United States Circuit Court of Appeals
for the Ninth Circuit.

8

IN THE

DISTRICT COURT

OF THE

UNITED STATES

WITHIN AND FOR THE

DISTRICT OF ARIZONA

No. 12. IN EQUITY.

THE MINE AND SMELTER SUPPLY COMPANY, a Corporation,
Complainant.

vs.

ARIZONA COPPER COMPANY, a Corporation,
Defendant.

BOOK OF COMPLAINANT'S PAPER EXHIBITS, DRAWINGS AND PHOTOGRAPHS

FREDERICK S. NAVE,
Solicitor for Complainant.
Globe, Arizona.

GEORGE L. HODGES,
D. EDGAR WILSON,
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FILED
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Court of Appeals
827

IN THE

DISTRICT COURT

OF THE

UNITED STATES

WITHIN AND FOR THE

DISTRICT OF ARIZONA

THE MINE AND SMELTER SUPPLY COMPANY, a Corporation, *Complainant,* vs. ARIZONA COPPER COMPANY, a Corporation, *Defendant.*	No. 12. In Equity.

PAPER EXHIBITS, DRAWINGS AND PHOTOGRAPHS INTRODUCED IN EVIDENCE ON BEHALF OF COMPLAINANT.

Appearances:

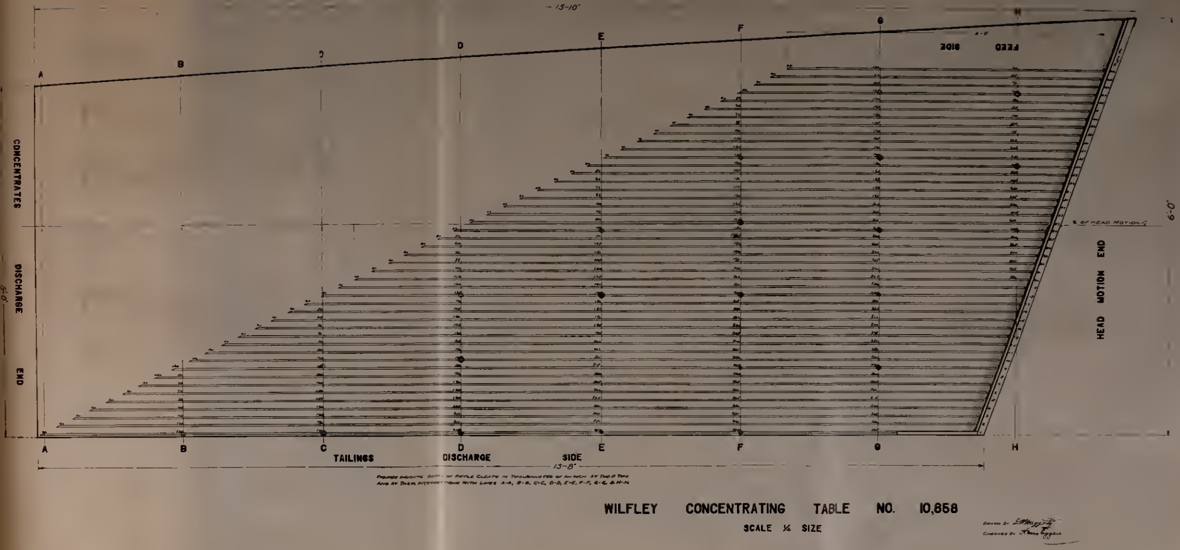
FREDERICK S. NAVE,
GEORGE L. HODGES, and
D. EDGAR WILSON,
For Complainant.

W. K. FLORA,
E. E. ELLENWOOD,
ROBERT S. TAYLOR, and
ELWIN M. HULSE,
For Defendant.

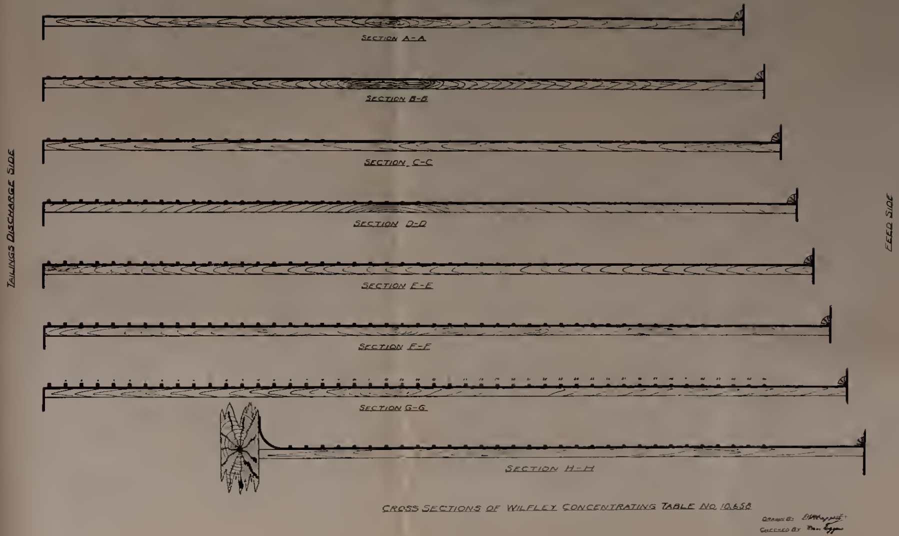
INDEX

COMPLAINANT'S PHYSICAL EXHIBITS.

Complainant's Exhibit No. 1. Blue Print Wilfley Concentrating Table Deck No. 10,658.
Almon E. Hart, Special Examiner.



Complainant's Exhibit No. 2. Cross-Sections Wilfley Concentrating Table No. 10,658.
Almon E. Hart, Special Examiner.



COMPLAINANTS' EXHIBIT No. 4
Wilfley Patent in Suit
ALMON E. HART, Special Examiner

(No Model.) 2 Sheets—Sheet 1.

A. R. WILFLEY.
ORE CONCENTRATOR.

No. 590,675 Patented Sept. 28, 1897.

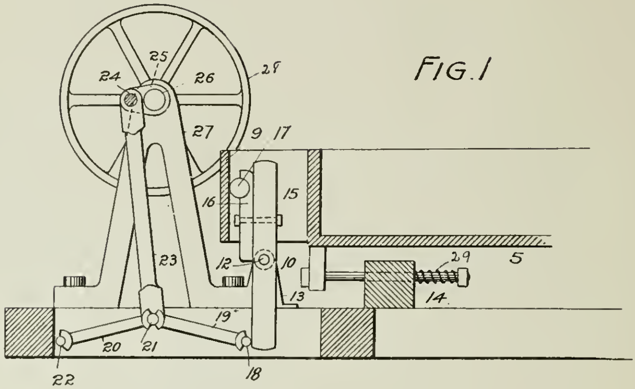


FIG. 1

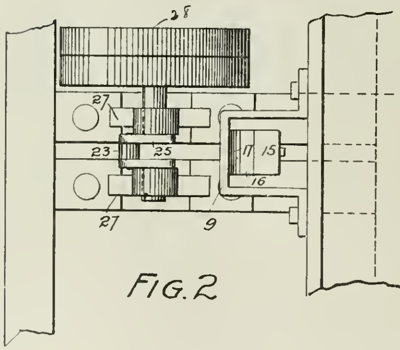


FIG. 2

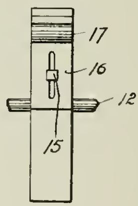


FIG. 6.

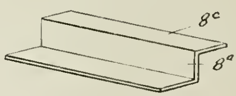


FIG. 7

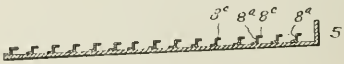


FIG. 5

Witnesses
G. J. Rollandet
Edith Farnsworth

Inventor:
A R Wilfley
By his Attorney

(No Model.) 2 Sheets—Sheet 2.

A. R. WILFLEY.

ORE CONCENTRATOR.

No. 590,675. Patented Sept. 28, 1897.

FIG. 3.

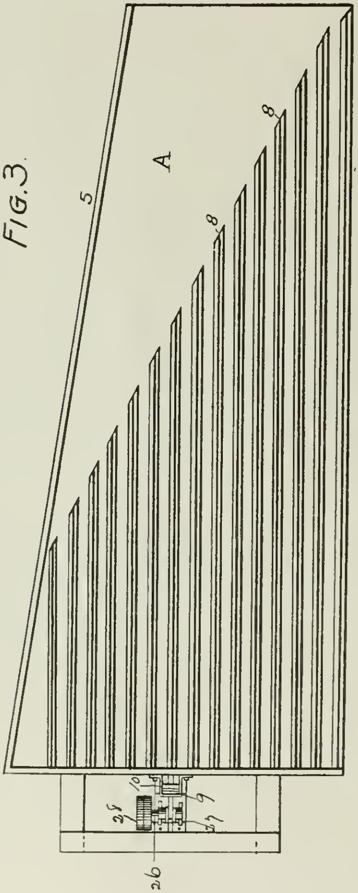
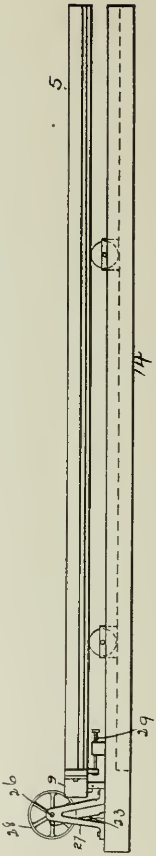


FIG. 4.



Witnesses
E. J. Mellander
Edith Hinsworth.

Inventor
A. R. Wilfley
By his Attorney H. J. O'Brien

UNITED STATES PATENT OFFICE.

ARTHUR R. WILFLEY, OF DENVER, COLORADO.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 590,675, dated September 28, 1897.

Application filed March 16, 1897. Serial No. 627,798. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR R. WILFLEY, a citizen of the United States of America, residing at Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Ore-Concentrators; and I do 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, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in ore-concentrators; and it consists of the features hereinafter described and claimed, all of which will be fully understood by reference to the accompanying drawings, in which is illustrated an embodiment thereof.

In the drawings, Figure 1 is a side elevation of the apparatus, partly in section. Fig. 2 is a top or plan view of the same. Fig. 3 is a plan view of the table. Fig. 4 is a side elevation of the same. Fig. 5 is a cross-section of the table. Fig. 6 is a detail view of a lever forming a part of the operating mechanism. Fig. 7 is a perspective view of one of the riffles detached.

Similar reference-characters indicate corresponding parts in the views.

Let the numeral 5 designate the table, provided with longitudinal riffles 8, attached to its upper surface These riffles are of unequal length and angular in cross-section. The vertical or upwardly-projecting part of the riffle is designated by the reference-character 8^a, and the upper part, which lies parallel with the bed of the table, is designated by the reference-character 8^c. The table tapers from the head toward the foot, where it is narrowest. It is transversely inclined, (see Fig. 5,) the gangue being discharged at its lower edge and the mineral at the tail thereof. The riffles increase in length from the upper edge of the table downward, where they are longest. The lowermost riffle extends nearly the full length of the table.

To the left of the riffle extremities (see Fig. 3) there is a triangular portion A of the table, which is smooth or free from riffles. The function of this smooth or unriffled portion of the table will be hereinafter described.

The table has a longitudinal reciprocating movement and is supported on rollers 7, mounted on a suitable stationary support.

The mechanism for actuating the table will now be described.

The extremity of the table farthest to the left (see Figs. 1 to 4 of the drawings) will for convenience of description in this specification be termed the "head," while the opposite extremity is termed the "tail" of the table.

To the head end of the table is attached a keeper 9, which is engaged by one extremity of a vertical lever 10, fulcrumed at 12 on a support 13, mounted on the stationary frame 14. The upper arm of the lever 10 is slotted (see Fig. 6) to receive a bolt 15, which holds a block 16 in place on the lever. This block carries an antifrictional roller 17, which engages the outer wall of the keeper 9. The block 16 is adjustable for the purpose of changing the bearing-point on the keeper and thereby regulating the length of the table's stroke.

The lower arm of the lever 10 is provided with a bearing 18, which is engaged by one extremity of a link 19. This link is connected at 21 with a link 20, forming a toggle-joint. One extremity of the link 20 engages a bar 22, attached to the stationary frame. The pin 21 connecting the two toggle parts also passes through one extremity of a pitman 23, whose opposite extremity is connected with a wrist 24 on a crank 25, carried by a shaft 26, journaled in an upright support 27, mounted on the stationary frame 14. The shaft 26 is provided with a pulley 28, which may be connected with any suitable motor for operating the mechanism. The outer extremities of the toggle are open, being simply recessed or forked to engage the bearings 18 and 22, respectively. Hence as the shaft 26 is rotated the toggles only impart the backward movement to the table or move it toward the left. (See Fig. 3.) The forward or reverse movement is effected or imparted by the recoil of a spring 29, which is compressed or placed under tension by the table during its backward movement.

In the operation of the machine the material to be treated is discharged in the form of pulp upon the upper left-hand corner of the table. (See Fig. 1.) The gangue passes transversely downward over the angular longitudinal riffles and is discharged over the lower edge of the table, which, as before stated, is transversely inclined.

All the mineral, together with a portion of the gangue, is first caught by the riffles, and under the influence of the table's motion is carried longitudinally toward the foot of the table until it reaches the smoother unriffled portion A of the table, where it is acted on by the water, which effects a perfect or approximately perfect separation of the gangue from the mineral. As the material caught by the uppermost and shortest riffle passes to the portion A of the table the action of the water, which is fed to the upper edge of the tables, carries the gangue downward to the next riffle, while the mineral remains on the smooth portion A and is carried toward the tail of the table, where it is finally discharged. It is expected that some of the mineral caught by the uppermost and shortest riffle will be carried downward with the gangue to the next riffle, which is longer. After leaving this last-named riffle and passing to the smooth or unriffled portion of the table the water again acts on the material and carries the gangue downward to the next riffle, leaving the clean mineral on the smooth portion A of the table. If any mineral escapes with the gangue the second time, it will be caught by the riffle next below and again subjected to the separating action of the water as soon as it reaches the smooth portion A of the table. In this manner the material is carried transversely downward and longitudinally forward, the gangue being discharged at the lower edge of the table completely impoverished of its mineral values, while the latter are discharged at the foot or tail of the table. A portion of the gangue—that is to say, the lighter part thereof—passes over each riffle in succession from the shortest or uppermost to the longest or lowermost riffle. The mineral and the heavier gangue are caught by the riffles and finally separated on the smooth portion A of the table. This combination, in a concentrating-table, of riffles of varying length for catching the mineral and a smooth, plain, or unriffled portion at the extremities of the riffles, where the final separation is effected through the action of the water, is believed to be entirely new in an apparatus of this class.

A riffle is the best means of catching mineral, while a smooth, plain, or unriffled surface is the best for effecting the separation of the mineral from the gangue caught with the mineral by the riffles, the separation being effected by the action of water.

While I prefer to employ the angular riffle shown and described in this application, I do not limit the invention to any special construction of riffle.

The function of the angular riffles will now be described in detail.

The part 5^3 of the riffles would be sufficient alone to catch the larger and heavier particles of mineral, but some of the more minute particles would be forced over the riffles and carried downward with the gangue and perhaps finally lost were it not for the part 5^4 of the riffles, which checks this tendency and allows specific gravity to prevail, the same as in hand-panning. It is well known that the finest particles of mineral can be saved by hand-panning. The specific gravity of the finest particle of gold is, of course, the same as the largest nugget, and if the proper conditions exist the minute particle can be saved as well as the nugget. The object of my angular riffles is to produce the conditions necessary to save not only the largest but also the finest mineral particles. Under ordinary conditions these fine particles when acted on by a current of water are carried along with the water, and consequently lost with the gangue. The upper part 5^4 of my riffle checks the tendency of these light particles to pass over the riffles with the water. Hence they are confined by the bed of the table below the part 5^3 of the riffles above, while the part 5^4 of the riffles checks their downward movement. Hence under the influence of the table's movement or vibration the mineral particles, both fine and coarse, are caught by the riffles.

It will be observed by an inspection of my operating mechanism that the length of the table's stroke may be regulated without changing, altering, or interfering with the quality of the movement imparted by the toggle.

With other toggle movements as applied to this class of machines the length of stroke is regulated by changing the point where the lower extremity of the connecting-rod or pitman is attached to the toggle. This is equivalent to changing the length of the pitman and of course not only changes the length of the table's stroke, but also the quality of the movement. For instance, if the pitman be made shorter the point where the toggle-links are connected must move farther upward, but not so far downward, and vice versa. In other words, by changing the length of the pitman (or changing the point where it is attached to the toggle, which is the same thing) the angle of the links becomes greater when the table has reached its limit of movement in one direction and less when the table has reached its limit of movement in the opposite direction. Hence in such constructions the speed of the table at a given point in its stroke varies as the length of the stroke is changed.

Having thus described my invention, what I claim is—

1. A transversely-inclined concentrating-table having a movement whose tendency is to carry the material longitudinally forward

toward the tail or foot of the table, said table being provided with a number of riffles extending longitudinally a portion of the distance from its head toward its foot, said riffles varying in length for the purpose specified, the table having a smooth, plain, or unriffled portion extending from the extremities of the riffles toward the tail of the table, whereby the material as it leaves the riffles is subjected to the action of the water on the smooth portion of the table and the final separation of the mineral from the gangue effected.

2. A transversely-inclined concentrating-table having a number of longitudinal riffles extending a portion of the table's length from the head toward the foot, said riffles being of unequal length, the uppermost being the shortest while the other riffles increase in length from the upper edge to the lower edge of the table, the table having a plain or unriffled portion lying at the extremities of the riffles and adapted to receive the material caught by the riffles.

3. The combination of a transversely-inclined concentrating-table having a number of longitudinal riffles of unequal length extending from the head toward the tail of the table, said riffles increasing in length from the upper toward the lower edge of the table, said table being provided with a plain or unriffled portion at the extremities of the riffles, and means for imparting to the table a longitudinally-reciprocating movement comprising a toggle, an operating-pitman, and a lever, one link of the toggle engaging one arm of the lever, while the other arm of the lever is connected with the head of the table.

4. The combination of a transversely-inclined concentrating-table having a number of longitudinal riffles extending from the head toward the foot of the table, the table being provided with a plain or unriffled portion located at the extremities of the riffles, and means for imparting to the table a longitudinal reciprocating movement comprising a toggle-joint, an operating-pitman and a lever, one link of the toggle engaging one arm of the lever, while the other arm of the lever is connected with the table and provided with an adjustable roller adapted to engage a keeper carried by the table.

5. The combination of a transversely-inclined concentrating-table having a series of longitudinal riffles extending from the head toward the foot of the table, the table being provided with a plain or unriffled portion extending from the riffle extremities to the foot of the table, and means for imparting to the table a longitudinally-reciprocating movement, said means comprising a toggle-joint, an operating-pitman and a lever, one link of the toggle engaging one arm of the lever, while the other arm of the lever is connected with the table and provided with an adjustable roller, said roller being mounted on a block adjustably attached to the lever.

6. The combination of a transversely-inclined concentrating-table having a number of longitudinal riffles extending from the head toward the tail of the table, the table being provided with a plain or unriffled portion located at the extremities of the riffles, and means for imparting to the table a longitudinally-reciprocating movement comprising a toggle-joint, an operating-pitman, and a lever, one link of the toggle engaging one arm of the lever, while the other arm of the lever is connected with the table and provided with a vertical slot, and a block held in place by a bolt passing through the slot and carrying an antifrictional roller engaging a keeper on the table.

7. The combination of a transversely-inclined concentrating-table having a series of riffles extending longitudinally from the head toward the tail of the table, said riffles being of unequal length, the uppermost being the shortest and the riffles increasing in length from the upper to the lower edge of the table, the table being provided with a plain or unriffled portion of suitable area located at the extremities of the riffles, means for feeding the material to the upper portion of the table's head, means for discharging water on the upper edge of the table, and suitable means for imparting to the table a longitudinally-reciprocating movement of a character adapted to move the material from the head toward the tail of the table.

In testimony whereof I affix my signature in presence of two witnesses.

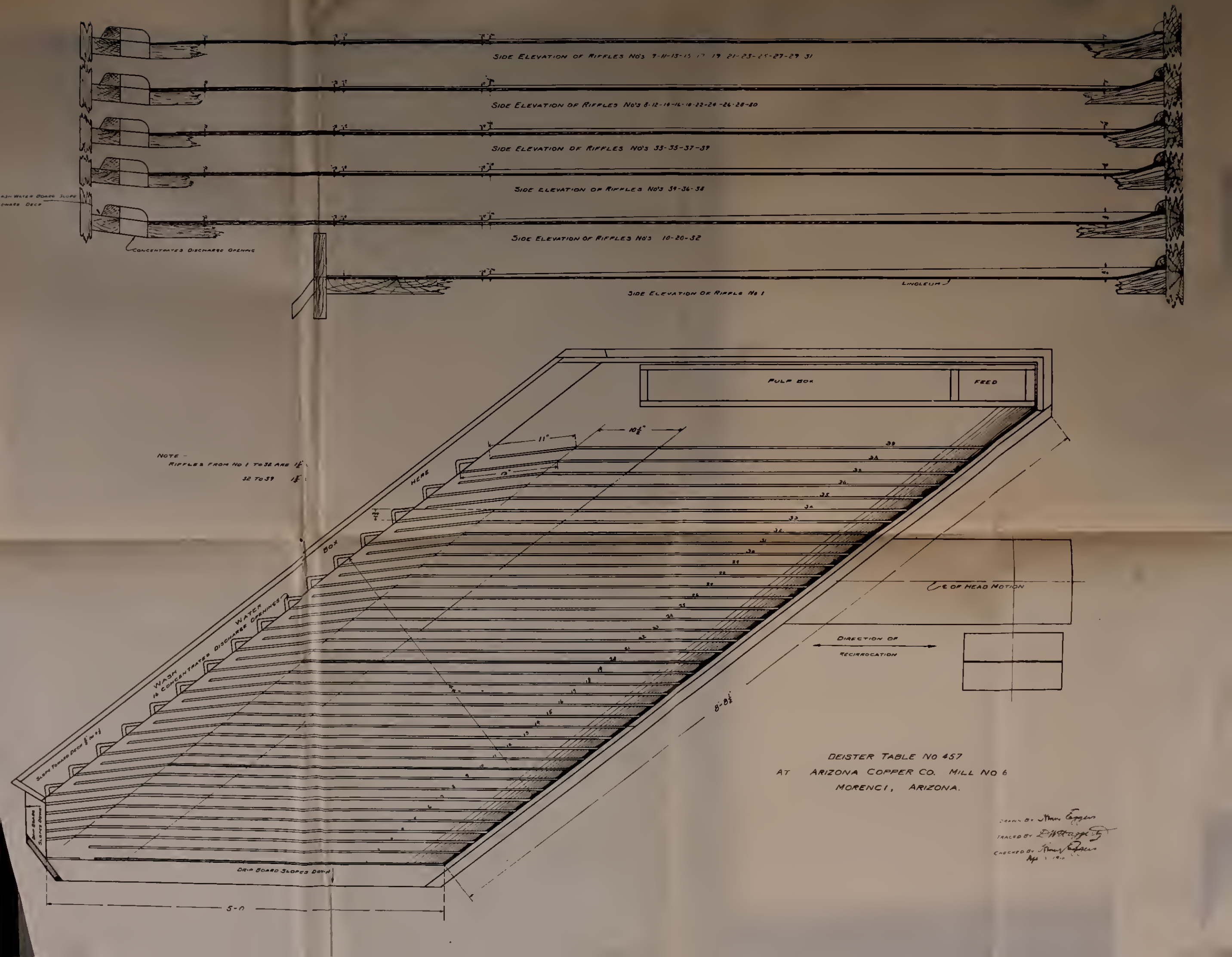
ARTHUR R. WILFLEY.

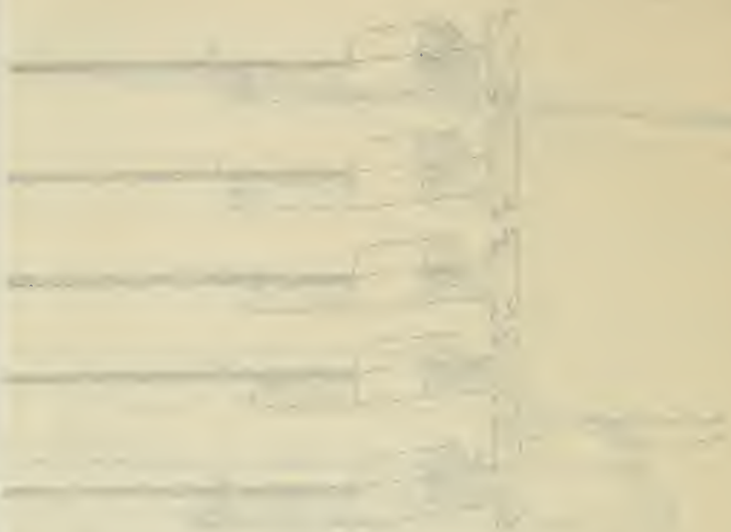
Witnesses:

ALFRED J. O'BRIEN.
G. J. ROLLANDET.

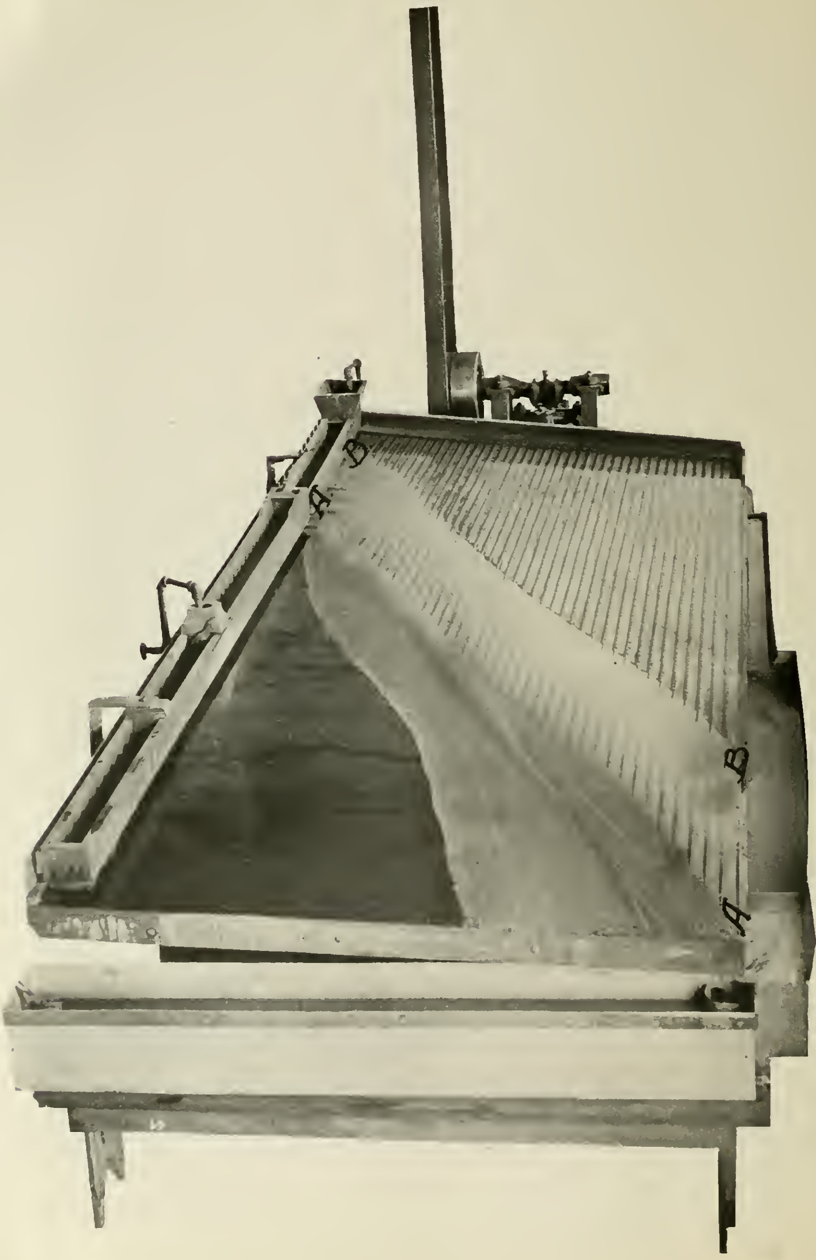
Complainant's Exhibit No. — Drawing Deister Table No. 2 Arizona Copper Co. Mill No. 6, Morenci, Arizona.

Almon E. Hart, Special Examiner.





Complainant's Exhibit No. 8. Photograph Wilfley Table in Operation.
Almon E. Hart, Special Examiner.



COMPLAINANTS' EXHIBIT No. 9
S. I. Hallett Patent No. 609,804
ALMON E. HART, Special Examiner

No. 609,804. Patented Aug. 30, 1898.

S. I. HALLETT.

ORE CONCENTRATOR.

(Application filed Sept. 16, 1897.)

(No Model.) 2 Sheets—Sheet I.

Fig. 1.

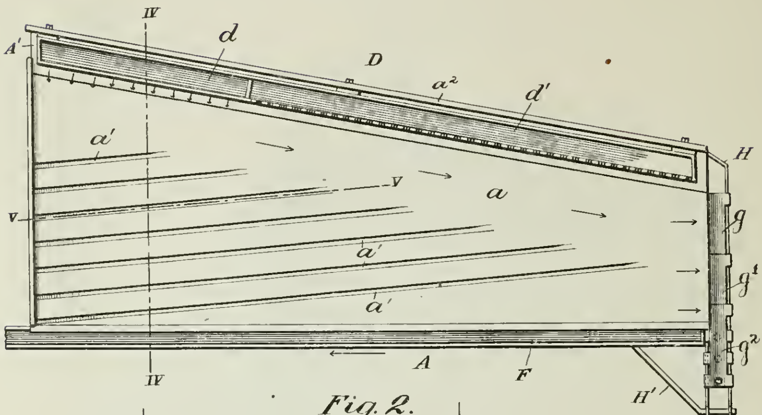


Fig. 2.

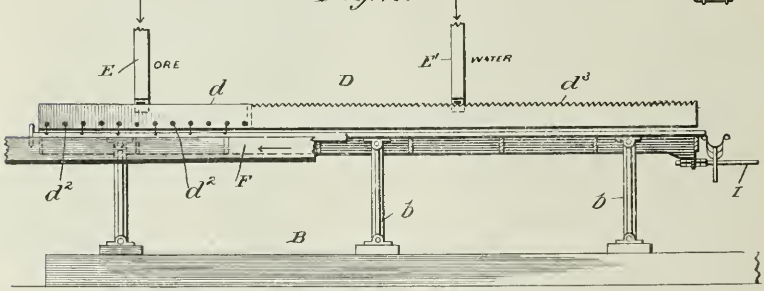
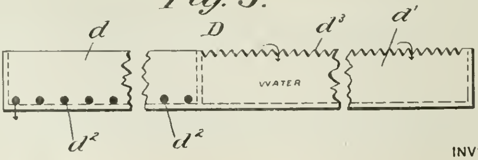


Fig. 3.



WITNESSES

Chas. E. Riordon

Wm. B. Dowell.

INVENTOR

Samuel I. Hallett

By Julian C. Dowell

His Atty

No. 609,804. Patented Aug. 30, 1898.

S. I. HALLETT.

ORE CONCENTRATOR.

(Application filed Sept. 16, 1897.)

(No Model.) 2 Sheets—Sheet 2

Fig. 4.

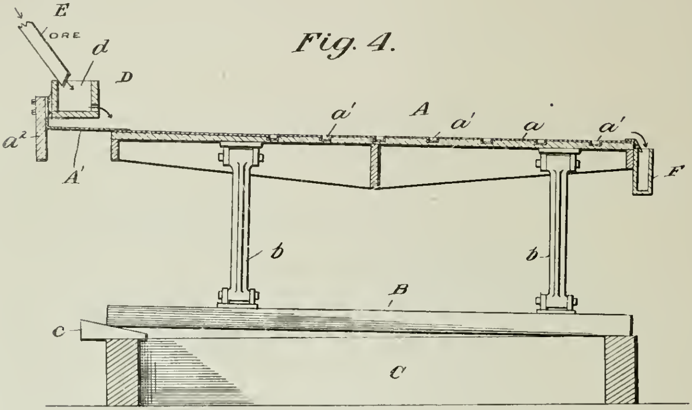


Fig. 5.

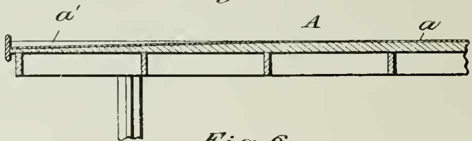


Fig. 6.

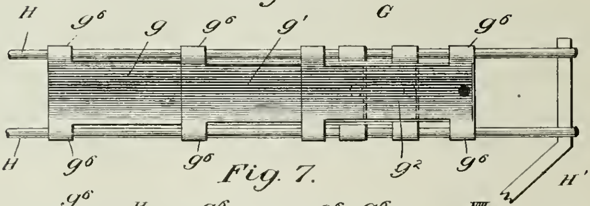


Fig. 7.

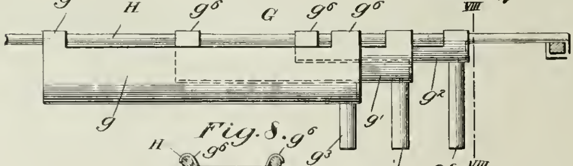
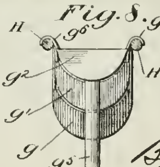


Fig. 8.



Witnesses.
Chas. E. Riordan
Wm. B. Crowell.

Inventor.
Samuel I. Hallett
By Julian C. Dowell
His Attorney.

UNITED STATES PATENT OFFICE.

SAMUEL IRVING HALLETT, OF ASPEN, COLORADO, ASSIGNOR OF ONE-HALF TO DAVID M. HYMAN, OF CINCINNATI, OHIO.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 609,604, dated August 30, 1898.

Application filed September 16, 1897. Serial No. 651,877. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL IRVING HALLETT, a citizen of the United States, residing at 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.

My invention relates to ore-concentrators or that class of machines or apparatus employed for concentrating or separating and grading mineral substances of different specific gravities, and more particularly to apparatus operating to carry out the wet process of concentrating ores, whereby ores of various kinds may be washed and concentrated and the valuable minerals separated and graded with economy of time and labor.

The invention is especially designed for use in connection with ore-concentrators of that class in which the crushed ore is distributed upon and caused to move or flow along a plane surface or table, to which is imparted a combination of shaking and rocking motions whereby the concentrates or particles of mineral settling on the surface of the table are carried along and discharged in different classes or grades at one end or side of the table, while the gangue and refuse matter are carried off at the side or end of the table opposite the distributing-launder.

The primary objects of my invention are to provide simple, inexpensive, and efficient means for separating the ore and for collecting the same in different grades or classes, so that in treating ores containing minerals of different specific gravities the different minerals may be separated and collected in their respective classes or grades.

The invention will first be hereinafter more particularly described with reference to the accompanying drawings, which form a part of this specification, and then pointed out in the claims at the end of the description.

Referring to the drawings, Figure 1 represents a top or plan view of an ore-concentrating table and its attachments embodying my invention. Fig. 2 is a side elevation of the same with parts broken away to show the construction of parts which would otherwise be concealed from view by the broken-away portions. Fig. 3 is a detail front view of the distributing-launder. Fig. 4 is a vertical transverse section taken on the line IV IV of Fig. 1. Fig. 5 is a detail sectional view through a portion of the table, the section being taken on the line V V of Fig. 1. Fig. 6 is a top or plan view, Fig. 7 a side elevation, and Fig. 8 an end view, of the sectional launder or trough for collecting the valuable metals separated from the gangue or tailings.

In the drawings, in which similar letters of reference are used to denote corresponding parts in different views, A denotes the table, which is suitably supported to adapt it to have imparted thereto by any suitable mechanism in common use a combination of shaking and rocking motions or any desired movement for accomplishing the desired results. As shown, it is mounted on posts or legs b b, the upper ends of which are pivotally connected to the under side of the table, while the lower ends thereof are pivotally connected with and rest upon suitable frame-pieces or bars B, which latter may rest upon a suitable support or frame C, as shown, or in any proper manner, suitable devices, as screws or adjustable wedges c, being interposed between the bars B and frame C for varying the inclination of the table. The legs or rocking arms that support the table act not alone as a support therefor, working on the arc of a circle and giving the ore a slightly-pitching motion, but they also act as a guide for the table, allowing it to have no side movement whatever, which is a very important consideration in separating the ore. The surface of the table A is covered or provided with a metallic sheet or facing a, of metal, having an affinity for the particular metal contained in the ore under treatment and which is the more valuable and desirable to be thoroughly separated—as, for instance, lead in treating lead ore or a silver sheet or coating in treating gold ore. This metallic surface or covering is provided with a series of longitudinal grooves, channels, or recesses a', which preferably extend from the rear end of the table toward the front or discharge end thereof with a slight rearward inclination and terminate a sufficient distance from the receiving or discharge end or side of the table to leave a clear unobstructed smooth surface extending the length of the table on the side thereof adjacent to the distributing-launders, as shown more clearly in Fig. 1. The grooves a' taper from end to end—that is to say, they gradually decrease in depth from the front or receiving end thereof to their opposite terminals, where they merge into the smooth unobstructed surface of the table-top.

At or near the receiving end or side of the table and on that portion thereof on which the crushed ore or pulp is delivered from the distributing-launder I provide a removable wearing-plate A', which may consist of a sheet-metal or other suitable plate, having one edge or angle thereof secured to the frame-piece or bar a^2, while the other portion or edge thereof overlaps and rests upon the surface of the table, as shown more clearly in Fig. 4. By this means when that portion of the table which is most subject to wear becomes worn and in need of repairs the wearing-plate may be removed and a new one substituted in its stead without necessitating the renewal of the entire metallic surface of the table or the substitution of a new table-top, as is usual in using ore-concentrators as heretofore constructed.

The distributing-launder D may be formed with two or more compartments d d', the compartment d being adapted to receive the pulp or crushed ore from a suitable conduit or pipe E, as indicated in Figs. 2 and 4, while the compartment d' is adapted to receive the water for washing the ore from a suitable conduit or pipe E', as shown in Fig. 2. The ore-compartment d of the launder D is provided on the discharge side thereof with a series of holes or perforations d^2, through which the pulp or ore mixed with water is permitted to escape onto the surface of the table. The upper edge of that side of the compartment d' nearest the table is preferably notched or serrated, as at d^3, in order that the water used for washing the ore as it passes downward toward the front or lower end of the table may be more evenly and smoothly distributed without splashing or spurting onto the table in greater volume or with greater force at any one point than at other points along the table, thus insuring an even distribution and smooth flow of the water across the table for the purpose of washing the ore and drawing off the lighter material and gangue into a water box or trough F, extending along underneath the edge of the table at that side thereof opposite the distributing-launder.

At the front or discharge end of the table is placed a sectional trough or launder G to receive the heavier particles of mineral or valuable metal separated from the ore. This launder G may be constructed in two, three, or more sections, which are preferably telescopically arranged, so that the material which is separated may be assorted and graded and collected in different grades or classes—as, for instance, lead, iron, and zinc—according to the nature and character of the ore under treatment and the specific gravities of the minerals contained therein. In the form shown the launder G is constructed in three concave or semicylindrical sections g, g', and g^2, which are telescopically arranged and supported on the rods or bars H, which bars extend transversely of the table at the discharge end thereof and are rigidly secured at one end to a bracket H' and at their opposite ends to the frame of the machine. The sections g g' g^2 of the launder are provided with discharge openings or spouts g^3, g^4, and g^5, respectively, and are supported, with capacity for longitudinal adjustment on the rods H H, by lateral lugs or hooks g^6, resting upon and overlying said rods, so that any one of the sections may be moved forward or back for the purpose of varying the extent or area of the surface of the section which is exposed to the discharge end of the table and adapted to receive the material therefrom, so as to adapt the same for use in treating different kinds of material or in classifying the material according to different requirements in use. Either of said sections may be removed bodily by simply lifting the same from the rods, and, if desired, any suitable securing device may be employed for securing the several sections in the positions to which they may be adjusted for use and to prevent accidental displacement in use caused by the jarring or shaking of the table. From the discharge openings or spouts g^3 g^4 g^5 the material may be discharged into a suitable receptacle or conducted through a suitable spout or conveyer to any desired point for further treatment or shipment.

In the operation of the table the ore is fed into the compartment d of receiving launder or trough D, while the wash-water, which is located farther down the length of the table and which is used to wash the ore as it passes downward toward the discharge end, is fed into the compartment d' and flows over the top or serrated edge d^3 of said compartment, so as to secure an even distribution and gentle flow thereof without spurting. At the same time a reciprocating movement, differential in its action, with the strength of the longest throw or bump toward the discharge end of the table, is imparted to the table by any suitable mechanism connecting with the pitman or rod I, which may be applied at either end of the table, so as to cause the ore to move along or over the surface of the table toward the discharge end thereof, whereby as the ore is moved along it is washed all the way at right angles by the water issuing from the compartment d' of the launder, thus washing the lighter material and gangue toward the opposite side of the table and into the trough or box F, from which the gangue and waste may flow off into any suitable receptacle or conduit provided therefor. The heavier ore or valuable material to be recovered remains scattered along the smooth surface of the table above the terminals of the inclined grooves or channels a' and is discharged at the end of the table into the section or compartment g of the receiving-launder G, while the float-lead or lighter particles of mineral, that are not sized, as is the heavier lead or particles, are caught in the grooves a' and caused to gradually work backward and toward the discharge end of the table, so as to be brought back into the plane of the body of ore or valuable metal which takes a position forward of an imaginary line running the length of the table outside of the terminals of the aforesaid grooves or slots, whereby the very fine float-lead or other float mineral is separated and recovered with the larger particles of like kind and specific gravity instead of being carried over and discharged into a middlings receiver or receptacle, as heretofore, and conveyed back to the distributing-launder to be again run over the table, with consequent loss resulting from the fact that the material which is so finely pulverized as to be once discharged and again returned to the table will seek the same place as before and be run again and again into the middlings-receptacle and returned until worn by attrition so fine that it will pass off with the dirty water into the waste. The inclined sloping grooves, which run against the slant of the table, cause the float mineral to be carried back to the place it should not have left, while allowing the waste to pass over it and off into the trough or receptacle to receive the same, thus saving the valuable float material with the heavier ore that lies along the upper line or surface of the table beyond the terminals of the grooves. I thus avoid all intricate savings and returnings and accomplish what has hitherto been attempted to be accomplished by returning the same ore to be run over two or more times. The mineral of less specific gravity and of a different class from that which is discharged into the first compartment or section of the sectional launder will be carried farther across the table and will be discharged into the second section or compartment, while the material of the next or third class will be discharged into the third section or compartment, thus separating and collecting the different grades or classes of material into two or more classes, the first of which, for instance, may be lead, the second iron, and the third zinc, according to the ore under treatment, the same rule applying to any minerals having different specific gravities.

By constructing the surface of the table of metal having an affinity for the particular metal it is desired to recover from the ore under treatment the separation and collection thereof are greatly facilitated, and a more complete separation is effected than is possible under the usual conditions.

The desired differential movement or bumping action may be imparted to the table by any suitable mechanism, such as has heretofore been employed in devices of a similar character and which it is unnecessary to illustrate or describe herein, inasmuch as my invention resides in the construction of the table and its attachments and not in the mechanism for imparting the desired vibratory or reciprocating movements thereto.

I may mention, however, as a desirable movement that which has heretofore been employed with what is known as the "Rittinger" table made in Germany many years ago and which has been in use in this country for many years, in which there is a side movement or bumping action combined with the transverse washing of the ore.

It will be understood, of course, that the form and construction of the parts hereinbefore described may be modified in a number of ways without departing from the spirit of my invention, and hence I do not desire to be limited to the exact construction shown and described.

The novel construction of table herein shown and described is made the subject of a separate divisional application, and hence claims to the same are omitted from the present case.

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

1. In an ore-concentrator the combination with the shaking-table, of a receiving-launder extending along the discharging side of the table and composed of sections independently adjustable to vary their individual longitudinal extent for receiving the ore from the table.

2. In an ore-concentrator the combination with the shaking-table, of a receiving-launder extending along the ore-discharging side of the table and composed of a series of overlapping sections independently adjustable in the direction of their length, substantially as and for the purpose described.

3. In an ore-concentrator, the combination of a shaking-table, rods extending crosswise of the discharging end of said table, and a series of overlapping troughs together constituting a sectional launder and separately supported on said rods with provision for separate longitudinal adjustment, substantially as described.

4. In an ore-concentrator, the combination with the table, of a sectional launder composed of a series of independent coöperatively-arranged longitudinally-adjustable and removable sections, substantially as described.

5. In combination with the table, the sectional launder or receptacle composed of telescopically-arranged sliding sections each removably supported adjacent to the discharge end of the table to adapt the several sections to be separately adjusted and secured in different positions relatively to each other and

to be readily removed and replaced, substantially as described.

6. A sectional launder comprising a series of independent concave sections or receptacles telescopically arranged and adapted to slide longitudinally with respect to each other, each having lateral supporting fingers or lugs adapted to rest on suitable supports adjacent thereto, and provided at one end with a discharge-opening, substantially as described.

7. In an ore-concentrator, the combination with the table, of the sectional launder comprising a series of concave sections or receptacles telescopically arranged and adapted to slide longitudinally with respect to each other, each having lateral supporting fingers or lugs and provided at one end with a discharge-opening, and longitudinally-arranged supporting rods or bars on which said sections are supported and adjustably secured adjacent to said table, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

SAMUEL IRVING HALLETT.

Witnesses:
JESSE J. MAY,
JOSEPH HICKS.

COMPLAINANTS' EXHIBIT No. 10
Hallett Patent 614,322
ALMON E. HART, Special Examiner

No. 614,322. Patented Nov. 15, 1898.

S. I. HALLETT.
ORE CONCENTRATOR.
(Application filed Jan. 29, 1898.)

(No Model.)

Fig. 1.

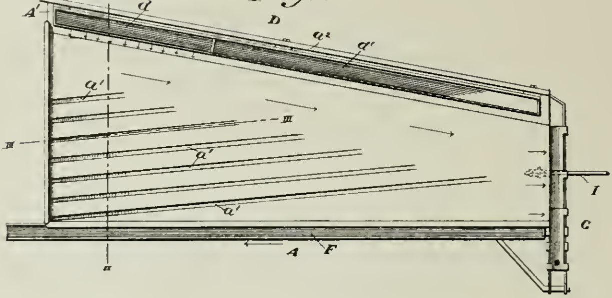


Fig. 2.

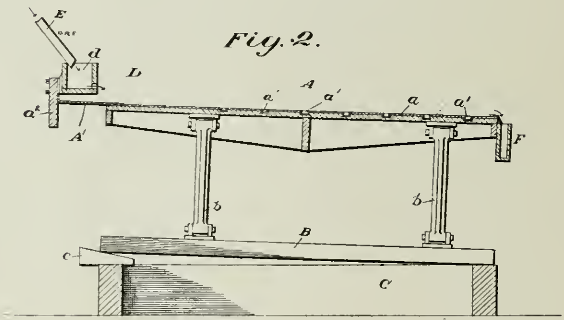


Fig. 3.

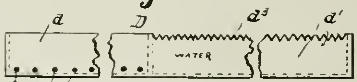
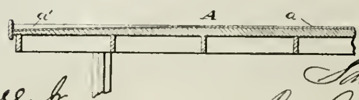


Fig. 3a.



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His Attorney

UNITED STATES PATENT OFFICE.

SAMUEL IRVING HALLETT, OF ASPEN, COLORADO, ASSIGNOR OF ONE-HALF TO DAVID M. HYMAN, OF CINCINNATI, OHIO.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 614,322, dated November 15, 1898.

Original application filed September 16, 1897, Serial No. 651,877. Divided and this application filed January 29, 1898. Serial No. 668,418. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL IRVING HALLETT, a citizen of the United States, residing at 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.

My invention relates to ore-concentrators, or that class of machines or apparatus employed for concentrating or separating and grading mineral substances of different specific gravities, and more particularly to apparatus operating to carry out the wet process of concentrating ores, whereby ores of various kinds may be washed and concentrated and the valuable minerals separated and graded with economy of time and labor.

The invention is especially designed for use in connection with ore-concentrators of that class in which the crushed ore is distributed upon and caused to move or flow along a plane surface or table to which is imparted a combination of shaking and rocking motions, whereby the concentrates or particles of mineral settling on the surface of the table are carried along and discharged in different classes or grades at one end or side of the table, while the gangue and refuse matter are carried off at the side or end of the table opposite the distributing-launder.

The primary objects of my invention are to provide simple, inexpensive, and efficient means for separating the ore and for collecting the same in different grades or classes, so that in treating ores containing minerals of different specific gravities the different minerals may be separated and collected in their respective classes or grades, and to provide a table which shall efficiently separate and collect the finer or lighter and unsized mineral substances or float-mineral which in the operation of concentrators as generally heretofore constructed is either carried off with the gangue or collected in the form of "middlings" and returned to the feed-trough for retreatment with the fresh material being fed into the feed-trough, with consequent loss of energy and waste of valuable metallic substances.

The invention will first be hereinafter more particularly described, with reference to the accompanying drawings, which form a part of this specification, and then pointed out in the claims at the end of the description.

Referring to the drawings, Figure 1 represents a top or plan view of an ore-concentrating table and its attachments embodying my invention. Fig. 2 is a cross-sectional view taken on the line II II of Fig. 1. Fig. 3 is a detail front view of the distributing-launder. Fig. 3ª is a longitudinal sectional view taken on line III III of Fig. 1.

In the drawings, in which similar letters of reference are used to denote corresponding parts in different views, A denotes the table, which is suitably supported to adapt it to have imparted thereto by any suitable mechanism in common use a combination of shaking and rocking motions or any desired movement for accomplishing the desired results. As shown, it is mounted on posts or legs b b, the upper ends of which are pivotally connected to the under side of the table, while the lower ends thereof are pivotally connected with and rest upon suitable frame pieces or bars B, which latter may rest upon a suitable support or frame C, as shown, or in any proper manner, suitable devices, as screws or adjustable wedges c, being interposed between the bars B and frame C for varying the inclination of the table.

