k^{10} on the ends of the bolts k^6, the spring bearing at one end against the plate k^5. The object of this special mechanism is to give to the several ore-tables a rotary motion which will be differential in its character—that is, it will cause the table to start slowly, the speed increasing until the end of the stroke is reached. Then the stroke is reversed suddenly, and the speed is gradually decreased on the return stroke. The spring-held rod k^4 assists in this motion being obtained. When the pitman K is moving in the direction to allow of the increase in the motion of the tables, the spring previously compressed during the slow motion is released and exerts a pulling action on the arm k^2. The fly-wheel i^2 and disk i^6 being of different diameters and connected by the pitman at certain points in the revolution of these disks, a fast and slow motion will be imparted to the shaft of the disk i^6, the speed of rotation of the horizontal and vertical operating-shafts remaining uniform. In this way there is no jar on the gearing between the two operating-shafts.

In Fig. 12 I have shown a slightly-modified form of driving mechanism. Instead of the gearing between the two operating-shafts I may employ a belt or rope pulley L, mounted on the upper end of the operating-shaft carrying the disk l. In this form I have shown the crank-pin l', which is connected by the pitman l^2 to the crank-pin l^3 of the disk l, as being secured to a head $l^\times$, which is adjustably connected to a disk l^4 by nutted bolts l^5, substantially after the form before described, the bolts, however, being inverted. Upon the shaft of the disk l^5 is mounted an eccentric l^6, which is adjustable on a disk l^7 by bolts l^9 and is provided with a rib l^{10}, which fits in a recess in the disk l^7, thereby placing the strain on said rib and removing it from the adjusting-bolts.

The operation is as follows: The tables are given the proper inclination by moving their shaft out of a truly-perpendicular line and holding it at the desired point by securing the lever a^3. At the same time or previously the driving mechanism is adjusted so as to secure the proper variant speed in the rotation or partial rotation of the several tables. Next the pulp or finely-crushed ore is fed onto the topmost table at the receiving end 2. If both riffles are used, the supply is placed upon the exposed end of the lower riffle E; but if only the upper riffle is employed the deposit is made directly on the table-cover at the receiving end. At the same time the proper amount of water is supplied to the several tables. The operating machinery being set in motion, the tables are first rotated in the direction of the arrow y, Fig. 3, causing the ore to gradually work around the circular table to the discharge end 3 and be discharged into the launders 5. The motion given the several tables is variant and irregular. In starting the tables are first moved slowly in the direction of the arrow y, the speed increasing until the end of the stroke is reached, when the direction of the rotation is reversed suddenly and a gradually-decreased speed is observed on the back or return stroke to the starting-point. The sudden stopping or, rather, the sudden reversing of the movement of the tables at the end of each forward stroke causes the heavy mineral to move toward the lower side of each table and also to pass tangentially toward the outer rib of each table. The three forces combined—to wit, the motion of the table, centrifugal force, and gravitation—cause the heavier particles of the ores to become separated from the tailings and settle to the bottom of the table, forming a bed of mineral at or near the outer rib at the lower side of each table. The tailings will flow over the inner rib into the circular trough d^2. That which passes into the trough of the topmost table is conveyed through the hose F to the next table below, to be again run over, if necessary, and so on to the lowermost table. If, however, the ore does not require a second working, the hose of each trough is extended into one of the launders. In this event each table is separately supplied with ore. The inner and outer ribs d and d' being proportioned as to their heights as before stated, when the tables are given the proper pitch or inclination the water will still cause the tailings to flow over the lip of the inner rib, while the minerals and all heavy particles will by the rotary motion imparted to the tables be carried around the latter to the raised side, where the water will wash the lighter particles back toward the lower side and the minerals will pass out through the discharge end 3 into the launder.

Instead of discharging the tailings at the center of each table they may be washed over the periphery of the table at the lowered side into a trough mounted independently of the table. In this arrangement the outer rib of the table need not be of greater height than the inner rib. In Fig. 14 I have shown a trough M, located adjacent to the periphery of the table, so as to receive the tailings. Each trough is curved throughout its length concentrically with the table and may be slightly inclined, so as to force the discharge to pass out at one end through a hose m. The troughs for the several tables are mounted on brackets m', secured to posts m^2.

If the riffles are not employed, each table is adjusted axially on the shaft a, so that the receiving end 2 will be moved around a short distance from the highest point, thus causing the ores to travel upward before moving to

the lowered side. This may be explained in connection with Fig. 14. Ordinarily the receiving end 2 is at the raised or higher side of the table. By turning the latter axially in the direction of the arrow, so as to locate the receiving end 2 at the point 5, the ores will in the reciprocal rotation of the tables travel upward and thence downward and again upward before being discharged.

The advantages of my invention are apparent to those skilled in the art. It will be observed that by giving to the circular tables an irregular reciprocating rotary motion—that is, a gradually-increasing motion—the heavy ores will be readily separated from the finer particles, which will be carried from the topmost table to a lower or a series of lower tables to be again worked, if necessary, while the heavier material is conveyed around each table and discharged into the several launders.

Changes may be made in the construction of the machine without departing from the scope of the invention.

I claim as my invention—

1. In an ore-concentrator, a table having a segmental opening, a circular passage extending nearly entirely around such table with a transverse opening between its ends over said segmental opening, and having inner and outer circularly-arranged ribs, means for tilting the table, a launder leading from beneath said openings in the table and passage-way, a trough concentric with the table in juxtaposition to one of its ribs, for receiving the tailings from the passage-way, and means for reciprocally rotating the table, substantially as set forth.