The table is provided with a riffled or grooved surface and with an unriffled or smooth surface, as shown, said riffles or grooves extending along the surface of the table transversely or obliquely to the direction or line of movement of said table and tapering or diminishing in depth toward the unriffled portion. In the form shown in the drawings the riffled and unriffled surfaces are obtained by providing the table with a metallic sheet or facing a, in which is formed a series of longitudinal grooves, channels, or recesses a', which preferably extend from the rear end of the table toward the front or discharge end thereof, with a slight rearward inclination, and terminate a sufficient distance from the receiving or discharge end or side of the table to leave a clear unobstructed smooth surface extending the length of the table on the side thereof adjacent to the distributing-launders, as shown more clearly in Fig. 1.

The metallic surface or covering of the table preferably consists of a metal having an affinity for the particular metal contained in the ore under treatment and which is the more valuable and desirable to be separated—as, for instance, lead in treating lead ore or a silver sheet or coating in treating gold ore.

The grooves a' taper from end to end—that is to say, they gradually decrease in depth from the front or receiving end thereof to their opposite terminals, where they merge into the smooth unobstructed surface of the table-top.

At or near the receiving end or side of the table and on that portion thereof on which the crushed ore or pulp is delivered from the distributing-launder I provide a removable wearing-plate A', which may consist of a sheet-metal or other suitable plate having one edge or angle thereof secured to the frame piece or bar a^2, while the other portion or edge thereof overlaps and rests upon the surface of the table, as shown more clearly in Fig. 2. By this means when that portion of the table which is most subject to wear becomes worn and in need of repairs the wearing-plate may be removed and a new one substituted in its stead without necessitating the renewal of the entire metallic surface of the table or the substitution of a new table-top, as is usual in using ore-concentrators as heretofore constructed.

The distributing-launder D may be formed with two or more compartments d d', the compartment d being adapted to receive the pulp or crushed ore from a suitable conduit or pipe E, as indicated in Fig. 2, while the compartment d' is adapted to receive the water for washing the ore from a suitable conduit or pipe. The ore-compartment d of the launder D is provided on the discharge side thereof with a series of holes or perforations d^2, through which the pulp or ore mixed with water is permitted to escape onto the surface of the table. The upper edge of that side of the compartment d' nearest the table is preferably notched or serrated, as at d^3, in order that the water used for washing the ore as it passes downward toward the front or lower end of the table may be more evenly and smoothly distributed without splashing or spurting onto the table in greater volume or with greater force at any one point than at other points along the table, thus insuring an even distribution and smooth flow of the water across the table for the purpose of washing the ore and drawing off the lighter material and gangue into a water box or trough F, extending along underneath the edge of the table at that side thereof opposite the distributing-launder. At the front or discharge end of the table is placed a sectional trough or launder G to receive the heavier particles of mineral or valuable metal separated from the ore.

In the operation of the table the ore is fed into the compartment d of receiving launder or trough D, while the wash-water, which is located farther down the length of the table and which is used to wash the ore as it passes downward toward the discharge end, is fed into the compartment d' and flows over the top or serrated edge d^3 of said compartment, so as to secure an even distribution and gentle flow thereof without spurting. At the same time a reciprocating movement differential in its action, with the strength of the longest throw or bump toward the discharge end of the table, is imparted to the table by any suitable mechanism connecting with the pitman I, which may be applied at either end of the table, so as to cause the ore to move along or over the surface of the table toward the discharge end thereof, whereby as the ore is moved along it is washed all the way at right angles by the water issuing from the compartment d' of the launder, thus washing the lighter material and gangue toward the opposite side of the table and into the trough or box F, from which the gangue and waste may flow off into any suitable receptacle or conduit provided therefor. The heavier ore or valuable material to be recovered remains scattered along the smooth surface of the table, above the terminals of the inclined grooves or channels a', and is discharged at the end of the table into the receiving-launder G, while the float-lead or lighter particles of mineral that are not sized, as is the heavier lead or particles, are caught in the grooves a' and caused to gradually work backward and toward the discharge end of the table, so as to be brought back into the plane of the body of ore or valuable metal, which takes a position forward of an imaginary line running the length of the table outside of the terminals of the aforesaid grooves or slots, whereby the very fine float-lead or other float-mineral is separated and recovered with the larger particles of like kind and specific gravity instead of being carried over and discharged into a middlings receiver or receptacle, as heretofore, and conveyed back to the distributing-launder to be again run over the table, with consequent loss resulting from the fact that the material which is so finely pulverized as to be once discharged and again returned to the table will seek the same place as before and be run again and again into the middlings-receptacle and returned until worn by attrition so fine that it will pass off with the dirty water into the waste. The inclined sloping riffles or grooves, which run against the slant of the table, cause the float-mineral to be carried back to the place it should not have left, while allowing the waste to pass over it and off into the trough or receptacle to receive the same, thus saving the valuable float material with the heavier ore that lies along the upper line or surface of the table beyond the terminals of the grooves. I thus avoid all intricate savings and returnings and accomplish what has hitherto been attempted to be accomplished by returning the same ore to be run over two or more times. The mineral of less specific gravity and of a different class from that which is discharged into the first compartment or section of the sectional launder will be carried farther across the table and will be discharged into the second section or compartment, while the material of the next or third-class will be discharged into the third section or compartment, thus separating and collecting the different grades or classes of material into two or more classes, the first of which, for instance, may be lead, the second iron, and the third zinc, according to the ore under treatment, the same rule applying to any minerals having different specific gravities.

By constructing the surface of the table of metal having an affinity for the particular metal it is desired to recover from the ore under treatment the separation and collection thereof is greatly facilitated and a more complete separation is effected than is possible under the usual conditions.

The desired differential movement or bumping action may be imparted to the table by any suitable mechanism such as has heretofore been employed in devices of a similar character and which it is unnecessary to illustrate or describe herein, inasmuch as my invention resides in the construction of the table and its attachments and not in the mechanism for imparting the desired vibratory or reciprocating movements thereto. I may mention, however, as a desirable movement that which has heretofore been employed with what is known as the "Rittinger" table, made in Germany many years ago and which has been in use in this country for many years, in which there is a side movement or bumping action combined with the transverse washing of the ore.

It will be understood, of course, that the form and construction of the parts hereinbefore described may be modified in a number of ways without departing from the spirit of my invention, and hence I do not desire to be limited to the exact construction shown and described.

This application is a division of an original application filed by me September 16, 1897, and in which the sectional receiving-launder hereinbefore briefly referred to is made the subject of claims.

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

1. In a concentrator, a table provided with tapered riffles which merge into the table-surface along a line oblique to said table.

2. An ore-concentrating table adapted to the "wet" process of separating ores, having a smooth upper surface extending along the side thereof on which the ore and water are received, and a series of spaced grooves or channels extending over the surface thereof at one side of said smooth portion toward its discharging end; the said grooves gradually diminishing in depth from their receiving to their delivery ends and inclined toward and merging in said smooth surface, substantially as described.

3. In an ore-concentrator, the combination of an endwise-reciprocatory transversely-inclined table having a series of grooves or channels in its surface extending toward the discharging end of the table and gradually diminishing in depth or tapering in a vertical plane from their receiving ends and merging into a smooth unobstructed surface of the table which extends along the higher side of the latter and across its discharging end; and means for distributing ore and water over the table from along its higher side.

4. In an ore-concentrator, the combination of an endwise-reciprocatory transversely-inclined table having a series of diagonally-extending grooves or channels in its surface diminishing in depth or tapering in a vertical plane from their receiving ends toward the discharge end of the table and merging into a smooth unobstructed surface of the latter which extends along its higher side and across its discharging end; and means for distributing ore and water over the table at its higher side.

5. In a concentrator, a table provided with tapered riffles which extend along the table-surface transversely or obliquely across the line of movement of the table and terminate along a line oblique to said table.

6. In a concentrator, a table provided with a riffled and an unriffled surface; said riffles tapering toward the unriffled portion and extending in a direction oblique to the direction or line of movement of the table.

7. In a concentrator, a table provided with a riffled and an unriffled surface; the riffles extending transversely or obliquely across the line of movement of the table, and tapering or diminishing in depth toward the unriffled portion.

8. A table for ore-concentrators having its surface provided with a series of longitudinal grooves or riffles diminishing in height from the head toward the tail and extending obliquely across the surface of the table and terminating on a line oblique to the table.

9. A table for ore-concentrators having its surface provided with tapered grooves or riffles diminishing in height from the head to the tail; said riffles diminishing in length from the rear to the front or feed end of said table, substantially as described.

10. In combination, a table for ore-concentrators grooved or riffled longitudinally from head to tail; said grooves being tapered and

diminishing in height from the head toward the tail end of the table, and the feed near the head end of the bed arranged to discharge the pulp transversely across the deeper parts of the grooves, substantially as described.

11. In combination, a bed or table for concentrators grooved or corrugated longitudinally from head to tail; said corrugations being deeper at the head and diminishing in height toward the tail end of the bed, and the feed near the head end of the bed arranged to discharge the pulp transversely across the deeper parts of the corrugations, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

SAMUEL IRVING HALLETT.

Witnesses:

ELIAS COHN,

ROBERT WOODBRIDGE.

COMPLAINANTS' EXHIBIT No. 11

James Patent No. 633,265

ALMON E. HART, Special Examiner

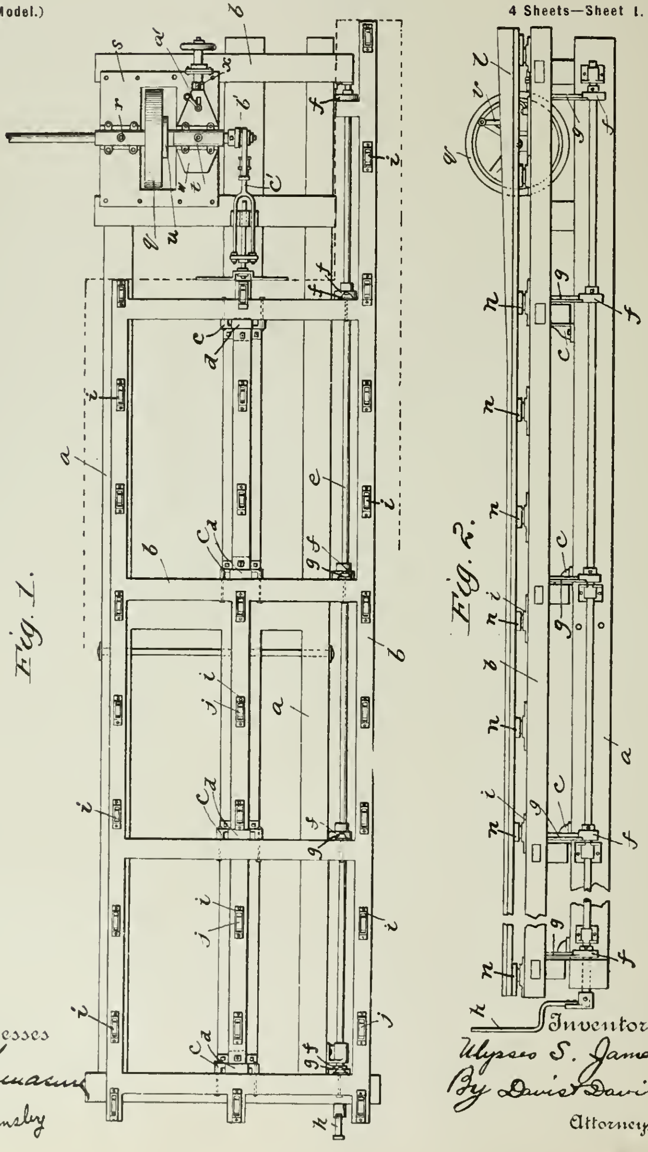
No. 633,265. Patented Sept. 19, 1899.

U. S. JAMES.

CONCENTRATING TABLE.

(Application filed Jan. 11, 1899.)

(No Model.) 4 Sheets—Sheet 1.



Witnesses
G M [illegible]
G. H. Walmsley

Inventor
Ulysses S. James
By Davis & Davis
Attorneys

No. 633,265.

Patented Sept. 19, 1899.

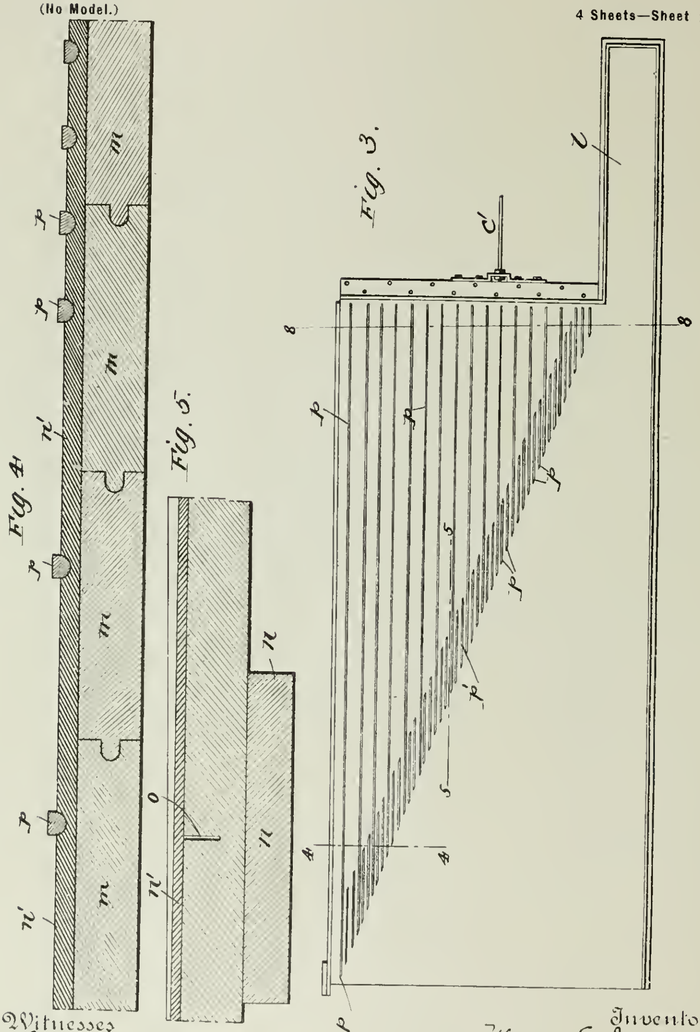
U. S. JAMES.

CONCENTRATING TABLE.

(Application filed Jan. 11, 1899.)

(No Model.)

4 Sheets—Sheet 2.



Witnesses

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No. 633,265. Patented Sept. 19. 1899.

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CONCENTRATING TABLE.

(Application filed Jan. 11, 1899

(No Model.) 4 Sheets—Sheet 3.

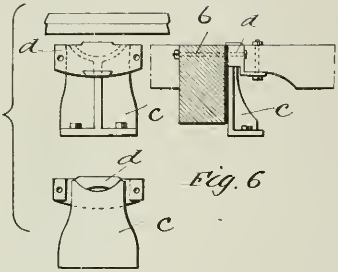


Fig. 6

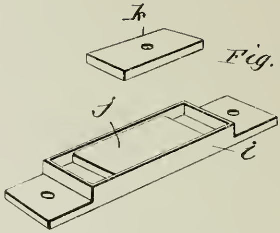
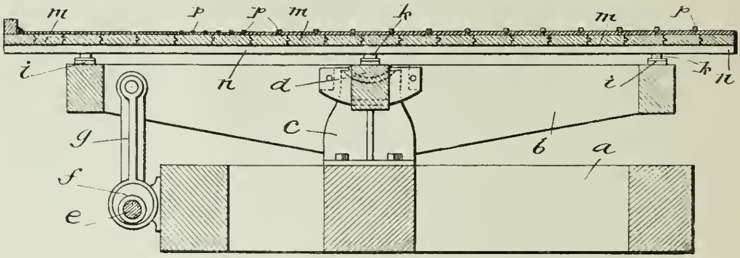


Fig. 7.

Fig. 8.



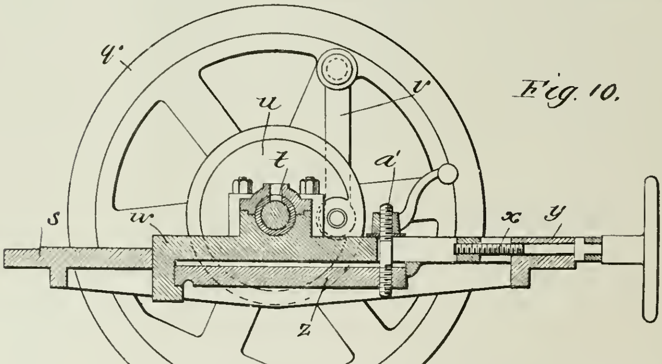


Fig. 10.

Witnesses

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Attorneys

No. 633,265. Patented Sept. 19, 1899.

U. S. JAMES.

CONCENTRATING TABLE.

(Application filed Jan. 11, 1899.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 9.

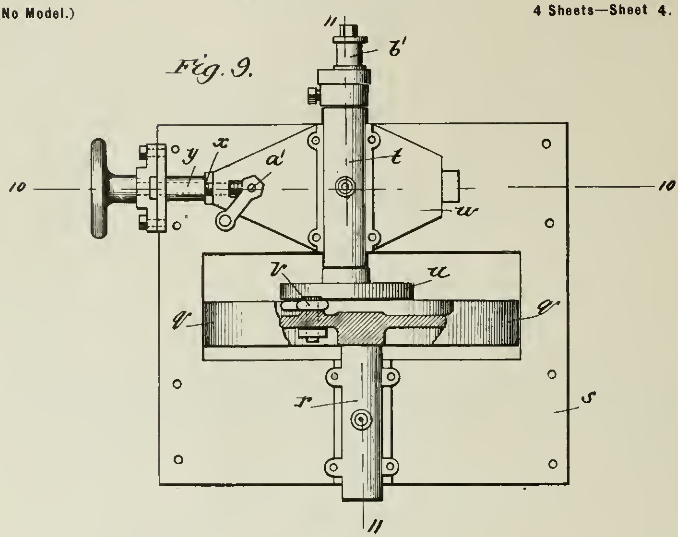


Fig. 11.

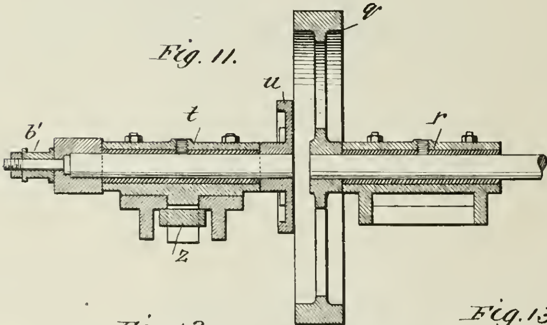


Fig. 12.

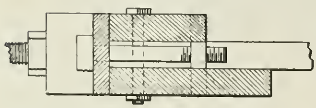
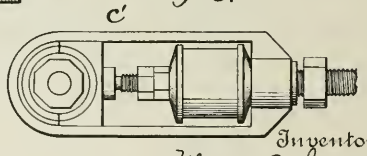


Fig. 13.



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Attorneys

UNITED STATES PATENT OFFICE.

ULYSSES S. JAMES, OF HELENA, MONTANA, ASSIGNOR OF ONE-HALF TO ROBERT A BELL, OF SAME PLACE.

CONCENTRATING-TABLE.

SPECIFICATION forming part of Letters Patent No. 633,265, dated September 19, 1899.

Application filed January 11, 1899. Serial No. 701,811. (No model.)

To all whom it may concern:

Be it known that I, ULYSSES S. JAMES, a citizen of the United States, residing at Helena, in the county of Lewis and Clarke and State of Montana, have invented certain new and useful Improvements in Concentrating-Tables, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to an improved concentrating-table for the separation of heavy minerals from the gangue or quartz matter in ores that have been crushed or reduced to pulp; and it has for its objects, briefly, to lessen the expense of separating the minerals and to save a higher percentum of mineral than is possible with similar appliances now in general use, as more fully hereinafter set forth.

In the drawings, Figure 1 is a plan view of the table-supporting frames. Fig. 2 is a side elevation complete. Fig. 3 is a detail plan of the table. Fig. 4, a detail section on the line 4 4 of Fig. 3; Fig. 5, a detail section on the line 5 5 of Fig. 3; Fig. 6, a group of views in detail of one of the rocker-bearings for supporting the rocker-frame; Fig. 7, a perspective of the parts of one of the slide-bearings for supporting the table-top; Fig. 8, a cross-section on the line 8 8 of Fig. 3 with the rocker-frame and base in position; Figs. 9, 10, and 11, views in detail of the mechanism for shaking the table-top, and Figs. 12 and 13 details of the pitman.

Referring to the drawings by letters, *a* designates a suitable base-frame, upon which is supported a rocker-frame *b*, both of which frames are constructed of a suitable number of longitudinal and transverse beams, their length being several times their width. The frame *b* is supported upon the base by a series of bearings *c*, arranged along the longitudinal center of the frame and bolted to the base, these bearings each having a concaved seat in its upper end for the reception of a pivot or journal *d*, bolted to an adjacent part of the rocker-frame. Thus supporting the rocker-frame it is free to be tilted in either direction transversely. Any suitable devices may be employed to tilt the frame; but I prefer the employment of a rock-shaft *e*, supported in suitable journals at one side of the base *a* and running the full length thereof and carrying at intervals eccentrics *f*, whose straps are connected to arms *g*, pivotally depending from the rocker-frame, said shaft being provided at one end with an operating-lever *h*. This simple arrangement enables the table-frame *b* to be readily tilted to the desired angle to suit the kind of ore being treated, and when tilted it will remain in the adjusted position until readjusted.

By supporting the rocker-frame along its longitudinal center it will be observed that it may be readily tilted with the utmost ease and accuracy, which will be especially advantageous in connection with exceptionally long tables used for certain kinds of ores. It will be observed that the bearings *c* extend up between the transverse beams, so as to bring the pivotal point at or near the upper face of the rocker-frame, whereby the rocker-frame is nicely suspended or balanced on the pivots, enabling the frame to be adjusted with a minimum of exertion. It will also be noted that the center line of the pivots—that is, a line running through the centers of the several circles of which the bearing-pivots *d* form arcs—is approximately in line with the operating-pitman *c'*, connected to the forward end of the table midway between the side edges thereof, whereby the table may be freely tilted without subjecting the pitman to any torsional strain or lateral oscillation, which obviously contributes to the utility of the apparatus.

Fastened at intervals along the longitudinal beams of the table-frame are slide-boxes *i*, each containing a sliding block *j*, upon which rests a slide-block *k*, secured to the under side of the table, the table being provided with one of these blocks for each of the slide-boxes, whereby the table will be slidingly supported throughout its length and breadth. The slide-blocks *k* rest upon the slide-blocks *j* and are confined within the side flanges of the boxes, whereby the reciprocating movements of the table will be guided and the table will be prevented from sliding down sidewise in the direction of its inclination.

The table at its forward end at one side is provided with a forward extension l, flanged around its edge to form a trough, into which the pulp is fed and along which it must pass to reach the main portion of the table and the riffles. The flange around this trough is continued across the forward edge of the table and along its upper longitudinal edge. It will be evident that the shaking motion of the table-top settles the fine mineral to the bottom and brings the coarse gangue on top before the material reaches the riffles, so that the gangue will not pack at the points of the riffles and dam the fine mineral; but the fine mineral having settled at the bottom will gradually move along above the points of the riffles, while the coarser gangue will move down across the riffles and separate from the fine mineral. It will therefore be noted that this trough-like extension of the feed end of the table-top is a very essential feature and that in order to be effective the extension must be sufficiently long to insure the settling of the fine mineral before the material reaches the riffles on the main surface. As a general thing the length of the extension should be a little greater than one-third the length of the table.

The table-top is constructed of longitudinal strips m of selected wood, preferably matched tongue-and-groove stuff, and bound together by cross-battens n, fastened at intervals to the under side of the table-top. At a point coincident with each of these battens the table-top is sawed entirely across, as at o, the kerfs extending down a sufficient depth to give the desired flexibility to the table, preferably about half-way through the strips m. Secured on the surface of the strips is a covering of heavy linoleum n' or other thick flexible material, this covering extending over and covering the transverse slits o. A table thus constructed is self-adjusting by reason of its transverse flexibility to all the slide-bearings, thereby practically abolishing vertical vibration, a great desideratum in this class of appliances.

The riffles p run longitudinally of the table parallel with each other and with the lower edge of the table, and their upper edges incline downward from their forward ends toward their rear ends, and they extend over that portion of the table-surface below a diagonal line running from near the upper forward corner of the table to its lower rear corner, making the field covered by the riffles a triangular one, although this location and arrangement of the riffles may be varied, if found desirable. The riffles are fastened in grooves formed in the upper surface of the linoleum cover and extend only partially therethrough, and they are of course sufficiently flexible transversely to yield to the sinuous movements of the table caused by irregularities in the supporting-surface thereof. This manner of fastening the riffles to the table has peculiar advantages. It enables the riffles to be planed down to any desired degree—in fact, actually to the table-surface—without destroying their strength, and, furthermore, it prevents the riffles breaking loose and springing up from the table-surface, whereby the life of the riffles will be greatly increased and their function rendered more perfect. The fastening means must obviously be something other than nails or screws or other devices passing down through the riffles. I prefer cement or glue that will not dissolve in water. Where the riffles are highest, (at the forward end of the table,) they are more widely spaced, and as their height is reduced their number is increased by the insertion of the short supplemental riffles p'. The reason of this is that where the riffles are low there is less tendency for the pulp to pack, and their number is increased in order to make a more continuous dam to resist or prevent waste of mineral. It will also be observed that if the riffles were laid the full length of the table extravagant agitation would be necessary to avoid packing the pulp, which would result in the fine mineral being held in suspense in the water and lost by being passed off across the riffles with the tailings.

The shaking or panning movement by which the pulp is made to travel downward and rearward on the table may be imparted to the table by any suitable devices; but I prefer the devices shown, because by means of them the pulp can be made to travel along the table at the desired speed without varying the velocity of the fly-wheel or the length of the stroke of the pitman. These devices consist of a balance-wheel q, secured to the end of a drive-shaft mounted in the bearing r, bolted to a bed-plate s, this bed-plate being in turn bolted to the table-frame b and having an opening in its center in which works said wheel q. Also fastened to the bed-plate is another long bearing t, in which is journaled a supplemental shaft carrying a disk or wheel u at its inner end, this disk u being close to the balance-wheel and being connected therewith by a pivotal link v. The shafts of the wheels q and u are supported in the same horizontal plane, and by reason of the lateral adjustability of the bearing t said shafts may be adjusted into axial alinement or out of axial alinement for a purpose hereinafter stated. The bearing t is rendered adjustable upon the bed-plate by being secured to a slide w, which is adapted to be adjusted back and forth by a screw-shaft x, journaled in a bearing y at the rear edge of the base-plate s. This slide is adapted to be clamped in its adjusted position by means of a clamp-plate z and screw a'. On the other end of the shaft carrying wheel u is formed or secured an eccentric b', to which is connected the pitman c', which at its rear end is connected to the table. This pitman is provided with suitable adjusting and cushioning devices, as is usual, so that the pitman may be extended to suit the adjustments of the supplemental shaft carrying the eccentric. It will be observed that when balance-wheel q is rotated wheel u and its shaft will be rotated and the table reciprocated. When the shafts are in axial alinement, as shown in Figs. 1, 10, and 11, the wheel u will have a regular rotary motion imparted to it, this motion being in unison with the balance-wheel. When, however, the slide-bearing is adjusted away from the table forward to bring the shaft of wheel u out of alinement with the driving-shaft, the rotary motion imparted to the eccentric-carrying shaft will be irregular—that is, accelerated at a certain point in each revolution, and this acceleration will be imparted to the table. By properly arranging the eccentric upon the shaft the acceleration can be made to act on the table at the proper point in its forward or backward stroke or portions of both to accelerate the movement of the pulp along the table. It will thus be observed that by this differential-operating mechanism the flow of the pulp along the table can be regulated to a nicety without varying the speed of the drive-shaft or the length of the pitman stroke.

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

1. A concentrating-table provided on its surface with a series of substantially parallel, longitudinal riffles extending from the forward end rearward and terminating short of the rear end of the table, on a substantially diagonal line running downward and rearward, and a series of supplemental riffles interposed between the rear extremities of the aforesaid riffles.

2. A concentrating-table having its feed-point at its forward upper corner and provided on its face with a series of parallel riffles tapering rearward and extending from the forward end of the table to a line running diagonally across the table from near the feed-point rearward and downward, and a series of supplemental riffles interposed between the rear extremities of the aforesaid riffles, as and for the purpose set forth.

3. A concentrating-table provided with longitudinal riffles tapering rearward and being more numerous and more closely spaced toward their rear ends, the riffles extending across the line of travel of the lighter material, substantially as set forth.

4. A concentrating-table provided with transverse kerfs to render it flexible transversely and provided with a series of longitudinal riffles extending across said kerfs and being transversely flexible.

5. A concentrating-table rendered transversely flexible by a series of kerfs extending across its upper surface, a flexible covering for said upper surface and kerfs, and a series of longitudinal riffles fastened to this covering and rendered transversely flexible.

6. A concentrating-table constructed of longitudinal wooden strips, cross-pieces binding the strips together, grooves or cuts being formed across the table coincidently with said cross-pieces, a flexible cover fastened to the table and covering said grooves or cuts, and riffles carried by said cover and made flexible transversely.

7. A concentrating-table rendered transversely flexible and provided on its upper surface with a flexible covering, and transversely-flexible riffles fastened in grooves in the face of said flexible covering, said grooves extending only partially through the covering.

In witness whereof I have hereunto affixed my signature, in the presence of two witnesses, this 3d day of January, 1899.

ULYSSES S. JAMES.

Witnesses:
L. P. BENEDICT,
JNO. K. SCOTT.

COMPLAINANTS' EXHIBIT No. 12

Lampert Patent No. 641,977

ALMON E. HART, Special Examiner

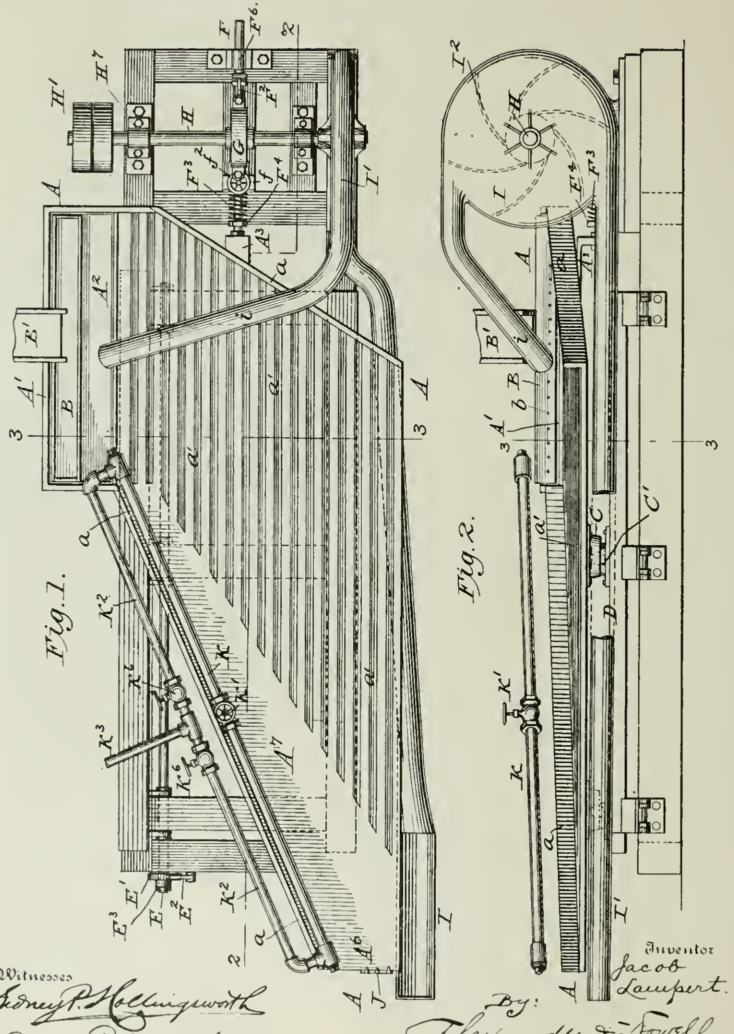
No. 641,977. Patented Jan. 23, 1900.

J. LAMPERT.

ORE CONCENTRATOR.

(Application filed Mar. 16, 1899.)

(No Model.) 4 Sheets—Sheet I.



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(No Model.) 4 Sheets—Sheet 2

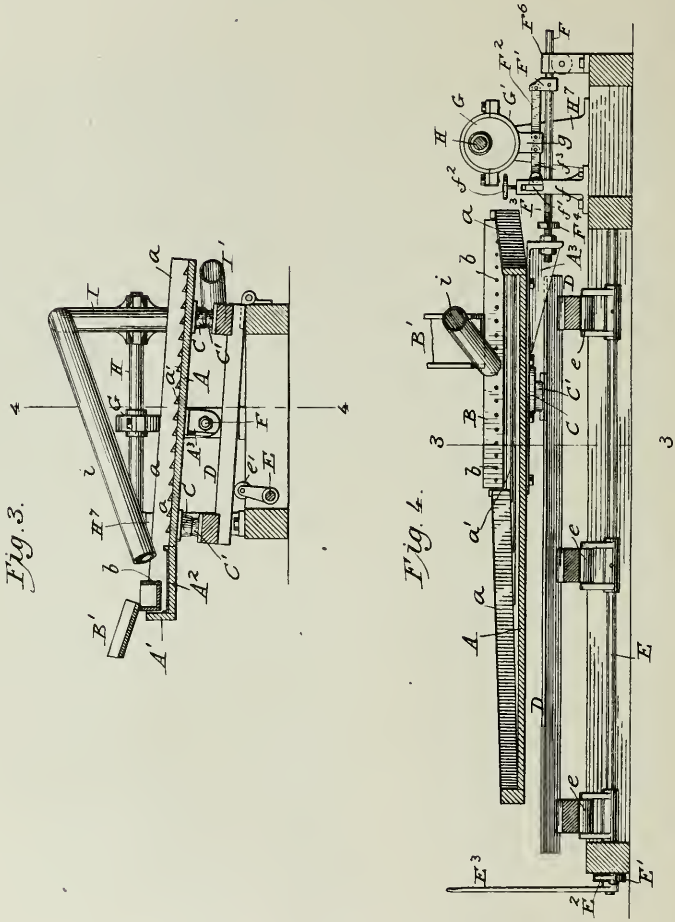

Fig. 3.

Fig. 4.

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(No Model.) 4 Sheets—Sheet 3.

Fig. 5.

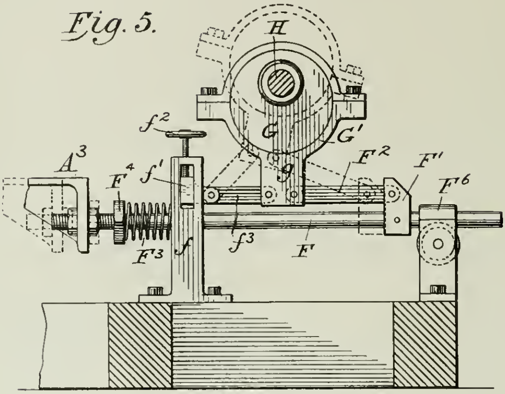


Fig. 6.

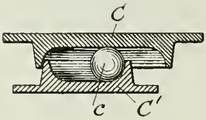


Fig. 7.

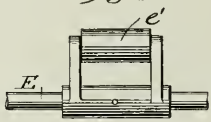
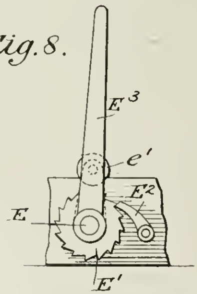


Fig. 8.



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4 Sheets—Sheet 4

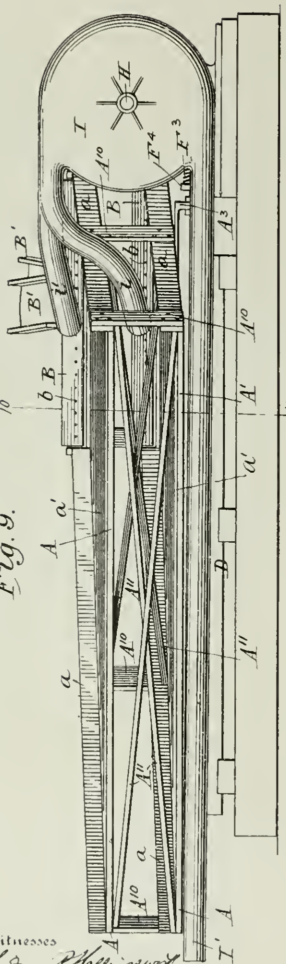

Fig. 9.

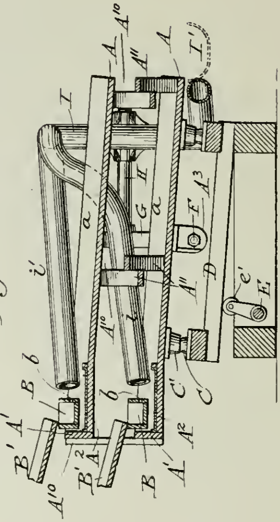

Fig. 10

Witnesses

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ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 641,977, dated January 23, 1900.

Application filed March 16, 1899. Serial No. 709,300. (No model.)

To all whom it may concern:

Be it known that I, JACOB LAMPERT, of Hill City, in the county of Pennington and State of South Dakota, have invented certain new and useful Improvements in Ore-Concentrators; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

This invention is an improvement in ore-concentrators of the kind shown in my Patent No. 533,362, of January 29, 1895, and the present invention is more particularly an improvement upon the concentrator shown in my said patent; and it consists in the novel combinations and constructions of parts hereinafter summarized in the claims and illustrated in the accompanying drawings and described with reference thereto, as follows.

Figure 1 is a plan view of the complete concentrator. Fig. 2 is a front side elevation of the device. Fig. 3 is a transverse section on line 3 3, Fig. 1. Fig. 4 is a longitudinal section thereof on line 2 2, Fig. 1. Fig. 5 is an enlarged detail view of the vibrating mechanism. Figs. 6, 7, and 8 are details. Fig. 9 is a front elevation of the device, showing how a tier of concentrating-tables may be operated by a single vibrating mechanism; and Fig. 10 is a transverse section on line 10 10, Fig. 9.

A designates the concentrating-table, which is preferably of the shape shown in Fig. 1, its opposite sides being parallel and its ends diagonal or beveled relatively to its sides, the tail end being beveled at a much greater angle to the sides than the head end and the receiving or rear side being shorter than its discharge or front side. The ends and rear side of the table are provided with upstanding flanges a, which will prevent the escape of material therefrom, and the rear side of the table, which is the receiving end, is also provided with a lateral extension forming a receiving-box A′, which box may have a removable plate A^2 in its bottom, preferably of copper. The box A′ is preferably so arranged that when the table is slightly tilted the bottom of the box A′ will be about level, and the metal plate A^2 in the box is used for the purpose of recovering amalgam in free-gold-ore treatment. This plate is removable to allow different plates to be replaced for different processes and different ores. The plate is preferably set in a recess in the top of the table or box and its edges turned up, so as to hold the recovered metals, which can from time to time be removed, as required, therefrom. In ordinary practice a feed-trough B is placed in this box over the plate A^2, ore being fed into this trough B through a spout B′ and escaping from the trough into the box through a series of perforations b in the side of the trough, as shown. From the box A′ the material passes onto the table proper, which is preferably slightly inclined from the rear to the front side thereof, as indicated in Fig. 3. This table is provided with a series of parallel riffles a', preferably extending parallel with the feed-box and with the front edge of the table, as shown, the riffles increasing in length toward the front edge of the table, as shown. This table is so mounted upon the main frame of the apparatus as to be capable of longitudinal vibration, and, as shown, it is preferably mounted by ball-bearings upon said frame, the table being provided on its under side with inverted oblong ball-holders or saucers C, which fit over balls c, resting in similar smaller saucers C′. Preferably the upper saucers C are larger than the saucers C′ to keep dirt and drippings from the table out of the lower saucers, and thus keep the ball-bearings clean. To provide for easy adjustment of this table without disturbing its bearings, the saucers C′ are fixed to a tiltable frame D, as indicated in the drawings, which frame can be tilted so as to properly adjust the inclination of the table. This frame may be hinged at its front side to the front side of the stationary main frame, and journaled in the main frame, near the rear side thereof, is a shaft E, which is provided at one end with a ratchet E′, engaged by a locking-pawl E^2 on the main frame to lock the shaft in any position desired. On this shaft E are keyed short arms e, carrying rollers e', which are adapted to contact with the transverse bars of frame D or the bottom of said frame, near the rear side thereof, and tilt said frame more or less upward when shaft E is rocked, as indicated in Fig. 3. Thus by turning shaft E the frame D can be tilted and the table adjusted to any desired inclination. The shaft may be turned by a lever E^3 or by any suitable wrench-lever.

The table is vibrated by the following means: To the under side of the table A, near the head end thereof, is attached a bracket A^3, to which is connected the inner end of a longitudinally-movable shaft, the outer end of which is guided in a proper bearing or housing F^6 on the main frame, which will permit free longitudinal movement of said shaft. This shaft passes through a standard f, provided above the shaft with a vertically-adjustable block f', which can be adjusted by means of a hand-screw f^2, as shown. Connected to the block f' is a short link f^3, which is connected to the tang g of an eccentric-strap G', fitted over an eccentric G on the main shaft H of the machine, said shaft H being journaled in suitable bearings H^7 on the main frame, near the head end of the table and above and at right angles to the shaft F, as shown. To the tang g is also connected one end of a long link F^2, the other end of which is connected to a block F', secured to said shaft F near the outer end thereof. A spring F^3 is strung on shaft F and interposed between the standard f and an adjustable nut F^4 on said shaft, said spring tending to force the table away from the standard f. The links F^2 and f^3 form a toggle connection between the shaft F and bracket f, and if said toggle is deflected by the lifting of the eccentric-strap the shaft F will be forced longitudinally inward, thereby permitting the spring to push the table quickly away from standard f, and when the toggle is extended again the table is drawn back toward the standard and the spring F^3 is compressed. Power is applied to the main shaft H through belt-pulleys H' or any other suitable means, and when this shaft is rotated rapidly the eccentric G opens and closes the toggle-joint, thereby imparting vibratory movement to the table, as described. The link f^3 being shorter than the link F^2, it results, practically, that the inward movement of the shaft F is more rapid and is brought more to an abrupt stop than would be the case if the toggle-links were of equal length, and the abruptness of the stop of the inward movement of the table can be measurably controlled by adjusting the block f'. When it is lowered, the stop is made more quickly and abruptly. A further advantage of this form of toggle connection is that the strain upon the shaft E is almost entirely linear and very little strain is brought upon its bearings in the outer journal-box F^6, and the lateral thrust on the shaft is also entirely obviated by this construction. The short link f^3, when the eccentric is turned half-way around from where it is shown in Fig. 1, will, as shown by the dotted lines, stand at about an angle of forty-five degrees upward or more, thus causing the sudden stop of the table, and this causes the mineral thereon to move forward toward the tail end thereof. The adjustable short link f^3 of the toggle renders this table-operating device very sensitive, or, in other words, a very fine adjustment of the stroke of the table can thereby be secured, and the longer link F^2 relieves the objectionable downthrust of the shaft F' on the box F^6.

The riffles a', as shown, do not extend entirely to the tail-end flange of the table, a smooth surface A^7 of gradually-increasing width being left between the ends of the riffles and the rear flange a', as shown. The apex of the tail end of the table is also cut off, as shown at A^6, and at this point should be placed the dividers J, by which the concentrated ores may be graded and directed into proper receivers, as in other machines of this class. A portion of the material on the table also escapes over the front edge thereof, between the dividers and the end of the next riffle, and as such material is more or less imperfectly separated it is customay to return it to the table and pass it thereover again. In order to do this, I employ a catch-spout I, which is adapted to catch this material and return it back under the table to a pump-casing I', within which is a rotary pump-propeller I^2, which may be mounted on one end of the main shaft H, as shown. This pump may be of any suitable construction. It has an outlet at its upper end which discharges into a spout i, by which the material is led back into the box A^2 at the head of the table, from whence it is passed again over the riffles, as before. Water may be supplied to the table as usual, and I employ the perforated supply-pipe K along the tail-end flange a' to admit water to the smooth surface A^7 at the tail end of the table. This pipe K is connected to any suitable source of supply and, as shown, is provided with a central valve K', and its opposite ends are connected by branches K^2, provided with valves K^6, with a main supply-pipe K^3. By means of the various valves the water may be regulated and supplied in more or less volume from the whole or either part of the pipe K to the table, as is evident.

Operation: In operation the pulp or crushed ore is fed from a spout or pipe to the trough B, from which it is fed onto the metal plate A^2 and then over the riffles on the table, which is inclined toward its front or wider end. A reciprocating movement is imparted to the table by the toggle and eccentric to move the mineral caught between the riffles forward to the tail end of the table, where in the smooth or unriffled portion A^7 the sand or refuse matter yet left in the mineral might be washed off. The mineral being carried forward to the tail end is there cut out by the dividers J into one or more receivers, the separation being so perfect that if there are minerals of different specific gravity in the ore they will come down in streaks, according to gravity, over to the end of the table and can be easily separated. A portion of the minerals not yet perfectly cleaned from refuse escapes off the edge of the table, between the lowest part of the dividers and the end of the lowest riffle, into spout I and is returned to the elevator I' and delivered back to the head of the table to be treated again, as shown.

In some cases where a great quantity of material is to be treated or where economy of room is desired the concentrating-tables may be arranged in tiers, as indicated in Figs. 9 and 10. The tables would be duplicate, the upper table being supported on the lower table by means of uprights A^{10}, rigidly braced by the diagonal braces A^{11}, so that the two tables will be vibrated and adjusted together, like the single table above described. In this case each table may be supplied with ore by separate feed-troughs, and the returns or tailings from the table may be returned by the pump L, the outlet from which may be provided with a branch pipe or pipes $i\,i'$, leading to the respective tables. By this means the capacity of the apparatus can be increased without material addition to the cost thereof and without taking up any more floor-room than would a single table.

One of the particularly valuable and novel features of my concentrator is the peculiar formation of the table with a beveled head and tail ends provided with flanges.

The pulp or wet ore delivered on the table moves forward diagonally down and toward the tail end instead of passing directly down, and its movement carries the concentrates that way also; but the water in the pulp seeks the easiest way to escape, and to prevent the water from directly escaping and to keep the water mixed with the pulp for the better settling of concentrates the head end of my table is cut diagonally and an upstanding flange fastened thereto, thereby saving much water, which in many locations where water is scarce is a material advantage and improvement. The diagonal tail end of the table, as shown, is sufficient to accomplish the proper separation of the minerals from the refuse, and a larger triangular smooth surface or square-ended table is useless and simply increases the power necessary to operate the machine. The object of the tail-end flange is to prevent the wash-water, which is turned on the table nearly over and in line with this flange, from slopping over or falling off and effects a large saving of water.

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

1. In an ore-concentrator, the table having its head and tail ends beveled and each provided with upstanding flanges, a feed-trough at the rear side of the table, and longitudinal parallel riffles extending from the head-flange toward the tail-flange, said riffles gradually increasing in length from the box toward the front edge of the table, substantially as described.

2. In an ore-concentrator, the combination of the table having its head and tail ends beveled and each provided with upstanding flanges, a laterally-projecting feed-box on the rear side of the table, and longitudinal parallel riffles extending from the head-flange toward the tail-flange and gradually increasing in length from the box toward the front edge of the table; with means for vibrating said table, substantially as described.

3. In an ore-concentrator, a table having parallel front and rear sides, its head cut on an obtuse angle to its sides, and its tail cut on an acute angle thereto, upstanding flanges on its rear side and head and tail ends, and parallel longitudinally-disposed riffles extending from its head toward its tail end.

4. In an ore-concentrator, the combination of a table having parallel front and rear sides, and beveled head and tail ends, the tail-end angle being more acute than the head angle, each end being provided with upstanding flanges, and a feed-box at the side of the table, and parallel longitudinally-disposed riffles on said table; with the removable amalgamating-plate in said feed-box, and means for vibrating said table longitudinally, and the ore and water feed and supply pipes.

5. In an ore-concentrator, the combination of a table having parallel front and rear sides, an obtuse-angled head end, an acute-angled tail end, said ends being provided with upstanding flanges, and a feed-box at the rear side of the table, and parallel longitudinally-disposed riffles on said table extending from the head toward the tail end of the table, of successively greater length as they approach the front side of the table, and terminating some distance from the tail end so as to leave a smooth surface between their extremities and the tail-end flange; with means for vibrating said table longitudinally, and the ore and water feed and supply pipes, all substantially as described.

6. In an ore-concentrator, the combination of a table having its head end cut on an obtuse angle, and its tail end cut on an acute angle and provided with upstanding flanges, a series of parallel longitudinally-disposed riffles extending from the head toward the tail end of the table and of successively greater length as they approach the front side of the table, said riffles terminating some distance from the tail end so as to leave a smooth surface between their extremities and the tail-end flange; in combination with the ore and water feed and supply pipes, means for vibrating said table, and means for returning partially-treated ores back to the feed-box.

7. In an ore-concentrator, the combination of a table having parallel front and rear sides, an obtuse-angled head end, an acute-angled tail end both ends being provided with upstanding flanges, a feed-box at the rear side of the table, and parallel longitudinally-disposed riffles on said table, extending from the head toward the tail end of the table and

being of successively greater length as they approach the discharge edge of the table; with the ore and water supply pipes leading to the feed-box, the wash-water-supply pipe along the tail end of the table, means for vibrating said table, and the pipe and pump for returning partially-treated ores back to the feed-box.

8. In an ore-concentrator, the combination of the concentrating-tables arranged one above the other and rigidly connected together, the adjustable laterally tilting frame supporting said tables, means for imparting longitudinally-reciprocatory motion to said tables, the ore and water supply pipes for each table, a pump, a pipe for collecting tailings for each table and returning the same to the pump, and the branch outlets from the pump for returning the tailings to the respective tables, for the purpose and substantially as described.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

JACOB LAMPERT.

Witnesses:

E. H. FANSMITH,

ORLIN H. LAMPERT.

COMPLAINANTS' EXHIBIT No. 13

Dodd Patent No. 638,324

ALMON E. HART, Special Examiner

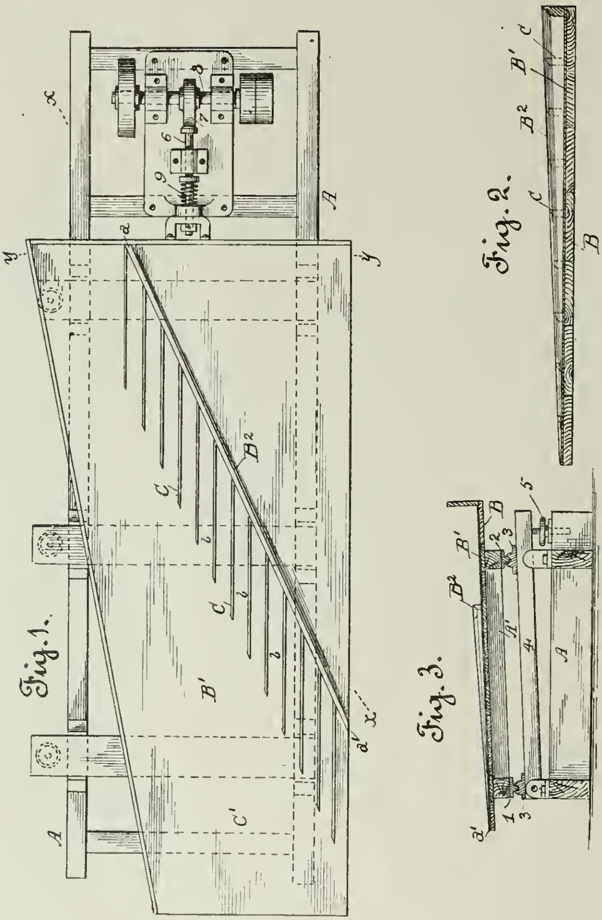
No. 638,324. Patented Dec. 5, 1899.

W. G. DODD.

CONCENTRATING TABLE.

(Application filed May 8, 1899.)

(No Model.)



Witnesses.

H. G. Monteverde.

Walter F. Vane.

Inventor.

Willis G. Dodd

by N. A. Acker

his atty.

UNITED STATES PATENT OFFICE.

WILLIS G. DODD, OF SAN FRANCISCO, CALIFORNIA.

CONCENTRATING-TABLE.

SPECIFICATION forming part of Letters Patent No. 638,324, dated December 5, 1899.

Application filed May 8, 1899. Serial No. 715,913. (No model.)

To all whom it may concern:

Be it known that I, WILLIS G. DODD, a citizen of the United States, residing at the city and in the county of San Francisco and State of California, have invented certain new and useful Improvements in Concentrating-Tables; and I do hereby declare that the following is a full, clear, and exact description thereof.

The present invention relates to a certain new and useful concentrating-table for use more especially in connection with that class of ore-concentrators employing transversely-inclined tables having longitudinally-vibratory movement which tends to carry the material to be concentrated longitudinally forward toward the foot or tail of the table; and it consists in the arrangement of parts and details of construction, as will be hereinafter set forth in the drawings and described and pointed out in the specification. Ordinarily the table or concentrating-surface of this class of concentrators has its working face provided with or covered with a series of riffles extending longitudinally from the head toward the foot of the table, the theory being that as the material to be separated, together with the water, is fed onto the table at its upper edge the downward travel or flow thereof across the face of the table will be obstructed or arrested by the longitudinal riffles and the valuable or heavier particles or portions of the material being caught or settling in the riffles will, owing to the longitudinally-reciprocating motion imparted to the table, be diverted from vertical travel and caused to move longitudinally toward the foot of the said table and be discharged at such point into a receptacle provided for this purpose. In actual working, however, complete recovery of all valuable particles or portions of the material fed onto the table does not take place under the operation just described and much of the lighter particles of the valuable portions is not recovered, but instead carried off with the gangue or waste material flowing or carried over the table. This is due to the fact that the material coming in contact with the riffles is moved or carried forward by the action of the table, while the water, with which the material is mixed, not being subjected to the action of the table, flows downward over the riffles at the head of the table with such violent action as to carry with it a large per cent. of the valuable particles of the material into the waste-sluice and at the same time bearing that portion of the material carried forward in the riffles in such condition as to require additional water-supply to assist in settling and separating the valuable particles contained therein.

The object of the present invention is to so construct the concentrating-table as to permit of the material to be treated and the water with which it is mixed to be more evenly distributed over the working face of the table and to obtain full control of the material during the operation of effecting a separation of the valuable portions from the gangue, thereby providing against loss of the valuable particles or portions of the material, which have heretofore been carried or washed down by the current or flow of water passing over the working face of the table.

To comprehend the invention, reference must be had to the accompanying sheet of drawings, forming a part of this application, wherein—

Figure 1 is a top plan view of the table. Fig. 2 is a diagrammatic sectional view on line $x\,x$, Fig. 1; and Fig. 3 is a cross-sectional view in elevation on line $y\,y$, Fig. 1.

In the drawings the letter A is used to indicate any suitable style of frame for the concentrator, within which is mounted to freely swing the concentrating-table, which in the present case consists of a frame A′, having a covering of narrow boards or strips B. Upon these boards or strips B is laid linoleum, oilcloth, or other covering B′, which constitutes the working face of the table. On this face or surface is secured an overflow-riffle B^2, which extends diagonally from the head end a of the table toward its foot edge or side, terminating at the point a' or lower edge of the table a distance from its head end. This overflow-riffle or obstructing-rib B^2 gradually decreases in height from its upper end toward its lower end, where its upper face is approximately flush with the surface or working face of the table. Joined to this diagonal riffle or rib is a series of longitudinal riffles or ribs C, each of which is located an equidistance apart and secured or attached to the working face of the table. These riffles or ribs extend longitudinally or lengthwise of the table toward its discharge end and preferably terminate a short distance from said foot or discharge end, so as to leave a plain or unriffled surface C′ at such end. The riffles or ribs C form a series of pockets or collecting-runways b, within which the material carried downward or crosswise of the table is caught and its travel diverted from crosswise of the table to lengthwise thereof. Each longitudinal riffle or rib C in height corresponds with the height of the diagonal overflow-riffle or rib B^2 at their points of juncture. Hence the table may be said to be provided on its working face with a series of longitudinal ribs which gradually decrease in height from the upper end of the table toward its lower end. Inasmuch as the flow of the water and material to be treated is strongest at the upper end of the table, it follows that the obstruction offered to the downward travel of the material should be greatest at such portion of the table and less resistance offered at its lower portion for the reason that the current is less at such portion. If the longitudinal riffles be of uniform height, a heavier flow of water will be required to wash the material downward than where the riffles are of unequal or gradually-reduced height. As stated, if of equal height a heavier flow of water is required, resulting in the material being washed over the upper riffles and "banking," so to speak, in the lower riffles, hence impairing the efficiency of the machine. However, by reducing or decreasing the height of the longitudinal ribs or riffles proportionately to that of the diagonal overflow-riffle or rib the material is permitted to flow gradually downward or crosswise of the table, and the work of each runway b being proportionately to the others as the body of material passed thereover and the obstruction offered by each riffle or rib being likewise in proportion to the force of the impelling stream or current of water at such points reaction of the water within the runways and carrying away of the lighter valuable particles of the material treated is prevented. As a consequence of this arrangement while the heavier valuable particles or portions will be mainly caught or settled in the upper runways of the table the lighter particles carried over such obstructing-ribs will settle, owing to their specific gravity and reduced flow of the water, within the lower runways, and thus be recovered or separated from the waste material and being carried forward to the unriffled portion of the table will be subjected to the action of clear water flowing thereover, and thus eliminated from the gangue with which it is mixed.

The diagonal overflow-riffle B^2 being placed, as shown, in line with the natural flow or path of the material confines the water with which the material is mixed and causes it to flow with the material, so as to wash or separate the base or worthless portion from that which is valuable, which base or worthless portion is carried over the diagonal riffle or rib, which decreases in height from the head toward the foot of the table for this purpose. This diagonal overflow-riffle or rib thus serves as an obstruction for confining the water at such end of the longitudinal riffles and preventing the same flowing too freely over such portion of the table and carrying the material containing valuable particles or portions therewith, although it permits the downflow of the water after being retarded for such time as to permit settling of the valuable particles. This riffle or rib thus acts as a restraining-wall. If it were not for this rib, all the material flowing at the head of the table would be washed away by the flow of the water, and if said rib or riffle extended straight, so as to form an end wall for the table, it would simply serve to cause the material to bank at such point and to throw the full current of water toward the foot of the table in order to wash or carry away the lighter valuable portions.

The concentrating-table is secured to the slides 1 2, which work in guides 3 of the adjustable frame 4, said frame being hinged at one side to the fixed frame A. By means of the adjusting-screw 5 the transverse inclination may be increased or decreased by raising or lowering the adjusting device. Below the table is secured the rod 6, which projects beyond the forward end of the table. This rod is thrown inward by means of the cam 7, mounted upon the drive-shaft 8, and is suddenly thrown outward by means of the spring 9, which surrounds the rod 6. Any suitable form of mechanism may be employed to impart the necessary motion to the concentrating-table, that described being made use of only on account of its simplicity.

In the operation of the machine the material to be treated is fed onto the table at its upper corner, near the head end thereof, the same being carried downward by the flow of water fed upon the table with the material to be treated. The reciprocating motion imparted to the table is such as to carry the material forward or toward the foot or tail of the table, while the inclination of the table is such as to tend to permit of the material to flow downward or crosswise of the table. These two forces acting upon the material forces the same to pass over the table in a diagonal path, as indicated by the diagonal overflow-riffle or rib B^2. (Shown in the drawings.) As the material flows over the table the valuable particles or portions by reason of their specific gravity settle within the various runways b, formed by the longitudinal riffles or ribs C, and owing to the reciprocating motion of the table are gradually forced toward the foot or tail end of the table, while the base or worthless material is carried over the diagonal riffle or rib B^2 and conveyed toward the lower end or bottom of the table and discharged therefrom.

With the described arrangement of the riffles perfect separation is effected, pure concentrates are obtained, and the loss of valuable, although light, material is practically eliminated, thereby making this class of ore-concentrators efficient and successful for the separation and recovery of fine or light gold from the ore and gangue.

I am aware that instead of securing independent riffles or ribs to the working face of the table a sheet or layer of rubber may be stamped or molded with said riffles or ribs thereon and said sheet or layer be used as the working face of the table. Hence my invention contemplates such form of table—*i. e.*, whether the working face of the table has independent riffles or ribs applied thereto or whether the same be formed integral with said working face.

I am aware that it is not novel to provide a concentrating-table having a series of riffles or ribs longitudinally arranged upon the working face thereof, and I do not wish to be understood as claiming this feature *per se*, for such is disclosed in Letters Patent No. 609,804, granted to Samuel I. Hallott August 30, 1898; but I am not aware that riffles or ribs so arranged have been made use of in combination with a rib or riffle run diagonally across the working face of the table and from which rib or riffle the longitudinally-arranged ribs or riffles extend.

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

1. In an ore-concentrator of the described class, the combination with the concentrating-table, of an overflow-riffle or rib arranged diagonally across the working face thereof, and of a series of parallel riffles or ribs joined to said diagonal riffle or rib and extending longitudinally toward the foot or tail of the table.

2. In an ore-concentrator of the described character, the combination with the concentrating-table, having a movement whose tendency is to carry the material fed thereon toward the foot or tail of the table, of the overflow-riffle or rib arranged diagonally across the working face of the table and extending from its upper end to its lower side, a series of parallel riffles or ribs extending from the diagonal riffle or rib longitudinally toward the foot or tail of the table, and of a plain unriffled surface between the ends of the longitudinal riffles or ribs and tail of the table.

3. In an ore-concentrator of the described character, the combination with the concentrating-table, of an overflow-riffle or rib arranged diagonally across the working face of the table and extending from its upper end to its lower side portion, said riffle or rib decreasing in height from its upper to its lower end, and of a series of parallel riffles or ribs extending from the diagonal riffle or rib longitudinally of the table or toward the tail or foot of the table, said ribs or riffles being of a height corresponding with the height of the diagonal riffle or rib at the juncture of said ribs therewith.

4. As a new article a concentrating-table for ore-concentrators the working face of which is provided with a diagonal overflow-riffle or rib extending across the face thereof from its upper end to its lower portion and with a series of parallel riffles or ribs extending from the diagonal riffle or rib longitudinally of the table or toward the foot or tail thereof.

In testimony whereof I hereunto affix my signature, in presence of two witnesses, this 21st day of April, 1899.

WILLIS G. DODD

Witnesses:
WALTER F. VANE,
N. A. ACKER.

COMPLAINANTS' EXHIBIT No. 14

Pinder Patent No. 658,120

ALMON E. HART, Special Examiner

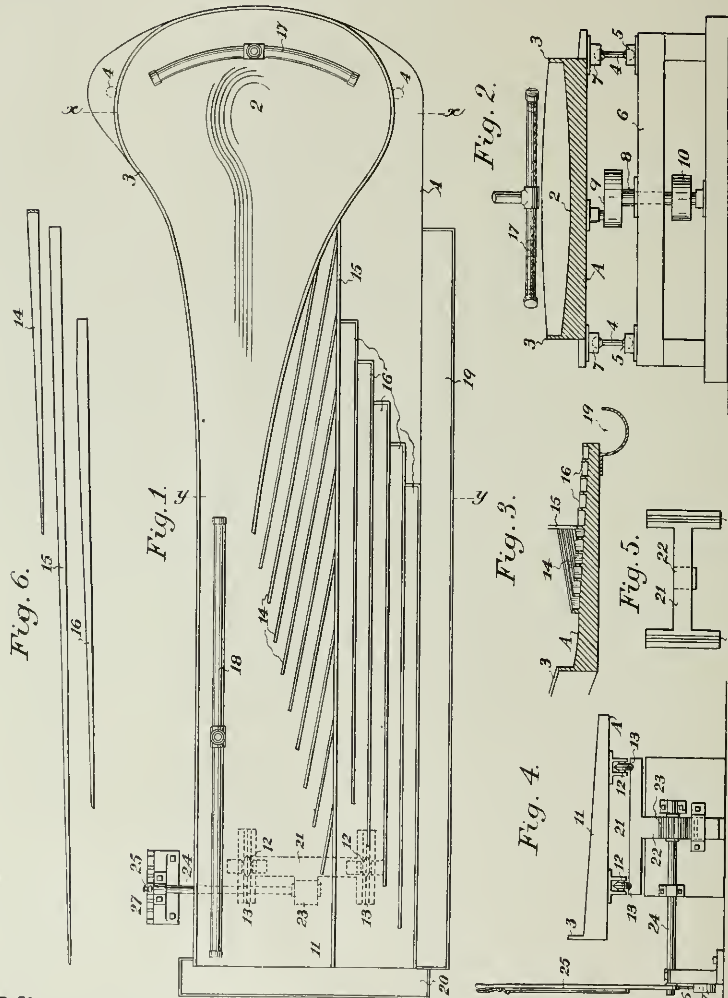
No. 658,120. Patented Sept. 18, 1900.

J. W. PINDER.

CONCENTRATOR.

(Application filed July 12, 1900.)

(No Model.)



Witnesses,

Ed Brandau

J. F. Amise

Inventor,

Joseph W. Pinder

By Dewey Strong & Co.

Attys

UNITED STATES PATENT OFFICE.

JOSEPH W. PINDER, OF GROVELAND, CALIFORNIA.

CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 658,120, dated September 18, 1900.

Application filed July 12, 1900. Serial No. 23,333. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH W. PINDER, a citizen of the United States, residing at Groveland, county of Tuolumne, State of California, have invented an Improvement in Concentrators; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to a device for first concentrating heavy materials and afterward separating the lighter and worthless material therefrom.

It consists of a table, the head of which is made concave, and the lower end connecting with said head portion is inclined both lengthwise and sidewise, and in conjunction with this table are a series of diagonally-disposed tapering riffles and another series of riffles parallel with the side of the table and separated from the first-named series and means for receiving the discharge from each series of riffles. The upper end of the table is supported upon vertical standards upon each side with heads which allow a perfect freedom of movement, and a vertically-disposed crank-wheel is connected with the central portion of the head, so that a revolving motion is given to the head, while the lower end of the table is supported upon wheels or rollers which allow a longitudinal movement of this end, the compound movements serving to first concentrate and afterward separate the material.

My invention also comprises details of construction which will be more fully explained by reference to the accompanying drawings.

Figure 1 is a plan of the concentrator. Fig. 2 is a transverse section on the line x x of Fig. 1. Fig. 3 is a transverse section on the line y y of Fig. 1. Fig. 4 is an end elevation. Fig. 5 is a plan of the grooved tracks. Fig. 6 shows elevations of some of the riffles.

The table A is made, preferably, of light wood or of other suitable material, and its upper end forms an enlarged rounded head, which narrows into the body and extends to any suitable length to form the lower portion of the table. This upper or head portion of the table is made slightly concave, as shown at 2, and it has a rim 3 around it of sufficient height to prevent the escape of material therefrom. This table is supported upon short vertical standards 4, which may have ball-bearings or other suitable heads, and these heads at the lower end rest in sockets at 5, which are supported upon the frame-timbers or other supports 6. The upper ends of the standards fit in similar sockets 7, which are fixed to the table at each side of the head. Intermediate between these supports is a vertical shaft 8, having a crank-wheel 9 upon it, the crank-pin of which connects with the lower part of the table, and power is derived to rotate the crank-shaft from any suitable source through a belt in the pulley 10, fixed upon the shaft 8, so that the rotary motion of this head portion is produced, the standards 4 having a universal movement, so that they easily follow the movement of the crank. This motion serves to concentrate and settle the heavy material in the deeper portion 2 of the head, and as the material accumulates it gradually flows outward down the straight portion of the table, the concaved depression of the head gradually merging itself into the lower or tail portion of the table. This lower end 11 of the table is supported upon journaled wheels 12. These wheels run in grooved tracks, as at 13, so that the rotary motion imparted to the head of the apparatus becomes a longitudinal shaking motion at the lower end.

Upon one side of the table are the riffles 14, which consist of tapering strips, the higher ends of which connect with an upwardly-projecting rib 15, and this rib separates the riffles 14 from another series of riffles 16, which are upon the outer side of the rib and toward the edge of the table, as shown. These ribs are all deepest at their upper ends and gradually taper down to a point where the lower ends terminate upon the table.

Material is fed into the upper end of the apparatus in any desired regular manner, and a supply of water is discharged into the head of the table through a curved perforated pipe 17.

A second water-supply pipe 18 is located at a suitable point along the side of the table opposite the riffles and the operation will then be as follows: The apparatus being set in motion the rotary movement of the head of the table concentrates the heavy portion into the central part of the head, while the lighter portion upon the surface gradually flows down toward the foot of the table. The body of concentrates accumulates in the concavity of the table, and when a sufficient amount has been settled they begin to flow downward; but by reason of the incline of the table they will also flow over the riffles 14 successively, and the lighter material flowing over these riffles with the concentrates will also flow over the interposed rib 15 and into the riffles 16, the angle of which, as before stated, differs from the angle of the riffles 14, as plainly shown in the drawings. The "seconds," so called, flowing over this rib 15 into the riffle 16 are rapidly separated from the concentrates and the latter are also graded by the various ribs or riffles over which they pass. Material which passes over the edge of the table is received into a trough 19, which conveys it away, and the concentrates which reach the lower end of the table are similarly received into a conducting trough or chute 20.

In order to vary the grade of the table to suit the character of the material which is being treated, I have shown the grooved tracks 13, connected by a cross-timber 21, which is supported by a vertical standard 22, having rack-teeth upon one side, and these rack-teeth are engaged by a pinion 23, mounted upon a suitably-journaled shaft 24. The outer end of this shaft has fixed to it a hand-lever 25, with a suitable spring-controlled pin at the lower end, as at 26, and this pin is adapted to enter holes in a concaved segment 27, so as to hold the device at any desired point of adjustment. Thus the grade of the table in the direction of its length can be readily changed at any time to suit the conditions of the material which is being acted upon.

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

1. In a concentrator, a table having a rounded, concaved head with a surrounding rim, an extension into which said head gradually merges, said extension being inclined from one side toward the other, and also inclined in the direction of its length, standards supporting the opposite sides of the head and capable of universal movement, a crank connection with the center of the head whereby a rotary movement is produced, and rollers upon which the lower end of the table is supported whereby a longitudinal movement of this end of the table is produced, and riffles upon the lower side of the table.

2. A concentrating-table consisting of a rounded head with the bottom sloping gradually to the center, and a peripheral rim, an extension forming the lower end of the table into which the concavity of the head merges, said extension being inclined transversely, means whereby a rotary movement of the head and a longitudinal reciprocating movement of the lower end of the table are produced, a series of divergent riffles extending from the side of the table toward th center a rib parallel with the side of the table against which the upper ends of said riffles abut, and a second series of riffles exterior to the rib and parallel with the side of the table.

3. A concentrating-table consisting of a rounded head having a bottom sloping toward a central point and a surrounding rim, the lower end of the table forming a continuation of said bottom into which it merges, said lower end being approximately flat and inclined longitudinally and also transversely with a rim upon its upper edge, pipes by which water is delivered into the head portion and along the sides of the lower portion, a tapering rib connecting with the rim of the head portion and extending toward the lower end, approximately parallel with the discharge side of the table, tapering riffles having their deeper ends contacting with the tapering rib and diverging toward the center of the table, other tapering riffles exterior to the rib and approximately parallel with the side of the table, troughs at the lower discharge side and end respectively to receive the materials separated upon the table and means whereby a rotary motion of the head, and a longitudinal movement of the lower end of the table are simultaneously produced.

4. A concentrator comprising a table having a rounded concaved head, with surrounding rim, the lower end forming a continuation of the bottom of the head portion and inclined longitudinally, and from one side to the other with a series of ribs and riffles for separating the materials flowing down the table, standards supporting the opposite sides of the head and having a universal movement, a crank-shaft connecting with the central portion of the head, and means for rotating said shaft to produce a rotary movement of the head, rollers journaled to the lower end of the table, guiding supports upon which the rollers are adapted to travel, a stem upon which said supports are carried having rack-teeth upon it, a pinion mounted upon a horizontally-journaled shaft engaging the rack-teeth of the stem, a lever fixed to the shaft by which it is turnable to raise or lower the table-support and change the grade thereof, and a spring-presssd pin and segment whereby the parts are retained at any position of adjustment.

In witness whereof I have hereunto set my hand.

J. W. PINDER.

Witnesses:
E. G. STINE,
W. B. FORSYTH.

COMPLAINANTS' EXHIBIT No. 15

Dodd Patent No. 676,427

ALMON E. HART, Special Examiner

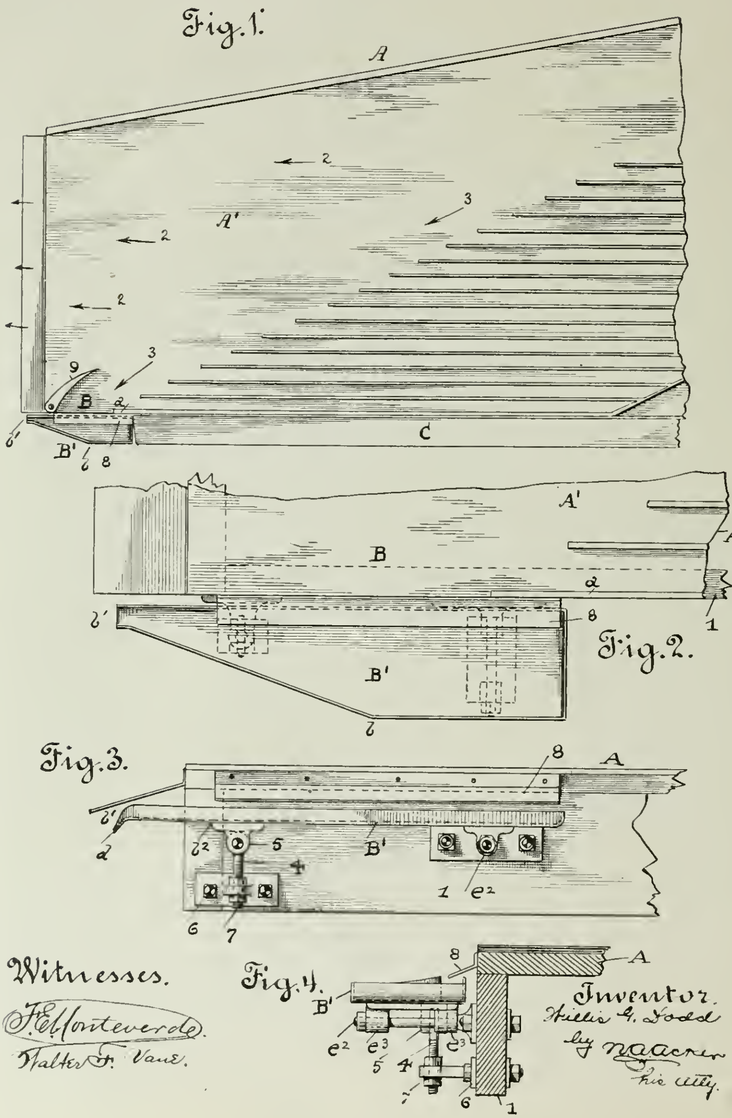
No. 676,427. Patented June 18, 1901.

W. G. DODD.

ATTACHMENT FOR CONCENTRATING TABLES.

(Application filed Aug. 30, 1900.)

(No Model.)



UNITED STATES PATENT OFFICE.

WILLIS G. DODD, OF SAN FRANCISCO, CALIFORNIA.

ATTACHMENT FOR CONCENTRATING-TABLES.

SPECIFICATION forming part of Letters Patent No. 676,427, dated June 18, 1901.

Application filed August 30, 1900. Serial No. 28,492. (No model.)

To all whom it may concern:

Be it known that I, WILLIS G. DODD, a citizen of the United States, residing in the city and county of San Francisco, in the State of California, have invented certain new and useful Improvements in Attachments for Concentrating-Tables; and I do hereby declare the following to be a full, clear, and exact description of the same.

Practical working of this class of machinery has proven that a certain proportion of the gold or valuable particles is carried off with what is known as "middlings," and is thus lost or remains unseparated unless reconveyed to the concentrating-table to be reworked. This is especially true in connection with the working of the ore by the use of what is known as the "transverse riffled reciprocating table," or such as have a plain or unriffled zone of flow at the extremity of the riffled surface of the table. With this class of tables the main separation takes place within the riffles of the table, while final separation of the valuable particles is made upon the plain or unriffled portion of the table during the travel of the concentrates toward the discharge end thereof. While passing over this portion of the table the concentrates are subject to the action of clear water in order to wash the same and separate the sand or base or worthless portions therefrom. This current or flow of water is sufficient to carry the extreme fine float-gold with the sand. This mixture of the sand and fine gold is termed "middlings." It is the recovery of fine gold from this class of material to which the present invention relates.

The object of the invention is to provide a simple and inexpensive attachment for the table, by means of which the middlings discharged may be reworked by the action of the table proper, the attachment being so arranged that it may be adjusted to meet the requirements of the material to be worked.

In order to comprehend the invention, reference should be had to the accompanying sheet of drawings.

Figure 1 is a top plan view of a concentrating-table, partly broken away, with the attachment applied thereto. Fig. 2 is an enlarged detail view of the attachment illustrated in Fig. 1. Fig. 3 is a side view in elevation of the mechanism disclosed by Fig. 2 of the drawings, and Fig. 4 is an end view in elevation of the attachment viewed from the feed end of the table.

In the drawings the letter A is used to indicate an ordinary riffled concentrating-table having a plain or unriffled portion A′. This unriffled portion constitutes the zone of flow of the material discharged from the riffled portion A^2 of the table. To the side of the table, at the discharge-end portion B for the middlings, is secured the attachment B′. This attachment has the action of a miner's "horn" and for such reason shall hereinafter be termed a "horn attachment." Said horn attachment extends from approximately the extremity of the lowermost riffle a to the discharge end of the table. Any suitable shape may be given thereto; but I prefer to gradually incline the outer wall or side thereof from approximately point b toward its discharge end b'. The bottom of the horn is also slightly upwardly inclined from b^2 toward its discharge end b', which discharge end preferably terminates in a downwardly curved or inclined lip d, Fig. 3. By thus constructing the side wall and inclining the bottom of the horn the material or middlings discharged therein may be worked to much better advantage, as greater resistance is offered to its outflow.

The forward end of the horn B′ is pivotally secured or fulcrumed to the bottom edge 1 of the table by bolt e^2, which passes through eyerings e^3, attached to the bottom of the horn. The discharge-end portion of the horn is supported by the adjustable bolt 4, which is fulcrumed between ears 5, depending from the horn, Figs. 3 and 4. This screw-bolt passes through plate 6, attached to bottom edge 1 of the table, and it is raised or lowered by adjusting-nuts 7. These supporting features of the discharge end of the horn may be said to constitute an adjustable support or hanger, by means of which the inclination of the horn may be varied, so as to regulate or adjust the horizontal of the horn in accordance with the requirements of the material to be treated.

Any suitable style of mechanism may be employed for uniting the horn to the table and providing for such adjustment as may be required. I have shown and described the simplest form of means for such purpose; but, as stated, these may be varied as desired or practical working prove expedient.

The body of the tailings flows over the riffles onto the launder C, from which it is discharged in any suitable manner.

The travel of the concentrates is represented by arrows 2, while the flow or path of the middlings is indicated by arrows 3. Heretofore it has been customary to rework the middlings upon the table, an elevator being employed for the purpose of reconveying the same thereto.

To the edge 1 of the table is attached plate or apron 8, which serves to convey the middlings discharged from the zone of flow into the horn B. This plate is utilized by reason of the fact that the horn is located a slight distance below the surface of the concentrating-table.

There is hinged or fulcrumed to the face of the concentrating-table, near the lower discharge corner of the zone of flow, the deflecting finger or plate 9. This plate is so regulated as to deflect onto the plate 8 such of the middlings as have a tendency to pass over the discharge end of the table at this point due to the impelling force of the table.

Such material as discharges into the horn B′ is subjected to a horning action due to the reciprocating motion of the table. During the movement of the horn the heavier or precious particles contained in the middlings, owing to their specific gravity, settle to the bottom of the horn and gradually work upward therein until finally discharged from end b' thereof, the worthless portion of the middlings being gradually worked over the opposite end thereof.

If the material to be collected from the middlings is heavy, then the inclination of the horn may be slight, while if the recovered material proves to be exceedingly light, then the inclination of the horn is so adjusted as to confine the material for a longer time therein.

Having thus described the invention, what I claim as new, and desire to secure protection in by Letters Patent, is—

1. The combination with a reciprocating concentrating-table, of a horn attachment secured thereto and carried thereby so as to receive and work the middlings discharged therefrom, said attachment extending from approximately the discharge end of the lowermost riffle of the table to the discharge end of said table, the discharge end of the horn attachment being contracted.

2. The combination with a reciprocating concentrating-table, of a horn attachment secured thereto and carried thereby so as to receive and work the middlings discharged therefrom, said attachment extending from approximately the discharge end of the lowermost riffle of the table to the discharge end of said table, the discharge end of the horn attachment being upwardly inclined, and a deflecting finger or plate secured to the surface of the table for deflecting the middlings into the horn attachment.

3. The combination with a reciprocating concentrating-table, of a horn attachment secured thereto so as to receive and work the middlings discharged therefrom, and a plate or apron for conveying the middlings into the horn attachment.

4. The combination with a reciprocating concentrating-table, of a horn attachment secured thereto so as to receive and work the middlings discharged therefrom, an apron or plate for conveying the middlings into the horn attachment, and a deflecting finger or plate for guiding the said material onto said plate or apron.

5. The combination with a reciprocating concentrating-table, of a horn attachment adjustably secured thereto so as to receive and work the middlings discharged therefrom.

6. The combination with a reciprocating concentrating-table, of a horn attachment fulcrumed thereto which receives and works the middlings discharged therefrom, and means for adjusting the inclination of the horn attachments.

In witness whereof I have hereunto set my hand.

WILLIS G. DODD.

Witnesses:
N. A. ACKER,
WALTER F. VANE.

COMPLAINANTS' EXHIBIT No. 16

Taylor Patent No. 682,371

ALMON E. HART, Special Examiner

No. 682,371. **Patented Sept. 10, 1901.**

H. P. TAYLOR.

ORE CONCENTRATOR.

(Application filed Jan. 7, 1901.)

(No Model.) **2 Sheets—Sheet 1.**

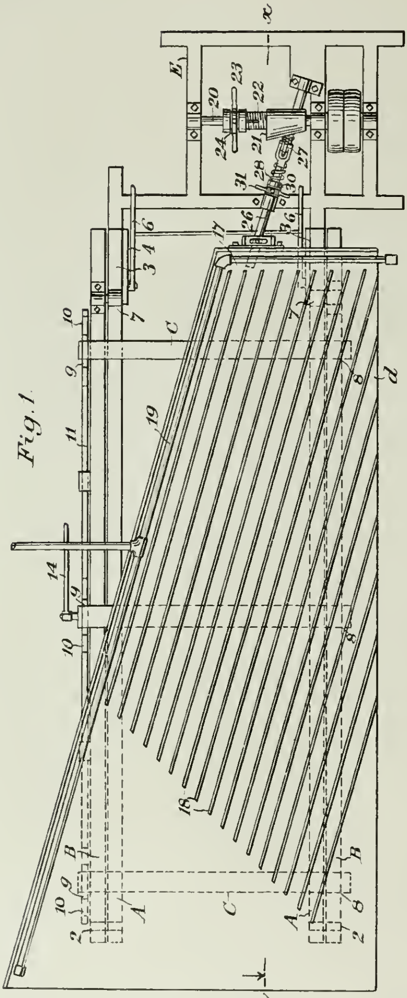


Fig. 1.

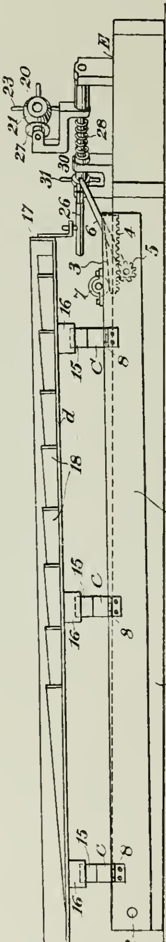


Fig. 2.

Witnesses,

E. A. Brandau

J. H. Amee

Inventor

Harry P. Taylor

By Dewey Strong & Co.

Atty.

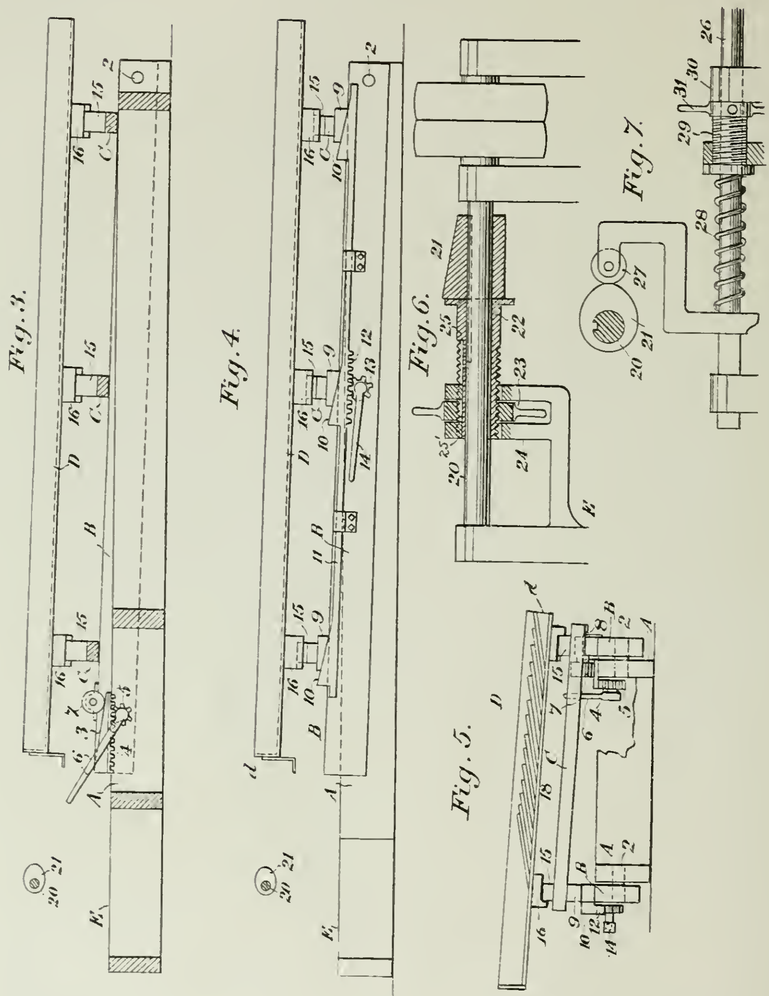
No. 682,371. Patented Sept. 10, 1901.

H. P. TAYLOR.

ORE CONCENTRATOR.

(Application filed Jan. 7, 1901.)

(No Model.) 2 Sheets—Sheet 2.



Witnesses,
E. A. Brandau
[illegible]

Inventor,
Harry P. Taylor
By Dewey Strong & Co.
att'ys

UNITED STATES PATENT OFFICE.

HARRY PICOTTE TAYLOR, OF HOWARD, OREGON, ASSIGNOR OF ONE-FOURTH TO W. P. KEADY, OF SAME PLACE.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 682,371, dated September 10, 1901.

Application filed January 7, 1901. Serial No. 42,344. (No model.)

To all whom it may concern:

Be it known that I, HARRY PICOTTE TAYLOR, a citizen of the United States, residing at Howard, county of Crook, State of Oregon, have invented an Improvement in Ore-Concentrators; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to improvements in concentrating-tables whereupon ores are separated from the refuse tailings and from each other according to their specific gravities.

It consists, essentially, of a horizontally-inclined support, a transversely-inclined bed upon this support, means by which these inclines may be varied, a shaking-table upon this bed, means by which a movement is given to this table oblique to the horizontal line of the support, means by which the length of this movement or stroke may be regulated, and of details more fully explained by reference to the following specification and accompanying drawings.

Figure 1 is a plan of my invention. Fig. 2 is a longitudinal elevation. Fig. 3 is a part section and elevation on the line x x of Fig. 1. Fig. 4 is a rear elevation. Fig. 5 is an end view. Figs. 6 and 7 are detail views of the driving mechanism.

The object of my invention is to provide a device in which I get the widest range of position and movement possible for the concentrating-table as may be best adapted to the varying kinds and grades of ores under treatment. It is capable of being given a longitudinal, a transverse, and a diagonal tilt at one and the same time, or it may be given any of these tilts singly, or it may remain horizontal, and in any of these positions the movement or length of stroke of the table is capable of variation at will.

Having reference to the drawings, A is a suitable foundation or base on which the mechanism is supported. A frame B, composed of horizontal timbers suitably connected, is pivoted at one end, as at 2, to the base A, so as to be capable of being given a longitudinal tilt. This tilting is effected by an inclined-plane lifting mechanism secured upon the parts of the base and the frame near the opposite end from the pivot 2, as follows: On each of the longitudinal pieces of the base A are similar sliding wedges 3, having projecting flanges by which their position on these pieces is maintained. One of these flanges of each wedge is notched to form a rack-bar 4. A pinion 5, having an axle journaled in the base, engages with the rack and by suitable means, as a lever 6, is operated to move the wedge. Secured upon the frame B are rollers 7, which are adapted to engage the inclined faces of the wedges 3. A simultaneous movement of the levers moves the wedges forward or backward and correspondingly raises or lowers the end of the frame. A bed portion C is hinged at 8 to the frame B. By means of these hinges the bed C is transversely tilted by a mechanism somewhat similar to that used in giving the frame its longitudinal tilt. Upon the opposite side of the bed from the hinges are the wedge portions 9, fitted so as to slide upon the inclines 10, carried upon a rod 11, which latter is secured to the longitudinal portion of the frame B. The under side of this bar is provided with a rack 12, and a pinion 13, journaled in the frame, engages this rack and is actuated, as by means of a lever 14. Thus by means of the lever 14 the wedges 10 are simultaneously moved and the lateral tilt of the bed and the table varied. This table D is supported above the bed in such manner that the table may be given a rocking or sliding movement in a direction oblique to the length of the machine. Such mounting I have shown by the standards 15 upon the bed, having their ends adapted to fit the cleats 16 on the bottom of the table and form sliding bearing-surfaces. The table is of irregular shape, having its "head" end narrowed. The pulp is fed in, as at 17. Parallel with the longer and outer edge of the table are the riffles 18, which may be either rectangular or otherwise formed in any well-known manner. Water is fed along the side and end of the table from the trough or perforated pipe 19. The object of making this table with its outer edge longer is to compensate in a manner for the longitudinal tilting of the table and to raise that edge of the concentrate end which would naturally be lower, so that the water may tend to flow toward the head and be equally distributed over the table. Furthermore, for reasons soon to be shown, the valuable particles or the "concentrates" will be carried "uphill" toward the concentrate or broad end of the table by means of the riffles and the shaking of the table, while the slime will flow off on the lower or "tailings" side *d*. A differential reciprocating movement in the direction of the riffles is given to this table in the following manner: At the head end of the machine a horizontal shaft 20 is journaled in a framework E and has suitable driving connections with a source of power. Upon this shaft is a cone-shaped cam 21. A sleeve 22 upon the shaft has one end abutting against the base of the cam, and the other end is threaded, on which the stroke-adjuster 23 is turnable. This adjuster is held between the guides 24 on the framework E. The sleeve 22 is prevented from turning on the shaft by means of a longitudinal groove 25 in the sleeve, in which a projection or lug 25′ on the frame engages. To the head of the table is attached an arm 26. The outer end of this arm has a wheel 27, running on the face of the cam. This wheel is kept against the cam by reason of a spring 28. The tension of this spring is regulated by a flanged sleeve 29 upon the arm. This sleeve is exteriorly threaded and is turnable in a threaded projection 30 of the framework E and is operated by means of the spokes 31. By means of the movable sleeve 22 upon the shaft 20 acting against the cam to move the latter so the wheel 27 runs upon a greater or less circumference of the cam I am able to give any desired length of stroke or "shake" to the table. This ability to change the shake of the table is of great value in many instances. The cam is given such a periphery that a differential movement is gained—*i. e.*, the table comes to a quick stop on the concentrate end of its stroke and to a gradual stop at the other end. As previously indicated, the table is capable, further, through means of the inclined wedges, of being given a longitudinal tilt and a transverse tilt. These features, coupled with the oblique shaking movement, gives a differential motion to the table, which, with the angle of the riffles, throws the valuable particles toward the concentrate end of the table and effects a cleaner and closer saving than is usual in concentrating-tables, this by reason that the slime is carried in another direction—*i. e.*, toward the lower side *d*—and the particles have more freedom to separate according to their relative specific gravities. Furthermore, it has been found that by the use of this machine the finely-ground ore may be concentrated in a dry state, a feature that is of immense value in dry and arid localities, where conservation of water is of first importance in all operations.

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

1. In a concentrator, the combination of a longitudinally and transversely inclined support, and a table mounted thereon said table being of irregular shape with a narrowed head end, riffles upon the table arranged parallel with the outer or longer side thereof and diagonal to the said support, and means by which the table is given an endwise reciprocating movement oblique to longitudinal axis of the machine, and in the line of said riffles.

2. In a concentrator, the combination with a base of a frame pivoted thereon, means by which the frame may be inclined longitudinally, a bed hinged on this frame and capable of being given an incline transverse to the frame, a table upon this bed, said table being of irregular shape and diverging from its head end, and having riffles parallel with its outer or long side and diagonal to the bed, and means by which the table may be given an endwise-reciprocating movement oblique to the longitudinal axis of the machine, and in the line of the riffles.

3. In a concentrator, a table having a narrow head end, and gradually increasing in width toward the foot having parallel riffles extending in a line oblique to the longitudinal axis of the table and parallel with the longer or outer side of the table, and means by which this table may be given a reciprocating movement in the line of these riffles.

4. In a concentrator, the combination with a base, of a frame pivoted at one end thereon, inclined wedges slidable upon the base, bearing-surfaces fixed upon the frame which engage these wedges and means by which the wedges are moved and the frame given a longitudinal tilt, a bed hinged upon the frame, and means by which the bed is laterally tilted, a table carried upon the bed having parallel riffles oblique to the axis of the machine, and extending in uphill direction, and means by which the table is given a reciprocating movement in the direction of the riffles.

5. The combination with a concentrator-table and means by which it may be longitudinally and transversely tilted, means whereby this table may be differentially reciprocated obliquely to the longitudinal axis of the table, said means consisting of a shaft, a cone-shaped cam slidable upon this shaft, a sleeve upon the shaft and also slidable thereon, and abutting against the base of the cone, said sleeve having exterior threads, a nut thereon held between guides by which the sliding movement of the sleeve on the shaft is effected, and the cam moved, and means whereby the sleeve is kept from turning, an arm upon the head of the table and carrying a wheel which runs on the periphery of the cam, means by which the contact of the wheel against the cam is maintained.

6. The combination in a concentrator of a longitudinally-tilted frame, and means by which this tilt may be varied, a transversely-tilted bed upon this frame and means whereby its tilt may be varied, a table mounted thereon having one side inclined outward from the axis of the machine and in the di-

rection of the foot end of the table, means by which water is fed to the table along this longer outer edge, riffles parallel with this longer edge, and means by which this table is given a differential reciprocating movement in the direction of the riffles and whereby the concentrates are made to travel "uphill" upon the table.

7. In an ore-concentrator, the combination with a longitudinally and transversely tilted table, said table having its outer and upper edge divergent from the axis of the machine, riffles of graduated lengths parallel with this upper edge and diagonal to the head end, and means whereby this table is given a differential reciprocating movement in the direction of this upper edge.

In witness whereof I have hereunto set my hand.

HARRY PICOTTE TAYLOR.

Witnesses:
B. F. AHALT,
M. MULVAHILL.

COMPLAINANTS' EXHIBIT No. 17

Lehrritter Patent No. 696,058

ALMON E. HART, Special Examiner

No. 696,058. Patented Mar. 25, 1902.

J. A. LEHRRITTER

CONCENTRATOR.

(Application filed Oct 30, 1900.)

(No Model.) 3 Sheets—Sheet 1.

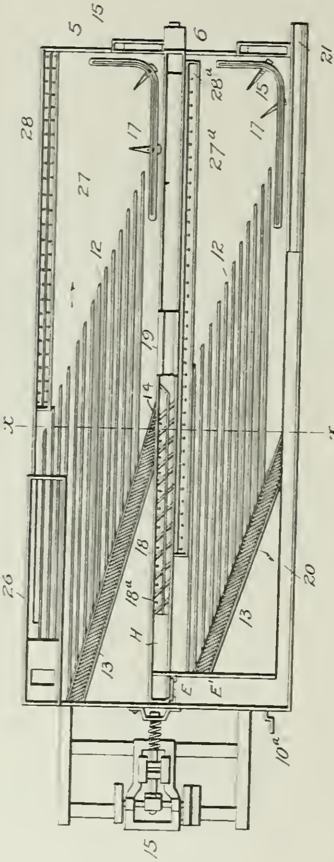


FIG. 1

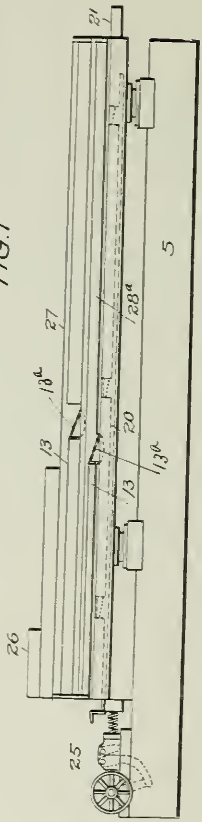


FIG. 2

WITNESSES

P. J. Rollandet

Dora C. Fluck

INVENTOR

John A. Lehrritter

BY

A. W. Bode ATTORNEY

No. 696,058. Patented Mar. 25, 1902.

J. A. LEHRRITTER.

CONCENTRATOR.

(Application filed Oct. 30, 1900.)

(No Model.) 3 Sheets—Sheet 2.

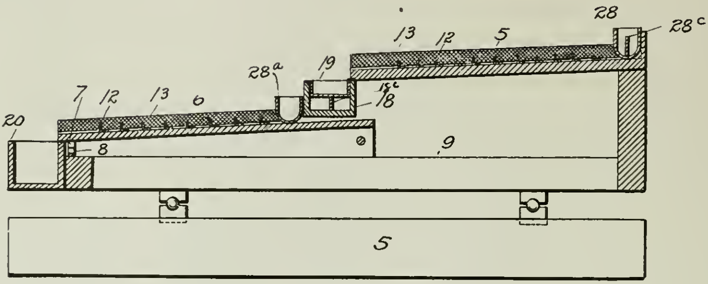


FIG.3

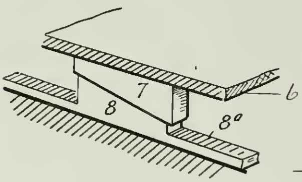


FIG.4.