2. In an ore-concentrator, a table having a segmental opening therein, a circular passage-way extending nearly entirely around such table with a transverse opening between its ends over said segmental opening, and having inner and outer circularly-arranged ribs, riffles in a portion of said passage-way near one of its ends, a launder beneath the openings in the table and passage-way, means for tilting the table and means for reciprocally rotating the table, as set forth.

3. An ore-concentrator comprising a series of tables arranged one above the other, each table having a segmental opening and a circular passage-way extending nearly entirely around such table with a transverse opening between its ends over said segmental opening, and inner and outer ribs concentric with said passage-way, a series of circular troughs for the tailings concentric with and partly surrounded by said inner ribs, means for conveying the tailings from each trough to and on the passage-way of the next lower table, means for tilting the several tables and means for reciprocally rotating all of the tables in unison, as set forth.

4. An ore-concentrator comprising a series of tables arranged one above the other, a vertically-disposed shaft upon which all of said tables are mounted, means for setting said shaft in different positions, each of said tables having a segmental opening and a circular passage-way extending nearly entirely around such table with a transverse opening between its ends over said segmental opening, the launders located beneath the openings in the several tables and the openings in the passage-way, and means connected to said shaft for reciprocally rotating the latter and the several tables in unison, substantially as set forth.

5. An ore-concentrator comprising a vertically-disposed shaft, a table carried by such shaft having a segmental opening, a circular passage-way extending nearly entirely around such table with a transverse opening between its ends over said segmental opening, means for tilting the shaft, operating mechanism for imparting a reciprocating rotary motion to the shaft, and mechanism intermediate of said operating mechanism and shaft for varying the speed of said motion, substantially as set forth.

6. An ore-concentrator comprising a vertically-disposed shaft, a table carried by such shaft having a segmental opening, a circular passage-way extending nearly entirely around such table with a transverse opening between its ends over said segmental opening, means for tilting the shaft-operating mechanism for imparting a reciprocating rotary motion to the shaft, a differentially-operated shaft driven by, and intermediate of, said operating mechanism and the vertically-disposed shaft, and a spring-actuated rod connected to the said vertically-disposed shaft, substantially as and for the purpose set forth.

7. An ore-concentrator comprising a vertically-disposed shaft, a table carried by such shaft having a segmental opening, a circular passage-way extending nearly entirely around such table with a transverse opening between its ends over said segmental opening, means for tilting the shaft-operating mechanism, a differentially-operated shaft driven by, and intermediate of, said operating mechanism and vertically-disposed shaft, a rod connected to said latter shaft, a spring acting on said rod, and an adjustable bearing for such spring, substantially as set forth.

8. An ore-concentrator comprising a vertically-disposed shaft, a table carried by such shaft, a circular passage-way thereon having receiving and discharging points on opposite sides of an opening extended transversely through the passage-way, means for tilting said shaft-operating mechanism, a differentially-operated shaft driven by, and intermediate of, said operating mechanism, and vertically-disposed shaft, a rod connected to said latter shaft, a spring acting on such rod, a plate through which said rod extends and against which the spring bears, and bolts for holding such plate, substantially as set forth.

9. An ore-concentrator comprising a vertically-disposed shaft, a table carried by such shaft, a circular passage-way thereon having

receiving and discharging points on opposite sides of an opening extended transversely through the passage-way, operating mechanism, a differentially-operated shaft driven by said operating mechanism, a head axially adjustable on said latter shaft, a crank-pin diametrically adjustable on said head, an arm carried by said vertically-disposed shaft, a pitman connecting said crank-pin and arm, and a spring-actuated rod also connected to said arm, substantially as set forth.

10. An ore-concentrator comprising an upright shaft, a circular table carried thereby having receiving and discharging points, means for tilting the shaft, and mechanism connected to the shaft for imparting a reciprocating rotary motion thereto, and means for varying the speed of such motion comprising two rotary members of different diameters in axial line with each other, a connection between such members and a second connection between one of them and the table-shaft, and a spring-held rod also connected to said latter shaft, substantially as set forth.

11. The combination with the frame, of the vertically-disposed shaft, a table mounted on said shaft having a segmental opening, a circular passage-way extending nearly entirely around such table with a transverse opening between its ends over said segmental opening, a boxing for one end of said shaft, means for moving such boxing so as to tilt the shaft and its table, and means for reciprocally rotrating the said shaft and table, substantially as set forth.

12. The combination with the frame, of the upright shaft, a table mounted thereon having a circular passage-way with an opening extended therethrough, a boxing for one end of such shaft having slots therein, screws, extended through such slots, a lever connected to such boxing, and means for holding such lever, substantially as set forth.

13. The combination with the table having a circular passage-way for the ore, and means for operating the table, of riffles located in said passage-way at or near the receiving end thereof, and a flexible strip to which the riffles are secured, such strip being removably attached to the table, as set forth.

14. The combination with the table having a circular passage-way for the ore, and means for operating the table, of two sets of oppositely-faced riffles located in said passage-way at or near the receiving end thereof, a flexible strip for each set of riffles, and means for securing said strips to the table, as set forth.

15. The combination with the table having a circular passage-way for the ore, and means for operating the table, of two sets of oppositely-faced riffles located in said passage-way at or near the receiving end thereof, said riffles being arranged tangentially to the axis of the table, and means for removably securing the riffles to the table, as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

HERBERT H. CRAMER.

Witnesses:
G. F. ROYAL,
MILLEGE WOOD.