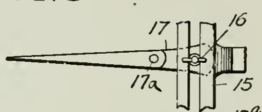


FIG.5

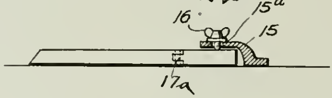


FIG.6

FIG.7

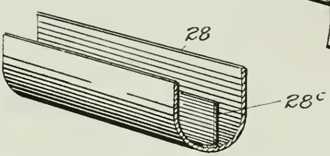
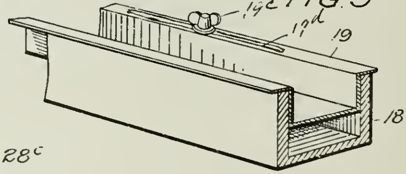


FIG.9



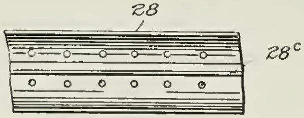
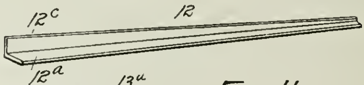


FIG.8

FIG.10



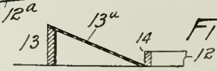


FIG.11

WITNESSES:

G. J. Gallaudet.

Dora C. Shick

INVENTOR.

John A Lehrritter

BY

ATTORNEY

No. 696,058. Patented Mar. 25, 1902.

J. A. LEHRRITTER.

CONCENTRATOR.

(Application filed Oct. 30, 1900.)

(No Model.) 3 Sheets—Sheet 3.

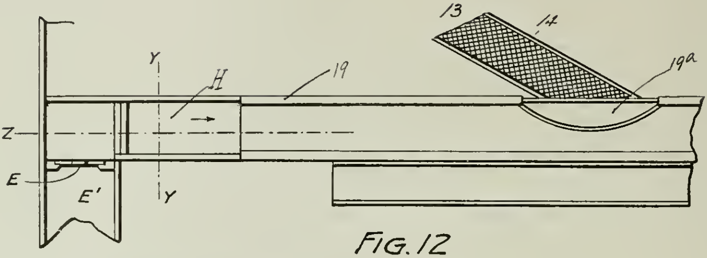


FIG. 12

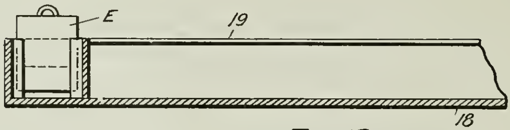


FIG. 13

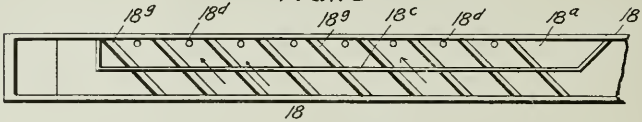


FIG. 14

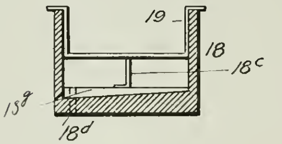


FIG. 15

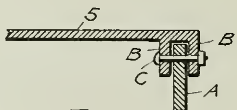


FIG. 16

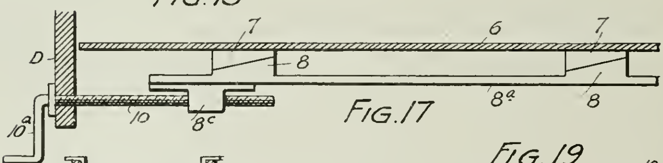


FIG. 17

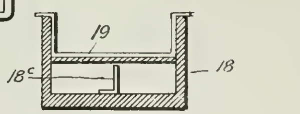
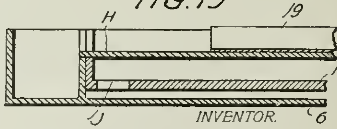


FIG. 18.

FIG. 19



WITNESSES:

G. J. Collandet.

Dora C. Shick

INVENTOR.

John A. Lehrritter.

BY [illegible signature] ATTORNEY.

UNITED STATES PATENT OFFICE.

JOHN A. LEHRRITTER, OF DENVER, COLORADO.

CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 696,058, dated March 25, 1902.

Application filed October 30, 1900. Serial No. 34,965. (No model.)

To all whom it may concern:

Be it known that I, JOHN A. LEHRRITTER, a citizen of the United States of America, residing at Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Concentrators; and I do 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, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in means for concentrating pulverized ore or other material containing mineral values and effecting a separation of the said values from the gangue.

The invention embodies certain features of construction intended to improve and perfect the apparatus set forth in Patent No. 660,342, dated October 23, 1900, all of which will be fully understood by reference to the accompanying drawings, in which—

Figure 1 is a top or plan view of a concentrating apparatus equipped with my improvements. Fig. 2 is a side elevation of the same. Fig. 3 is a cross-section taken on the line x x, Fig. 1. Fig. 4 is a perspective view illustrating the construction for changing the inclination of the lower table. Fig. 5 is an enlarged fragmentary top view of the slotted bar attached to the table, showing one of the separating-fingers in place. Fig. 6 is a section taken through the same. Fig. 7 is a perspective view, on a larger scale, of the divided feed-water trough. Fig. 8 is a top view of the same. Fig. 9 is a perspective view of an auxiliary sliding conveyer adjustably attached to the return-conveyer. Fig. 10 is a perspective view of a flanged metallic riffle. Fig. 11 is a section taken through the slime trough or conveyer. Figs. 12 and 13 are fragmentary top and side views of the upper table, illustrating the tailings trough or conveyer. Fig. 14 is a fragmentary top view of the return-conveyer, showing the slime-compartment. Fig. 15 is a cross-section taken through the same, showing the tailings-trough in place. Fig. 16 shows the manner of hinging the lower table to the upper table. Fig. 17 further illustrates the construction for adjusting the inclination of the lower table. Fig. 18 is a section taken through the return-conveyer on the line y y, Fig. 12. Fig. 19 is a section taken on the line z z, Fig. 12.

The same reference characters indicate the same parts in all the views.

Let the numeral 5 designate the relatively stationary base, upon which are mounted two table members 5 and 6, which are normally laterally inclined. (See Fig. 3.) The lower table 6 is hinged at its upper edge to the supporting structure, whereby it is independently adjustable to vary its inclination to correspond with the character of the material to be treated. The material treated by the lower table passes thereto from the upper table and consists of middlings or tailings material containing sufficient mineral values which have escaped from the upper table to justify retreatment. Hence the function of the lower table; but as the material passing to the lower table is different in character from that which is treated by the upper table it is often desirable to change the inclination of the lower table, so that it shall be different from the inclination of the upper table. This independent lateral adjustability of the lower table forms one of my improvements. It may be accomplished in any desired manner. As shown in the drawings, the lower table is provided with arms A, one of which is shown in Fig. 16. These arms are hinged to projections B on the upper table by means of bolts C. (See Fig. 16.) The lower portion of the table 6 is provided with blocks 7, having inclined lower faces, which are engaged by the inclined faces of blocks 8, attached to the bar 8^a. This bar is provided with a lug 8^c, having a threaded opening engaged by an adjusting-screw 10, which is journaled in a part D, stationary with reference to the table part 6. By turning this screw it is evident that the inclination of the table 6 may be regulated at pleasure.

The riffles 12 of each table are angular in cross-section, being provided with a bottom flange 12^a, forming a right angle with the vertical part 12. The riffles are so arranged that the flanges 12 project upwardly on the slope of the table's inclination, whereby their exposed edges form an obstruction or shallow riffle part, facilitating the catching of the concentrates on the riffled surface of the table.

The slime-troughs 13 extend diagonally across the head of the respective table members. Each slime-trough marks the line of the head extremities of the riffles. Along each of these troughs 13 and on the side adjacent the riffles is placed a rib or diagonal riffle 14 to prevent the finer concentrates from passing through the wire-cloth screen 13^a into the slime-trough. This screen 13^a occupies an inclined position and covers the top of each trough. The rib 14 causes an accumulation of water equal to the depth of the rib at the head of the table along the slime-trough to facilitate the concentration and settling of the mineral values. Without the rib 14 the water would be drawn off from the table through the slime-trough. In the operation of a table of this character its tail or the extremity farther to the right (see Figs. 1 and 2) is highest, causing the water to flow naturally toward the head of the table. Each table is provided at its lower right-hand corner with a slotted bar 15, bent around the corner of the table. Through the slot 15^a of this bar are passed thumb-screws 16, to which are attached separating-fingers 17, adapted to be adjusted to separate the concentrates from the middlings or to separate the concentrates into a number of different grades, as may be required. By loosening its thumb-screw any finger may be moved along the bar at will, the stem of the screw sliding in the slot of the bar.

Mounted upon the return-conveyer 18, which receives the middlings discharged from the upper table, is an auxiliary conveyer 19, which may be arranged to receive a grade of tailings containing no mineral values, whereby they may be discharged directly from the machine, thus avoiding the necessity of passing them over the concentrating-surface of the lower table, where they would only be a burden and interfere with the treatment of the middlings discharged thereon from the return-conveyer. These worthless tailings are discharged through an opening controlled by a gate E, whence they pass by way of a trough E', formed at the head of the table 6, to the tailings-conveyer 20 of the said table, whence they are discharged from the machine. It will be understood that whatever is discharged into the conveyer 20 of the lower table is supposed to contain no mineral values. This conveyer 20 of the lower table is also provided with a suitable slidable trough 21, supported on the upper edge of the conveyer and adapted to catch and save the middlings from the lower edge of the tail of the table in case it is desirable to save any portion of the tailings from said table.

The slime-trough 13 of the table 5 is arranged to discharge into a compartment 18^a, separated from the return-conveyer compartment by a partition 18^c. In the bottom of this compartment 18^a are formed a number of openings 18^d, through which the slimes pass to the lower table, whose upper edge projects under and below the lower edge of the upper table, whereby the slimes are delivered to the table 6 in the rear or to the right of (see Figs. 1 and 2) the discharge of the middlings to the said table from the head extremity of the return-conveyer 18, whereby these slimes are carried rearwardly or toward the tail of the table by the heavier material in front and saved with the concentrates at the discharge extremity or tail at the extreme right of the table 6. In the bottom of the slime-compartment 18^a are formed grooves 18^g, which are continued across the bottom of the main return-conveyer in order to catch any values that may settle as the material passes toward the head of the conveyer. Whatever is caught in these grooves passes in the direction indicated by the arrows (see Fig. 14) to the upper edge of the lower table and is treated in the same manner as the slimes.

A suitable reciprocating movement is imparted to the entire table construction by operating mechanism 25, which is covered by another application, filed October 15, 1900, Serial No. 33,176. Hence the said operating mechanism will not be described in detail. This operating mechanism, however, imparts a movement which is calculated to cause the concentrates to travel toward the tail of the table or in the direction indicated by the arrows in Fig. 1, while the tailings or gangue is carried downwardly and discharged from the lower edge of the table.

When the apparatus is in use, the material to be treated is discharged in the form of pulp into a feed-box 26, located at the upper left-hand corner of the table 5. (See Figs. 1 and 2.) From this feed-box the material passes to the riffled surface of the table, where the mineral values are caught by the riffles and carried to the plain surface 27 of the table, where the final separation of the mineral from the gangue is effected. The concentrates proper are discharged over the right-hand extremity of the table. (See Figs. 1 and 2.) The worthless tailings are caught by the trough 19, whose position is so regulated that it does not extend far enough toward the tail of the table to catch any middlings or tailings containing values. It will be understood that the nearer the tail of the table a discharge takes place the more likely is the discharged material to contain mineral values. Hence the position of the adjustable trough 19 may be regulated according to the material under treatment. The material caught by the trough 19 is discharged under the gate E into the trough E' and thence into the discharge-conveyer 20 of the lower table. The middlings are discharged into the return-conveyer 18 in the rear of the tailings-conveyer 19 and carried thereby to the lower table for retreatment, as explained in the aforesaid patent. The slimes which pass through the screen 13^a of the slime-trough of the upper table are carried downwardly by the trough 13 and discharged into the slime-compartment 18^a, the trough or conveyer 19 being cut away at 19^a for the purpose. (See Fig. 12.) These slimes which enter the compartment 18^a pass to the lower table, as heretofore explained. The middlings which pass to the lower table are treated in the same manner as the material discharged to the upper table, except that the tailings and slimes trough discharge passes directly into the discharge-conveyer 20, whence it passes as worthless material from the machine. If any values pass over the lower edge of the table 6, it will occur near the extremity of the table farther to the right, (see Figs. 1 and 2,) and these may be caught by the slidable trough 21 and conducted to a suitable receptacle (not shown) for retreatment.

The pure water necessary to effect the final separation of the material from the gangue on the plain portions 27 and 27^a of the tables 5 and 6 is fed to the tables from troughs 28 and 28^a, respectively. These troughs have perforated bottoms. The trough 28 is centrally divided by a partition 28^c. If a comparatively small amount of water is needed, feed-water from a source of water-supply (not shown) is only fed to one compartment of the trough 28. If, however, more wash-water is required, it is fed to both compartments of the trough, thus furnishing a double discharge.

Below the discharge extremity of the tailings-conveyer 19 is formed a partition H, upon which the tailings fall from the conveyer 19 and pass to the upper extremity of the trough E′ and thence into the body of said trough when the gate E is open. The middlings pass to the table 6 through an opening J, formed at the extremity of the return-conveyer 18.

The conveyer 21, heretofore mentioned, is particularly useful to collect the zinc from the lower edge of the table 6, near the tail thereof. This zinc would otherwise pass into the bulk of the tailings and require retreatment, which by this device is avoided. The separating-fingers 17 are provided with joints 17^a, whereby their direction may be changed at pleasure without loosening the set-screws 16.

In further explanation of the function of the metal riffles 12 it may be stated that by using the metal riffles it makes it practicable to employ a greater number of riffles without occupying any more space on the table; since the metal riffles may be formed much thinner than the wooden riffles.

The slidable trough or carrier 19 is held in place by a set-screw 19^c, passing through a slot 19^d, formed in the flange of the trough and made of sufficient length to permit the desired range of adjustability or sliding movement.

Having thus described my invention, what I claim is—

1. A concentrating apparatus comprising a laterally-inclined, riffled table, having a slime-trough extending diagonally across its head at the extremities of the riffles, and provided with a screen through which the slimes pass to the trough, and a rib arranged along the slime-trough between the lower edge of the screen and the riffled portion of the table, to dam the water and also prevent any of the settled concentrates from passing through the screen into the slime-trough.

2. In a concentrating apparatus the combination of two laterally-inclined table-sections, the lower of which is adapted to receive the tailings discharge from the lower edge of the upper table, a slime-trough arranged across the head of the upper table, riffles extending longitudinally on the upper table and terminating at the slime-trough, a return-conveyer for carrying the tailings from the lower edge of the upper table to the head of the lower table, and a compartment separated from the return-conveyer and adapted to receive the slimes from the slime-trough of the upper table, the said compartment being provided with an outlet allowing the slimes to pass to the lower table in the rear of the discharge from the return-conveyer.

3. The combination of two laterally-inclined table-sections, the upper section overlapping the lower section, a return-conveyer arranged along the lower edge of the upper table and adapted to carry the middlings from the upper table to the head of the lower table, a slime-trough arranged across the head of the upper table, and a compartment separated from the return-conveyer and adapted to receive the slimes from the slime-trough of the upper table, the bottom of the slime-trough being provided with escape-openings allowing the slimes to pass to the lower table in the rear of the discharge from the return-conveyer.

4. The combination of two laterally-inclined table-sections, so arranged that the lower edge of the upper table overlaps the upper edge of the lower table, a return-conveyer arranged along the lower edge of the upper table, and adapted to carry the middlings discharge to the head of the lower table, and an auxiliary conveyer located above the return-conveyer and adapted to catch the worthless portion of the tailings and discharge them from the machine.

5. The combination with a laterally-inclined concentrating-table, having a movement adapted to carry the concentrates over the tail of the table, of a slotted bar extending around the lower corner of the tail of the table, set-screws passing through the slot of the bar, and separating-fingers attached to the set-screws whereby the fingers may be adjusted at pleasure.

6. The combination of two laterally-inclined table-sections, a return-conveyer arranged along the lower edge of the upper table and adapted to carry the middlings from the upper table to the head of the lower ta-

ble, a slime-trough arranged diagonally across the head of the upper table, and a compartment separated from the return-conveyer and adapted to receive the slimes from the slime-trough of the upper table, the said compartment being provided with an outlet allowing the slimes to pass to the lower table in the rear of the discharge from the return-conveyer.

7. The combination with a laterally-inclined concentrating-table having a movement adapted to carry the concentrates over one extremity or the tail of the table, of a bar located at the lower corner of the tail of the table and one or more jointed separating-fingers connected with said bar and adjustable bodily thereon.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN A. LEHRRITTER.

Witnesses:

DORA C. SHICK,

G. J. ROLLANDET.

COMPLAINANTS' EXHIBIT No. 18

Smith Patent No. 660,342

ALMON E. HART, Special Examiner

No. 660,342

Patented Oct. 23, 1900.

J. P. SMITH.

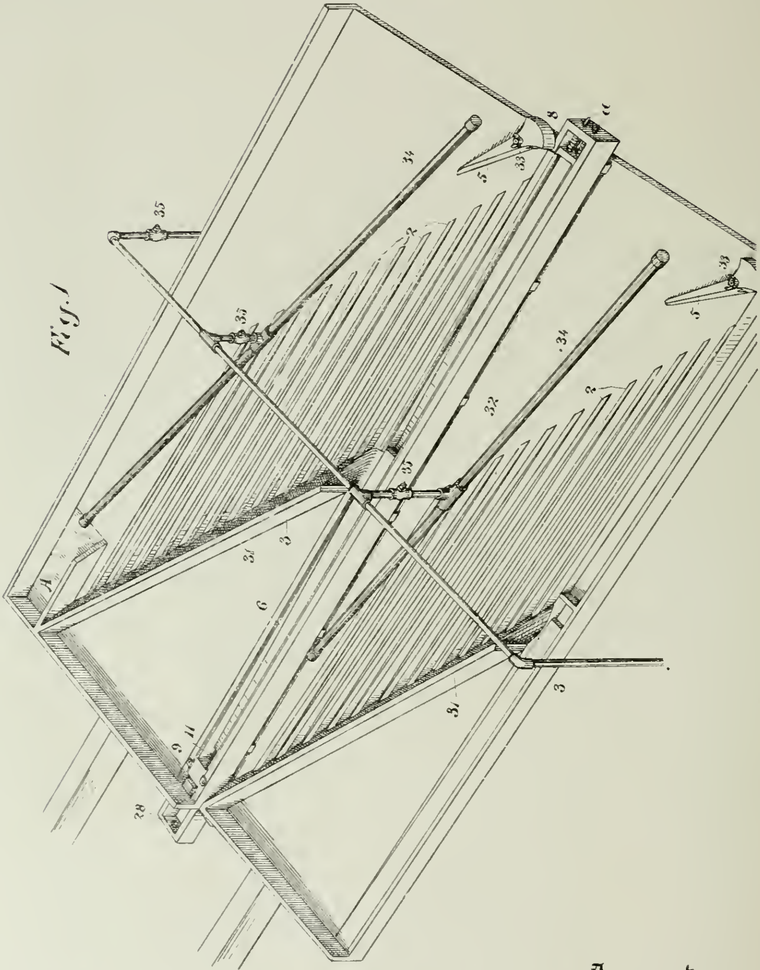
ORE SEPARATOR.

(Application filed Jan. 2, 1900.)

(No Model.)

3 Sheets—Sheet 1.

Fig. 1



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No. 660,342. Patented Oct. 23, 1900.

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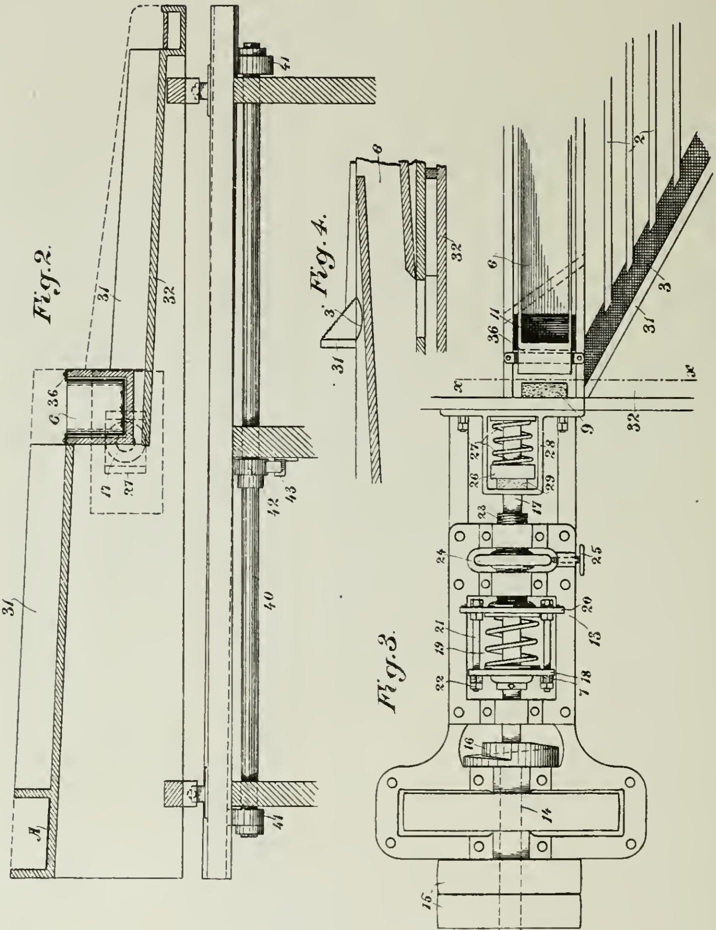
ORE SEPARATOR.

(Application filed Jan. 2, 1900.)

(No Model.) 3 Sheets—Sheet 2.



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No. 660,342. Patented Oct. 23, 1900.

J. P. SMITH.

ORE SEPARATOR.

(Application filed Jan. 2, 1900.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 5.

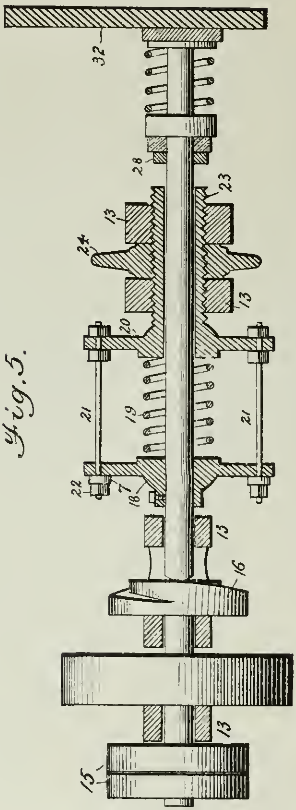
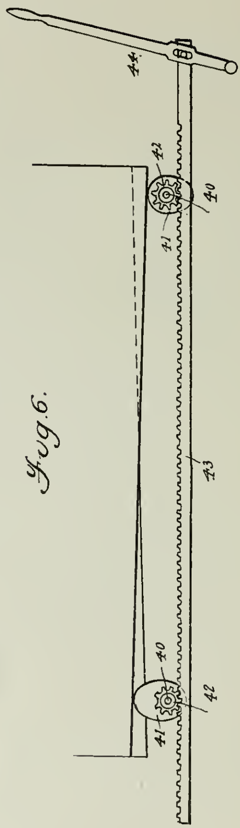


Fig. 6.



WITNESSES

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ORE-SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 660,342, dated October 23, 1900.

Application filed January 2, 1900. Serial No. 60. (No model.)

To all whom it may concern:

Be it known that I, JONATHAN P. SMITH, a citizen of the United States, residing in the city of Denver, county of Arapahoe, State of Colorado, have invented an Improvement in Ore-Separators; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to an apparatus which is designed for the separation of ores from their gangue and from other associated material as well as from each other.

It consists, essentially, of transversely-inclined shaking-tables having longitudinally-disposed guides, the ends of which lie in diagonal lines from one side to the other of the table, slime-conveyers, and one or more movable hinged fingers at the end of the table opposite the receiving-point. In connection with these tables is a return-conveyer, which receives the pulp from the first table and has a movement independent of that of the tables. In conjunction with these tables is a mechanism for producing a shaking movement.

The invention also comprises details of construction, which will be more fully explained by reference to the accompanying drawings, in which—

Figure 1 is a perspective view. Fig. 2 is a transverse vertical section through $x x$ of Fig. 3. Fig. 3 is a plan of the actuating mechanism. Fig. 4 is a partial longitudinal section of the central part of the return-conveyer. Fig. 5 is a longitudinal vertical sectional view of the reciprocating mechanism. Fig. 6 is a detail showing the rack-bar 43 and its pinions and the eccentrics for raising the ends of the table.

The object of this invention is to separate ores from their gangue and from each other. Ores frequently carry lead, sulfid of copper, iron pyrites, and zinc, and often chlorids and various other substances, and this ore and material it is the object of my invention to separate each into an individual class according to its specific weight.

The material to be treated is transferred from any usual or ordinary table or source of supply and delivered upon my apparatus, in which I am enabled to separate the various substances by difference in their specific gravity.

As shown in the drawings, A is the point on the upper table at which the pulp or concentrates are received either from other tables or from any other source of supply. The upper longitudinal edge of the table is approximately horizontal, and the table inclines from this side to the opposite one. Diagonally across the table and extending from the receiving-point to a point near the center of opposite side is the slime-conveyer 3. This consists of a shallow trough or excavation made in the surface of the table, having an elevated rail or bar 31 extending along its lower side and a fine wire-cloth screen extending from the upper edge of this rail to the surface of the table at the opposite side of the trough, so as to cover the channel or trough, and thus prevent the coarse material from entering this conveyer. Other forms may be used, the object being to collect and convey the slimes to a point of discharge. From the edge of the slime-conveyer guides 2 extend approximately parallel with each other in the line of the length of the table. These guides are here shown of essentially the same length; but by reason of their commencing at the line of the diagonally-disposed slime-conveyer the outer ends of each guide extends beyond the preceding one, so that the ends of these guides terminate upon a diagonal line, which is here shown as being approximately parallel with the diagonal line of the slime-conveyer. These guides are made of any suitable depth, depending upon the character of the material to be operated upon. In the present case I have illustrated them as being about three sixteenths of an inch deep at their commencement adjacent to the slime-conveyer and tapering to a thin edge at their termination. The material which is delivered upon the table having a different specific gravity is gradually moved from the receiving end toward the opposite end by a peculiar longitudinally-shaking action of the table, which is produced as will be hereinafter more fully described. At the same time the transverse inclination of the table is such that the tendency of the material is to move toward the lower side. For this reason all the lighter material and "slimes," so called, will pass over the guides and enter the slime-conveyer, which conducts these slimes diagonally across the table and delivers them at the lower end of the conveyer upon what I call a "return-conveyer" 6. This return-conveyer is divided into two portions, the one at the left receiving the material from the slime-conveyer and delivering it at the left end through an opening, (shown at 11,) from which it passes upon the upper end of a second table 32, which is similarly arranged to the first-named table and is subject to the same shaking movement. The heavier material, which, as before stated, may have different specific gravities, is gradually moved along the table by the shaking movement communicated thereto and the material of different gravity will be separated as it passes the outer ends of the guides 2, and will thus pass diagonally across the table in as many divergent streams as there may be differences of specific gravity. Thus the lead, sulfid of copper, iron pyrites, zinc, &c., will be separated from the slimes and also separated from each other by the action of this single table.

At the end of the table I have shown one or more arms or fingers 5, jointed or pivoted at the outer end and having their inner ends or points directed toward the guides. These fingers are turnable on the pivot-points, their lower surfaces resting upon the table, and they may be fixed at any desired point by clamping-screws, as 33, these points being set to suit the character of the material arriving and the separation which may be desired. One portion of the material will pass to one side of the point and the other to the opposite. The portion passing below the lowermost of these points will fall upon the right end of the return-conveyer and, moving along this conveyer, will be discharged through an opening in the bottom at a point near the center and before the point is reached where the slimes are discharged from the left end of the upper table. The material thus discharged from the central part of the conveyer is delivered upon the second table, the upper edge of which extends beneath the conveyer, and as it is subjected to the same shaking movement as the upper table a second and more complete separation is effected thereon. The remainder of the material passes over the end of the table with as many separations by fingers 5 as may be desired and is collected at this end.

Water is distributed upon the table during the operation by means of adjustable perforated pipes 34, which extend across above the table, and a supply to which is controlled by suitable cocks, as shown at 35. The movement of this table is produced by a reciprocating shaft 17, which is supported and slidable longitudinally in guides upon a bed 13, which is suitably fixed with relation to the table, and by a cam and springs which are connected to act upon the shaft, as will be hereinafter described. The cam 16 is mounted upon a shaft 14, suitably journaled upon the frame 13 and having pulleys 15, through which power may be transmitted to rotate it. The cam 16 is so constructed that as it revolves it engages the end of the shaft 17, and the latter, following the gradual incline of the cam, forces the shaft forward, and with it the table upon which it acts. When the cam has passed the end of the shaft 17, the latter is acted upon by a spring 19, one end of which abuts against a disk or plate 20, and the other end acts against the disk 18, which surrounds the shaft 17 and which is adjustable with relation to the disk 20 by means of screw-threaded rods 21 and nuts 22. By this arrangement the tension of the spring 19 and its consequent action upon the table will be regulated. Between the nuts 22 and the plate or disk 18 are rubber or other elastic buffers 7, which receive the disk 18 as it is returned by the spring 19, and thus reduces the jar and shock of the return movement, which for this reason differs essentially from the sharp bumping movement of tables which are reciprocated and in which the return movement is received by a solid bumper. The shaft 17 passes through a sleeve 23. This sleeve is screw-threaded upon the outside, and a hand-wheel 24 is turnable in a slot transversely of the frame and fits upon this sleeve. By turning this hand-wheel the shaft and sleeve may be moved one way or the other, and through the disk 20, which is carried with the sleeve, the length of the stroke is regulated to suit the character of the material which is being operated upon on the table without stopping the table. When this adjustment has been satisfactorily reached, the disk 24 is locked by a set-screw 25.

28 is a yoke which is secured to the end of the table, and through the outer end of this yoke the shaft 17 is slidable. A spring 27 surrounds this shaft, one end abutting against the end of the yoke adjacent to the table and the other against a collar 26 on the shaft 17. Between this collar and the outer end of the yoke is an elastic rubber or other buffer 29. The spring 27 is somewhat stiffer than the spring 19, and when the cam acts to push the shaft 17 the spring 27 will yield slightly by reason of the inertia of the table, so that the movement of the latter will be commenced gently. The incline of the cam ceases just before the offset is reached, and the end of the shaft 17, passing over this part, ceases to be advanced. During this short interval the spring 27 recovers its extension, and when the cam releases the shaft the spring 19 acts to give a soft quick return movement to the table. This action of the two springs, consisting in the compression of spring 19 by the direct action of the cam on shaft 17 and the partial compression of the spring 27 by reason of the inertia of the table, to which motion is communicated through this spring,

causes a slow forward movement of the table with the material to be separated upon it, and when the level part of the cam reaches the end of the shaft 17 the final extension of the spring 27 and the quick return of the spring 19 produce a differential motion, which is very effective in the operation upon ores having different gravities which it is desired to separate from each other.

The return-conveyer, which lies between the two tables, is a structure independent of the tables and is suspended at one end by a stirrup or hanger, as at 36, which rests upon the edges of a casing surrounding the conveyers, and at the other end by pins or rods a, which are slidable in the end of the casing, as shown. The conveyer thus partakes of the movements of the table; but it is relieved, so as to have a certain independent movement upon the return stroke of the table caused by its inertia, as follows: Coiled springs 8 surround the pins a, so that the springs press against the end of the conveyer, and when the return movement of the table takes place the inertia of the conveyer compresses these springs, so that it does not partake of full instantaneous movement of the table; but when the springs expand at the end of the return movement of the table the conveyer is forced forward by a movement which is subsequent to that of the table. At the opposite end of the casing in which the conveyer is suspended is a rubber buffer 9, against which it strikes as it completes its return movement. This action upon the conveyer, while primarily communicated by the same mechanism which moves the main tables, actually causes a reverse movement of this return-conveyer, so that while the material upon the main tables is moving from left to right the material which has been received into this conveyer moves from right to left, the portion received from the slime-conveyer of the first table being delivered upon the left end of the second table and the portion which passes beyond the guides being received and discharged near the ends of the guides of the second table, as previously described.

In order to adjust the angle of inclination of the tables to suit varying character of ores to be separated, I have shown the tables so supported that they may be tilted and their inclination changed. Various devices may be employed for this purpose. I have here shown shafts 40, having fixed to them eccentrics 41, so disposed that when the shafts are turned the eccentrics at one end will raise that side of the table and those at the opposite end will correspondingly depress that side. The tables may rest upon or be connected with the eccentrics in any suitable manner to produce this result. In order to move the shafts and eccentrics in unison, toothed pinions 42 are fixed to the shafts, and a rack-bar 43 engages the pinions. This rack-bar is slidably guided and by means of a lever it can be moved so as to simultaneously rotate the shafts and eccentrics.

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

1. In an ore-separator, inclined tables having the longitudinally-disposed guides, the diagonally-disposed slime-conveyers arranged with reference to the guides as shown, and an independent return-conveyer.

2. An ore-separator consisting of an inclined shaking-table having longitudinally-disposed guides terminating at points in a diagonal line across the table, a turnable separating-point pivoted upon the table beyond the guides, and a diagonally-disposed slime-conveyer having a screen surface or covering.

3. In an ore-separator, a transversely-inclined shaking-table having longitudinally-fixed guides terminating successively upon a line diagonal to the table, a turnable separating-point pivoted upon the table near the end of the lowermost guides, a screen-covered slime-conveyer, and a return-conveyer which receives the pulp substantially as described.

4. In an ore-separator, a plurality of shaking-tables having longitudinally-disposed parallel guides, the terminal ends of which are in a line diagonally across the table, a movable separating-point pivoted upon the table near the lowermost of said guides, a diagonally-disposed slime-conveyer having a screen-covering, a return-conveyer into which the pulp is discharged, having a motion the reverse of that of the table, and discharging upon the upper end of the second table.

5. In an ore-separator, a plurality of tables having longitudinally-disposed parallel guides and turnable separating-points at the ends of the tables, diagonally-placed screen-covered slime-conveyers, a return-conveyer intermediate of the two tables receiving from the uppermost at one end and discharging upon the lowermost at the opposite end, and mechanism by which the tables are given a longitudinal shaking movement.

6. The combination with tables having longitudinal guides, diagonally-disposed screen-covered slime-conveyers and a return-conveyer, of a mechanism whereby a longitudinal shaking movement is effected, said mechanism consisting of a horizontal revoluble shaft having a disk cam carried thereby, a guided shaft substantially in line with the first-named shaft and upon the end of which the cam operates whereby motion is transmitted to the table, and return-springs connected therewith.

7. A mechanism for producing a longitudinal shaking movement of an ore-separating table, consisting of a horizontal rotary shaft, a disk cam fixed to one end of said shaft and revoluble therewith, a longitudinally-guided slidable shaft, one end of which is acted upon by the cam-disk, springs surrounding said slidable shaft with plates whereby the springs are compressed by the movement of the shaft

in one direction, and act to return the shaft when the cam passes it, and means including an externally-threaded sleeve surrounding the shaft, a slotted bed and a hand-wheel engaging the threads of the sleeve and working against the walls of the slot for adjusting the shaft with relation to the cam-disk so as to increase or diminish the length of the stroke.

8. In an ore-separator, transversely-inclined tables having longitudinally-disposed guides, diagonal slime-conveyers extending across the tables near the receiving ends of the guides, an independent return-conveyer suspended to receive the slimes from the conveyer of the first table, and the heavier portions from the discharge end, and to transmit them separately to the second table.

9. In an ore-separator, transversely-inclined tables with longitudinally-disposed guides, slime-conveyers arranged diagonally to the guides and an intermediate return-conveyer, and mechanism by which a gradual forward movement and a quick return movement of the tables are effected.

10. In an ore-separator, transversely-inclined tables with longitudinally-disposed guides, diagonal slime-conveyers, an intermediate independently-supported return-conveyer by which the slimes and the heavier separated material are transferred independently from the first to the second table, and a mechanism consisting of a cam by which a forward movement of the tables is effected, a return-spring, and a second spring interposed between said mechanism and the table, said spring yielding when the tables are advanced to produce a gradual forward movement without disturbing the pulp.

11. In an ore-separator, transversely-inclined tables with longitudinally-disposed guides, diagonally-disposed slime-conveyers, an intermediate return-conveyer by which the slimes and the heavier separated material are transferred from the first to the second table, a mechanism consisting of an advancing cam and a return-spring by which the tables and conveyer are reciprocated, a second spring interposed between said mechanism and the tables, and compressible by the inertia of the tables during their forward movement, and a plane section of the cam just previous to the offset which allows the return movement of the tables, whereby the forward movement of the tables ceases and the second spring is allowed to expand just before the return of the tables.

12. In an ore-separator, transversely-inclined tables with longitudinally-disposed guides, diagonal slime-conveyers, an intermediate independently-supported return-conveyer by which the slimes and heavier separated material are transferred from the first to the second table, a mechanism consisting of an advancing cam, and a return-spring by which the tables and the return-conveyer are reciprocated, and springs interposed between the return-conveyer and its support carried by the tables, said springs yielding during the return movement of the tables, and expanding after said movement is completed to produce a subsequent movement of the return-conveyer.

13. In an ore-separator, transversely-inclined tables with longitudinal guides, diagonal slime-conveyers, and a return-conveyer adapted to receive the slimes and heavier substances and transfer them separately to the second table, said conveyer being independently supported with relation to the tables, a cam and return-spring whereby the tables are reciprocated and the material advanced in one direction thereon, and other springs acting against the conveyer whereby an impulse is given it to move the material carried by it in a direction opposite to the movement of material upon the tables.

14. An ore-separator consisting of transversely-inclined tables with longitudinal guides, diagonal slime-conveyers, and a return-conveyer intermediate between the two tables, and a reciprocating mechanism, in combination with a supporting device and mechanism whereby the angle of inclination of the tables may be adjusted.

15. An ore-separator consisting of transversely-inclined tables with longitudinal guides, slime-conveyers arranged diagonally to the guides, and a return-conveyer intermediate between the two tables, and a reciprocating mechanism, in combination with an adjusting device consisting of transverse shafts with eccentrics connected with the table, pinions upon the shafts, and a rack-bar engaging the pinions, whereby the shafts may be turned and the eccentrics act to change the angle of the table.

In witness whereof I have hereunto set my hand.

JONATHAN P. SMITH.

Witnesses:
S. H. NOURSE,
JESSIE C. BRODIE.

COMPLAINANTS' EXHIBIT No. 19
Fritsch Patent No. 671,276
ALMON E. HART, Special Examiner

No. 671,276.

Patented Apr. 2, 1901.

A. FRITSCH.

ORE CONCENTRATOR.

(Application filed Sept. 13, 1900.)

(No Model.)

3 Sheets—Sheet I.

Fig. 1.

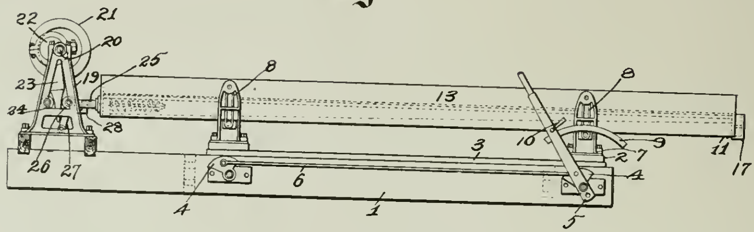


Fig. 2.

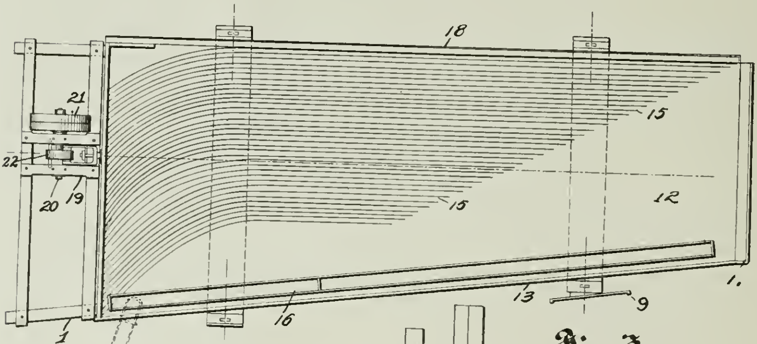
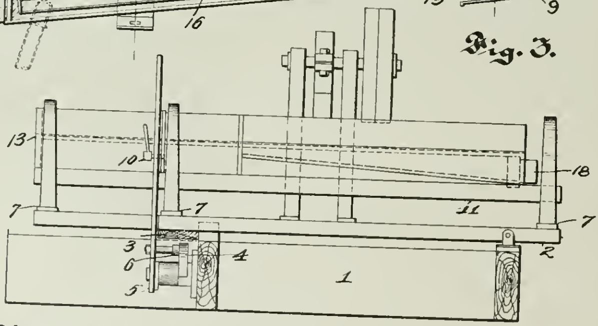


Fig. 3.



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No. 671,276.

Patented Apr. 2, 1901.

A. FRITSCH.

ORE CONCENTRATOR

(Application filed Sept. 13, 1900.)

(No Model.)

3 Sheets—Sheet 2.

Fig. 4.

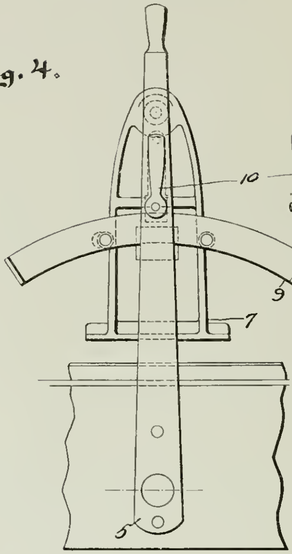


Fig. 5.

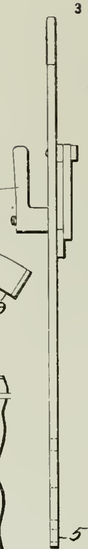


Fig. 6.

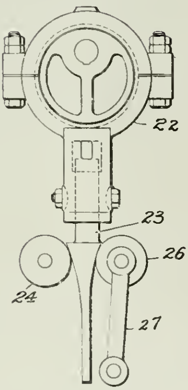
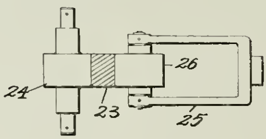


Fig. 7.



Witnesses:
F.W. Dueucke.
J. D. Rippey

Inventor:
Arthur Fritsch.
By Higdon & Longan Attys

No. 671,276. Patented Apr. 2, 1901.

A. FRITSCH.

ORE CONCENTRATOR.

(Application filed Sept. 13, 1900.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 8.

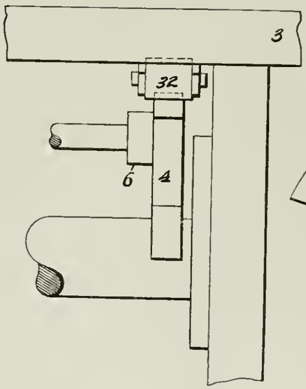


Fig. 9.

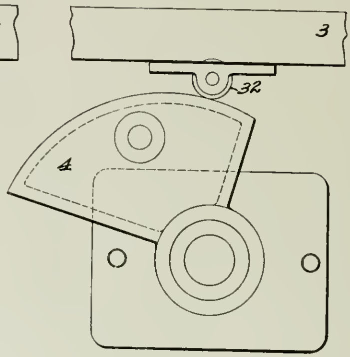


Fig. 10

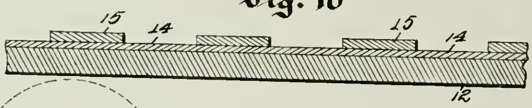
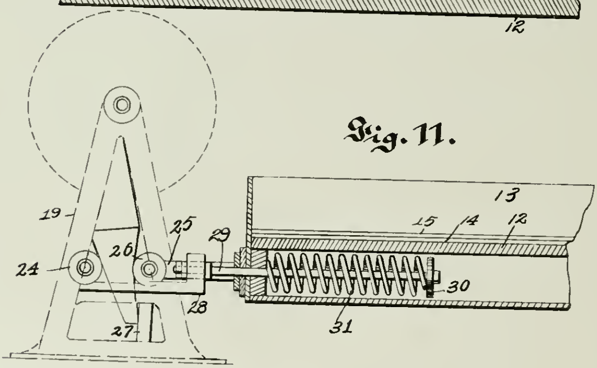


Fig. 11.



Witnesses:

F.W. Dueuckel

J.D. Rippey

Inventor:

Arthur Fritsch.

By Higdon & Longan Atty.

United States Patent Office.

ARTHUR FRITSCH, OF ST. LOUIS, MISSOURI.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 671,276, dated April 2, 1901.

Application filed September 13, 1900. Serial No. 29,931. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR FRITSCH, of the city of St. Louis, State of Missouri, have invented certain new and useful Improvements in Ore-Concentrators, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

This invention relates to ore-concentrators; and it consists of the novel construction, combination, and arrangement of parts hereinafter shown, described, and claimed.

Figure 1 is a side elevation showing my improved ore-concentrator. Fig. 2 is a plan view. Fig. 3 is an end view. Fig. 4 is a detail view of a standard and adjusting-lever made use of in carrying out the invention. Fig. 5 is a view showing the adjusting-lever and the parts carried thereby. Fig. 6 is a detail view showing a portion of the operating mechanism. Fig. 7 is a view showing the means by which the table is operated. Figs. 8 and 9 are detail views showing the adjusting device made use of in carrying out the invention. Fig. 10 is a sectional view showing a portion of the table. Fig. 11 is a detail view showing the devices made use of to reciprocate the table.

In the construction of this invention I provide a base-frame 1 of any preferred construction, and pivoted to one side of which are transverse bars 2, the opposite ends of the bars being connected by the member 3. Pivotally carried by the base-frame 1 on the side opposite from the pivoted ends of the bars 2 are cams 4, upon which the member 3 rests and by means of which the free ends of the bars 2 may be raised or lowered. Rigidly connected to one of the cams 4 is an operating-lever 5, by means of which the cam may be turned on its pivot, thereby raising or lowering the ends of the bars 2. The cams are made to operate simultaneously by means of a connecting-rod 6, thereby causing the free ends of both the bars to stand at a uniform elevation.

Secured to the ends of the bars 2 are the upright standard-frames 7, pivotally carried within which are the suspending-links 8, the upper ends of the said suspending-links being pivoted to the said standard-frames and the lower ends of which support the table. A segment 9 is supported by one of the standard-frames 7, adjacent to the lever 5, and the locking-cam 10, carried by the lever, operates upon the said segment, thereby holding the lever and the cams 4 in any adjustment in which they are placed.

Supported by the lower ends of the links 8 are transverse bars 11, upon which is mounted the bottom of the table. The said table is constructed in the form of a receptacle and comprises the top 12 and the upwardly-projecting sides 13, whereby the material is retained on the table. As shown, the rear end of the table is broader than the forward end, the purpose of which will hereinafter appear. Secured upon the top of the table is a section 14 of linoleum, and secured upon the linoleum covering are strips 15 of wood, the rear ends of which, as shown in Fig. 2, being curved, the purpose of which is to guide the ore toward the forward end of the table when the machine is in operation. The rear ends of the strips 15 are thicker than the forward ends, and said strips gradually taper toward their termination, and the forward ends are arranged in graduated form, those toward the left of the table becoming gradually shorter than those to the right, whereby the ore as it is separated is guided toward the forward end of the table.

16 indicates a trough into which the material is delivered and out of which it is allowed to gradually pass onto the top of the table as the machine operates. Upon the forward end of the table is carried a trough 17, into which the ore is received as it is separated and from which it may be delivered to any suitable receptacle. 18 indicates a corresponding trough carried by the side of the table into which the sludge is delivered after the ore has been removed therefrom.

Supported above the rear end of the base 1 are brackets 19, carried by which is an operating-shaft 20, and keyed upon one end of the said shaft is a belt-pulley 21. Carried by the shaft 20 between the brackets 19 is an eccentric 22, suspended from which is a wedge-shaped member 23, the function of which is to operate the table. Carried between the brackets 19 is a roller 24, and extending rearwardly from the table between the brackets 19 is a U-shaped frame 25, carried by which is a roller 26, corresponding to the roller 24, The lower end of the wedge 23 operates between the said rollers, and whenever the drive-shaft 20 is rotated the said wedge is reciprocated vertically, thereby operating the table out of its normal position, into which it will again be thrown in the manner presently described.

27 indicates a suitable guide secured to the frame 25 and to the brackets 19, whereby the rear end of the table is prevented from moving laterally. Carried by the brackets 19 below the rollers 24 and 26 is an integral member 28, and connected to the forward end of the said member is a rod 29, which projects forwardly into a suitable opening in the rear end of the table and carries on its forward end a washer 30. A coil-spring 31 is arranged around the rod 29 within the table, the ends of the said coil-spring bearing against the washer 30 and the end of the table, respectively. By this means the table will be thrown back toward the brackets 19 after the wedge 23 is raised from between the rollers 24 and 26. In operation the shaft 20 is rotated by applying motive power to the belt 21. This alternately raises and lowers the wedge 23, causing it to pass between the rollers 24 and 26, whereby the table will be operated forwardly, as above described. As the shaft is continually rotated and the wedge 23 is raised from between the rollers 24 and 26 the tension of the spring 31 serves to throw the table again toward the brackets 19, thereby imparting a continuous reciprocatory movement to the table. The material during the operation is fed into the trough 16, from which it passes gradually onto the top of the table and is guided therefrom by means of the strips 15, the ore being gradually led into the trough 17 and the gangue and sludge passing into the trough 18.

One side of the table may be raised or lowered in order to facilitate the movement of the ore and sludge by manipulating the lever 5, and thereby operating the cams 4 in the manner described. The small rollers 32, carried by the under side of the bar 3, operate upon the cams 4, thereby causing their operation to be free and without friction.

I claim—

An ore-concentrator, comprising a base, standard-frames supported above it, cams under certain of said frames for raising and lowering them, a lever for operating said cams, a lock for retaining the lever and thereby the cams in the adjustment in which they are placed, a table supported to swing between the said frames, means for passing the material onto the said table in a thin stream, a series of curved and tapering guides for regulating the movement of the ore, an operating-shaft, means operated by the shaft for forcing the table rearwardly whenever it is rotated, and a separate means for drawing the table to the front, substantially as specified.

In testimony whereof I affix my signature in presence of two witnesses.

ARTHUR FRITSCH.

Witnesses:
EDWARD E. LONGAN,
JOHN D. RIPPEY.

COMPLAINANTS' EXHIBIT No. 20

Woodbury Patent No. 715,328

ALMON E. HART, Special Examiner

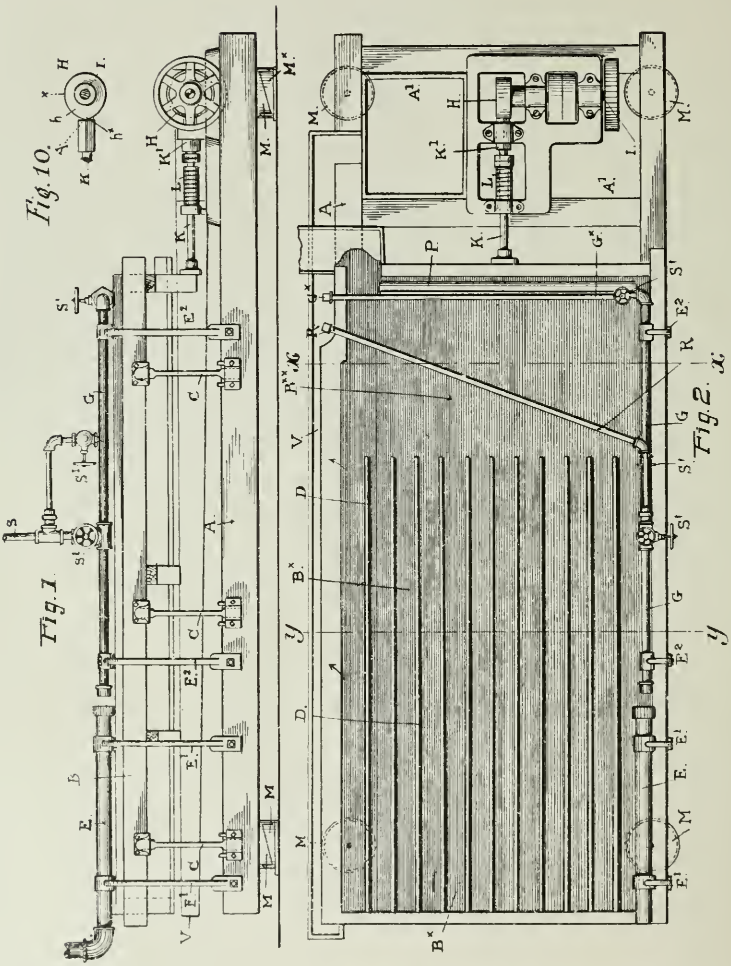
No. 715,328. Patented Dec. 9, 1902.

G. E. WOODBURY.

ORE CONCENTRATOR.

(Application filed Jan. 24, 1899.)

(No Model.) 2 Sheets—Sheet I.



Witnesses:

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M. Regner

Inventor:

George E. Woodbury

By Smith & Osborn his Attys

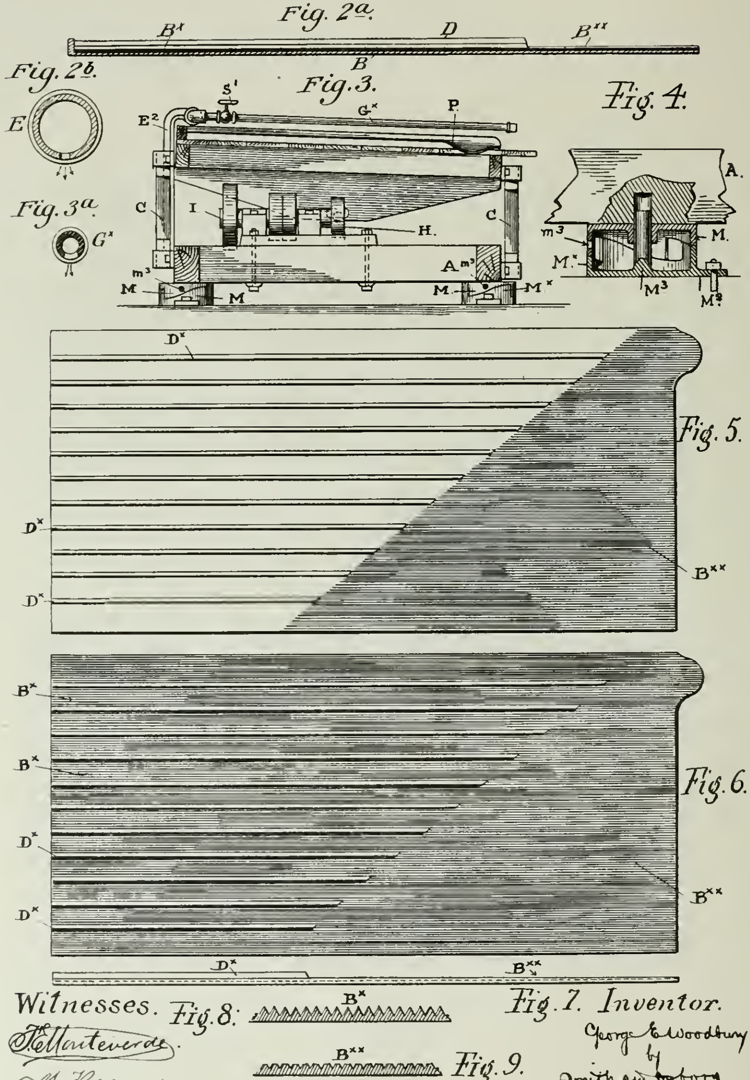
No. 715,328. Patented Dec. 9, 1902.

G. E. WOODBURY.

ORE CONCENTRATOR.

(Application filed Jan. 24, 1899.)

(No Model.) 2 Sheets—Sheet 2.



Witnesses.

F. Monteverde.

M. Regner.

Inventor.

George E. Woodbury

by

Smith & Osborn

his attorneys.

UNITED STATES PATENT OFFICE.

GEORGE E. WOODBURY, OF SAN FRANCISCO, CALIFORNIA.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 715,328, dated December 9, 1902.

Application filed January 24, 1899. Serial No. 703,269. (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, State of California, have invented new and useful Improvements in Ore-Concentrators, of which the following is a specification.

This invention relates to improvements made in ore-concentrating machines of that class or description in which the concentrating-surface is grooved or channeled and has a shaking motion without a traveling or progressive movement, machines of this class being commonly known as "concentrating-tables." In the various grades and qualities of material treated in these machines there is always to be found a proportion of the mineral particles existing in a fine state of division, produced principally in the preparatory disintegration of the ore in the mill, and these finest particles being the more readily influenced by the streams of water that are applied to the surface of the table to separate and wash off the sand than by the motion of the table, which in this class of concentrator constitutes the means of concentrating the mineral particles and bringing them to a common point of discharge, there is of necessity a certain proportion of loss of the mineral taking place by the escape of the finest particles with the water. To overcome this imperfect operation and the consequent loss of concentrates, it is important to carry on the operation with the least quantity of water and bring the mineral particles under the influence of the shaking motion of the table as thoroughly as possible, and especially upon the upper part or head of the table, where the concentrates are finally separated and discharged.

To secure the above results is the principal object of this invention; and to that end these improvements consist, mainly, in certain construction of grooved or channeled concentrating-surface and the combination of certain parts and mechanism on, all as hereinafter fully described, and pointed out in the claims at the end of this specification.

The following description explains at length the nature of my said improvements and the manner in which I proceed to construct, apply, and carry out the same, reference being had to the accompanying drawings, forming part thereof.

Figure 1 of the drawings is a side elevation of a concentrating-table embodying my said improvements, the view being taken from the rear or higher side of the machine. Fig. 2 is a plan or top view of Fig. 1. Fig. 2^a is a longitudinal section through the table-surface shown in Fig. 2, the section being taken along the bottom of one of the grooves. Fig. 2^b is a cross-section through the perforated pulp-distributing pipe E. Fig. 3 is an end elevation taken from the right-hand side of Fig. 2. Fig. 3^a is a cross-section through the water-pipes G $G^{\times}$ R. Fig. 4 is a sectional view, on an enlarged scale, of the device for adjusting the inclination of the table. Figs. 5 and 6 are plans of the table, showing two modifications of the concentrating-surface. Fig. 7 is a side elevation taken from the lower side of Fig. 6. Fig. 8 is a cross-section of a portion of the grooved concentrating-surface between the partition-strips. Fig. 9 is a similar section through the grooved portion at the head of the table. Fig. 10 is a side view in detail of the cam and follower of the vibrating mechanism.

Upon a stationary bed-frame composed of timbers A A′, stiffly joined and bolted together, the table B is mounted on spring legs or stanchions C C, so as to be movable in a longitudinal direction. Reciprocating motion of the table is produced through the medium of mechanism applied to the head of the table, consisting principally of a cam H on a rotating shaft I and a sliding bar or follower K, attached at one end to the table and carrying on the opposite end a head K′, that is held against the cam by a spring L. The cam is shaped to produce a relatively slow forward throw and a quick return movement of the table in one complete revolution of the cam, and for this purpose the periphery of the cam is formed, as shown in Fig. 10, with an increased eccentric portion h and an angular projection $h^{\times}$, the relation of these portions to the remainder of the periphery being such that from x to y, or about one-fourth of the entire revolution, the cam gives a forward motion, while the remaining portion gives the return or backward throw. By virtue of this form the return movement takes place in less time than the forward movement, thereby giving the mineral particles a forward impulse, causing them to creep upon the surface of the table toward the head by virtue of their inertia. In this table, as in other concentrators of the kind, the top or working surface $B^{\times}$ has an inclination downward and across the table transversely or from side to side, and the pulp or material to be treated is introduced at the higher side, near one end, together with a greater or less quantity of water that is distributed on that end, so that a movement of the material is produced diagonally over the working surface under the combined action and influence of the flow of water and the vibratory motion and inclination of the table.

In regulating or adjusting the operation to meet the variations in character or condition of the material under treatment, and also in changing from one kind or grade of ore to another, it is necessary to vary the inclination or pitch of the table, both transversely or sidewise and longitudinally or endwise, in order to control the even distribution and movement of the material in the required direction over the table, so that the inclination can be varied by raising the table at either side or at either end without disturbing the general adjustment and position of the table with relation to its driving mechanism and the pulp and water distributing pipes. Under the timbers of the stationary bed-frame, on which the table and the parts before mentioned are mounted, I interpose between the frame-sills and the ground two circular plates $M M^{\times}$, having cam-like faces or inclines. The lower one of these plates is fastened to the floor or ground and is formed with a center post M^8, which is let into the timbers above, while the upper one, M, of the plates is fitted to rotate on that post and is finished with a flat top surface upon which the timber rests. Holes m^3 are provided in the circumference of this upper plate for inserting a hand-spike by which the parts can be turned in one direction or the other, and thus raise or lower the stationary frame by virtue of the inclines before mentioned. The angle of these inclined surfaces is properly regulated to hold the weight of the table without slipping wherever the movable plates may be set. By this means the inclination of the working surface is readily varied in both directions by moving the parts before mentioned at either side and at either end of the stationary frame.

The pulp-distributing pipe E is supported from the stationary bed over the higher side of the table by means of standards $E' E'$, fastened at the lower ends to the timbers A, and the water-pipe G is carried by similar supports $E^2 E^2$, secured at the lower ends to the stationary frame, the pipe E and the water-pipe G being perforated with apertures along the bottom, so as to direct the pulp and the water in a number of streams or jets along the upper side of the table.

For the principal or greater portion of its length the working surface of the table is divided by means of narrow strips D D into a number of separate channels or sections $B^{\times}$, extending from the lower end, on which the material is first introduced, toward the head or opposite end, where the strips terminate at a distance from the end of the table, leaving the portion of the surface at that end of the table undivided. This portion $B^{\times\times}$ of the surface from which the strips are removed or omitted at the head of the table is finely grooved or corrugated from the line on which the strips terminate upward to the end of the table, the corrugations running longitudinally or substantially in the same direction as the motion and in close order across the entire width of the working surface. The bottom surfaces of the divisions between the standing strips are also corrugated or grooved longitudinally with grooves of about the same degree of fineness as those composing the surface $B^{\times\times}$ at the head of the table. The last-mentioned corrugations, however, while being a continuation of the grooved surface between the standing strips, are reduced in depth or made more shallow than those on the main portion of the table either by cutting down the top surface or by raising or filling up the bottoms of the grooves, so that on any line of cross-section, as at $x\ x$, Fig. 2, the grooves on the surface $B^{\times\times}$ are of less depth than those on the main portion and at any line of cross-section, as $y\ y$. Upon this finely-grooved portion $B^{\times\times}$ at the head of the machine the partially cleaned or separated concentrates are delivered from all the divisions or sections of the table-surface for the final washing out and separation of the particles of sand and earthy matter that may remain mixed with the mineral particles up to this point in their progress through the machine. The grooves in this portion of the surface are carried to the end of the table, where they are intercepted by a cross-gutter P, running from the higher side downward to the lower side practically at right angles to the grooves and terminating at or merging into a spout or widened outlet at the lower corner of the table. Into this gutter the grooves or corrugations are arranged to deliver such particles as are received from the sections or divisions $B^{\times}$ and are retained in the grooves against the washing action of the water applied on this part of the table. These grooves $B^{\times\times}$ are reduced in depth either by grinding or cutting down the top surface of this part of the table or by raising or filling up the bottoms of the grooves $B^{\times}$, so that instead of having the same depth as those on the principal portion of the table they are made comparatively smaller. The object of this construction is to bring the particles in the grooves as they arrive at this portion of the surface more completely under the action of the streams of water and to effectively wash out and carry off the waste particles with a much less quantity of water than is necessary for the deep grooves, thereby preventing the mineral particles that exist in a finely-divided condition from yielding to the influence of the water and being carried off in the sand and other refuse matter.

By cutting down the quantity of water required to clean the concentrates and by controlling movement of the mineral particles across the surface by means of the grooves the finest particles are held back and brought under the influence of the motion to such a degree that their discharge with the tailings instead of with the concentrates is materially prevented and a considerable saving in the mineral is effected.

In operating on slimes and tailings from other machines I have obtained good results by making the sections or divisions $B^{\times}$ of the concentrating-surface of the same length for the whole width of the table, as illustrated in the construction Fig. 2, for which purpose dividing-strips $D^{\times}$ $D^{\times}$ of uniform length are used, and the ends of the strips nearest the head of the table are set on a line drawn transversely across the table substantially at right angles to the direction of the motion. On the other hand, with material containing a large proportion of sulfurets or consisting of what is known as "heavy material" the table will work to better advantage in many cases when the divisions $B^{\times}$ are made of varying lengths increasing regularly in lengths one over another from the higher toward the lower side, as shown in the modification Fig. 6, so that the ends of the dividing-strips $D^{\times}$ $D^{\times}$ nearest the head of the table terminate on a diagonal line drawn from the higher side downward toward the lower corner at the head of the machine. From the slanting line on which the divisions of the table-surface end the fine grooves $B^{\times\times}$ on this triangular portion run longitudinally to the head of the table.

In the slight modification represented in Fig. 5 the surface between the dividing-strips D may be left smooth or without the grooves. This form or construction of surface will be found to give good results in working heavy material, while for many grades of ore the grooved surface will be found to work to better advantage.

Vulcanized rubber is a good material to form the working surface of the table, as the same can readily be molded with fine grooves and finished with a smooth surface within and between the grooves. The standing strips D can also be molded or formed integrally with the rubber, so that the whole working surface of the table will be in one piece without seams or joints. The grooved portions of the concentrating-surface may be formed by separate strips or pieces of rubber nailed or secured in any smooth and permanent manner upon the table-surface between the dividing-strips and upon the undivided portion at the head of the machine. In place of this rubber covering sheet-copper or other soft metal in the surface of which the grooves can easily be formed can be substituted.

The usual tailings-trough V along the lower side and a settling tank or receptacle for the concentrates are provided for handling the material discharged from the table.

The water-distributing pipes are arranged for operation in the best position to obtain the desired results with a minimum quantity of water. For this purpose a distributing-pipe $G^{\times}$, with perforations along the under side, is placed transversely across the table near the head and just over the inner edge of the gutter P, so as to keep the material continuously moistened along the line of its discharge from the grooves into the gutter and also to keep the gutter itself constantly wet, thereby preventing the concentrates from choking or clogging these channels of discharge. A water-pipe R, supported over the triangular surface in a diagonal position, directs streams of water across the grooves, so that they fall in parallel lines covering the principal portion of the surface on which the concentrates are finally cleaned. These pipes are connected to a common water-supply pipe S and are provided with separate valves S' for regulating the delivery of the water on both portions of the working surface.

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

1. An ore-concentrating table having the principal portion of its working surface divided into longitudinal channels by standing strips and the portion at and near the concentrates-discharging end undivided, the surface both between and beyond the standing strips being finely grooved and said grooves running in the general direction of the standing strips, as described.

2. An ore-concentrating table having a surface composed of fine grooves extending lengthwise thereof in the general direction of the motion, the grooves in the table-surface at and near the concentrates-discharging end being of less depth than the grooves composing the principal portion of the table, and standing strips dividing the principal portion of the table-surface into longitudinal sections that open upon the portion of the table-surface at the discharge end having the grooves of less depth.

3. In an ore-concentrating table, a working surface composed of grooves running longitudinally of the table, standing strips dividing the principal portion of the grooved surface into a number of sections, that portion of the surface between the concentrates-discharging end of the table and the ends of the standing strips having grooves of less depth than the remaining portion of the surface, and means for imparting vibratory motion to the table

4. In an ore-concentrating table having vi-

bratory motion, a working surface divided into channels running longitudinally and in the general direction of the motion, said channels terminating at a distance from the concentrates-discharging end of the table, and a surface composed of fine grooves covering that portion of the table between the ends of the channels and the concentrates-discharge end of the table.

5. In a table-concentrator having vibratory motion in the general direction of its length, the combination of a working surface divided into longitudinal channels that terminate at a distance from the concentrates-discharge end of the table, a surface of fine grooves composing that portion of the table-surface between the channels and the discharging end, and means for distributing water diagonally across said grooved surface.

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.

COMPLAINANTS' EXHIBIT No. 21

Michelsen & Borglum Patent No. 721,591

ALMON E. HART, Special Examiner

No. 721,591. PATENTED FEB. 24, 1903.

J. H. MICHELSEN & M. LA M. BORGLUM.

ORE CONCENTRATOR.

APPLICATION FILED JAN. 27, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

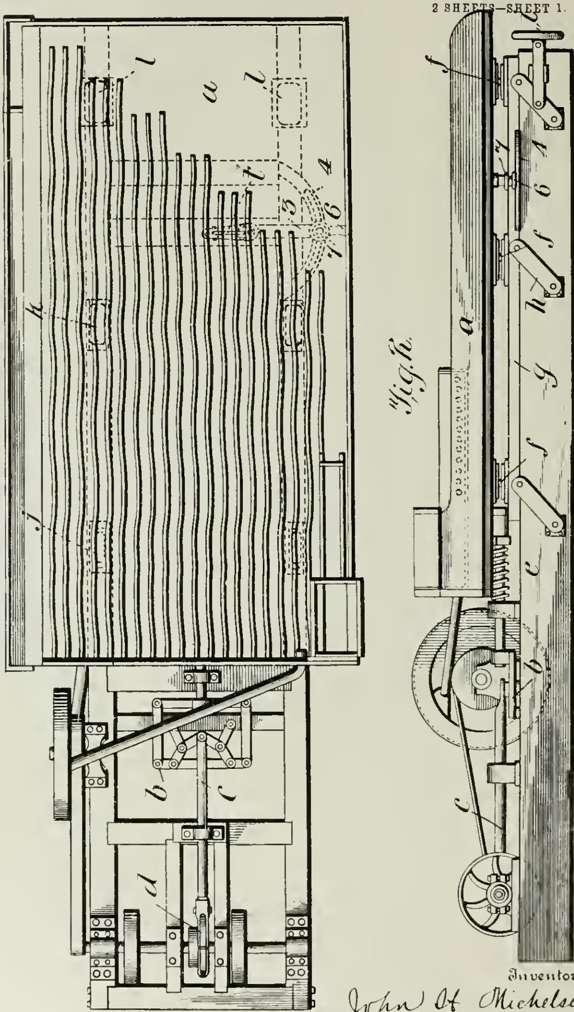


Fig. 2.

Witnesses

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Inventors

John H. Michelsen,
+ Millie La M. Borglum.

By Wilkinson & Fisher,

Attorneys

No. 721,591. PATENTED FEB. 24, 1903.

J. H. MICHELSEN & M. LA M. BORGLUM.

ORE CONCENTRATOR.

APPLICATION FILED JAN. 27, 1902.

NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3.

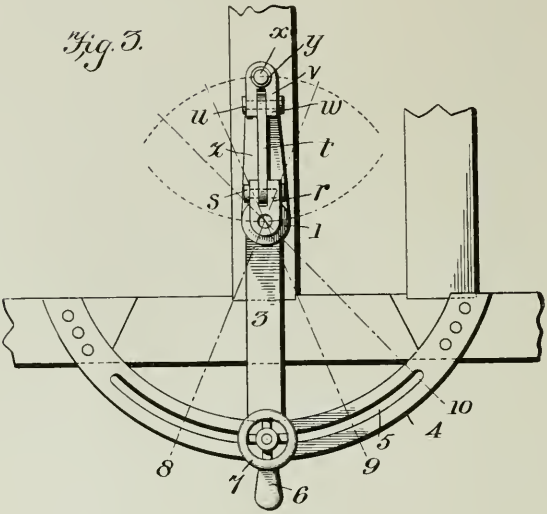
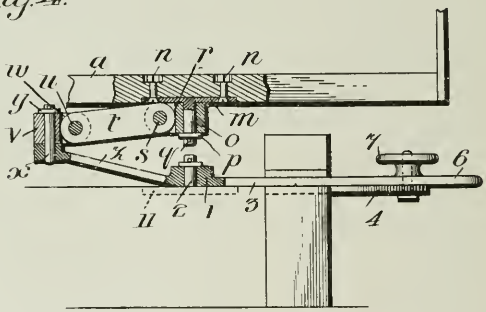


Fig. 4.



Witnesses
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UNITED STATES PATENT OFFICE.

JOHN H. MICHELSEN AND MILLER LA MOTHE BORGLUM, OF BUTTE, MONTANA; SAID MICHELSEN ASSIGNOR TO JOHN H. CURTIS AND GREEN MAJORS, OF BUTTE, MONTANA.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 721,591, dated February 24, 1903.

Application filed January 27, 1902. Serial No. 91,448. (No model.)

To all whom it may concern:

Be it known that we, JOHN H. MICHELSEN and MILLER LA MOTHE BORGLUM, citizens of the United States, residing at Butte, in the county of Silverbow and State of Montana, have invented certain new and useful Improvements in Ore-Concentrators; and we 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.

Our invention relates to improvements in ore-concentrators, and it is a specific improvement upon the structure shown in Patent No. 636,679, dated November 7, 1899, and Patent No. 671,348, dated April 2, 1901.

The object of our invention is to provide an ore-concentrating table which shall have in addition to the reciprocating motion described in said patents a side motion at the rear or tail end thereof, which motion may be increased or diminished, as preferred.

In the accompanying drawings, Figure 1 is a plan view of our improved ore-concentrator. Fig. 2 is a side elevation thereof, and Figs. 3 and 4 are enlarged views showing details.

The table *a* is driven by the shaft *c* through the toggle mechanism *b*, and the shaft *c* is actuated by the eccentric *d*. The table is supported upon balls *f*, resting in sockets on the frame *g*, which frame is carried on links *h* and the height of which may be adjusted by the hand-wheel *i*. A spring *e* is used to prevent the motion from being too sudden. These parts are as previously described in the patents referred to. The supporting-balls *f* are carried in sockets *j*, *k*, and *l*, which increase in size successively. This is to provide for the side shake of the rear end of the table. Attached to the lower part of the table by means of bolts *n* is a plate *m*, provided with a projecting pintle *o*. On this pintle is mounted a casting having projecting ears *r*. A washer *p* supports this casting in position, and a pin *q*, passing through the pintle *o*, supports the washer.

t represents a link, which is pivoted in the ears *r* by means of the pin *s*. A pin *u* at the other end of the link or arm *t* passes through ears *w* in a casting *v*, which is supported on a pin *x*, provided with a washer *y*. A lever or arm *z* is also pivoted upon the pin *x* and near its center is enlarged, as shown at 1, and is perforated for the passage of the pin 2, which is carried by the plate 11. This lever has an outwardly-extending portion 3, extending outside of the framework, and is provided with a handle 6. The part 3 rests upon a curved support 4, fastened to the framework of the machine and provided with a curved slot 5, whereby the part 3 may be moved back and forth into various positions in regard to the plate 4. A hand-wheel 7 serves to secure the part 3 in any desired position.

With the parts as shown in Fig. 3—that is, with the pivots in a line perpendicular to the longitudinal axis of the machine—the table being pivotally connected to the link *t*, pivoted on the stationary arm or lever 3, a longitudinal movement of the table by the reciprocating mechanism will cause it to swing sidewise on one side of the before-mentioned perpendicular in the arc of a circle around the point *x* as a center, and a reverse or reciprocal longitudinal movement of the table will cause the table to be deflected to an equal extent circularly in the opposite direction on the other side of the perpendicular. Thus we have a simple reciprocal side or end shake of the table. Moving the arm 3 to the right coincident with the line 9 shifts the line of pivots to a position oblique to the transverse axis of the table. Therefore the table on its forward swing—that is, to the right on Fig. 1—will approach much nearer the central line than on its backward swing. If the lever or arm 3 is moved still farther to the right to a position indicated by the dotted line 10, a motion similar to that of a hand-pan is obtained. Shifting the arm 3 to the position indicated by the line 8 will move the line of pivots to a position oblique to the transverse axis, but in an opposite direction to that in the previous case, causing the table in its forward motion to swing sidewise farther from the transverse axis than in the backward motion. By actual experiment with the particular kind of ore under treatment the position most favorable for concentration is found, and by this simple means of adjustment we provide a table which will effectively concentrate almost any kind of ore.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent of the United States, is—

1. In an ore-concentrator, the combination of a table, means for reciprocating said table, a lever mounted on the frame of the machine and movable thereon, and a link pivoted to the table, said lever and link being pivoted together in a substantially horizontal plane, substantially as described.

2. In an ore-concentrator, the combination of a table, means for reciprocating said table longitudinally, the framework of the machine, a lever pivoted thereon, means for securing said lever in different positions upon said framework, and a link or arm pivoted to said table, said link and lever being pivoted together in a substantially horizontal plane, substantially as described.

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

JOHN H. MICHELSEN.
MILLER LA MOTHE BORGLUM.

Witnesses:
A. T. MORGAN,
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COMPLAINANTS' EXHIBIT No. 22

Rogers & Hanson Patent No. 732,319

ALMON E. HART, Special Examiner

No. 732,319. PATENTED JUNE 30, 1903.

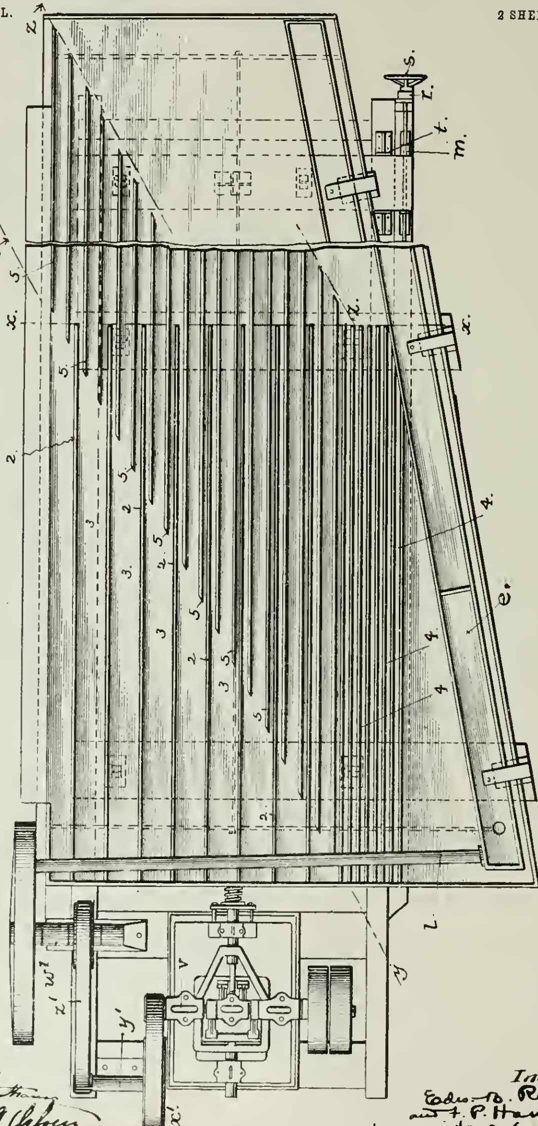
E. B. ROGERS & F. P. HANSON.

ORE CONCENTRATOR.

APPLICATION FILED JUNE 29, 1901.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1



Witnesses

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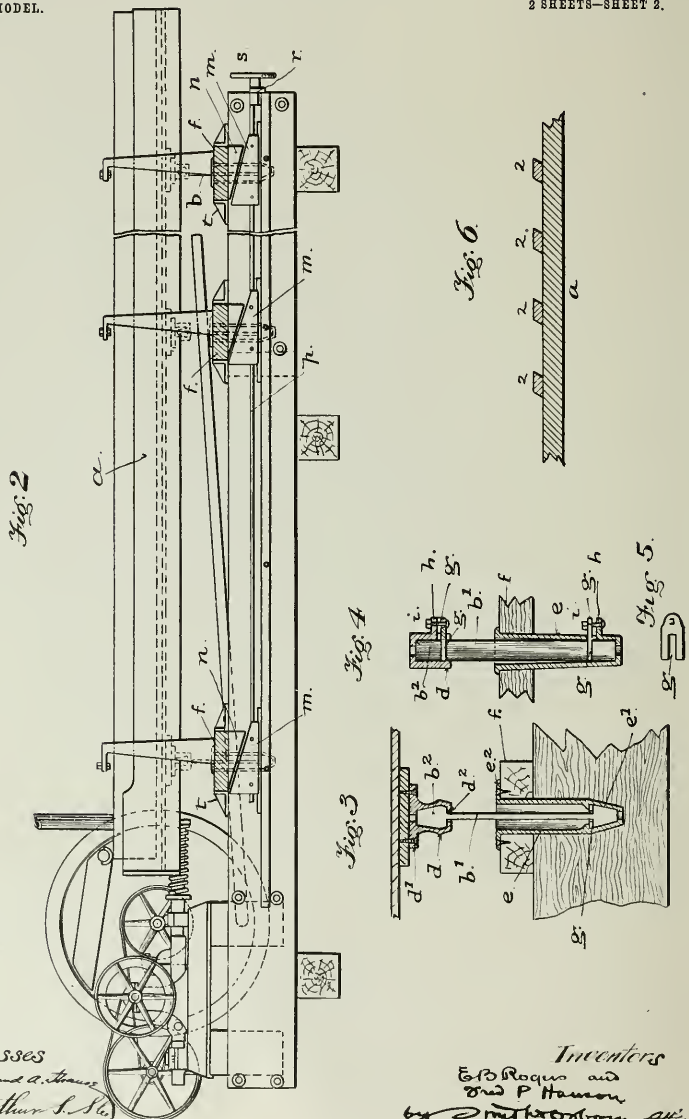
No. 732,319. PATENTED JUNE 30, 1903.

E. B. ROGERS & F. P. HANSON.

ORE CONCENTRATOR.

APPLICATION FILED JUNE 29, 1901.

NO MODEL. 2 SHEETS—SHEET 2.



Witnesses

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UNITED STATES PATENT OFFICE.

EDWARD B. ROGERS AND FREDRICK P. HANSON, OF SAN FRANCISCO, CALIFORNIA.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 732,319, dated June 30, 1903.

Application filed June 29, 1901. Serial No. 66,548. (No model.)

To all whom it may concern:

Be it known that we, EDWARD B. ROGERS and FREDRICK P. HANSON, citizens of the United States, and residents of the city and county of San Francisco and State of California, have invented certain new and useful Improvements in Ore-Concentrators, of which the following is a specification.

This invention relates to improvements made in ore-concentrators of the kind or description known as "concentrating-tables," in which the mineral particles are separated from the sand and worthless matter by the combined influence and action of the vibratory motion of the table and currents of water flowing over the table-surface transversely across or in directions more or less opposed to the motion. In concentrators of this description it is customary to provide the surface of the table with riffles or standing strips extending longitudinally and in the general direction of the motion, provision being made also for varying the inclination of the table-surface transversely for the purpose of accelerating or retarding the flow of the water.

The present invention in this class of concentrators has for its object mainly to provide an improved construction of riffled surface by which the mineral particles will be effectively separated and concentrated, and at the same time the gangue, of varying degrees of richness, will be closely graded and the grades separated one from the other for additional treatment either upon the same table or by passing it to another table.

The invention has for its object, further, to provide a simple and efficient means for setting and fastening in place the spring-standards that carry the shaking-table and for adjusting the degrees of inclination of the table-surface while the machine is at work.

To such ends and object our said improvements consist in a peculiar construction of riffled table-surface and in certain novel parts and combination of parts, producing an improved machine for the purpose specified, as hereinafter described, and pointed out in the claims at the end of this specification, reference being had therein to the accompanying drawings, forming part thereof.

Figure 1 of the drawings is a top plan of a concentrating-table having a riffled table-surface constructed in accordance with our invention, a portion of the table between the feeding-on end and the concentrates-discharging end being broken out to reduce the length of the figure within the limits of the sheet. Fig. 2 is an elevation of the table, taken from the higher side, where the material is first introduced. Figs. 3, 4, and 5 are details, on an enlarged scale, of the spring-standards on which the table is mounted, showing the manner of securing the top end of the standard to the table and the bottom end or foot to the stationary frame, Fig. 3 being a vertical longitudinal sectional view of the sockets and fastenings, Fig. 4 a vertical transverse section, and Fig. 5 a top plan of the removable key that secures the ends of the standards of the sockets. Fig. 6 is a vertical transverse section taken through the table-surface, showing in cross-section the peculiar form of riffles employed.

The table *a* is mounted on spring-standards *b b* in the usual manner, with an inclination breadthwise or transversely of the surface, the foot of each standard being secured to the stationary frame and the top end to the bottom of the movable table by sockets and fastenings, in the construction of which provision is made for securely fixing the standards so that they will not be loosened by the vibrations, and at the same time allowing a standard to be removed and another set in place without loss of time.

In Figs. 1 and 2 of the drawings we illustrate a simple mechanism for giving a rapidly-vibrating motion to the table of the character or quality necessary for producing a continuous progressive movement of the mineral upon the surface of the channels or spaces between the riffles, but as no special novelty is claimed for the construction there shown a detailed description of such mechanism is not necessary to a clear understanding of the present improvements, which relate especially to the other parts of the machine. Other means than that therein illustrated can be employed for giving vibratory motion to the table.

The shape of the table in outline is preferably an irregular parallelogram, decreasing in width from end to end along one side of the longer sides and having the remaining side and the top ends at right angles to one another. This reduction in the width of the table from the feeding-on end to the concentrates-discharging end is a feature observed in the construction of many styles of tables now in use and one that is allowed by the reduction in the mass or body of the material in its progress from the feeding-on side to the head or upper end, where the mineral is collected and discharged.

Our present construction of riffled surface is applicable, however, to tables that are of other shapes in outline, and while we describe and show a table-surface varying in width transversely we do not desire or intend to confine our improvement to that particular shape of table.

The part or feature of our improvement which relates to the construction of the riffled surface consists in dividing that portion of the working surface *a* from the end nearest the feeding-on trough *c*, which for distinction may be termed the "lower end," to about the middle line of the table into a number of parallel channels 3 by a series of riffles or standing strips 2 of uniform length extending lengthwise of the table in the general direction of the motion. Commencing at the lower end before mentioned, the riffles 2 terminate on a common line *x x* running transversely across the table and in about the middle thereof from the higher to the lower side, and for the principal portion of that surface between the lower end and such median line the riffles are set and spaced at relatively wide distances apart. On that portion of the same surface which lies immediately in front of the feeding-on trough and which first receives the material from the trough the riffles 2 increase in number and are closely set and that portion of the table-surface is composed of narrower channels 4 than the principal portion below. On this higher side of the table the material as it flows from the feeding-on trough is at first retarded, and its movement laterally is resisted by the closely-riffled section to such an extent or degree that the mineral particles are kept under the influence of the vibratory motion, to be acted on by the motion to a greater degree than by the flow of the wash-water and the inclination of the table-surface, while that portion of the material which by virtue of its light and valueless character is carried by the wash-water over the riffles last mentioned is allowed to pass more freely across the remaining portion of the riffled surface below because of the reduction in the number of riffles on such lower section. On that part of the table a further variation in the character of the riffled surface is made by inserting a series of intermediate riffles 5 between the widely-set riffles 2, so as to increase the number of riffles for a portion of the table-surface without affecting the character of the remaining portion of the openly-riffled surface nearer the lower end of the table. For this purpose the intermediate riffles 5 are set between the riffles 2, starting from a line *y y* running diagonally across the openly-riffled section from the higher corner downward to the lower side of the table and terminating at the median line *x x*, or thereabout. Starting from that diagonal line *y y*, the intermediate riffles are carried beyond the transverse median line *x x* toward the foot of the table, and upon that portion of the surface lying between that line and the concentrates-discharge end they are arranged in stepped position, extending beyond the ends of the principal riffles 2 so as to terminate on a diagonal line from the higher to the lower side of the table, and dividing that surface also into a smooth or unriffled portion nearest the head of the table of a triangular shape and a riffled portion or section between the diagonal line *z z* and the adjacent ends of the principal riffles 2. The three series of riffles 2 4 5 set in this manner produce a strip or section of riffled surface that extends diagonally across the table-surface from the higher feeding-on side to the relatively lower end, where the clean concentrates are discharged and on which the riffles vary in number both in a transverse direction directly across the table from the higher to the lower side and also in a longitudinal direction or coincident with the vibratory motion. In addition to this the riffles will be seen to vary in number in a diagonal direction, producing a graduated surface that presents regularly-decreasing resistance in the diagonal path or course in which the middlings are caused to travel by the combined action of the motion and the inclination of the table and the currents of water. By varying the character of the riffled surface in this manner we secure a thorough grading of the mineral-bearing gangue, holding the different grades under the influence of the vibrations without retarding too much the lateral movement and discharge of the worthless portions from the lower side of the table. In this operation we have found that the best results are secured by retarding or holding back the material to the greatest degree or extent, at first on the highest part of the table-surface, where the riffles are increased in number for that purpose, and causing the separation of the mineral to take place mostly on the highest part, where it is first introduced.

In concentrators of this class or description, in which the moving table is set on spring legs or standards, it is necessary to attach the ends of the standards rigidly both to the table and to the stationary frame, as well as to fasten them securely, so that they will not by working loose affect the character of the vibrations set up in the table, and it is desirable also to provide for readily taking out a standard when it becomes broken and for placing a new one in position without throwing the machine out of service. In this part of our improvement the top and bottom ends of the standard are stiffly held in socket-irons d e, that are secured to the under side of the table and on the stationary frame beneath, the construction of which will be understood from Figs. 3 and 5 of the drawings. The standard b has a flat and relatively wide shank b', reduced in thickness to give the proper flexibility in the direction of the length of the table and the necessary strength and stiffness to carry the load, and on the top and bottom ends a thick wedge-shaped head b^2, corresponding in shape with the recess in the socket-iron, is formed integral with the shank, the standards being usually constructed of wood. The top socket-iron d is provided with a flange d', with screw-holes for securing it against the under side of the table, and the front side of the socket is open to admit the head of the standard, which is inserted and removed from the front side by a lateral movement, a slit d^2 in the bottom of the same being provided to admit the flat shank of the standard. The lower socket-iron e being longer than the top iron, it has a seat e' at the bottom for the wedge-shaped foot b^2 of the standard, and it is also open on one side for inserting the standard. The top rim is provided with a projecting rim or flange e^2 to rest on the cross-timber f, through which the socket-iron is let, as shown in Fig. 3. The lower socket-iron is made longer than the upper socket-iron for the purpose of dropping the foot of the standard, allowing a long standard to be used, and at the same time enabling the surface of the moving table to be kept at a convenient height above the base. The head and foot of the standard after they are inserted in their respective sockets are fastened in place by a forked slotted key g, inserted from one side of the socket, so as to straddle the shank of the standard just at the junction with the wedge-shaped head. This key, which is made sufficiently long for the purpose, extends beyond the side of the socket-iron and in line with a lug h on that part, and by means of a short bolt and nut i, passed through the lug and the end of the key, the latter is held in place, embracing the shank of the standard and preventing that part from working out of its position in the socket.

The means for varying the inclination of the table consists of a wedge-shaped slide-block m, under one end of each of the cross-timbers f, that carries the socket-irons e of the standards, and a fixed incline n on the under side of the timber directly over the slide-block, the inclined faces of the two parts being in working position to produce vertical movement of that end of the cross-timber from the longitudinal movement of the slide-block. All the slide-blocks are connected by a long rod p, running along the side of the stationary frame, for setting them simultaneously and with an equal throw, the outer end of the rod being screw-threaded and fitted to a threaded nut or sleeve r, with a hand-wheel s for turning it. The ends of the movable cross-timbers that are raised and lowered by the wedges above described are detached from the longitudinal bed-timbers in which they rest, but are confined against lateral movement by angle-irons t, bolted to the stationary timbers on each side of the movable timber. The construction will be clearly understood from Fig. 2 of the drawings.

In situations where it may be desired to return different portions of the tailings to the higher side of the table for a second running through the table a rotary cylindrical elevator can be connected with the main shaft of the vibrating mechanism, as illustrated in Figs. 1 and 2, the connection being conveniently made by a counter-shaft y', driven from the main shaft v by belt and pulleys x' and connected to the shaft w' of the elevator by a belt and pulleys z', as illustrated in Fig. 1. A pipe 1, leading from the elevator to the feeding-in trough, conducts the material over the table and delivers it for a second distribution on the table-surface. The construction of this elevating means is not described or shown in detail by us, for the reason that it contains no specially novel features.

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

1. A laterally-inclined, vibrating ore-concentrating table having its surface divided by riffles extending longitudinally thereof, and in the general direction of the vibratory movement, the riffles at the high end of the table being arranged uniformly close together for a short distance, the remaining riffles upon the table being arranged uniformly comparatively far apart, and intermediate riffles arranged to extend from a line extending diagonally across the surface of the table, over the portion thereof containing the widely-arranged riffles, substantially as described.

2. In an ore-concentrating table, the combination with a transversely-inclined table-surface having a vibratory motion in the general direction of the length of the table, of a plurality of parallel longitudinally-set riffles, variably spaced in a transverse direction, producing a closely-set uniformly-spaced section in the vicinity of the feeding-on side of the table, and an openly-set, uniformly-spaced section below, and intermediate, uniformly-spaced riffles arranged in stepped position from a line extending diagonally across the table between the openly-set riffles and parallel with the principal riffles below said closely-set section.

3. A transversely-inclined ore-concentrating table having a riffled surface, a group of riffles being set close together at the high side of the table while the remainder of the table is covered with riffles set far apart, intermediate riffles arranged to extend diagonally of the table, so that the widely-spaced riffles project between every other pair of diagonally-arranged riffles, substantially as described.

4. The combination with an inclined ore vibrating concentrating-table, and a stationary bed, of a spring-standard having wedge-shaped heads and socket-irons having flanges for securing them to the table and the bed respectively, said socket-irons having wedge-shaped sockets adapted to receive the heads of the standards, keys for securing the standards therein, and means for detachably fastening the keys.

5. The combination with a vibrating ore-concentrating table, of the stationary bed-timbers, the movable cross-timber *f*, socket-irons *d e* secured therein, spring-standards *b* having their ends fixed in the lower ends of the sockets on the stationary frame but being free to vibrate in said sockets above that point, inclines *n* on the movable timbers, wedge-shaped slide-blocks *m* set in operative position thereto, and the rod *p*, threaded nut and hand-wheel as a means for moving and setting the slide-blocks, the sockets holding the standards against endwise movement.

6. In an ore-concentrating table the combination with a transversely-inclined table-surface having a vibratory motion in the general direction of the length of the table, of a plurality of longitudinally-set riffles 2, variably spaced in a transverse direction producing a closely-set section in the vicinity of the feeding-on side of the table and an openly-set section below, and intermediate riffles arranged in stepped position between the openly-set riffles and parallel with them.

7. The combination with an inclined ore vibrating concentrating-table, and a stationary bed of spring-standards for supporting the table on said bed, sockets upon the table for receiving the upper ends of the standards, and comparatively deep sockets formed on the stationary bed, the lower ends of the spring-standards being thus secured at a suitable distance below the table in the bottom of said sockets and vibrating in the upper parts thereof, the table being thus supported at no great distance from the bed, enlarged retaining-heads on the lower ends of said standards, and means in the said sockets for engaging and holding the said enlarged heads in place, substantially as described.

In testimony whereof we have hereunto set our hands to the foregoing specification.

EDWARD B. ROGERS. [L. S.]
FREDRICK P. HANSON. [L. S.]

Witnesses:
EDWARD E. OSBORN,
M. REGNER.

COMPLAINANTS' EXHIBIT No. 23
Schraubstadter Patent No. 738,493
ALMON E. HART, Special Examiner

No. 738,493. PATENTED SEPT. 8, 1903.

R. T. SCHRAUBSTADTER.
CONCENTRATOR TABLE.
APPLICATION FILED JULY 5, 1901.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

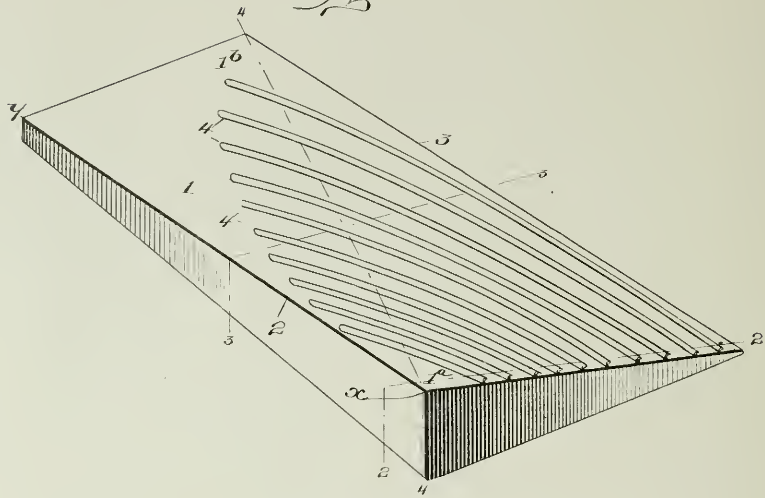

Fig. 2.

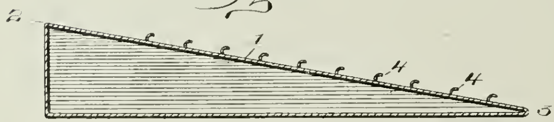

Fig. 3.

Fig. 4.

Witnesses:
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Richard T. Schraubstadter
by F. W. Ritter Jr. Atty

No. 738,493.

PATENTED SEPT. 8, 1903.

R. T. SCHRAUBSTADTER.

CONCENTRATOR TABLE.

APPLICATION FILED JULY 5, 1901.

NO MODEL.

2 SHEETS—SHEET 2.

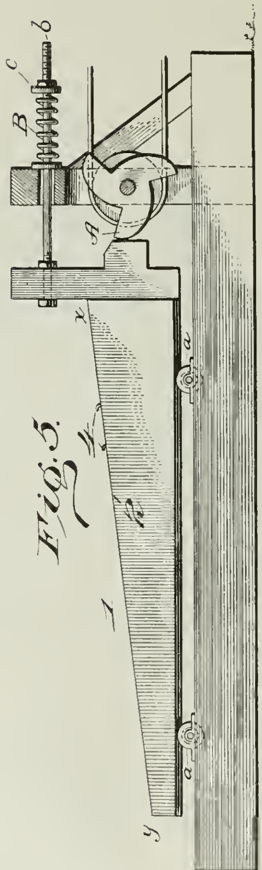

Fig. 5.

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By F. W. Ritter, Jr.
Attorney

UNITED STATES PATENT OFFICE.

RICHARD T. SCHRAUBSTADTER, OF ST LOUIS, MISSOURI, ASSIGNOR TO FREDERIC W. RITTER, JR., OF WASHINGTON, DISTRICT OF COLUMBIA.

CONCENTRATOR-TABLE.

SPECIFICATION forming part of Letters Patent No. 738,493, dated September 8, 1903.

Application filed July 5, 1901. Serial No. 67,210. (No model.)

To all whom it may concern:

Be it known that I, RICHARD T. SCHRAUBSTADTER, a citizen of the United States, residing at St. Louis, in the State of Missouri, have invented certain new and useful Improvements in Concentrator-Tables; and I hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, in which—

Figure 1 is a perspective view of a concentrator-table embodying my invention, the feed end being in the foreground. Figs. 2 and 3 are transverse sections thereof, taken on the lines 2 2 and 3 3, Fig. 1. Fig. 4 is a vertical section on the line 4 4, Fig. 1, the riffles omitted. Fig. 5 is a side elevation of the concentrator-table, showing means for reciprocating the same.

Like symbols refer to like parts wherever they occur.

My invention relates generally to that class of ore-concentrators wherein the matrix and values are separated by gravity and water, but more particularly to that class which is laterally inclined and to which an endwise vibratory motion is imparted by suitable mechanism and with which a flow of water is employed to carry off the gangue or lighter material at the lower edge of the table, while the values are directed lengthwise of the table and delivered at the tail thereof. In this class of concentrators, as is well understood by those skilled in the art, the lateral inclination of the table determines the capacity as well as the range of sizes of the material capable of treatment by the concentrator, the steeper the inclination the greater the capacity, the less the inclination the greater the saving of fine values. Concentrator-tables, therefore, as heretofore constructed may be said to have been of a compromise character—that is to say, the table proper has been in the nature of a plane surface set at an inclination to obtain the desired capacity and having its surface broken at internals by riffles to check the flow of the water and intercept the values and direct the same to the tail of the table. To increase the range and efficiency of such concentrators, the riffles have been variously arranged—as, for instance, diagonally, longitudinally of different lengths, increasing gradually toward the tail and discharge edge of the table, and also longitudinally and curved at one or both ends, all of which while somewhat increasing the capacity of the table result in the utilization of but a limited portion of the table-surface and a more or less imperfect separation of values.

The object of my present invention is to increase the capacity of the concentrator-table, utilize the greater part of its surface, effect a cleaner separation of values from the matrix, and to dispense with the previous use of jigs or screens.

To this end the main feature of my invention consists in a concentrator-table having a "warped" surface or approximation thereto, whereby the lateral inclination or slope is rendered variable from head to tail or from the feed to the discharge end of the table and whereby an increased range of sizes of the material to be treated is rendered possible, and, second, in a horizontal arrangement of riffles with relation to said warped surface of the table, whereby said riffles being at right angles to the trajectory of the flow saving of the fine values is insured.

There are other minor features of invention, all as will hereinafter more fully appear.

I will now proceed to describe my invention more fully, so that others skilled in the art to which it appertains may apply the same.

In the drawings, 1 indicates the surface of a concentrator-table embodying my invention, 1^a the head, and 1^b the tail or discharge end for values.

The lateral edges 2 and 3 of the table lie in different planes and are not parallel, while the head and tail edges 1^a and 1^b lie in the plane of the surface of the table and parallel to a common plane, which results in relatively elevating the corner x (the feed-corner) with relation to the corner y (upper tail-corner) and giving to the surface 1 of the table the form of a "hyperbolic paraboloid," which is the preferred form of my warped table.

4 4 indicate riffles which are applied to the table at intervals on lines formed by the intersection of horizontal planes with the warped surface 1 of the table, which causes said riffles to assume the form of parabolas, with their

curvatures substantially normal or at right angles to the direction of flow of the material operated upon, which effects a more perfect separation of the values from the matrix or gangue as well as adding to the durability or life of the table.

The surface of the table will preferably be covered with linoleum, and the riffles 4, which may be of wood or other suitable material, will, owing to the warp of the table, be made to taper toward the tail of the table and preferably terminate along a parabola. The table may also be mounted in any suitable manner and vibrated by any preferred mechanism—as, for instance, the table may be supported or suspended by adjustable links or rest upon rollers *a* (see Fig. 5) and reciprocated by means of a power-driven cam-wheel A and a rod and return-spring *b* B, the former being changeable and the latter adjustable by means of the nut *c* or otherwise to vary the length and time of the movement of the table.

The operation of the table is in general the same as tables of like class—that is to say, the table being given a longitudinal vibratory motion, preferably with a quick forward and slow return movement, and a flow of water provided for, the material to be treated is fed on the table at its upper corner, near the head, and is carried downward by the flow and moved toward the tail of the table by the vibratory motion thereof, so as to assume a more or less diagonal travel from the head to the tail of the table, extending for at least three-fourths of the length of the table. During the travel of the material diagonally across the table the direction of the flow will be at substantially right angles to the riffles, and the values will be deposited in the runs formed by the riffles and will move the length of the table under the impulse of vibration, being discharged at the tail thereof, while the gangue will be carried down and over the lower lateral edge of the table for the greater part of its length. The riffles may terminate along a parabola, which is practically a line of equal fall or grade. The lower edge of this parabola will be normal to the edge of the table. Hence the headings can be better removed or separated from the middlings which adjoin them as compared to plain surfaces, where the products proceed along an acute angle to the edge, as in previous constructions. Owing to the paraboloid form of the table and the parabolas formed by the riffles, I am enabled to utilize at least three-fourths of the table-surface, which results in a better distribution of the material, less crowding thereof at the feed, a more perfect separation, and greater capacity.

While I have shown and described a hyperbolic paraboloid as the preferred surface, it will be evident that other warped surface may be employed without departing from the spirit of my invention, which includes, broadly, the utilization of a warped surface or approximations thereto for concentrator-tables either with or without riffles.

Wherever in the foregoing specification and the following claims the term "warped surface" is used the same is to be taken as meaning any surface which may be generated by a right line moving so that no two of its consecutive positions shall be in the same plane.

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

1. A concentrator-table having a "warped" surface and means for reciprocating said table, substantially as and for the purposes specified.

2. A concentrator-table having a "warped" surface provided with riffles and means for reciprocating said table, substantially as and for the purposes specified.

3. A concentrator-table having a "warped" surface and provided with riffles arranged on lines formed by the intersection of horizontal planes with the warped surface of the table and means for reciprocating said table, substantially as and for the purposes specified.

4. A concentrator-table having a concentrating-surface in the form of a hyperbolic paraboloid, and means for reciprocating said table, substantially as and for the purposes specified.

5. A concentrator-table having a concentrating-surface in the form of a hyperbolic paraboloid, provided with riffles which have the form of parabolas, and means for reciprocating said table, substantially as and for the purposes specified.

In testimony whereof I affix my signature, in presence of two witnesses, this 1st day of July, 1901.

RICHARD T. SCHRAUBSTADTER.

Witnesses:
JOSEPH H. ZUMBALEN,
W. E. FISSE.

Corrections in Letters Patent No. 738,493.

It is hereby certified that in Letters Patent No. 738,493, granted September 8, 1903, upon the application of Richard T. Schraubstadter, of St. Louis, Missouri, for an improvement in "Concentrator-Tables," errors appear in the printed specification requiring correction, as follows: On page 1, line 46, the word "internals" should read *intervals;* same page, line 52, a comma should be inserted after the word "longitudinally," and the comma after the word "lengths" should be stricken out. Page 2, line 50, the period after the word "table" should be stricken out and a comma inserted, and the following word "Hence" should begin with a small "h," thus making a continuous sentence; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 27th day of October, A. D., 1903.

[SEAL.]

F. I. ALLEN,
Commissioner of Patents.

COMPLAINANTS' EXHIBIT No. 24

Dodd Patent No. 716,205

ALMON E. HART, Special Examiner

No. 716.205.

Patented Dec. 16, 1902.

W. G. DODD.

ORE CONCENTRATING TABLE.

Application filed July 25, 1902.)

(No Model.)

2 Sheets—Sheet 1.

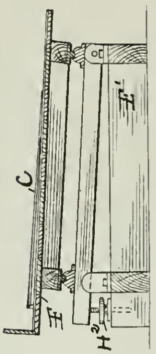


FIG. 3

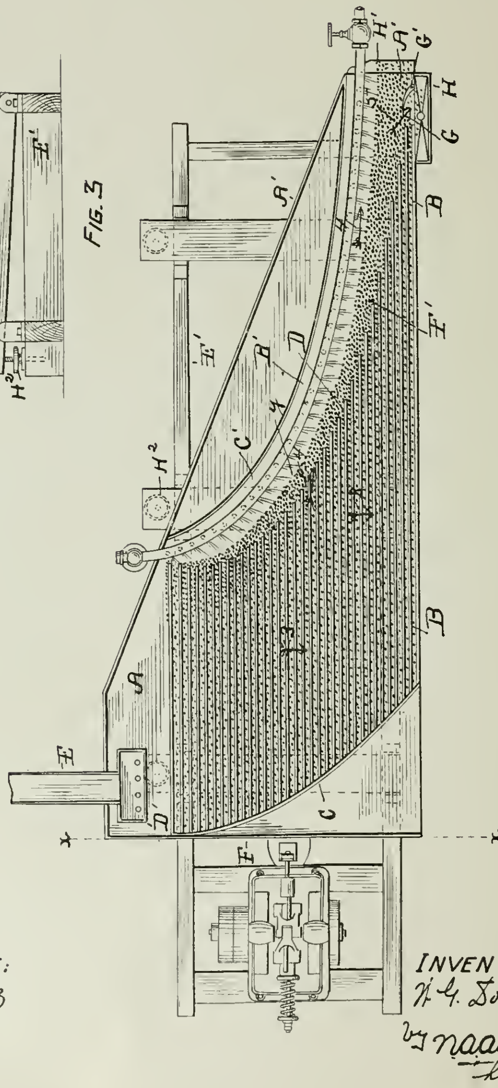


FIG. 1

WITNESSES:

D.B. Richards

Walter T. Vane.

INVENTOR:

W. G. Dodd

by N.A. Acker

his atty.

No. 716,205.

Patented Dec. 16, 1902.

W. G. DODD.

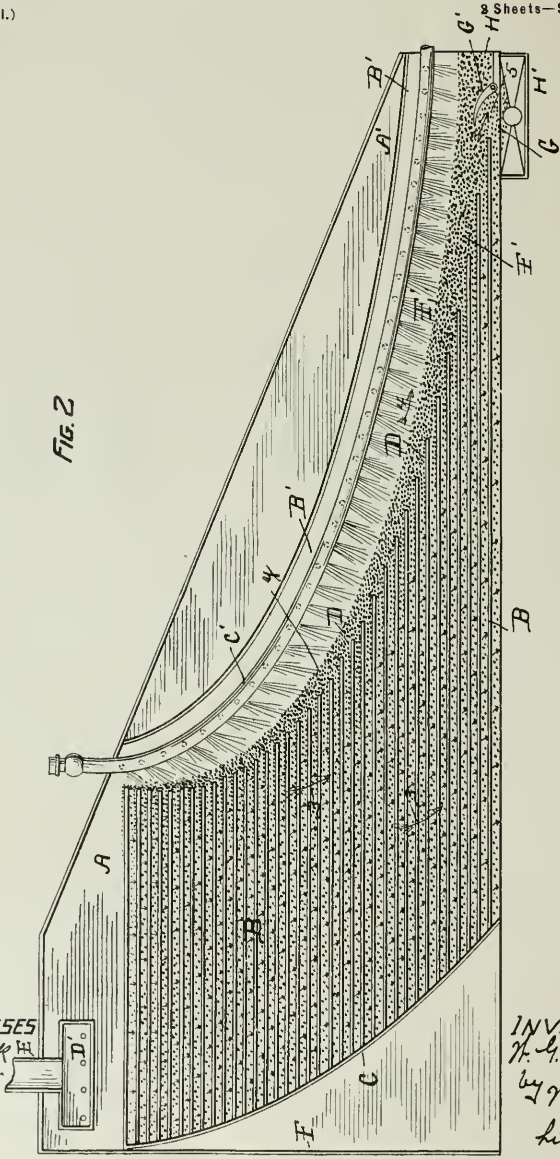
ORE CONCENTRATING TABLE.

(Application filed July 25, 1902.)

(No Model.)

2 Sheets—Sheet 2.

FIG. 2



WITNESSES
D. B. Richards
Walter F. Ames.

INVENTOR:
W. G. Dodd
by N. A. Acker
his atty.

UNITED STATES PATENT OFFICE.

WILLIS G. DODD, OF SAN FRANCISCO, CALIFORNIA.

ORE-CONCENTRATING TABLE.

SPECIFICATION forming part of Letters Patent No. 716,205, dated December 16, 1902.

Application filed July 25, 1902. Serial No. 116,944. (No model.)

To all whom it may concern:

Be it known that I, WILLIS G. DODD, a citizen of the United States, residing in the city and county of San Francisco, State of California, have invented certain new and useful Improvements in Ore-Concentrating Tables; and I do hereby declare the following to be a full, clear, and exact description of the same.

The present invention relates to concentrating-tables, and more particularly to that class of concentrating-tables known as "transversely-inclined reciprocating concentrating-tables," the working surfaces of which are provided with a series of longitudinal deflecting slats or riffles which discharge the mineral they collect upon a smooth or unriffled portion of the table for final washing and separation by subjecting the material fed thereon to the action of a flow of clear water, the invention pertaining more particularly to the manner of arranging and applying the deflecting slats or riffles to the working surfaces of such tables, together with other details hereinafter explained.

The object of my improvement is, first, to increase the capacity of such concentrating-tables without enlarging the working surface thereof, and, secondly, to increase their efficiency by producing less of the mixed product, termed "middlings," which requires subsequent treatment. I attain these objects by the manner of riffling the tables illustrated in the accompanying drawings, wherein—

Figure 1 is a top plan view of the concentrator. Fig. 2 is an enlarged top plan view of the table detached from its frame; and Fig. 3 is a cross-sectional end view in elevation, taken on line *x x*, Fig. 1, of the drawings.

Various United States Letters Patent have been granted for concentrating-tables having riffles arranged on the working face thereof for the separation of the valuable particles as the pulp is treated thereon. Perhaps the prior art may be said to be substantially defined by United States Letters Patent No. 247,629, granted Garvin, September 27, 1881; United States Letters Patent No. 258,879, granted Blatchly *et al.*, June 6, 1882; United States Letters Patent No. 533,362, granted Lampert, January 29, 1895, and United States Letters Patent No. 590,675, granted Wilfley, September 28, 1897. Many other United States Letters Patent have issued disclosing various improvements in connection with these concentrators; but the foregoing will suffice to illustrate ore-concentrating tables provided with separating-riffles arranged to separate, collect, and discharge the valuable particles from the pulp fed or delivered onto the working face of the tables. The Wilfley Letters Patent, No. 590,675, may be said to constitute one of the latest types of such form of table—that is, a concentrating-table having longitudinal riffles which guide the material for separation. This table combines the advantageous features of the prior tables and eliminates supposed defects. It utilizes the arrangement of riffles of the Lampert patent, No. 533,362—that is, arranges the riffles to extend from the head of the table, feeding the pulp thereto at substantially right angles to the riffles, and imparts to the table a jolting movement in the direction of the line of riffles. To the riffles is given the advancing terminal feature of the Garvin patent, No. 247,629, and the plain or unriffled portion of the table set forth in the Blatchly *et al.* patent, No. 258,879, and disclosed to a limited extent at the terminal of the riffles of the said Lampert patent. In the said Lampert and the said Wilfley patents the longitudinal riffles extend from the head of the table, are arranged diagonally across the working face thereof, terminate at a plain or unriffled portion, and the jolting movement of the table is in the line of riffles. The riffles of the Wilfley table extend onto the plain or unriffled portion with advancing terminals, while the Lampert riffles terminate in the same line. This extension or advancing terminals of the Wilfley riffles give riffles of increasing length, each extending from the head of the table a distance beyond its preceding riffle onto the plain or unriffled portion of the table. This arrangement of the riffles allows of the material assuming a natural diagonal line of movement over the smooth surface of the table and subjects it to repeated washings in its passage from riffle to riffle. With this form of table the material caught by the uppermost and shortest riffle, consisting of mineral and gangue, is discharged upon the smooth or unriffled portion of the table. The action of the flowing water, which is fed upon the upper edge of the table, separates and carries the gangue, which is lighter than the mineral, downward to the advanced terminal of the next riffle, while the mineral remains on the smooth or unriffled portion of the table and, due to the motion given the table, is carried forward over the smooth surface toward the tail of the table, where it is finally discharged into a receptacle provided for the purpose. In actual practice a slight portion of the mineral caught by the uppermost and shortest riffle will be carried downward with the gangue to the advanced terminal of the riffle below, mixing with the material caught by this riffle, which is discharged upon the smooth surface and is again subjected to the separating action of the water, as before, washing the gangue downward to the advanced terminal of the riffle below, while the mineral continues on its travel over the smooth surface to the tail of the table and is discharged, this operation successively repeating itself down to the lower riffles on the table, leaving an unseparated quantity of material termed "middlings." It is obvious that the operation described could not be successfully performed should the table be given a steep transverse inclination or should the flow of water fed upon the upper edge of the table be heavier than that sufficient to wash the gangue transversely downward without disturbing the mineral clinging to the smooth surface; otherwise the mineral and gangue would both be carried transversely downward and entangled among the advancing terminals of the riffles, producing middlings only. Thus it will be seen that the capacity of the table is governed by the delicate conditions named—*i. e.*, a slight transverse inclination and a light flow of water transversely across the smooth surface of the table.

My improvement consists in placing the riffles upon the working face of a transversely-inclined concentrating-table in such a manner that all the mineral collected by the riffles will be discharged upon and guided by the terminals of the riffles along the line of its natural path of travel over the table, due to the forces acting upon it, caused by giving the table a greater transverse inclination than can be employed in concentrating-tables of this class as usually constructed when a transverse flow of water is used sufficient to move the mineral downward across the smooth or unruffled portion of the working face of the table. The forces acting upon and governing the mineral in its travel over the table under the conditions named are inversely the same as those acting upon a projectile discharged from a gun, the constant flow of water acting as gravity and the impulse given the table acting as the projecting force. These forces being known, the same formula may be applied to determine the trajectory or path of the mineral over the table as is employed to determine the trajectory of a projectile, and when this is done the natural trajectory or path of the mineral over the table will be found to follow a curve approximating an inverted parabola.

By refering to Fig. 1, which is a plan view of a transversely-inclined reciprocating concentrating-table provided with means for adjusting the transverse inclination as required and fitted with my improved form of riffling, the area inclosed by the letter A is the working face of the table, usually covered with linoleum. The area inclosed by the letter B is that portion of the table covered or fitted with my improvement, consisting of a series of mineral-collecting riffles. These are usually tapering strips of wood, and they extend longitudinally from the overflow-riffle C toward the foot A′ of the table, the terminals of these riffles advancing to the curved line or path D approximating an inverted parabola. The area represented by letter B′ is that portion of the table which forms a smooth runway or trough, which is utilized for the cleaning and conveying of the mineral to its discharge-point at the foot of the table. The stationary water pipe or distributer C′ is suitably supported above the table. From this pipe clear water through suitably-controlled openings or jets is delivered to the table a short distance from the terminals or discharge ends of the riffles. The feed-box D′ is located near the head of the table, at its upper edge, which delivers the pulp or material to be concentrated upon the table above the riffles. A sluice or launder E connects the feed-box with any suitable device for crushing the material. Any suitable mechanism for imparting a variable longitudinal reciprocating motion to the table may be employed, that illustrated in the drawings being a simple and well-known form.

The operation is as follows: The table is placed upon its frame or base E′ with sufficient elevation to give a longitudinal inclination toward the head F. The table is then given a transverse inclination sufficient to cause the pulp to flow rapidly and smoothly downward over the riffles. Power being applied to the driving mechanism a longitudinal reciprocating motion is then imparted to the table, which motion has a tendency to carry the material fed upon the table forward toward the foot A′. Pulp, consisting of a mixture of water, gangue, and mineral, is now introduced by means of a sluice into the feed-box D′, from which it is delivered onto the table above the riffles and flows transversely downward over the same. The mineral contained in the pulp being heavier than the gangue settles between the riffles and is caught by them. A large portion of the slimy water introduced with the pulp in passing transversely downward over the table washes over the overflow-riffle C. Should this water carry in suspension any of the fine particles of mineral, the same will be conducted into a sluice provided for the purpose of conveying it to a settling-tank, thus recovering the fine particles of suspended mineral that would otherwise be lost. The gangue or worthless portion of the pulp continues on its course, flows over the lower side of the table, and is permitted to escape. The mineral which has been caught by the riffles is carried, due to the motion imparted to the table, longitudinally forward along the riffles and is discharged with more or less gangue into the smooth runway or trough, where it is subjected to the action of a flow of clear water delivered upon the table from the water pipe or distributer C'. The action of the water upon the material discharged by the riffles and the cleaning and separation of the mineral in its travel through the runway or trough to its point of discharge will be more fully understood by referring to Fig. 2 of the drawings, which is an enlarged plan view of the table and that portion upon which the operation is performed. As soon as the material—a mixture of mineral and gangue—which has been collected by the first riffle is discharged upon the smooth portion of the table it comes in contact with the flow of water delivered from the pipe C' and is carried down and mixed with the discharge of the riffle below. This mixture in turn is carried down and mixed with the discharge of the next riffle below, this operation successively repeating itself until a point—say *y*—in the path of the mineral has been reached where the trajectory begins to flatten. At this point the downward speed of travel is diminished and the mass of collected material begins to come under greater control of the motion imparted to the table, which agitates the material, consisting of mineral and gangue, causing the mineral to settle and the gangue to rise to the top and be carried off by the overflow of the clear water. The mass of clean mineral is gradually carried down the curve in the form of a band F', due to the motion of the table on one side and by the flow of the water on the other side, holding it together, thus forming a heavy band or riffle of traveling mineral, into which the lower riffles cannot discharge the lighter particles of gangue. It will, however, assimilate or take up any mineral that the riffles may have collected and discharged on its path. When the band of mineral has reached the terminal of the last riffle, the fringe of gangue G at the lower edge of the table, mixed with small particles of mineral, is sliced off by using the hinged pointer G', and the middlings thus obtained are discharged into the hopper H, from whence they are taken and returned to the table by means of any suitable device to be again treated. The mineral continues on and is discharged from the table over the apron H' into any suitable receptacle provided for the purpose.

The longitudinal inclination given the table is an important factor, as it gives a slight diagonal direction to the flow of water at the head of the table, which tends to retard the lighter gangue from being discharged by the riffles, but does not interfere with the discharge of the mineral which the riffles may collect.

This method of riffling enables the upper riffles to be used for the purpose of roughly collecting the mineral in mass and the lower riffles for guiding, cleaning, and separating it from the gangue, performing these two operations while the mineral is traveling over the table on a natural trajectory, due to the forces acting upon it, forming a curved line approximating an inverted parabola.

It is obvious that the described treatment of mineral in mass on a table of this type is much more rapid than with the ordinary method employed, and the middlings produced are reduced to a minimum. The means herein described of treating mineral on a table of this class by the use of a series of longitudinal riffles having advancing terminals terminating in a curved line approximating an inverted parabola is believed to be new. The inclination of the table is controlled by means of the adjusting devices H^2, which work against frame E'. The flow of the pulp is indicated by arrow 3 and that of the separated material by arrows 4, the middling being designated by arrows 5.

Having thus described the invention, what is claimed as new, and desired to be protected by Letters Patent, is—

1. A transversely-inclined concentrating-table having a movement whose tendency is to carry the material fed thereon longitudinally forward toward the tail or foot of the table, said table being provided with a number of longitudinal riffles, the terminals of said riffles successively advancing and terminating upon the surface of the table in a curve-line approximating an inverted parabola so as to permit of a band of discharge, leaving a smooth surface onto which the material collected by the riffles is discharged, washed and cleaned by being subjected to the action of clear water, and means whereby water is admitted onto the table for washing the material delivered onto the unriffled portion thereof.

2. A concentrating-table provided with means for imparting thereto a longitudinal and a transverse inclination, the working surface of said table being provided with a number of riffles extending longitudinally from an overflow-riffle toward its foot, the terminals of said riffles successively advancing and terminating upon the surface of the table in a curve-line, approximating an inverted pa-

rabola, a smooth or unriffled surface to the table onto which the material collected by the riffle is cleaned and separated by being subjected to the action of clear water, means for imparting a reciprocating motion to the table, devices for giving thereto a longitudinal and a lateral inclination, and means whereby water is admitted onto the table for washing the material delivered onto the unriffled portion thereof.

In witness whereof I have hereunto set my hand.

WILLIS G. DODD.

Witnesses:
HARRY J. LASK,
WALTER F. VANE.

COMPLAINANTS' EXHIBIT No. 25

Ruedy Patent No. 757,350

ALMON E. HART, Special Examiner

No. 757,350. PATENTED APR. 12, 1904.

J. RUEDY.

CONCENTRATOR.

APPLICATION FILED AUG. 22, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

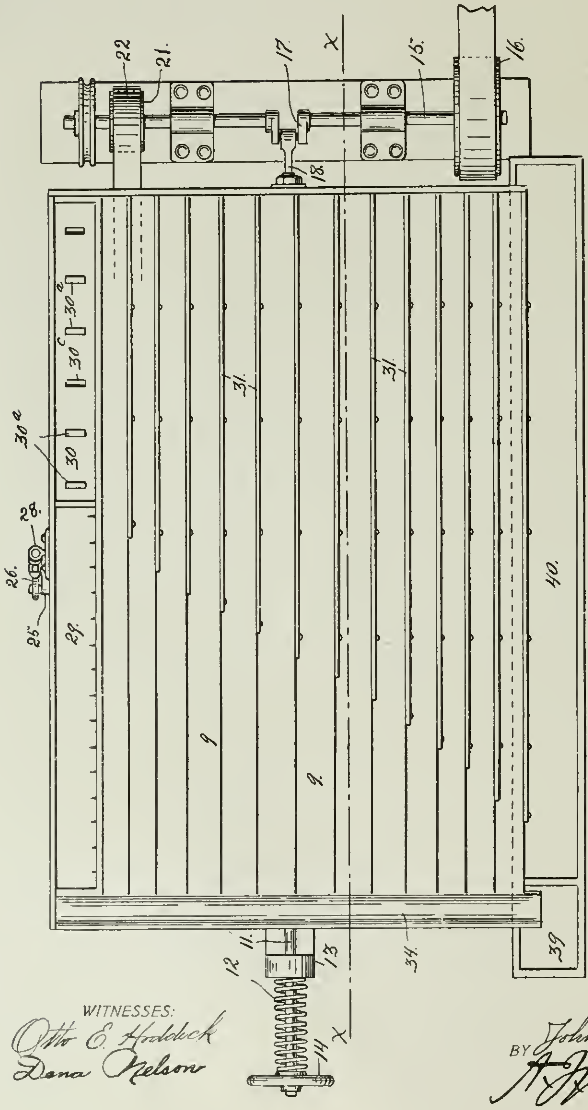


Fig. 1

WITNESSES:

Otto E. Hoddick

Dena Nelson

INVENTOR.

John Ruedy

BY A. J. O'Brien

ATTORNEY.

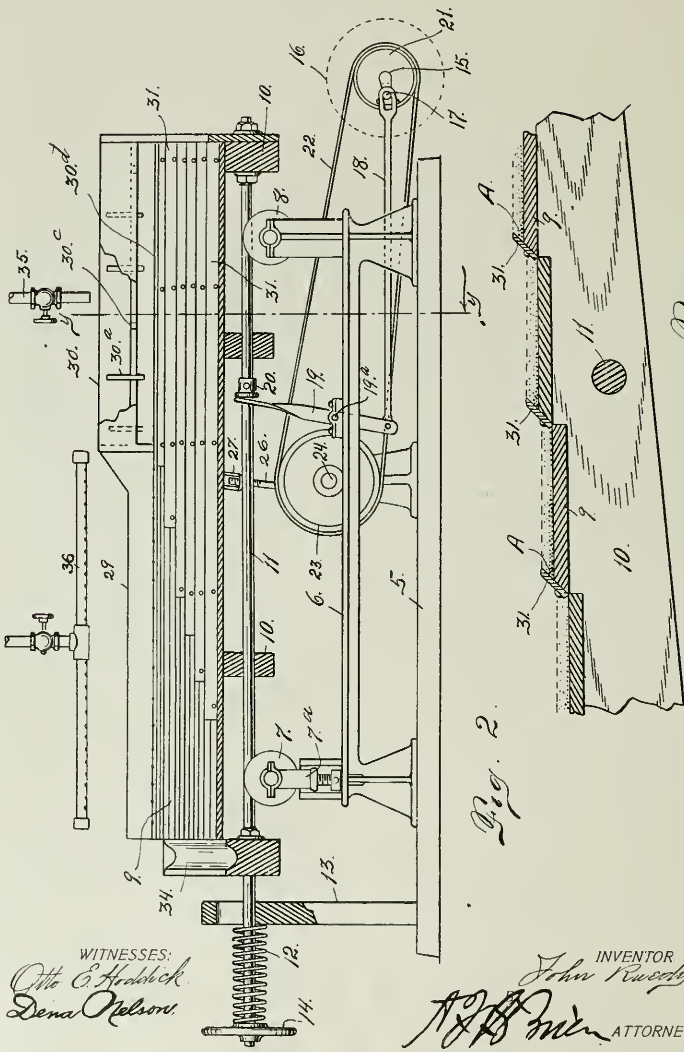
No. 757,350. PATENTED APR. 12, 1904.

J. RUEDY.

CONCENTRATOR.

APPLICATION FILED AUG. 22, 1902.

NO MODEL. 3 SHEETS—SHEET 2.



WITNESSES:

Otto E. Hoddick

Dena Nelson.

INVENTOR

John Ruedy.

ATTORNEY.

No. 757,350. PATENTED APR. 12, 1904.

J. RUEDY.

CONCENTRATOR.

APPLICATION FILED AUG. 22, 1902.

NO MODEL. 3 SHEETS—SHEET 3.

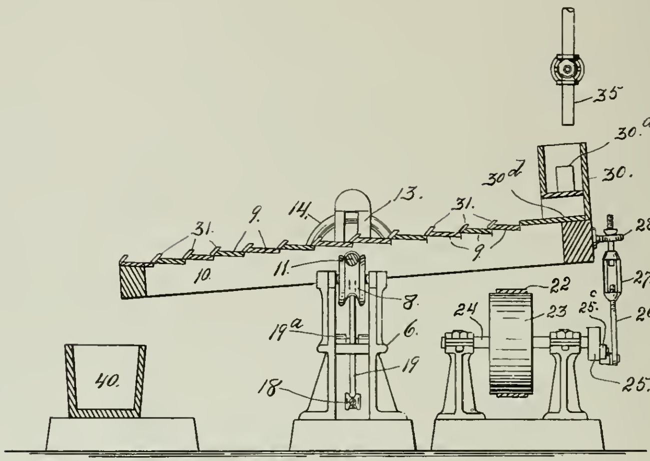


Fig. 3.

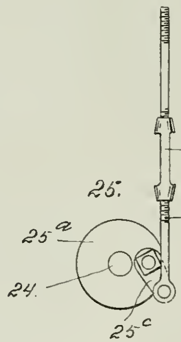


Fig. 4.

WITNESSES:
Otto E Hoddick.
Dena Nelson.

INVENTOR.
John Ruedy.
BY
[signature]
ATTORNEY.

UNITED STATES PATENT OFFICE.

JOHN RUEDY, OF DENVER, COLORADO.

CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 757,350, dated April 12, 1904.

Application filed August 22, 1902. Serial No. 120,701. (No model.)

To all whom it may concern:

Be it known that I, JOHN RUEDY, a citizen of the United States of America, residing at Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Concentrators; and I do 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, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in concentrators, and more particularly to a machine in which the gangue is separated from the mineral values by a washing and panning operation. Its object is to produce a concentrator of the class described by means of which practically all of the mineral values may be separated from the ore, which may be readily adjusted to produce the most effective results for any given grade of ore under treatment, which may be readily assembled for operation, which is light in weight and economical in use.

To this end the invention consists of a series of concentrating-pans forming a table which is centrally mounted on a reciprocating rock shaft or bearing, is provided with adjustable means for tilting said table, and is also provided with detachable riffles for regulating the overflow or escape of the material from one pan or shelf to another.

Having briefly outlined my improvement, I will proceed to describe the same in detail, reference being made to the accompanying drawings, in which is illustrated an embodiment thereof.

In the drawings, Figure 1 is a top or plan view of a concentrator constructed according to my invention. Fig. 2 is a longitudinal section of the same, taken on the line x x, Fig. 1. Fig. 3 is a cross-section taken on the line y y of Fig. 2. Fig. 4 is a detail view of the adjustable crank and the connection employed for giving the oscillating or rocking motion to the pans or shelves of the table. Fig. 5 is an enlarged detail sectional view showing the construction and arrangement of the riffles secured to the edges of the pans or shelves.

The same reference characters indicate the same parts in all the views.

Let the numeral 5 designate the foundation of the machine, and 6 the bed or frame mounted thereon. In this frame are mounted the grooved sheaves 7 and 8. (See Fig. 2.) The sheave 7 is mounted in a vertically-adjustable bearing 7^a. Resting on these sheaves 7 and 8 are the pans or shelves 9, consisting of a series of flat strips or pieces, forming a transversely-stepped table mounted on cross beams or bars 10. Centrally secured on the cross-bars 10 and extending lengthwise of the table is the rock-shaft 11. This rock-shaft rests in the grooves of the sheaves 7 and 8 and is made to reciprocate on said sheaves. Its rear end, which projects beyond the frame 10, is provided with a spiral spring 12, which surrounds the shaft and rests between a rigid upright part 13 and a hand-wheel 14, threaded on the end of the said shaft. At the opposite or forward end of the machine is arranged the power-shaft 15, provided with the transmitting-pulley 16 and a crank 17. Extending from the crank 17 is a connecting rod or link 18, the inner end of which is pivoted to a vertical lever 19. This lever is fulcrumed, as shown at 19^a, on the frame 6, and its upper end is bifurcated to straddle the reciprocating rock-shaft 11. Just in front of this pivoted lever 19 is mounted a collar or stop 20, which is rigidly secured on the shaft 11.

Mounted on the power-shaft 15 is a second pulley 21, which is connected with a pulley 23 by a belt 22. This pulley 23 is mounted below and near the longitudinal center of the table 10 on a shaft 24, upon which is also mounted the adjustable crank 25. (See Figs. 2 and 3.) This crank is shown in detail in Fig. 4 and consists of a short crank-arm 25^c, which is secured to a disk or wheel 25^a, fast on the shaft 24, in such a manner as to permit the free end of the arm 25^c to be readily swung to and from the center of the disk 6, regulating the stroke of the crank. This crank-arm is pivotally mounted on the wheel or disk, and when in use its inner extremity is locked on the disk. To adjust it, the crank is loosened where it is attached to the disk and swung in one direction or the other, according as it is necessary to increase or diminish its stroke, after which it is locked on the disk and is ready for operation. To connect this crank 25 to the longitudinal edge of the table, I have provided a connecting-rod 26, having a turnbuckle 27, which is swiveled on a pin 28, as shown in the drawings. Arranged above the edge of the table with which the aforesaid crank is connected are the feed and wash water troughs or launders 29 and 30. The launder 30 is provided with a series of projections 30^a to prevent the ore in the pulp which is fed to the launder from caking or packing. The pulp which is fed to this launder is obliged to pass around these projections 30^a on its way to the openings 30^c, through which it falls, to a spreading-board 30^d, whence it is carried by its own gravity and the rocking motion of the table to the concentrating pans or shelves 9. At the free or outer edge of each pan or shelf is secured a detachable riffle 31. These riffles are placed in an inclined position, as shown in detail in Fig. 5, forming a V-shaped recess A for retaining the mineral particles while the gangue is being thrown over the riffles by the rocking action of the table. A valve-controlled pipe 35 is mounted above the feed-launder 30 for supplying the necessary water to form, with the ore, a pulp of suitable consistency, while above the launder 29 is supported a perforated pipe 36 for supplying the table with the necessary wash-water, which is first discharged into the last-named launder.

It will be observed from an inspection of Figs. 1 and 3 of the drawings that the pans or shelves 9 are widest at the center of the table and gradually diminish in width toward its outer edges in both directions. The reasons of this construction is that when the table is subjected to a transverse rocking action with the shaft 11, which is located directly below the longitudinal center of the table, the motion is less on a line extending through the table's longitudinal center and increases toward the outer edges of the table in both directions from said line. Hence in order that the material in the longitudinal pans at the center of the table may have the necessary motion or agitation to separate the pulverized-ore particles from each other and allow the mineral values to settle the pans are given greater width, whereby the material, though having a slower movement, has a greater scope of travel on the wider pans than the pans farther from the center or the narrower pans, whereby the panning motion becomes equal or approximately equal in all of the pans.

In operation, the parts being assembled as above described, the sheave 7 is adjusted so as to slightly raise the table at this point, whereby the latter is longitudinally inclined, its head or right-hand extremity (see Figs. 1 and 2) being lowest. In this manner the pans are usually raised to keep them free from water, or nearly so, at their rear end or left-hand extremity, referring to Figs. 1 and 2, while the greatest depth of water is found in the forward end of the pans. The pulp containing the pulverized ore to be treated passes from the launder 30 to the pans 9, where it is carried successively from one pan to its adjoining pan by virtue of the rocking or oscillating motion to which the table is subjected during the rotation of the shaft 24 by the crank 25 and its connections. The heavier particles or mineral values of the pulp are retained by the riffles 31 and remain in the pans 9 nearer the feed edge of the table, while the lighter mineral values in the order of their gravity are caught by the pans farther from the feed edge of the table. The gangue is carried over each successive riffle, being deprived of a portion of the mineral values in each pan, until it is finally discharged from the table into the tailings-trough 40, having been completely or approximately completely impoverished of the mineral values originally contained in the pulp. The mechanism for rocking the table is so adjusted that when the outer extremity of the operating-arm 25^c is at its lowest point the table will occupy a slightly-inclined position, (see Fig. 3,) while when the same extremity of the crank is at its upward limit of movement the table will be considerably inclined, thus throwing the gangue-discharge edge of the table relatively lower than the feed edge of the table. It will be understood that this arrangement facilitates the discharge of the gangue over the riffles of the pans or shelves, while there is no tendency to throw the material in the opposite direction or toward the feed edge of the table, since the latter is never moved beyond the horizontal in that direction. The rocking motion of the table is regulated to produce this result to the end that the discharge from one pan to the other is intermittent, as distinguished from continuous, whereby each pan becomes in itself a complete concentrating device, which discharges a portion of the lighter material every time the table is tilted in one direction sufficiently for the purpose. As soon as this occurs the discharge is interrupted by the reverse movement of the table. During this last-named stroke or movement the concentrating function takes place, the gangue rising and the concentrates settling preparatory to the reverse stroke, which tips off the top or upper stratum of the pan's contents. Simultaneously with the separation of the mineral values from the gangue the concentrates or mineral values caught by the pans are carried rearwardly in the pans or shelves by the reciprocating motion of the table imparted by the lever 19, which is connected with the crank-shaft 15, as heretofore explained.

It will be seen that by virtue of the mechanism above described the table is carried forward by the movement of the pivoted lever 19 engaging the rigid collar 20 on the rock-shaft 11, the return stroke or travel of the table being produced by the recoil of the spiral spring 12, which is adjusted to return the table by a sudden impulse, and the next forward movement of the lever 19 engaging the collar 20 suddenly overcomes the rearward movement of the table, whereby the mineral values resting on the several pans 9 are carried gradually to the rear end of the pans up the slight incline of the latter. In this manner the concentrates are gradually carried to the receiving-trough 34, from which they pass to the receptacle 39.

From the foregoing it will be understood that the rocking motion of the table may be regulated by the relative position of the adjustable crank 25, according to the character of the material to be treated, while the adjustment of the sheave 7 and the tension of the spiral spring 12 fully control the travel of the mineral values toward the rear of the table.

Having thus described my invention, what I claim is—

1. A concentrating-table composed of a number of longitudinal pans widest at the center of the table and diminishing in width toward the opposite edges thereof arranged to have a transverse intermittent discharge from one to the other, the discharge being completely interrupted during the rocking stroke of the table in one direction, the said pans or shelves being provided with riffles projecting above their discharge edge and shaped to hold the concentrates on the pan, and means for simultaneously imparting to the table a longitudinal reciprocation and a rocking or oscillating movement.

2. A table for saving mineral values, said table having a series of longitudinal shelves widest at the center of the table and diminishing in width toward the opposite edges thereof, giving the table a stepped surface crosswise of its length, the shelves having a transverse discharge from one to another, and means for simultaneously imparting to the table a longitudinal reciprocation and a rocking or oscillating motion, the latter being regulated to make the transverse discharge intermittent whereby the discharge is completely interrupted during the rocking stroke of the table in one direction.

3. A table for saving mineral values, said table being provided with a series of longitudinally-disposed concentrating-pans adapted to retain a portion of the material under treatment, said pans being widest at the central portion of the table and diminishing in width toward the opposite edges thereof and means for simultaneously imparting to the table a movement having a tendency to cause the material to travel thereon from the head toward the tail of the table, and a movement causing the pans to overflow or discharge intermittently from one to another in a transverse direction, whereby the discharge is completely interrupted during appreciable intervals.

4. A table for saving mineral values, said table having a series of longitudinally-disposed pans arranged to give the table a transversely-stepped surface, the table being mounted on an axis lying in a vertical plane passed longitudinally through its central portion, the central pans being widest, and the other pans diminishing in width from the center in both directions, and means for imparting to the table a longitudinal reciprocation and a rocking motion at right angles to its longitudinal movement, substantially as described.

5. In a concentrating apparatus, the combination with a suitable support, of a concentrating-table provided with a series of longitudinally-disposed parallel pans rigidly connected with the table and giving its surface a transversely-stepped appearance, said pans being of varying width to compensate for the reduced motion in the vicinity of the table's axis, a shaft secured to the longitudinal center of the table and resting on the support, and means for simultaneously imparting to the shaft and table a longitudinal reciprocation and a transverse rocking or oscillating movement, the arrangement being such as to cause the pans to have an intermittent discharge from one to the other, the discharge being completely interrupted during one stroke of the rocking movement.

6. In a concentrating apparatus, the combination with a suitable support, of grooved wheels mounted thereon, a shaft engaging said wheels, and a concentrating-table having its central longitudinal portion secured to the shaft, said table being composed of a series of longitudinal, parallel pans decreasing in width from the central portion of the table in both directions, and means for imparting to the shaft and table a longitudinal reciprocation and a rocking motion at right angles to the reciprocation, substantially as described.

7. In concentrating apparatus, the combination with a suitable support, of grooved pulleys mounted thereon, one of said pulleys being vertically adjustable, a shaft engaging said pulleys, a concentrating-table mounted on the shaft, said table being composed of longitudinal parallel pans decreasing in width from the central part of the table in both directions, and means for simultaneously imparting to the table a longitudinal reciprocation and a transverse rocking motion, said means being arranged to give the pans an intermittent, transverse discharge from one to the other.

8. In a concentrating apparatus, the combination with a suitable support, of a shaft mounted to rock and slide longitudinally thereon, a concentrating-table having its central longitudinal portion made fast to said shaft,

said table being composed of a series of longitudinal, parallel pans decreasing in width from the central part of the table in both directions, and means for simultaneously imparting to the shaft and table a longitudinal reciprocation and a rocking motion, substantially as described.

9. The combination with a suitable support, of a shaft mounted thereon and having a longitudinal movement, said shaft being spring-actuated in one direction, a lever connected with the shaft for actuating the table in the opposite direction to place the spring under tension, and a concentrating-table having its central longitudinal portion attached to the shaft, said table being composed of a series of parallel, longitudinally-disposed pans widest at the center or in the vicinity of the table's axis, and means for imparting to the table a rocking movement at right angles to its longitudinal reciprocation, the rocking means being arranged to cause the pans to discharge intermittently from one to the other, the discharge from one pan to another being completely interrupted during the rocking stroke of the table in one direction.

10. The combination with a suitable support, of a table movably mounted thereon and composed of a series of parallel longitudinally-disposed pans widest at the center of the table, means for imparting to the table a longitudinal reciprocation, an operating-crank, and a suitable connection between the said crank and the table whereby a rocking movement is imparted to the table, calculated to cause the pans to have an intermittent discharge from one to the other, the discharge from one pan to the other being completely interrupted at predetermined intervals.

11. The combination with a suitable support, of a table movably mounted thereon and composed of a series of parallel, longitudinally-disposed pans widest at the center of the table, and means for imparting to the table a transverse rocking movement whereby the pans are made to overflow or discharge intermittently from one to another, the discharge being completely interrupted during the rocking stroke of the table in one direction.

12. In concentrating apparatus, the combination with a suitable support, of sheaves mounted thereon, a shaft engaging said sheaves, a spring surrounding the shaft, a hand-wheel threaded on the shaft and bearing against one extremity of the spring, a stationary support through which the shaft passes, a lever for imparting to the shaft a longitudinal movement in one direction whereby the spring is placed under tension, the spring imparting the movement in the opposite direction, and a table mounted on the support and composed of a series of parallel longitudinally-disposed pans, said pans being widest at the center of the table, means for feeding the material to be treated, to the table, means for supplying the necessary wash-water to the table, and means for imparting to the table a rocking movement at right angles to its reciprocating movement, whereby the pans are caused to overflow or discharge intermittently from one to another, the discharge or overflow from one pan to another being completely interrupted at regular intervals or during the rocking movement of the table in one direction, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN RUEDY.

Witnesses:
DENA NELSON,
A. J. O'BRIEN.

COMPLAINANTS' EXHIBIT No. 26

Overstrom Patent No. 763,784

ALMON E. HART, Special Examiner

No. 763,784. PATENTED JUNE 28, 1904.

G. A. OVERSTROM.

CONCENTRATING TABLE.

APPLICATION FILED JULY 19, 1901.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

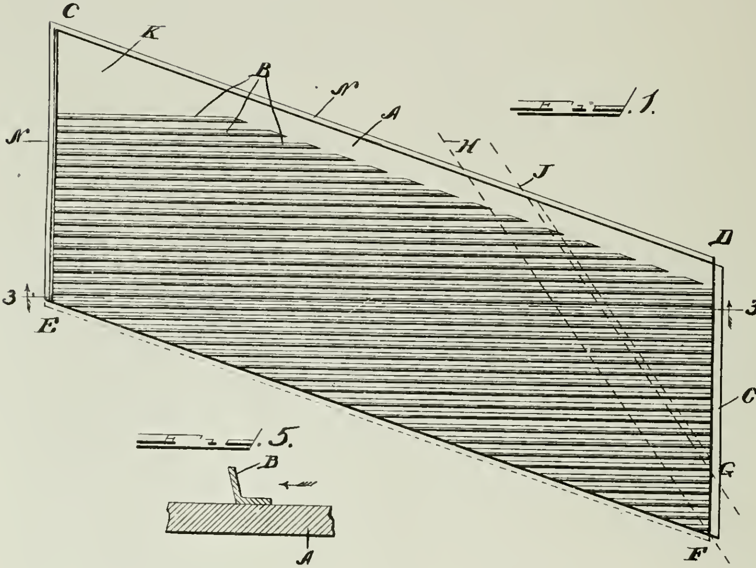


Fig. 5.

Fig. 2.

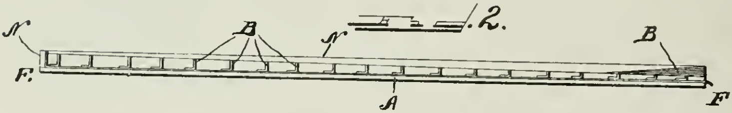


Fig. 3

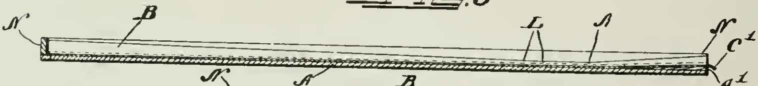


Fig. 6.

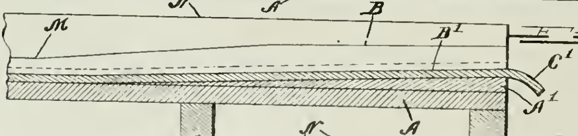
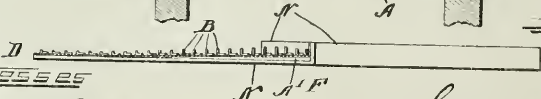


Fig. 4.



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Inventor
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By Brown & Darby
Attys

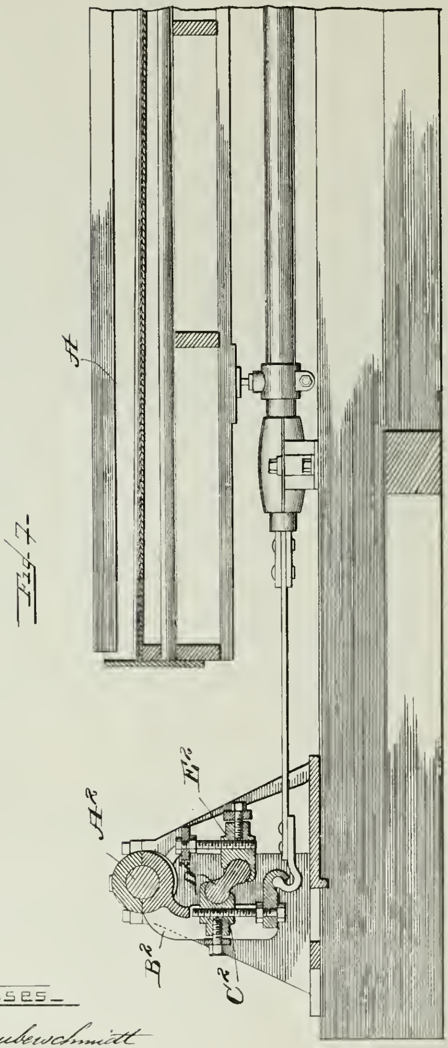
No. 763,784. PATENTED JUNE 28, 1904.

G. A. OVERSTROM.

CONCENTRATING TABLE.

APPLICATION FILED JULY 19, 1901.

NO MODEL. 2 SHEETS—SHEET 2.



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Gustave A. Overstrom

By Brown & Darby

Attys.

No. 763,784. Patented June 28, 1904.

UNITED STATES PATENT OFFICE.

GUSTAVE A. OVERSTROM, OF ANACONDA, MONTANA, ASSIGNOR TO OVERSTROM CONCENTRATOR COMPANY, OF BUTTE, MONTANA, A CORPORATION OF MONTANA.

CONCENTRATING-TABLE.

SPECIFICATION forming part of Letters Patent No. 763,784, dated June 28, 1904.

Application filed July 19, 1901. Serial No. 68,958. (No model.)

To all whom it may concern:

Be it known that I, GUSTAVE A. OVERSTROM, a citizen of the United States, residing at Anaconda, in the county of Deerlodge and State of Montana, have invented a new and useful Concentrating-Table, of which the following is a specification.

This invention relates to ore-concentrating tables.

The object of the invention is to improve the construction of concentrating-tables whereby a more efficient separation of mineral from the silica, rock, dirt, and the like is effected.

The invention consists, substantially, in the construction, combination, location, and arrangement of parts, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally pointed out in the appended claims.

Referring to the accompanying drawings and to the various views and reference-signs appearing thereon, Figure 1 is a plan view of a concentrating-table embodying the principles of my invention. Fig. 2 is an edge view, taken from the tailings-discharge edge or side of the table, looking from the bottom of Fig. 1, the edge flange or riffle being omitted. Fig. 3 is a longitudinal section on the line 3 3, Fig. 1, looking in the direction of the arrows. Fig. 4 is an end view looking from the right-hand end of Fig. 1. Fig. 5 is an enlarged detail view in cross-section, showing the arrangement of riffle on the upper surface of the table. Fig. 6 is a broken view similar to Fig. 3, but on a larger scale. Fig. 7 is a view in section, taken longitudinally of an ore-concentrating table embodying the principles of my invention and showing the form of reciprocating mechanism therefor.

The same part is designated by the same reference-sign wherever it occurs throughout the several views.

In the operation of ore-concentrating plants the crushed ore is delivered upon a table to which a reciprocatory movement is imparted and upon which is delivered wash-water, the longitudinal reciprocations imparted to said table serving to effect the advancement of the particles of silica, rock, and mineral along said table, and the mineral portion being heaviest gravitates to the bottom of the mass, is deposited upon the table, and progressed along said table, while the rock portions, the silicate, dirt, and the like are gradually washed away from the mineral portion and are discharged over one edge of the table (which edge I will hereinafter designate the "tailings-discharge" edge) along with the wash-water, while the mineral portion is advanced or progressed over the end of the table. In order to prevent the mineral from being washed off with the wash-water, it is usual to provide riffles upon the upper surface of the table, the purpose and function of which is to form stops to catch and hold the mineral portions, while at the same time permitting the lighter silica, rock, dirt, and the like to wash over the upper or top edges of the riffles. These riffles have been arranged in various ways, and riffles of various shapes in cross-section have been employed for this purpose.

My present invention relates particularly to a construction and arrangement of riffles; and the special object in view is to insure as complete a separation of the silica, rock, dirt, and the like as possible from the mineral without the danger of losing any of the mineral by the same being washed off or away with the wash-water which carries the silica, rock, &c., and while I have shown and will now describe a particular construction and arrangement of table I desire it to be understood that my invention is not limited in this application to a table of the specific construction shown, but is equally well adapted for use with other types and constructions of tables.

Referring to the accompanying drawings, reference-sign A designates the table, which is of quadrangular shape—that is, the sides or edges thereof are parallel with each other and the ends thereof are parallel with each other; but the sides, as shown, are inclined with respect to the ends.

B designates generally the riffles. These riffles are arranged in the particular form shown, and preferably to extend parallel each other and substantially at right angles to the ends and diagonally to the sides or edges of the table. In practice reciprocatory movements are imparted to the table substantially in the direction of length of the riffles—that is, in a diagonal direction with respect to the table. I have shown an illustrative form of means for imparting such reciprocatory movements to the table. In the form of apparatus for imparting reciprocatory movements to the table shown reference-sign A^2 designates a shaft to which is eccentrically connected an arm B^2, carrying a bearing-block C^2. A block D^2 is journaled in said bearing-block and a coöperating stationary bearing-block E^2, so that when shaft A^2 is rotated the end of said arm B^2 describes an orbital movement. The free end of said arm B^2 is connected in suitable manner to the table A. The construction and arrangement of this reciprocating mechanism is more fully described and claimed in my pending application, Serial No. 38,435, filed December 3, 1900. It is obvious that any suitable form of reciprocating mechanism may be employed. Such mechanism in the specific details of construction thereof forms no part of my present invention.

The crushed ore is in practice deposited upon the table at the point K. Wash-water is supplied along the edge C D and by reason of the component of forces due to the reciprocatory movements imparted to the table about in the diagonal line from E to D and the flow of wash-water transversely across the table from the edge C D the ore is progressed toward the end D F, while at the same time the mineral portion settles to the bottom or upon the surface of the table and the lighter silica, rock, dirt, or the like is washed over the top edges of the riffles B by the wash-water and is discharged along the edge E F, the mineral portion being discharged along the edge D F. In practice each succeeding riffle after the one terminating at the corner E and on each side thereof is slightly less in height above the surface of the table than the one immediately preceding it; but a diagonal line parallel with the line H F will cut the riffles at points of uniform height. The object of this is to insure an even and uniform spreading out of the ore over the entire surface of the table, thereby enabling every portion of the table to perform its proper part of the concentrating-work. Thus, as viewed in Fig. 2, (which is an edge view looking from the bottom of Fig. 1 toward the edge E F,) the ends of the riffles shown in end view at the left-hand side of Fig. 2 are of greater height than the riffles shown in end view at the right-hand end of said figure, each succeeding riffle being slightly lower than the immediately-preceding riffle. This is also shown in Fig. 4, which is a view looking from the right of Fig. 1 along the end D F, the riffle shown at the right of said figure being of greater height than those at the left-hand end of said figure. The riffles, as above specified, extend diagonally with respect to the table, and those which terminate along the end D F extend all the way to the end of the table, and those which would otherwise intersect the edge C D terminate a short distance from said edge, as clearly shown in Fig. 1. Each riffle, in accordance with the principles of my invention, is of decreasing height from the left-hand end thereof toward the right-hand end to a point indicated at L, Fig. 3, and from thence to a point indicated at M, Fig. 3, the height of the riffle remains substantially uniform and slightly above the top surface of the table, and from the point M to the extreme right-hand end the riffle increases in height to the point N, Fig. 3. The point L of each riffle is somewhat nearer the edge D F than the corresponding point of the preceding riffle. Consequently the dotted lines H F and J G, Fig. 1, indicate the line of the straight parallel surfaces of the riffles between the points L M, and which portions of the riffle extend only a very slight distance above the top surface of the table. The special purpose of this arrangement is to provide means for insuring a complete and efficient concentration of the mineral and the elimination of the dirt, rock, silica, and the like therefrom. Thus when the mineral reaches the point L, for instance, in the length of a riffle there is still provided a ledge for retaining mineral; but the height of such ledge is not sufficient to prevent any silicate or rock to be washed over, but is of sufficient extent to prevent the mineral from being carried over the top edge thereof, and even if some particles of mineral are carried over the depressed portion L M of one riffle they will be caught by the projecting edge of the next succeeding riffle and progressed somewhat farther toward the end D F of the table before it reaches the depression L M of the next succeeding riffle, and after the depression L M of any riffle is passed by any mineral it is desirable to provide against any further wash over the top edge of the riffle, for at that period a complete separation of the silica, rock, &c., from the mineral has been effected. In other words, whatever portions of the rock, silica, and the like which have not been separated and washed away from the mineral will be separated and washed away at the lowest portions L M of the riffles, and after passing the point M of any riffle the riffle increases in height, so as to insure against any particle of the mineral being washed over. It will be understood that when the crushed ore is first supplied upon the surface of the table at the point K it partially lodges against the first riffle, a portion of the crushed material washing over the top edge of the first riffle and being caught by the next succeeding riffle, and so on, at the same time being progressed lengthwise of the first riffle and finally falling over the extreme end of the first riffle and being caught by the extended length of the next succeeding riffle, and so on. In order to still further insure the separation of the silica, rock, and the like from the mineral and also to prevent too much of the water from flowing over the edge D F of the table along with the mineral, I prefer to slightly raise the surface of the table adjacent to said edge. This result may be accomplished in many ways. A simple way is shown most clearly in Fig. 6, wherein a tapering or wedge-shaped piece A′ is inserted underneath the linoleum lining B′ of the table-surface, the thickened portion of the wedge being presented toward the edge D F of the table. The piece A′ tapers not only in a direction away from and normal to the edge D F, but also in a direction parallel with said edge in order to diminish the height of the raised portion or surface of the table toward the extreme lower corner of the table. This raised portion begins immediately beyond the seats or depressions in the riffles, the bounds of which are indicated by the lines J G and H F and continues to the extreme end of the table, and in order that the riffles may not be raised a too great height above the surface of the table said riffles toward the ends thereof may be slightly reduced in height to compensate for the wedge-blocks, as clearly shown in Fig. 6. The purpose of this construction is to prevent the possibility of any silica, rock, or the like or too much water being carried over the end of the table. The silica, rock, water, and the like being lighter than the mineral will not travel up the inclined surface of the table near the end thereof, while the momentum of the mineral under the impetus of the reciprocations of the table will cause the mineral to travel up the incline. Therefore the silica, rock, water, or the like is retarded and caused to be washed away toward the tailings-delivery edge of the table, while the mineral is fed or progressed on over the edge D F of the table and over the extending apron C′ of the linoleum. This I regard as a valuable feature of my invention.

The riffles, as above stated, may be of any suitable or convenient shape in cross-section. In Fig. 5 I have shown the construction of riffle which I have found suitable, comprising an angle-strip somewhat inclined in the direction of flow of the wash-water delivered upon the table along the edge C D—that is, the riffles incline somewhat toward the tailings-delivery edge E F—the direction of transverse flow of the wash-water being indicated by the arrow in Fig. 5. I do not desire, however, to be limited to this specific shape in cross-section of the riffle, as other specific shapes in cross-section of riffles may equally well answer the purpose. In practice I prefer to employ a flange or riffle (indicated at X) along the upper edge from D to C of the table, along the end from C to E, and along the tailings-discharge edge from E to F, as indicated in dotted lines in Fig. 1. The flange or riffle extending from E to F is omitted in the view shown in Fig. 2, and in practice this edge or flange should be of decreasing height from the corner E toward the corner F and corresponding in height to the height of the riffles—that is, corresponding to the decrease in height of the riffles, as viewed in Fig. 2.

Variations and changes in the specific details of construction and arrangement would readily occur to persons skilled in the art and still fall within the spirit and scope of my invention. I do not desire, therefore, to be limited or restricted to the exact details of construction shown and described; but,

Having now set forth the object and nature of my invention and a construction embodying the principles thereof, what I claim as new and useful and of my own invention, and desire to secure by Letters Patent, is—

1. An ore-concentrating table having an open discharge end, riffles arranged upon the surface of said table and extending toward said open discharge end, each of said riffles having a depressed portion and elevated or raised portions on each side of the depressed portion, the depressed portion being formed therein between the ends of the riffles, and means for reciprocating said table in the direction of the length of said riffles, as and for the purpose set forth.

2. An ore-concentrating table having an open dischatge end provided with riffles, arranged upon the surface of said table and extending toward said open discharge end, each of said rifles being of decreasing height for a portion of the length thereof and increasing in height at the extreme end thereof, and means for reciprocating said table in the direction of the length of said riffle, as and for the purpose set forth.

3. An ore-concentrating table, an open discharge end provided with riffles arranged upon the surface of said table and extending toward said open discharge end, each riffle having a portion of its length of uniform height, and increasing in height from said portion of uniform height toward the respective ends thereof, and means for reciprocating said table in the direction of the length of said riffles, as and for the purpose set forth.

4. The combination with a concentrating-table, of riffles mounted on the upper surface of said table and extending diagonally of said table, said riffles being of decreasing height for a portion, and in the direction of, the length thereof, and of increasing height for another portion of the length thereof, and means for reciprocating said table in the direction of the length of said riffles, as and for the purpose set forth.

5. The combination with a concentrating-

table, of riffles mounted on the upper surface thereof and extending parallel with respect to each other, each of said riffles provided with a portion of uniform height and increasing in height toward the respective ends thereof from said portion of uniform height, thereby forming a seat or depression, the seat or depression formed in one riffle being somewhat in advance of or nearer the end of the table than the seat or depression formed in the preceding riffle, means for reciprocating said table in the direction of the length of the riffles, as and for the purpose set forth.

6. The combination with a concentrating-table having parallel sides and parallel ends, the sides being inclined with respect to the ends, of riffles mounted on the top surface of said table and arranged in substantially parallel relation with respect to each other and substantially at right angles of said table, said riffles decreasing in height for a portion of the length thereof and increasing in height for a portion of the remaining length thereof, and means for reciprocating said table in the direction of the length of said riffles, as and for the purpose set forth.

7. A concentrating-table having riffles upon the upper surface thereof, a covering or lining interposed between the riffles and table, and a wedge-block interposed between said table and covering to form an upwardly-inclined surface at the mineral-delivery end of the table, and means for reciprocating the table in the direction of the length of said riffles, as and for the purpose set forth.

8. A concentrating-table having a covering or lining for the upper surface thereof, and a block interposed between said cover and table adjacent to the mineral-delivery end of the latter, in combination with riffles arranged on said table-covering, said block being tapered lengthwise with respect to said riffles to form an upwardly-inclined surface at the mineral-delivery edge of the table, and means for reciprocating the table in the direction of the length of said riffles, as and for the purpose set forth.

9. A concentrating-table having riffles arranged to extend in the direction of the length of the table, in combination with a block arranged adjacent to the mineral-delivery end of said table, said block being tapered both lengthwise and transversely with respect to the length of said riffles to form an upwardly-inclined surface at the mineral-delivery end of the table, and means for reciprocating said table in the direction of the length of said riffles, as and for the purpose set forth.

10. The combination with a concentrating-table having parallel sides and parallel ends, said ends being inclined with respect to said sides, of riffles mounted on the upper surface of said table, said riffles being parallel with respect to each other and inclined to the sides and substantially at right angles to the ends of the table, and means for reciprocating said table in the direction of the length of said riffles, as and for the purpose set forth.

In witness whereof I have hereunto set my hand, this 2d day of July, 1901, in the presence of the subscribing witnesses.

GUSTAVE A. OVERSTROM.

Witnesses:
CHAS. H. SEEM,
S. E. DARBY.

COMPLAINANTS' EXHIBIT No. 27

Perkins Patent No. 769,231

ALMON E. HART, Special Examiner

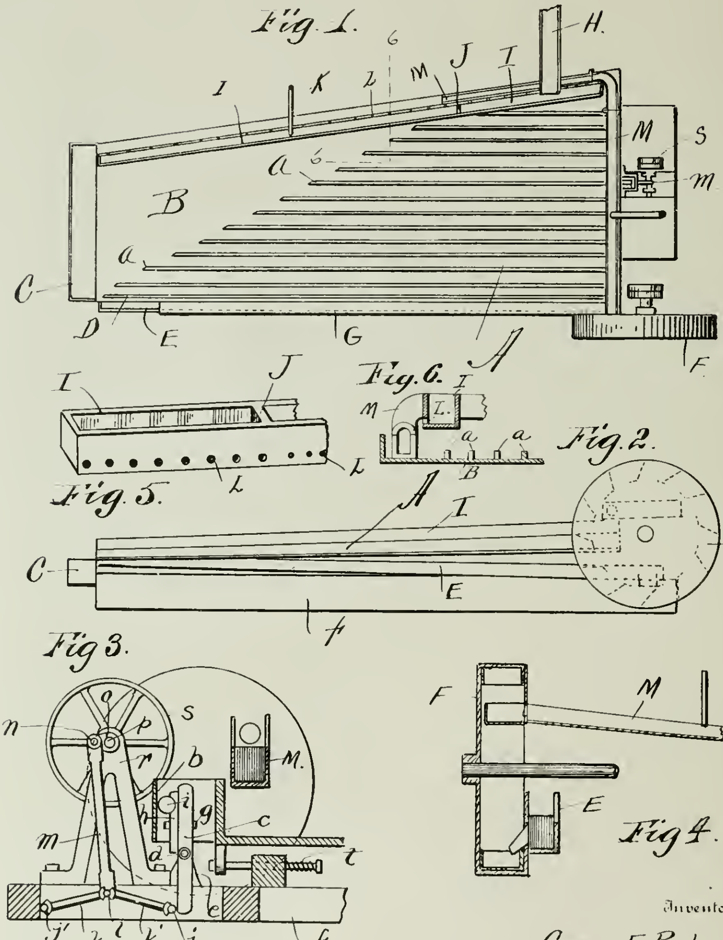
No. 769,231. PATENTED SEPT. 6, 1904.

G. E. PERKINS.

ORE CONCENTRATOR.

APPLICATION FILED JUNE 13, 1903.

NO MODEL.



Witnesses

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E. D. Ogden.

Inventor

George E. Perkins.

By Howard E. Barlow.

Attorney

UNITED STATES PATENT OFFICE.

GEORGE E. PERKINS, OF PROVIDENCE, RHODE ISLAND.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 769,231, dated September 6, 1904.

Application filed June 13, 1903. Serial No. 161,364. (No model.)

To all whom it may concern:

Be it known that I, GEORGE E. PERKINS, a resident of the city of Providence, in the county of Providence and State of Rhode Island, 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 thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention pertains to improvements in ore-concentrators, and has for its object to collect and return the partly-separated pulp, or that portion known as "middlings," back to the table, where it is deposited at a point just below the pulp-feed to the table, thereby materially increasing the percentage saved of the richer or more valuable portion of the material during this second separation.

The invention consists of novel features and parts and combinations of the same, as will be fully described hereinafter and then pointed out in claims.

A practical embodiment of the invention is represented in the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a plan view of the table, showing my spout or trough in position to conduct and deposit the middlings around and below the pulp-feed. Fig. 2 is a side elevation of the table, showing the spout for conducting the middlings from the end of the table back to the elevator. Fig. 3 shows the mechanism for imparting to the table a reciprocating motion. Fig. 4 shows the elevator, the trough leading to it, and the spout leading from it. Fig. 5 is an enlarged perspective view of the main feed or distributing trough, showing the distributing-holes through the rear wall of the same. Fig. 6 is a detail sectional view on the line 6 6, Fig. 1.

Referring to the drawings, A is the table, which tapers from the head toward the foot, where it is the narrowest, and is transversely inclined, causing the gangue or waste pulp discharged at its lower edge and the mineral or richer portion at the foot thereof. This table is provided with longitudinal riffles *a*, attached to its upper face, which are of unequal length, increasing from the upper edge of the table downward, where they are the longest, the lowermost riffle extending nearly the full length of the table. To the right of the riffle extremities (see Fig. 1) there is a portion B of the table which is smooth or free from riffles.

H is the main feed-spout, through which the material is fed to the distributing-trough I. This trough runs along the upper edge of the table, extending nearly throughout its length. On the lower edge and through the rear wall of this trough are a series of holes L. (See Fig. 5.) A dam or stop-wall J is placed in said trough a short distance from the pulp-feed end, forming a pocket for holding and distributing the pulp on the table through said holes L. The trough beyond this dam is for the purpose of receiving water through the supply-pipe K and distributing it over the table through the series of holes L in its section for this purpose. At the narrow end or foot of the table is a receptacle C for receiving the concentrates or richer portion of the separated material.

E is a spout or trough extending from the foot of the table along the side to the elevator F. The apron G extends along the side of the table and is for the purpose of conducting the gangue or waste over this trough E, causing it to be deposited into a suitable drain or waste trough below. Near the foot of the table the space or aperture D is left open, through which flow the middlings or that portion of the pulp from which the richer mineral has not been entirely extracted. These middlings are conducted through the aforesaid trough E to the elevator F, by which they are raised and deposited into trough M, which trough in turn conducts them around back of the distributing-trough I, where they are deposited onto the table beyond the point where the initial pulp is discharged onto the table.

To the head end of the table is attached the mechanism which gives said table a longitudinal reciprocating movement and is described as follows: *b* is a keeper which is engaged by one extremity of a vertical lever *c*, fulcrumed at d on a support e, mounted on the stationary frame f. The upper arm of the lever c is slotted to receive a bolt g, which holds a block h in place on the lever. This block carries an antifrictional roller i, which engages the outer wall of the keeper b. The block h is adjustable for the purpose of changing the bearing-point on the keeper, and thereby regulating the length of the table's stroke. The lower arm of the lever c is provided with a bearing j, which is engaged by one extremity of a link k'. This link is connected at l with a link k, forming a toggle-joint. One extremity of the link k engages a bar j'', attached to the stationary frame. The pin connecting the two toggle parts also passes through one extremity of a pitman m, whose opposite extremity is connected with a wrist n on a crank o, carried by a shaft p, journaled in an upright support r, mounted on the stationary frame f. The shaft p is provided with tight and loose pulleys s, which may be connected with any suitable motor for operating the mechanism. The outer extremities of the toggle are open, being simply recessed or forked to engage the bearings j and j'', respectively. Hence as the shaft p is rotated the toggles only impart the backward movement to the table or move it toward the left. The forward or reverse movement is effected or imparted by the recoil of a spring t, which is compressed or placed under tension by the table during its backward movement.

In the operation of the machine the material to be treated is discharged in the form of pulp upon the upper right-hand corner of the table through the supply-trough H. (See Fig. 1.) The gangue or waste passes transversely downward over the longitudinal riffles and is discharged over the apron G at the lower edge of the table, the middlings, or that portion partially separated or which still contains a percentage of the more precious minerals, is carried through the space D at the end of the table into the trough or spout E and back by way of the elevator F and spout M onto the table to be treated again and more thoroughly separated, while the mineral is discharged over the foot into the receptacle C. All the mineral, together with a portion of the gangue, is first caught by the riffles and under the influence of the table's motion is carried longitudinally toward the foot until it reaches the smoother unriffled portion B, where it is acted on by the water, which effects a perfect or approximately perfect separation of the gangue from the mineral. As the material caught by the uppermost and shortest riffle passes to the portion B of the table the action of the water, which is fed to the upper edge of the table, carries the gangue downward to the next riffle, while the mineral remains on the smooth portion B and is carried toward the tail of the table, where it is finally discharged. It is expected that some of the mineral caught by the uppermost and shortest riffle will be carried downward with the gangue to the next riffle, which is longer. After leaving this last-named riffle and passing to the smooth or unriffled portion of the table the water again acts on the material and carries the gangue downward to the next riffle, leaving the clean mineral on the smooth portion B of the table.

In this manner the material is carried transversely downward and longitudinally forward, the gangue being discharged at the lower edge of the table completely impoverished of its mineral values, and the partially-separated material or middlings are discharged through the aperture D into the trough E and returned to undergo another separation, while the richest portion is discharged at the foot or tail of the table. A portion of the gangue—that is to say, the light part thereof—passes over each riffle in succession from the shortest or uppermost to the longest or lowermost riffle. The mineral and the heavier gangue are caught by the riffles and finally separated on the smooth portion B of the table.

The essential feature of this invention is my improved method of acting upon and saving the middlings. The middlings are of a comparatively light weight, and when they are first deposited upon the table with the rest of the gangue they are not able to free themselves and entirely withstand the strong flow of the mass with which they are mixed in their first passage across the table and are therefore carried through the aperture D and deposited in the middlings-trough at the lower left-hand corner, whence they are returned and again deposited on the table, this time beyond this strong flow of material, where the water alone can act upon the particles and finally wash and free them from the gangue, allowing them to be carried and deposited in the receptacle C at the foot of the table and saved. The idea of carrying and depositing these returned middlings around and beyond the point where the pulp is primarily fed to the machine is of great importance and has been so demonstrated in practice. For example, should the middlings be deposited on the table at any point above the pulp-feed instead of below it these light particles would again be swept away by the flow of the gangue, as they were the first time, and could not be saved, as is now the case, by the use of my improved method. These middlings constitute a very considerable proportion of the whole values in the pulp, and by returning them to the table in the manner above described a much larger percentage of the valuable mineral is saved.

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

1. A device of the character described, comprising a concentrating-table, a distributing-trough arranged near one side thereof and hav-

ing perforations in its outer side, said trough being elevated, whereby middlings may pass thereunder, a second trough elevated above the plane of said discharge-trough and terminating at a point beyond the outer side of the latter and nearer the concentrate discharge than the initial pulp-feed, means for collecting the middlings from said table and delivering them to said elevated trough, and means for supplying water to said distributing-trough.

2. A device of the character described, comprising a concentrating-table, a distributing-trough arranged near one side thereof and having perforations in its outer side, said trough being elevated, a pulp-feeding pocket formed in said trough, an inclined trough located at the opposite side of said table and leading from the lower end thereof, an apron located over said inclined trough, an elevated trough leading from a point above said inclined trough and terminating at a point beyond the outer side of said distributing-trough and nearer the concentrate discharge than said pocket, means for supplying water to said distributing-trough, and means for elevating the middlings from said inclined trough to said elevated trough, whereby said middlings are discharged back of the distributing-trough and will pass thereunder.

In testimony whereof I have hereunto set my hand this 12th day of June, A. D. 1903.

GEORGE E. PERKINS.

In presence of—
HOWARD E. BARLOW,
E. I. OGDEN.

COMPLAINANTS' EXHIBIT No. 28

Forster Patent No. 780,031

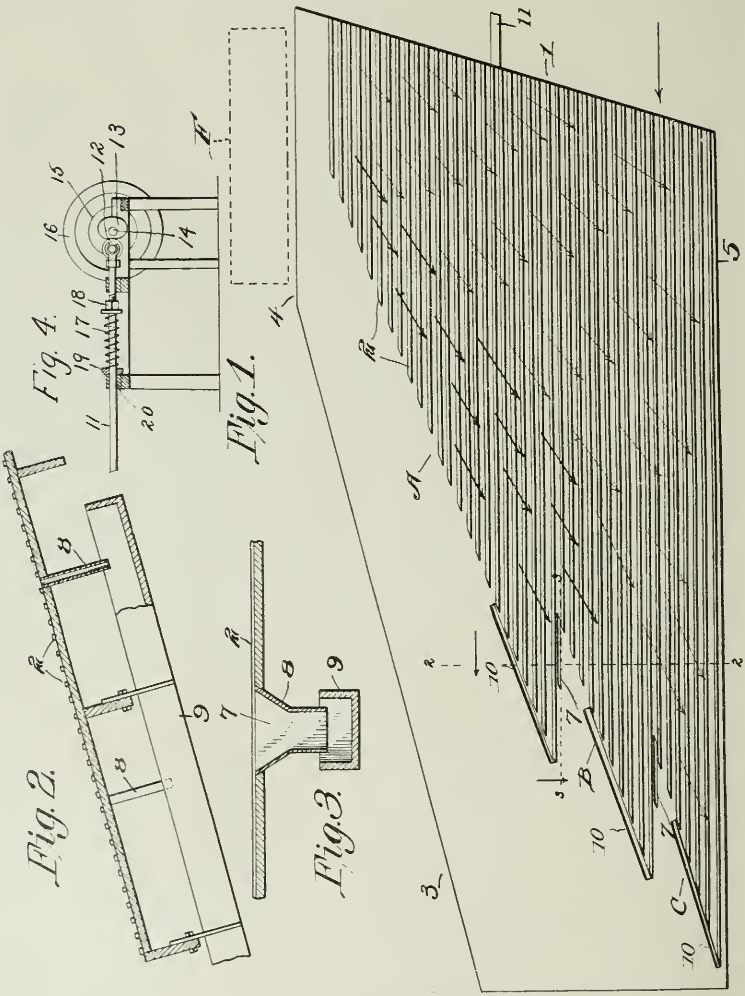
ALMON E. HART, Special Examiner

No. 780,031. PATENTED JAN. 17, 1905.

F. E. FORSTER.

CONCENTRATOR TABLE.

APPLICATION FILED JAN. 23, 1904.



Witnesses

E. J. Stewart

Pastor Morton

Frank E. Forster Inventor

by C. A. Snow & Co

Attorneys

UNITED STATES PATENT OFFICE.

FRANK EDMON FORSTER, OF CLIFTON, ARIZONA TERRITORY, ASSIGNOR OF ONE-HALF TO WILLIAM H. DE ROSEAU, OF CLIFTON, ARIZONA TERRITORY.

CONCENTRATOR-TABLE.

SPECIFICATION forming part of Letters Patent No. 780,031, dated January 17, 1905.

Application filed January 23, 1904. Serial No. 190,393.

To all whom it may concern:

Be it known that I, FRANK EDMON FORSTER, a citizen of the United States, residing at Clifton, in the county of Graham and Territory of Arizona, have invented a new and useful Concentrator-Table, of which the following is a specification.

This invention relates to concentrator-tables, and refers more particularly to tables for concentrators of the type in which the table is disposed in an inclined plane and is given a longitudinal reciprocatory movement when the concentrator is in operation.

In concentrators of the type mentioned the ore discharged upon the table passes obliquely across the table, the heavier particles of the ore taking the more oblique course and the lighter particles moving more nearly in a direction transverse to the line of movement of the table. In such tables the action is satisfactory so far as the separation of the coarser masses of gangue and the larger particles of ore is concerned; but the separation of the metallic values contained in the slimes is not complete, because the heavier masses of gangue tend to force the slimes off the table before complete separation of the metallic values therefrom can be effected.

The principal object of the present invention is to provide a concentrator-table of the type above mentioned with a novel arrangement of riffles and slots through which most of the gangue or tailings may pass into a launder or trough and be carried away from the table, thus allowing the slimes to work forward on the table and cause a complete separation of the metallic values therefrom.

In attaining the object above mentioned and others which will appear as the invention is more fully disclosed the same consists in the novel construction of a concentrator-table, as hereinafter fully described and claimed, and illustrated in preferred form in the accompanying drawings, it being understood that changes in the minor details of construction may be resorted to without departing from the spirit of the invention or exceeding the scope of the appended claims.

In the drawings, Figure 1 is a view in perspective of the improved concentrator-table, the feed-box from which the ore is discharged upon the table being indicated at the upper margin of the table by means of dotted lines. Fig 2 is a section on the line 2 2 of Fig. 1. Fig. 3 is a section on the line 3 3 of Fig. 1. Fig. 4 is a view in side elevation, partly in section, exhibiting one form of mechanism that may be employed for imparting reciprocatory movements to the table.

Referring to the drawings, in which corresponding parts are designated by similar characters of reference throughout the several views, 1 designates the back or rear margin of the concentrator-table, from which riffles 2 extend longitudinally of the table toward its forward end 3. The riffles near the upper margin 4 of the table are comparatively short and increase in length toward the lower margin 5. The riffles are preferably arranged in a plurality of groups, three groups being shown, the groups being designated A, B, and C, respectively, from the upper part of the table to the lower. Group A contains a much larger number of riffles than either of the groups B and C; but the average length of the riffles in group A is considerably less than the average length of the riffles in either of the other groups. In each group the riffles increase uniformly in length from the uppermost to the lowermost riffle, as shown in Fig. 1; but the uppermost riffle of group B is considerably shorter than the lowermost riffle of group A, and the lowermost riffle of group B is considerably longer than the uppermost riffle of group C. The object of this arrangement is to cause the heavier masses of tailings which pass downward over the riffles in the upper group from interfering with the passage of ore along the riffles in the lower groups. By so arranging the riffles the gangue or tailings may be separated into three grades, the coarsest grade passing over the ends of the riffles of group A, the intermediate grade passing over the ends of the riffles in group B, and the finest grade passing over the ends of the riffles in group C.

In order to prevent masses of gangue from passing over the riffles in an upper group and descending upon the riffles of the next group, I provide slots 7 in the surface of the table at the points shown, a slot being provided below the lowermost riffle of groups A and B, near the forward end thereof. Chutes 8 extend downward from said slots and discharge into a trough or launder 9, along which the material discharged from the chute may be carried by water or otherwise.

The direction of the movement imparted to the concentrator-table is indicated by the arrow at the end of Fig. 1, and the course of the larger masses of gangue and ore over the table is indicated by heavy arrows, while the course of the finer particles, including the slimes, is indicated by the light arrows.

The ore is discharged upon the concentrator-table from the feed-box F, (indicated in dotted lines at the upper margin of the table,) and the longitudinal reciprocatory movement of the table causes the heavier masses to travel more rapidly toward the forward end of the table than the lighter and finer particles. A considerable portion of the largest particles of gangue will pass over the ends of the lower riffles in group A and will be carried off through the slot below the lowermost riffle of group A. Particles of gangue of the next finer grade will pass over the ends of the riffles in group B and be discharged through the slot below the lowermost riffle of that group, thus allowing the fine particles of ore and tailings to work forward along the riffles of group C, practically to the end thereof, and thus permit complete separation of the metallic values from the tailings.

While the table has been shown as provided with three groups of riffles only, it will be obvious that the number of groups may be increased, if desired, to separate the gangue or tailings into a greater number of different grades, and it will also be obvious that, if desired, slots may be provided, as indicated at 10, for the escape of the metallic values which work along the riffles to their ends.

Any form of mechanism may be employed for imparting reciprocatory movements to the table, the form shown in Fig. 4 being one that will be effective for the purpose and comprises a rod 11, one end of which is detachably secured in any suitable way to the under side of the table. The free end of the rod 11 carries a friction-roller 12, which contacts with a cam 13, secured upon a shaft 14 and carrying fast and loose pulleys, one of which is designated 15, the said pulleys being engaged by a belt (not shown) leading to a suitable source of power. The shaft also carries a fly-wheel 16 to insure a steady motion of the shaft, as usual. Mounted upon the rod 11 is a spring 17, one end of which bears against a collar 18, adjustable on the shaft, and the other end against a washer 19, also mounted upon the shaft and held against longitudinal movement by one of the cross-pieces 20 of the supporting-frame. The spring serves to hold the roller 12 in contact with the cam 13, so that when the shaft 14 is rotated the cam imparts a quick forward and backward impulse to the rod, and consequently to the table, without any rest between the two movements, a rest, however, taking place when the friction-roller engages the flat side of the cam, as clearly shown in Fig. 4.

Having thus described the construction and operation of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A table for reciprocatory concentrators having a plurality of sets of riffles the upper edges of which are disposed in the same plane, each set being arranged to overlap the next lower set.

2. A table for reciprocatory concentrators provided with escape-openings and with a plurality of sets of riffles, each set being arranged to overlap the next lower set, and the openings being disposed within the line of termination of the riffles above them.

3. A table for reciprocatory concentrators having a plurality of sets of riffles, each set being arranged to overlap the next lower set, and having, further, escape-openings disposed within the line of termination of the riffles, and at the outer terminals thereof.

4. A table for reciprocatory concentrators provided with escape-slots and with a plurality of sets of riffles, each set being arranged to overlap the next lower set, and the slots being disposed parallel with the riffles and within the line of termination of the riffles above them.

5. A table for reciprocatory concentrators provided with two series of escape-slots and with a plurality of sets of riffles each set being arranged to overlap the next lower set, one series of the slots being disposed parallel with the riffles and within the line of termination of the riffles above them, and the other series being disposed at the outer terminals of the riffles.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

FRANK EDMON FORSTER.

Witnesses:

W. B. Tompkins,

W. H. De Roseau.

COMPLAINANTS' EXHIBIT No. 29

Dodd Patent No. 794,928

ALMON E. HART, Special Examiner

No. 794,928. PATENTED JULY 18, 1905.

W. G. DODD.

ORE CONCENTRATING TABLE.

APPLICATION FILED JAN. 17, 1903.

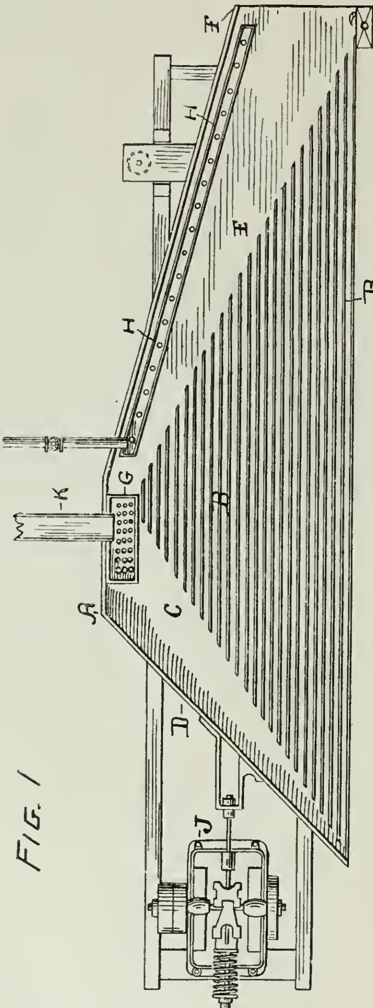


FIG. 1

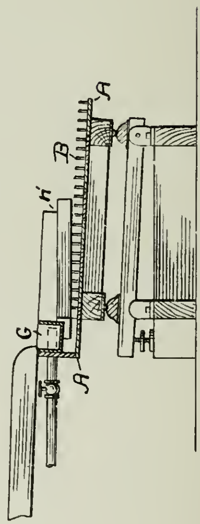


FIG. 2

WITNESSES

Walter F. Vane.

Leon Böller

INVENTOR

Willis G. Dodd

by N. A. Acker

his atty.

UNITED STATES PATENT OFFICE.

WILLIS G. DODD, OF SAN FRANCISCO, CALIFORNIA.

ORE-CONCENTRATING TABLE.

SPECIFICATION forming part of Letters Patent No. 794,928, dated July 18, 1905.

Application filed January 17, 1903. Serial No. 139,407.

To all whom it may concern:

Be it known that I, WILLIS G. DODD, a citizen of the United States, residing in the city and county of San Francisco, State of California, have invented certain new and useful Improvements in Ore-Concentrating Tables, relating more particularly to that class of ore-concentrators known as "transversely-inclined reciprocating riffled tables," and pertains specially to the method of arranging the riffles upon the working face of such tables, of which the following is a specification.

The usual type of transversely-inclined concentrating-table of the class referred to when in operation has a peculiar reciprocating motion imparted to it, which motion has a tendency to carry material fed thereon longitudinally toward the foot or tail of the table. The working face of the table proper has arranged upon its surface a series of longitudinal deflecting slats or riffles extending from the head of the table toward the foot or tail thereof, said riffles terminating in such a manner as to leave a plain, smooth, or unriffled portion of the table between the terminals of the riffles and the foot or tail of the table, onto which the mineral and gangue which may have been collected by the riffles is discharged, and final separation of the mineral from the gangue is effected by subjecting it to a transverse flow of clear water while it is being carried forward onto the plain, smooth, or unriffled portion. The pulp, which consists of a mixture of water carrying a small quantity of finely-crushed grains of valuable mineral intermingled with a large quantity of finely-crushed quartz, when fed upon the upper edge of the table flows transversely downward over and across the riffled portion of the table at approximately a right angle to the line of motion or to the longitudinal direction of the riffles. The mineral in the pulp having a specific gravity much greater than that of the gangue or quartz is arrested in its transverse downward course, settles or becomes entangled among the riffles, and due to the peculiar longitudinal reciprocating motion given the table is carried longitudinally along the riffles and is discharged upon the plain, smooth, or unriffled portion of the table above referred to. This transverse flow of the gangue over the riffles in a succession of miniature Niagaras across the path of the valuable mineral which is being conveyed toward the foot or tail of the table along the riffles keeps the mineral while being collected in a constant state of agitation and causes the finer particles of mineral to be carried with the worthless gangue and is discharged over the lower edge of the table, where these particles are finally lost. Said distributer is arranged a slight distance above the surface of the concentrating-table and so located that the pulp discharged therefrom will be received onto the table's surface immediately in advance of the uppermost or shortest riffle of the series of collecting-riffles.

The object of my present invention is to decrease this loss by unloading the riffles of a portion of the gangue, which I accomplish by a special arrangement of the riffles on the working face of the table, leaving a plain, smooth, or unriffled portion between the head of the table and the receiving ends of the riffles, upon which surface a partial separation of the gangue from the mineral is effected prior to entering the riffles for further treatment, all of which is set forth and illustrated in the accompanying drawings, which form a part of this specification, wherein—

Figure 1 is a plan view of a transversely-inclined reciprocating concentrating-table fitted with my improved method of riffling, and Fig. 2 is an end view of same in cross-section.

The letter A represents the table proper of a concentrating-machine of the class described, the face of which is usually covered with sheet-rubber or linoleum, or any suitable material may be used that will produce a smooth and even surface to the working face of the table. Upon this smooth working face of the table a series of deflecting-slats or mineral-collecting riffles B, usually consisting of tapering strips of wood, are secured. These riffles are of varying length, the shortest usually being the uppermost, and they are so arranged that the receiving end and the terminal end of each successive riffle from the uppermost downward advance beyond the receiving end and the terminal end of the riffle above, thus leaving a smooth or unriffled portion of the table C between the receiving ends of the riffles and the head D of the table and a smooth or unriffled portion of the table E between the discharge ends of the riffles and the foot or tail of the table F.

A feed-box or distributer G is suitably mounted or secured to the table and is provided with a perforated bottom, which sifts or distributes the material to be concentrated upon the table. A water-distributer H is suitably suspended at and above the upper edge of the table, from which, through suitable openings, clear water as required is delivered onto the table.

J is any suitable driving mechanism that will impart to the table a reciprocating motion that will impel the material delivered to the riffles longitudinally toward the foot or tail of the table.

K is a sluice or launder by means of which the material to be concentrated is conveyed from any suitable crushing device into the feed-box or distributer G.

The operation of the concentrator is as follows: The table A is given a slight transverse inclination sufficient to permit the pulp to flow downward over the smooth or unriffled portion C between the receiving ends of the riffles and the head D of the table. Power is then applied by any suitable means to the driving mechanism J, which imparts a reciprocating motion to the table. Pulp, consisting of water carrying finely-crushed quartz containing a small quantity of finely-crushed mineral is now introduced by means of the sluice K into the feed-box G, from which it is sifted or distributed onto the smooth or unriffled portion C of the table A, adjacent to the receiving ends of the riffles. As soon as this pulp is deposited upon the smooth surface of the table the quartz or gangue flows downward and is entangled among the receiving ends of the lower riffles and after depositing any particles of mineral that may have been carried with it is permitted to run to waste. The mineral contained in the pulp, due to its specific gravity being greater than the quartz or gangue associated with it, settles and clings to the table, moving slowly downward in a diagonal direction, due to the motion given the table, and becomes entangled with the advancing receiving ends of the riffles, enters them, and is carried longitudinally along the tapering riffles, and is discharged upon the smooth or unriffled portion of the table E, where the final separation of the gangue from the mineral is effected by subjecting it to the action of a transverse flow of clear water delivered upon the table from the water-distributer H, the mineral being carried over the foot or tail of the table and deposited in a box or receptacle provided for the purpose. The middlings produced, being a mixture of mineral containing a small quantity of quartz, are conducted into a special receptacle, from which they are returned to the table by any suitable device for reworking.

By the method of riffling herein described I am enabled to effect a partial separation of the mineral from the gangue before delivering it to the riffles, thus relieving them from a part of the load of pulp that has heretofore been necessary to pass over them and by avoiding excessive disturbance to the mineral while traveling along the riffles reduce the loss of fine particles to a minimum.

Having thus described the invention, what is claimed as new, and desired to be protected by Letters Patent, is—

1. A transversely-inclined ore-concentrating table provided on its working face with a series of longitudinally-extending collecting-riffles, which riffles gradually increase in length from the uppermost riffle to the lowermost one of the series, the receiving and terminal ends of each riffle extending beyond the said ends of the preceding riffle, there being an unriffled or plain surface to the table intermediate the terminals of the riffles and its head and tail respectively, and feeding means so arranged at the upper edge of the table as to cause a portion of the pulp delivered onto the table to overlap the uppermost riffle toward the head, so as to feed directly to the projecting ends of part of the subsequent riffles.

2. An ore-concentrating table provided on its working face with a series of longitudinally-extending collecting-riffles, which riffles gradually increase in length from the uppermost riffle to the lowermost one of the series, the receiving end of each riffle extending beyond the receiving end of the preceding riffle, there being an unriffled surface to the table intermediate its head end and the receiving end of the riffles, and feeding means so arranged at the upper edge of the table as to cause a portion of the pulp delivered onto the table to overlap the uppermost riffle toward the head, so as to feed directly to the projecting ends of part of the subsequent riffles.

In witness whereof I have hereunto set my hand.

WILLIS G. DODD.

Witnesses:

WALTER F. VANE,

D. B. RICHARDS.

COMPLAINANTS' EXHIBIT No. 30

Sheridan Patent No. 796,940

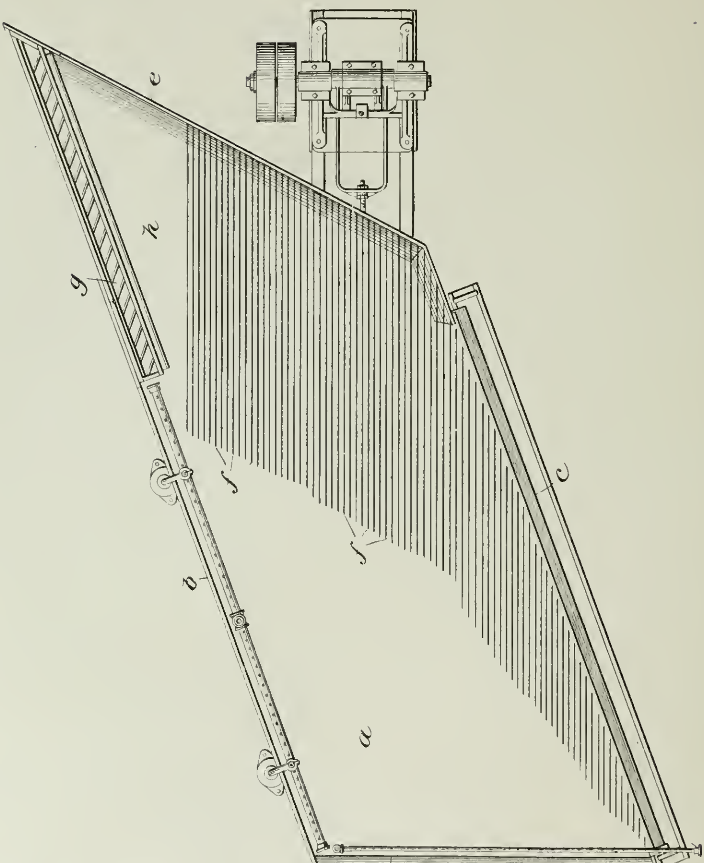
ALMON E. HART, Special Examiner

No. 796,940. PATENTED AUG. 8, 1905.

T. F. SHERIDAN.

CONCENTRATING TABLE.

APPLICATION FILED FEB. 6, 1904.



Witnesses:

A. L. Savoie.

J. A. MacEdward

Inventor:

Thomas F. Sheridan

UNITED STATES PATENT OFFICE.

THOMAS F. SHERIDAN, OF CHICAGO, ILLINOIS.

CONCENTRATING-TABLE.

No. 796,940. Specification of Letters Patent. Patented Aug. 8, 1905.

Application filed February 6, 1904. Serial No. 192,446.

To all whom it may concern:

Be it known that I, THOMAS F. SHERIDAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Concentrating-Tables, of which the following is a specification.

The invention relates to that class of concentrating-tables which are provided with riffle-boards that have a vibratory motion parallel to the plane of the separating-surface thereof and which are provided with riffled and smooth portions for the purpose of separating the values from the waste materials, all of which will more fully hereinafter appear.

The principal object of the invention is to provide a simple, economical, and efficient riffle-board for concentrating-tables.

The invention consists principally in a riffle-board provided with a smooth separating-surface at one end thereof and provided with riffles having their discharge ends opening upon and substantially bounding two sides thereof, substantially as described.

The invention consists, further and finally, in the features, combinations, and details of construction hereinafter described and claimed.

In the accompanying drawing, the figure represents, in plan view, a concentrating-table having a riffle-board constructed in accordance with my improvements looking at the same from above.

In illustrating and describing these improvements I have only illustrated and described that which I consider to be new, taken in connection with so much as is old as will properly disclose the invention to others and enable those skilled in the art to practice the same, leaving out of consideration other and well-known elements, which, if set forth herein, might tend to confusion, prolixity, and ambiguity.

In constructing a concentrating-table in accordance with these improvements I provide a riffle-board having a four-sided or quadrilateral smooth separating-surface *a* at one end thereof, upon which the values are finally separated from the gangue and lighter or waste materials. It will be noticed on examining the drawing that this table, which is transversely inclined and adapted to be reciprocated in any desired ordinary or well-known manner, has two parallel sides, an upper side *b* and lower side *c*, and divergent end portions *d* and *e*, so that the front end edge and the lower side edge are in oblique relation to each other.

To assist in the separation of the values from the waste materials, the board is further provided with a plurality of riffles *f*, arranged at an incline to the side portions and substantially at right angles to one side of the quadrilateral smooth separating-surface and to one end—the inclined end—of the board.

Any desired mechanism may be provided for the purpose of imparting a vibratory motion to said table, and said vibratory motion is imparted to said table in the direction of the length of its riffles, so as to throw the materials to be separated forward from the head of the table to the foot thereof, all of which is well known and understood in this art and needs no further illustration or description herein.

The material enters the table from the box *g* onto the surface *h* thereof and contacts the multiplicity of parallel-arranged riffles, the upper set of which riffles contact the front end or edge of the table and are substantially equal in length, terminating at their rear ends in a line parallel with the front end or edge of the table, the desire being to subject the materials at first and at once to the maximum effect of riffles of the necessary length, and thereby prevent any sudden flushing or washing over of the values. The separation takes place in a uniform step-by-step manner and not in a progressive manner, as is the case where the riffles vary in length. It will further be seen that the table presents a smooth surface of maximum size, upon which the final separation or washing effect may be obtained, all of which will be understood and appreciated by those skilled in the art. It will also be observed that these riffles substantially bound two sides of the separating-surface—namely, the forward and lower side—thereby confining the concentrates within the influence of the smooth separating-surface and tending to throw the material to be separated from all of said riffles onto the smooth separating-surface. In other words, the upper set of riffles—those which contact the front end—extend from such end to the smooth-surface portion rearward thereof in the direction of the concentrates-discharge end *d* of the table. The lower set or series of riffles—those which contact the lower side or edge of the table—extend from such lower side edge rearward to the smooth-surface portion. The first set of riffles are of substantially equal length, and the second set are of constantly-diminishing length as they approach the lower side and rear end of the table, and the rear or concentrates-discharge end of each riffle extends beyond the end of the riffle next above it, as do those of the upper series, but to a greater extent, so that they subtend the entire lower side of the smooth-surface portion. The upper series of riffles subtend the entire front side of such smooth-surface portion. The middlings discharged by the upper series of riffles upon the smooth-surface portion are thus, in effect, reconcentrated, and any values are diverted back to the smooth-surface portion and to the concentrates-discharge against the spray or slight flow due thereto to carry them into the gangue discharge or trough. The effect of the above is to provide practically the equivalent of a second concentrating-table, reconcentrating the middlings discharged from the first or upper series of riffles, and discharging the gangue quickly from the front lower side. The gangue-trough extends along the entire length of the lower side of the table, as shown in the drawing, and the concentrates-discharge extends the entire length of the concentrates end or smooth-surface portion. By this arrangement the longest riffles are where they are needed most—namely, at the front upper portion of the table—and the gangue which passes over them is at once discharged by the progressively-diminishing length of the lower series of riffles, all tending to produce advantageous results by preventing waste of values and producing high-grade concentrates, thus obviating the necessity of a second table for the middlings in most cases.

I claim—

1. A reciprocating transversely-inclined concentrating-table having a lower side edge and a forward end edge in oblique relation to each other, a series of riffles of substantially equal length extending from the forward end toward the rear end of the table upon the upper portion thereof, a smooth-surface portion between the rear ends of such riffles and the rear end of the table, and a second series of riffles of progressively-diminishing length extending progressively from the lower side edge of the table wholly subtending such smooth-surface portion and adapted to return concentrates thereto.

2. A reciprocating transversely-inclined concentrating-table having a lower side edge and a forward end edge in oblique relation to each other, a series of riffles of substantially equal length extending from the forward end toward the rear end of the table upon the upper portion thereof, a smooth-surface portion between the rear ends of such riffles and the rear end of the table, a second series of riffles of progressively-diminishing length extending progressively from the lower side edge of the table and wholly subtending such smooth-surface portion and adapted to return concentrates thereto, such table being provided with a concentrates-discharge extending the entire length of the concentrates end, and a gangue-trough extending the entire length of the lower side thereof.

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COMPLAINANTS' EXHIBIT No. 31

Morgan & Hoheisel Patent No. 829,884

ALMON E. HART, Special Examiner

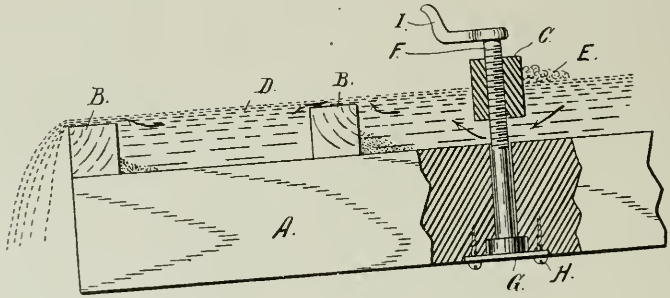
No. 829,884. PATENTED AUG. 28, 1906.

C. L. MORGAN & J. F. HOHEISEL.

FLOATING METAL SAVING DEVICE FOR CONCENTRATORS.

APPLICATION FILED APR. 11, 1904.

2 SHEETS—SHEET 1.



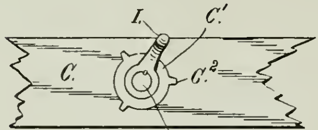


Fig. 1.

Fig. 3.

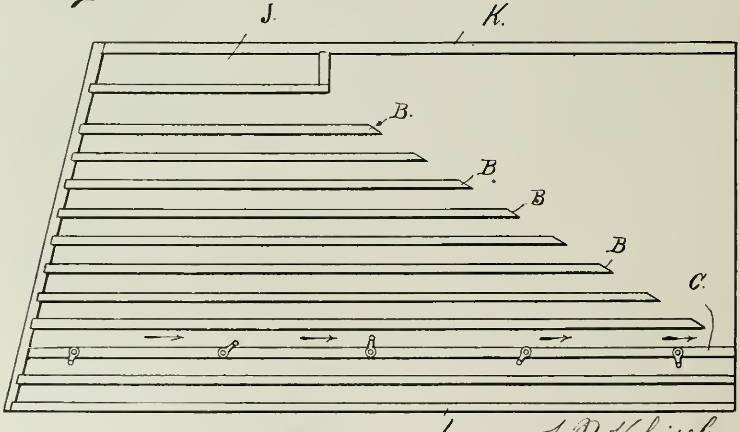


Fig. 2.

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Dena Nelson.

By [illegible]

Attorney

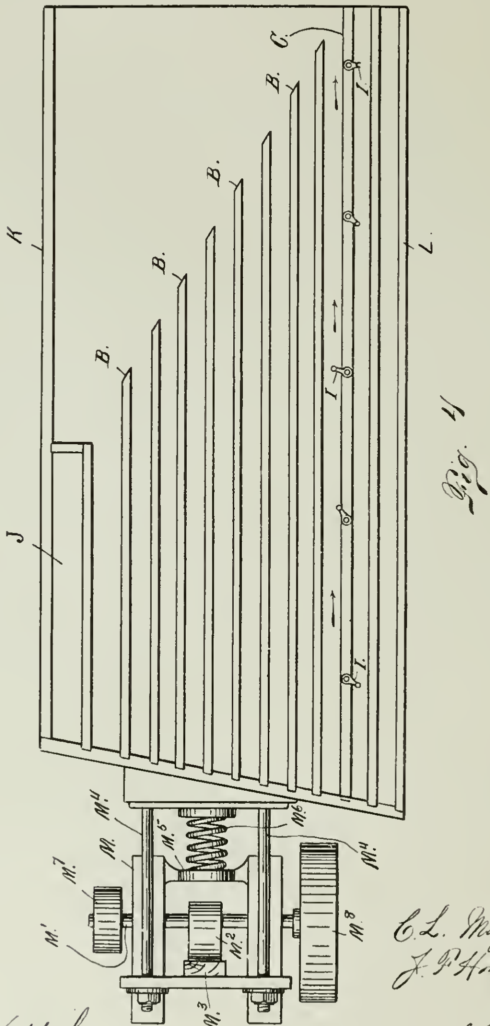
No. 829,884. PATENTED AUG. 28, 1906.

C. L. MORGAN & J. F. HOHEISEL.

FLOATING METAL SAVING DEVICE FOR CONCENTRATORS.

APPLICATION FILED APR. 11, 1904.

2 SHEETS—SHEET 2



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UNITED STATES PATENT OFFICE.

CLAUDE L. MORGAN AND JOSEPH F. HOHEISEL, OF IDAHO SPRINGS, COLORADO.

FLOATING-METAL-SAVING DEVICE FOR CONCENTRATORS.

No. 829,884. Specification of Letters Patent. Patented Aug. 28, 1906.

Application filed April 11, 1904. Serial No. 202,679.

To all whom it may concern:

Be it known that we, CLAUDE L. MORGAN and JOSEPH F. HOHEISEL, citizens of the United States of America, residing at Idaho Springs, in the county of Clear Creek and State of Colorado, have invented certain new and useful Improvements in Floating-Metal-Saving Devices for Concentrators; and we do 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, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

Our invention relates to improvements in means for saving the light portion of the metallic values sometimes termed "slimes," which float upon the top of the water and under ordinary conditions are lost with the gangue.

Our improvement is adapted for use in connection with concentrating-tables of the Wilfley type, in which the concentrating-surface of the table is provided with longitudinally-disposed riffles extending lengthwise of the table or in the direction of motion, the table being transversely inclined and having a movement in the direction of the riffles, the material to be treated, as well as the wash-water, being fed upon the upper edge of the table. In this style of tables the gangue is carried transversely across the table and discharged over its lower longitudinal edge, while the concentrates are carried lengthwise of the table and discharged at its rear or tail extremity. In the treating of some classes of material a very important proportion of the values are in the form of slimes or floating material, which in this style of table and under the conditions above outlined naturally are carried transversely across the table and lost with the gangue. Our improvement is intended to overcome this difficulty; and it consists in equipping the table with a raised riffle or retarding device located near its gangue-discharge edge, said retarding device being raised from the bottom of the table, its lower surface, however, occupying a position beneath the top of the depth of pulp on the table, whereby the floating material is stopped thereby and made to travel along to the tail extremity of the table. In the construction herein illustrated and which will in regular order be described in detail, we have chosen to place our retarding device in a position where a third riffle from the lower or gangue-discharge edge of the table would be placed, and for this reason the riffle corresponding to this position is removed, or it may be said to be raised to form the retarding slime-saving device. This retarding device may be supported in any suitable manner. It is preferred, however, to connect it with suitable means whereby it may be readily adjusted in order that the said device may be vertically adjustable at will, since it may be desirable in some instances to have a greater depth of pulp upon the table than in other instances, and to this end in the drawings the retarding device is threaded on a number of bolts which are journaled in the table and provided at their upper extremities with hand-cranks, whereby as the bolts are turned the retarding device is made to travel up or down at will, according to the direction of the bolts' movement.

Having briefly outlined our improved construction, as well as the function it is intended to perform, we will proceed to describe the same in detail, reference being made to the accompanying drawings, in which is illustrated an embodiment thereof.

In the drawings, Figure 1 is a fragmentary end view, partly in section, illustrating a concentrating-table equipped with our improvement. Fig 2 is a plan view of a concentrating-table provided with our improved device, the same being shown on a smaller scale. Fig. 3 is a top view illustrating a modified form of construction shown on a larger scale. Fig. 4 is a plan view of a concentrating-table provided with our improvements, the table being shown in connection with means for imparting a reciprocating movement thereto lengthwise of the table.

The same reference characters indicate the same parts in all the views.

Let A designate the body of a suitable concentrating-table, which, as shown in the drawings, is transversely inclined and provided with a number of riffles B. As shown in the drawings, these riffles terminate in a diagonal line across the table, being of unequal length, the riffle highest on the table, being shortest and the other riffles increasing in length toward the lower or gangue-discharge edge of the table. In the drawings the two riffles adjacent the gangue-discharge edge extend the whole length of the table, while immediately above the next to the lowest riffle is located our improved device, which is designated by the reference character C. This device consists of a bar composed of any suitable material and may be of any desired size. It takes the place of one of the riffles on the table, but may be of different size, if desirable or required. This device C, which we term the "retarding" device, since it stops the slimes or floating material from passing downwardly over the table with the gangue, is mounted above the upper surface of the table; but its bottom or lower edge occupies a position beneath the level of the pulp D on the table, (see Fig. 1,) whereby the slimes E or floating values are prevented from escaping with the gangue and are carried over the tail or concentrates-discharge end of the table in the direction indicated by the arrows, the said tail of the table being located at the right in Fig. 2 of the drawings. As heretofore intimated, this retarding device or means for saving the floating metallic values may be supported in the required position in any suitable manner. In the drawings it is shown provided with a number of threaded openings, through which are passed a number of bolts F, which are passed upwardly through the body of the table and journaled therein, their threaded portions being passed through the threaded openings of the floating-mineral-saving device. The heads of these bolts are let into the sockets in the under surface of the table, and the bolts are retained in place by plates G, secured to the lower surface of the table by screws H, whereby the said plates are flush with the lower surface of the table. To the top of each bolt F above the device C is secured a hand-crank I for ease of manipulation. It will be understood that as these hand-cranks are turned the retarding device C may be raised or lowered, as may be desired, according as it is necessary to lower the bottom of the device C or raise it in order that it may occupy a proper position with reference to the depth of pulp or water upon the table.

In Fig. 4 of the drawings we have illustrated suitable mechanism for imparting a reciprocating movement to the table lengthwise thereof, whereby the concentrates are made to travel rearwardly on the table toward the right, referring to Fig. 4. Any suitable mechanism may be employed for imparting this movement. In the drawings, M illustrates a suitable stationary support, in which is journaled a shaft M′, provided with a cam M^2, acting on an abutment M^3, connected with the head of the table by rods M^4. Between the table and the stationary cross-piece M^5 is located a coil-spring M^6. A pulley M^7 is applied to one end of the shaft M′ and a fly-wheel M^8 to the opposite end of the shaft. As the shaft M′ is rotated the cam acts on the abutment M^3 to draw the table rearwardly, and as the cam leaves the abutment the table is thrown forwardly through the recoil of the spring M^6. The cam again engages the abutment in time to check the spring-actuated movement of the table, whereby the concentrates are caused to continue their forward movement by the stopping of the table. As this movement is continued the concentrates are carried forwardly and discharged at the rear open extremity of the table.

Nothing is claimed on the operating mechanism in this application, since we are aware that many devices may be employed for this purpose; neither do we claim that we have illustrated the best mechanism for imparting the reciprocating movement. The device shown is only for the purpose of illustrating one way of imparting a longitudinally-reciprocating movement or a vibratory action to a table of this character.

In treating ore upon a table of this class the pulp to be treated may be said to be discharged into a feed-box J and pass therefrom to the body of the table at its upper edge, which is designated K in Fig. 2. At the same time that the material to be treated is fed to the table wash-water is also fed thereto at the upper edge K. The vibrating longitudinal movement being imparted to the table, the concentrates are carried toward the right, referring to Fig. 2, while the gangue is carried downwardly and discharged over the lower edge L. The slimes or floating values, however, are caught by the device C and carried along in the direction of the arrow (see Fig. 2) and discharged with the concentrates into a general trough or into a separate receptacle, as may be desired.

Attention is called to the fact that as nothing is claimed on the general features of a concentrating-table we have not thought it necessary to indicate any mechanism or mechanical power or movement for imparting the longitudinal vibration to concentrating-tables of this class. We have, however, called attention to the general operation of the table which it is believed will be as readily understood from the foregoing description as if it had been fully illustrated, since mechanisms of this kind are very common nowadays, and while many different types may be employed they all seek to perform substantially the same function.

In Fig. 3 of the drawings we have illustrated a construction for use when it is desired to form a device C of wood. In this case it would not be practicable to thread the bolts F in the wood, and consequently a sleeve C′, provided with exterior ribs C^2 to prevent it from turning in the wood, is employed, the sleeve being forced into an opening formed in the wood and forming a nut which the threaded part of the bolt engages.

Having thus described our invention, what we claim is—

1. The combination with a transversely-inclined concentrating-table having a movement whose tendency is to cause the material to travel longitudinally thereon toward the rear or concentrates-discharge end of the table, the said end being open and the table having longitudinally-disposed riffles, of a retarding device for saving the floating values, said device being supported above the bottom of the table, its lower edge, however, occupying a position beneath the top of the pulp or water thereon.

2. The combination with a transversely-inclined concentrating-table having a movement whose tendency is to carry the material from the head toward the tail of the table, the said tail end of the table being open to permit the discharge of the concentrates, of a retarding device disposed longitudinally of the table and supported thereon above its concentrating-surface, whereby the pulp is allowed to pass thereunder, the lower edge of the said device, however, occupying a position below the top of the water or pulp on the table whereby the travel of the floating-metal values or slimes is arrested, and the said values separated from the gangue.

3. The combination with a transversely-inclined concentrating-table having longitudinally-disposed riffles, and means for imparting to the table a longitudinally-reciprocating movement whereby the material is caused to travel toward the tail or concentrates-discharge end of the table, the said end of the table being open to permit said discharge, of a bar supported near the lower or gangue-discharge edge of the table and occupying a position above its concentrating-surface whereby the pulp is allowed to flow thereunder, the lower edge of the bar occupying a position below the top of the water or pulp on the table, whereby the floating or metallic values or slimes may be arrested in their downward travel with the gangue, and caused to travel toward the concentrates end of the table.

4. The combination with a transversely-inclined concentrating-table having a movement whose tendency is to cause the material to travel longitudinally thereon toward the rear of the table which is open to permit the discharge of the concentrates, the table having longitudinally-disposed riffles, of a retarding device located adjacent the lower or gangue-discharge edge of the table and in the path of the flow of the gangue across the table, the said device being raised above the bottom or concentrating surface of the table, its lower edge occupying a position below the top of the water or slimes thereon, the said device being vertically adjustable on the table.

5. The combination with a transversely-inclined concentrating-table having a movement whose tendency is to cause the material to travel longitudinally thereon toward the rear or concentrates-discharge end of the table, the said end of the table being open to permit such discharge, the said table having longitudinally-disposed riffles, of a retarding strip or riffle arranged along the table in the path of the travel of the gangue thereon, the said retarding strip or riffle being provided with threaded openings, bolts journaled in the bottom of the table and having threaded parts engaging the openings in the retarding device, a hand-crank applied to the upper extremities of the bolts whereby the retarding device may be vertically adjusted at will, the said device being raised above the concentrating-surface of the table and its bottom or lower edge being located beneath the top of the pulp or water thereon.

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

CLAUDE L. MORGAN.
JOS. F. HOHEISEL.

Witnesses:
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W. A. Roberts.

COMPLAINANTS' EXHIBIT No. 32

Taylor Re-issue Patent No. 12,592

ALMON E. HART, Special Examiner

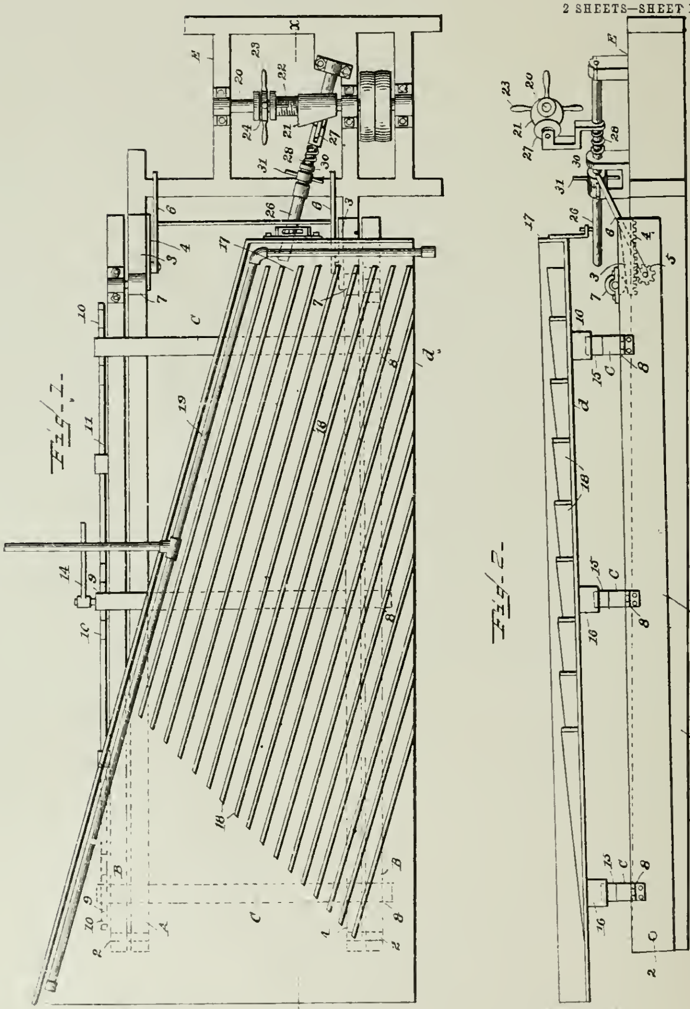
No. 12,592. REISSUED JAN. 8, 1907.

H. P. TAYLOR.

ORE CONCENTRATOR.

APPLICATION FILED JULY 28, 1903.

2 SHEETS—SHEET 1.



WITNESSES

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By H. H. Bliss

Attorney

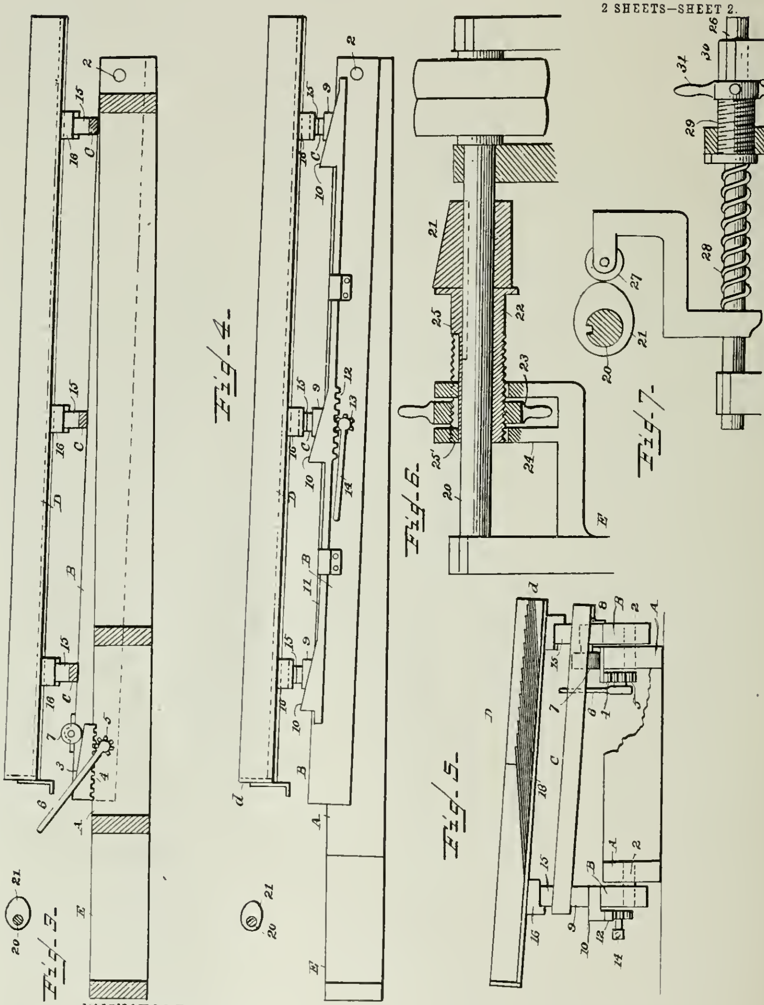
No. 12,592. REISSUED JAN. 8, 1907.

H. P. TAYLOR.

ORE CONCENTRATOR.

APPLICATION FILED JULY 28, 1903

2 SHEETS—SHEET 2.



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ORE-CONCENTRATOR.

No. 12,592. Specification of Reissued Letters Patent. Reissued Jan. 8, 1907.

Original No. 682,371, dated September 10, 1901. Application for reissue filed July 28, 1903. Serial No. 167,360.

To all whom it may concern:

Be it known that I, HARRY PICOTTE TAYLOR, a citizen of the United States, residing at Howard, in the county of Crook and State of Oregon, have invented certain new and useful Improvements in Ore-Concentrators, of which the following is a specification.

My invention relates to improvements in concentrating-tables whereupon ores are separated from the refuse tailings and from each other according to their specific gravities.

It consists, essentially, of a longitudinally-inclined support, a transversely-inclined bed upon this support, means by which these inclines may be varied, a shaking-table upon this bed, means by which a movement is given to this table oblique to the longitudinal line of the support, means by which the length of this movement or stroke may be regulated, and of details more fully explained by reference to the following specification and accompanying drawings.

Figure 1 is a plan of my invention. Fig. 2 is a longitudinal elevation. Fig. 3 is a part section and elevation on the line x x of Fig. 1. Fig. 4 is a rear elevation. Fig. 5 is an end view. Figs. 6 and 7 are detail views of the driving mechanism.

The object of my invention is to provide a device in which I get the widest range of position and movement possible for the concentrating-table as may be best adapted to the varying kinds and grades of ores under treatment. It is capable of being given a longitudinal, a transverse, and a diagonal tilt at one and the same time, or it may be given any of these tilts singly, or it may remain horizontal, and in any of these positions the movement or length of stroke of the table is capable of variation at will.

Having reference to the drawings, A is a suitable foundation or base on which the mechanism is supported. A frame B, composed of longitudinal timbers suitably connected, is pivoted at one end, as at 2, to the base A, so as to be capable of being given a longitudinal tilt. This tilting is effected by an inclined-plane lifting mechanism secured upon the parts of the base and the frame, near the opposite end from the pivot 2, as follows: On each of the longitudinal pieces of the base A are similar sliding wedges 3, having projecting flanges by which their position on these pieces is maintained. One of these flanges of each wedge is notched to form a rack-bar 4. A pinion 5, having an axle journaled in the base, engages with the rack and by suitable means, as a lever 6, is operated to move the wedge. Secured upon the frame B are rollers 7, which are adapted to engage the inclined faces of the wedges 3. A simultaneous movement of the levers moves the wedges forward or backward and correspondingly raises or lowers the end of the frame. A bed portion C is hinged at 8 to the frame B. By means of these hinges the bed C is transversely tilted by a mechanism somewhat similar to that used in giving the frame its longitudinal tilt. Upon the opposite side of the bed from the hinges are the wedge portions 9, fitted so as to slide upon the inclines 10, carried upon a rod 11, which latter is secured to the longitudinal portion of the frame B. The under side of this bar is provided with a rack 12, and a pinion 13, journaled in the frame, engages this rack and is actuated as by means of a lever 14. Thus by means of the lever 14 the wedges 10 are simultaneously moved and the lateral tilt of the bed and the table varied. The shaking or concentrating table D is supported above the bed in such manner that it may be given a rocking or sliding movement in a direction oblique to the length of the machine. Such mounting I have shown by the standards 15 upon the bed, having their ends adapted to fit the cleats 16 on the bottom of the table and form sliding bearing-surfaces. The table is of irregular shape, having its "head" end narrowed. The pulp is fed in, as at 17. Parallel with the longer and outer edge of the table are the riffles 18, which may be either rectangular or otherwise formed in any well-known manner. Water is fed along the side and end of the table from the trough or perforated pipe 19. The object of making this table with its outer edge longer is to compensate in a manner for the longitudinal tilting of the table and to raise that edge of the concentrate end which would naturally be lower, so that the water may tend to flow toward the head and be equally distributed over the table. Furthermore, for reasons soon to be shown, the valuable particles or the "concentrates" will be carried "uphill" toward the concentrate or broad end of the table by means of the riffles and the shaking of the table, while the slime will flow off on the lower or "tailings" side *d*. A differential reciprocating movement in the direction of the riffles is given to this table in the following manner: At the head end of the machine a horizontal shaft 20 is journaled in a framework E and has suitable driving connections with a source of power. Upon this shaft is a cone-shaped cam 21. A sleeve 22 upon the shaft has one end abutting against the base of the cam and the other end is threaded, on which the stroke-adjuster 23 is turnable. This adjuster is held between the guides 24 on the framework E. The sleeve 22 is prevented from turning on the shaft by means of a longitudinal groove 25 in the sleeve, in which a projection or lug 25′ on the frame engages. To the head of the table is attached an arm 26. The outer end of this arm has a wheel 27 running on the face of the cam. This wheel is kept against the cam by reason of a spring 28. The tension of this spring is regulated by a flanged sleeve 29 upon the arm. This sleeve is exteriorly threaded and is turnable in a threaded projection 30 of the framework E and is operated by means of the spokes 31. By means of the movable sleeve 22 upon the shaft 20 acting against the cam to move the latter, so the wheel 27 runs upon a greater or less circumference of the cam, I am able to give any desired length of stroke or "shake" to the table. This ability to change the shake of the table is of great value in many instances. The cam is given such a periphery that a differential movement is gained—*i. e.*, the table comes to a quick stop on the concentrate end of its stroke and to a gradual stop at the other end. As previously indicated, the table is capable, further, through means of the inclined wedges, of being given a longitudinal tilt and a transverse tilt. These features, coupled with the oblique shaking movement, gives a differential motion to the table, which, with the angle of the riffles, throws the valuable particles toward the concentrate end of the table and effects a cleaner and closer saving than is usual in concentrating-tables, this by reason that the slime is carried in another direction—*i. e.*, toward the lower side *d*—and the particles have more freedom to separate according to their relative specific gravities. Furthermore, it has been found that by the use of this machine the finely-ground ore may be concentrated in a dry state—a feature that is of immense value in dry and arid localities where conservation of water is of first importance in all operations.

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

1. In a concentrator, the combination of a longitudinally and transversely inclined support, and a table mounted thereon, said table being of irregular shape with a narrowed head end, riffles upon the table arranged parallel with the outer or longer side thereof and diagonal to the said support, and means by which the table is given an endwise-reciprocating movement oblique to longitudinal axis of the machine, and in the line of said riffles.

2. In a concentrator, the combination with a base of a frame pivoted thereon, means by which the frame may be inclined longitudinally, a bed hinged on this frame and capable of being given an incline transverse to the frame, a table upon this bed, said table being of irregular shape and diverging from its head end, and having riffles parallel with its outer or long side and diagonal to the bed, and means by which the table may be given an endwise-reciprocating movement oblique to the longitudinal axis of the machine, and in the line of the riffles.

3. In a concentrator, a table having a narrow head end, and gradually increasing in width toward the foot having parallel riffles extending in a line oblique to the longitudinal axis of the table and parallel with the longer or outer side of the table, and means by which this table may be given a reciprocating movement in the line of these riffles.

4. In a concentrator, the combination with a base, of a frame pivoted at one end thereon, inclined wedges slidable upon the base, bearing-surfaces fixed upon the frame which engage these wedges, and means by which the wedges are moved and the frame given a longitudinal tilt, a bed hinged upon the frame, and means by which the bed is laterally tilted, a table carried upon the bed having parallel riffles oblique to the axis of the machine, and extending in uphill direction, and means by which the table is given a reciprocating movement in the direction of the riffles.

5. The combination with a concentrator table and means by which it may be longitudinally and transversely tilted, means whereby this table may be differentially reciprocated obliquely to the longitudinal axis of the table, said means consisting of a shaft, a cone-shaped cam slidable upon this shaft, a sleeve upon the shaft and also slidable thereon, and abutting against the base of the cone, said sleeve having exterior threads, a nut thereon held between guides by which the sliding movement of the sleeve on the shaft is effected, and the cam moved, and means whereby the sleeve is kept from turning, an arm upon the head of the table and carrying a wheel which runs on the periphery of the cam, means by which the contact of the wheel against the cam is maintained.

6. The combination in a concentrator of a longitudinally-tilted frame, and means by which this tilt may be varied, a transversely-tilted bed upon this frame and means whereby its tilt may be varied, a table mounted thereon having one side inclined outward

from the axis of the machine and in the direction of the foot end of the table, means by which water is fed to the table along this longer outer edge, riffles parallel with this longer edge, and means by which this table is given a differential reciprocating movement in the direction of the riffles and whereby the concentrates are made to travel "uphill" upon the table.

7. In an ore-concentrator, the combination with a longitudinally and transversely tilted table, said table having its outer and upper edge divergent from the axis of the machine, riffles of graduated lengths parallel with this upper edge and diagonal to the head end, and means whereby this table is given a differential reciprocating movement in the direction of this upper edge.

8. In an ore-concentrator, the combination of a table carrying a series of parallel riffles, the table being transversely adjustable about an axis which is situated in a longitudinal vertical plane, and also longitudinally adjustable about an axis that is situated in a transverse vertical plane, such adjustments being adapted to bring the surface of the table into different planes relative to the horizontal, and the said riffles being arranged in a direction oblique or inclined to the said longitudinal and transverse vertical planes, and means for imparting reciprocatory movements to the table on lines parallel with the riffles, substantially as set forth.

In testimony that I claim the above I have hereunto subscribed my name in the presence of two witnesses.

HARRY PICOTTE TAYLOR.

Witnesses:

A. B. Kohny,

R. J. McAfee.

COMPLAINANTS' EXHIBIT No. 33

Christmann Patent No. 845,449

ALMON E. HART, Special Examiner

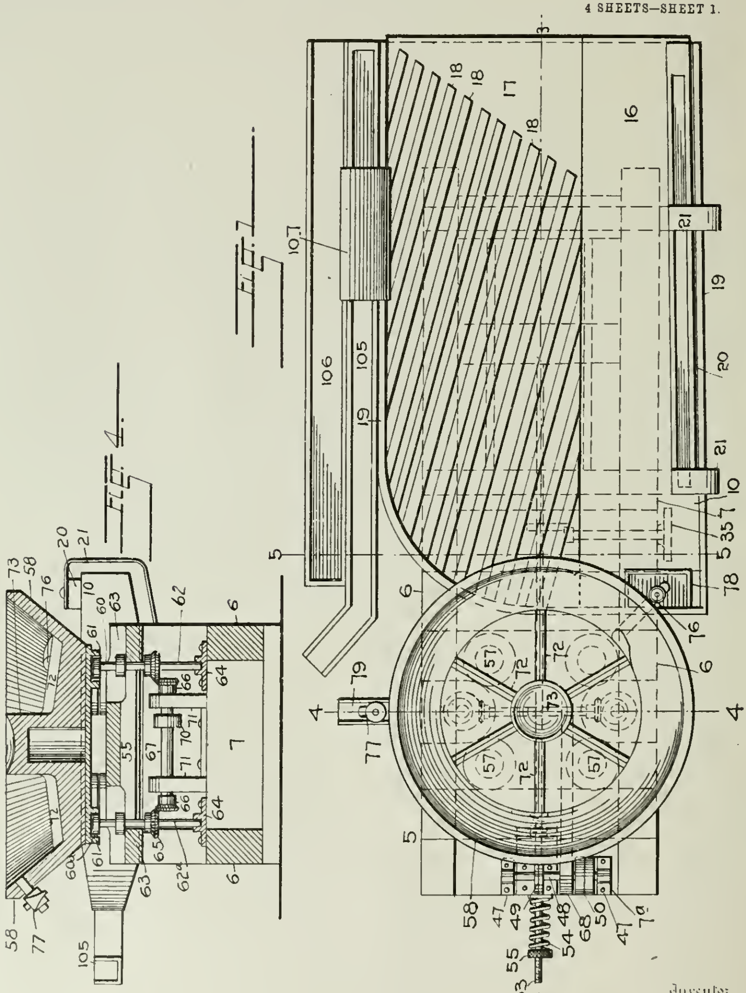
No. 845,449. PATENTED FEB. 26, 1907.

M. CHRISTMANN.

ORE CONCENTRATOR.

APPLICATION FILED JUNE 7, 1905.

4 SHEETS—SHEET 1.



Witnesses:

H. L. McCann

T. M. Stump

Inventor:

Michael Christmann

by

Attorney

No. 845,449. PATENTED FEB. 26, 1907.

M. CHRISTMANN.

ORE CONCENTRATOR.

APPLICATION FILED JUNE 7, 1905.

4 SHEETS—SHEET 2.

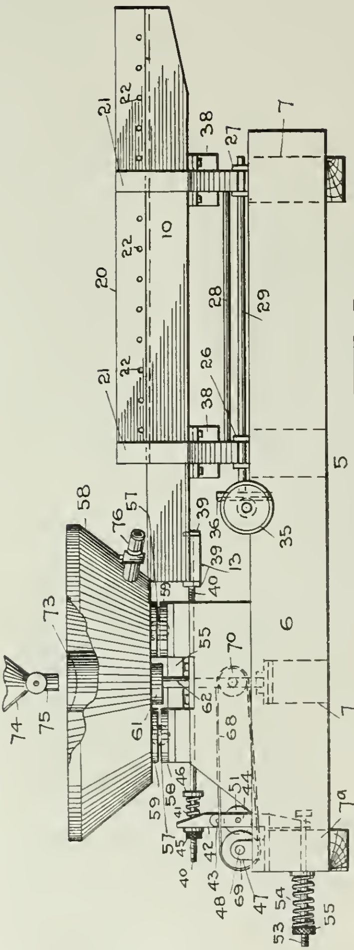


Fig. 2.

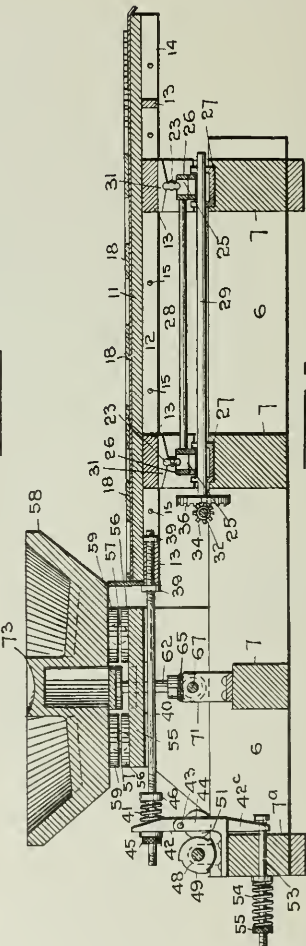


Fig. 3.

Witnesses

John Rollandet.

A. F. Seymour Jr

Inventor

Michael Christmann

by G. J. Rollandet.

Attorney

No. [illegible] PATENTED FEB. 26, 1907.

[illegible]

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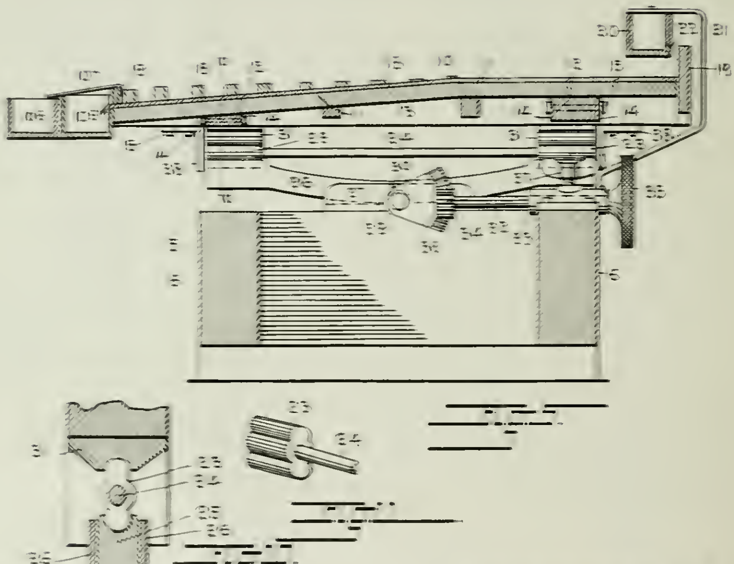
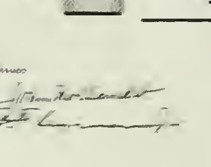
[illegible] 1906.

4 SHEETS—SHEET 3.





Inventor
Michael Christmann

Witnesses

Attorney

No. 845,449. PATENTED FEB. 26, 1907.

M. CHRISTMANN.

ORE CONCENTRATOR.

APPLICATION FILED JUNE 7, 1905.

4 SHEETS—SHEET 4.

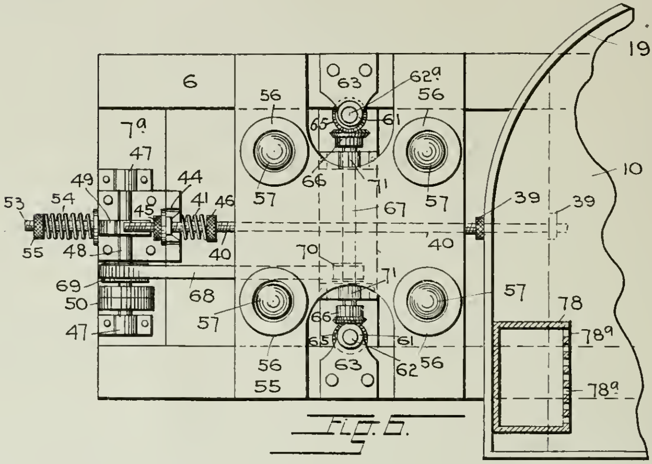


Fig. 6.

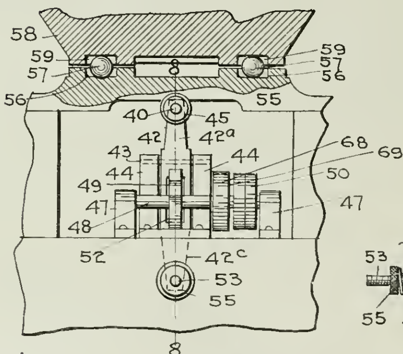


Fig. 7.

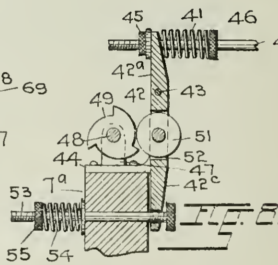


Fig. 8.

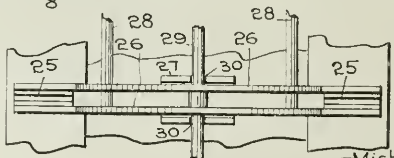


Fig. 9.

Witnesses
John Rolland
D. F. Seymour Jr

Inventor
Michael Christmann
by J. J. Rolland
Attorney

UNITED STATES PATENT OFFICE.

MICHAEL CHRISTMANN, OF LEADVILLE, COLORADO.

ORE-CONCENTRATOR.

No. 845,449. Specification of Letters Patent. Patented Feb. 26, 1907.

Application filed June 7, 1905. Serial No. 264,154.

To all whom it may concern:

Be it known that I, MICHAEL CHRISTMANN, a citizen of the United States of America, residing at Leadville, in the county of Lake and State of Colorado, have invented certain new and useful Improvements in Ore-Concentrators, of which the following is a specification.

My invention relates to improvements in ore-concentrators, and has for object to provide an apparatus which, being simple and efficient, will adequately separate the mineral from the gangue during one operation, thereby obviating repeating and consequent use of elevators and similar appliances and saving time and labor. I attain these objects by the mechanism illustrated in the accompanying drawings, in the several figures of which like parts are similarly designated, and in which—

Figure 1 represents a plan view of the apparatus; Fig. 2, a side elevation thereof; Fig. 3, a vertical longitudinal section therethrough; Fig. 4, an enlarged vertical cross-section taken along line 4 4, Fig. 1; Fig. 5, an enlarged vertical cross-section along line 5 5, Fig. 1; Fig. 6, an enlarged plan view of the "movement end" of the stationary frame; Fig. 7, a sectional fragmentary end view thereof; Fig. 8, a section along line 8 8, Fig. 7; Fig. 9, a fragmentary plan view of part of the stationary frame and superposed rocker-arm; Fig. 10, an enlarged fragmentary section along the line 10 10, Fig. 5; Fig. 11, a perspective view of one of the table-supporting rockers.

5 represents the bed or base frame, consisting of the longitudinal beams 6 and 6 and cross-timbers 7, securely bolted together to form a rigid and adequate support for the table, operating mechanism, and other parts of my device. Mounted on frame 5 is the longitudinally-movable table 10, composed of the linoleum-covered deck 11, securely braced on girders 12 and suitable cross-timbers 13. To further strengthen the structure and prevent warping, girders 12 may be lined with metal plates 14, secured thereto by bolts 15.

Deck 11 is longitudinally divided into two parts 16 and 17, the former of which is plain and normally level, while the other is provided with diagonally-extending riffles 18 and inclines toward the lower or gangue-discharge side of the table. Riffles 18, which, if so desired, may be made to taper from the head to the foot end of the deck, terminate a certain distance from the table's outer edge, leaving a smooth plane for final separation of the mineral from the gangue.

Table 10 is, with the exception of its foot or discharge end, provided with upwardly-extending flanges 19 and surmounted on its upper edge by a water-trough 20, supported on suitably-formed brackets 21 and provided on its outer side with a series of discharge-apertures 22. The table is movably supported on two pairs of rockers 23, interposed between it and the stationary frame, each pair of rockers being connected by a transversely-extending rod 24. The lower rounded extremities of rockers 23 are supported in correspondingly-shaped dies 25, secured in the outer and upwardly-extending extremities of parallel curved rocker-arms 26, which are mounted transversely of frame 5 in chairs 27, centrally secured on the cross-timbers 7. Arms 26 are connected by tie-rods 28 and a pivot-rod 29, which being secured at their lowermost point extends beyond the arms and is mounted in slots 30 in chairs 27. Lateral deflection of the table is prevented by guide-plates 38, secured to the under side of the table and engaging the outer surfaces of rockers 23. The upper extremities of rockers 23 extend in inverted dies 31, shaped similarly to those on the curved rocker-arms and rigidly secured in corresponding positions to suitable parts of the table-frame.

It will be observed that the above-described arrangement of parts not only permits longitudinal movement of the table, but also allows it to be transversely inclined by reason of its being pivotally mounted in chairs 27 through instrumentality of the pivot-rod 29.

The transverse inclination of the table is adjustable by means of a short shaft 32, revolubly mounted in a bearing 33 on the stationary frame and provided with a pinion 34 at its inner and a hand-wheel 35 at its outer extremity. Pinion 34 meshes into a segmental gear 36 on the inner extremity of pivot-rod 29, and the various parts may be held in any desired position by a set-screw 37, extending through box 33 and engaging shaft 32.

During the operation of the device a rapid longitudinal reciprocating or vibrating motion is imparted to the table by the mechanism mounted on the upper end of the stationary frame and which will now be described.

Rigidly secured to table 10 by nuts 39 is the forwardly and longitudinally extending draw or thrust rod 40, the outer extremity of hich extends through a spring 41 and an aperture in the extremity of the upper arm 42^a of a vertical lever 42, fulcrumed at 43 in a standard 44, which is mounted on the stationary frame 5. A nut 45, screwed onto the outer extremity of the draw-rod, engages the outer surface of arm 42^a, while a second nut 46 gives tension to spring 41, which forms an adjustable buffer during the operation of the device.

Mounted in bearings 47, bolted to the stationary frame, is the transverse shaft 48, which carries the cam or wiper wheel 49. Shaft 48 may receive its rotary motion from any convenient source of power by means of pulleys 50. The peripheral surface of wheel 49 engages the periphery of an antifriction-wheel 51, revolubly mounted in a slot 52 in the lower arm 42^c of lever 42, which extends along the inner surface of the end timber 7^a of the stationary fra A headed rod 53 extends through apertures in the lower extremity of arm 42^c and timber 7^a and through a coil-spring 54, its head engaging the surface of said arm, while a nut 55, screwed onto its outer extremity, gives tension to spring 54.

During the operation of the device the rotation of shaft 48 will cause the peripheral projections on the cam-wheel to engage the antifriction-wheel 51 in arm 42^c, which, being forced inwardly, impels the opposite arm of lever 42 to move outwardly, drawing the table with it. Spring 54 is at the same time compressed, with the result that the moment the projection on the wiper-wheel is disengaged from the periphery of the antifriction-wheel the relaxation of said spring will cause the lever and table to resume their original position. In this manner a rapid reciprocating or vibrating movement is imparted to the table, the speed of which may be regulated by the number of peripheral projections on wheel 49.

Although the ore may be fed onto the table in any suitable manner, I preferably and in order to obtain perfect results make use of a pan 58, which is mounted on an elevated platform 55 at the feed end of the table by means of antifriction-balls 57, which, being interposed between the two, engage correspondingly-shaped sockets 56, secured to the platform, and oppositely-located inverted sockets 59 on the lower surface of the pan. Two horizontally-arranged eccentrics 60 and 60^a, extending in correspondingly-shaped sockets 61 on the under surface of the pan, are adapted to impart an eccentric movement to pan 58 and are to this end secured to the upper extremities of vertical shafts 62 and 62^a, mounted in bearings 63 and steps 64 on the stationary frame. Shafts 62 and 62^a are, furthermore, provided with bevel gear-wheels 65, which mesh into corresponding wheels 66 on a counter-shaft 67, mounted in bearings on standard 71, and which is operatively connected with shaft 48 by a belt 68, passing around pulleys 69 and 70 on said shafts. Pan 58, having an outwardly-flaring peripheral side, is provided with a number of radially-extending riffles 72 and a central upwardly-extending cylindrical projection 32, the upper surface of which is concave to receive the pulp discharged thereon through a valve-controlled spout 75 from a superposed receptacle 74. By reason of the eccentric motion of pan 58 the pulp overflowing the edges of projection 32 will thus be fed around all parts of the pan instead of being discharged therein at one point. Pan 58 is, furthermore, provided with two valve-controlled discharge-spouts 76 and 77, the lower one, 76, of which being located near the bottom discharges the heavy and valuable particles contained in the pulp into a feed-box 78, mounted on table 10 and having a number of apertures 78^a, through which the material is spread over the surface of the deck. The upper spout 77, located near the upper edge of the pan, discharges the lighter matter or gangue into a launder 79, which conveys it to a settling-tank or other suitable receptacle. The classifying and feeding apparatus thus described in combination with my table is subject of a separate application for patent, Serial No. 284,193, filed October 24, 1905.

The worthless matter or gangue discharged over the lower or discharge side of the table falls in a launder 105, placed alongside said table, and which, like launder 79, may lead to a settling-tank or other receptacle. A second launder 106, placed alongside launder 105, receives and conveys the silica contained in the pulp, which, collecting at one point on the lower side of the table during the operation of the device, is discharged over an apron 107, which, being hung over the side of the table and launder 105, may be moved to any desired point.

Having thus described the mechanical construction of my device, its operation is as follows: The pulp being discharged from tank 74 through spout 75 onto the concave surface of projection 73 of pan 58, is, as heretofore explained, fed evenly along the inner surface of the pan, in which, by reason of it eccentric motion, resembling that of the ordinary miner's pan, the heavy mineral-bearing particles of the pulp settle on the bottom to be discharged through spout 76 into the feed-box 78 on part 16 of the deck. Being spread over the smooth portion 16 of the table through apertures 78^a in the feed-box, the matter is separated by reason of the vibrating motion of the table, the heaviest and most valuable particles moving along part 16 of the deck to be discharged along its lower end, while the lighter matter, aided by the water supplied from trough 20, will flow over the riffled inclined portion 17 of the table, the riffles on which progressively catch the heavier particles and guide them to the lower or discharge-end of the table, while the lighter matter or gangue overflowing the side of the table falls into launder 105.

Although the device has been illustrated in the drawings as being in a horizontal position, it may be preferable while operating to incline the same from the head to the tail end by elevating and propping the movement end of the stationary frame.

Having thus described my invention, what I claim is—

1. In combination a stationary frame, a concentration-deck mounted thereon said deck having a level portion extending from end to end thereof and a portion inclining laterally from said level portion, riffles arranged diagonally on said inclined portion, a space being left between the rear ends of the riffles and the end of the deck and means for reciprocating the deck.

2. In combination a stationary frame, a concentrator-deck thereon, said deck having a level portion extending from end to end thereof and a portion inclining laterally from said level portion, riffles diagonally arranged on said inclined portion, a trough located along the side edge of said inclined portion, means for spraying water on the outer edge of the level portion, means for feeding the material at the upper end of said level portion, means for reciprocating said deck and means for inclining said deck transversely.

3. In combination, a stationary frame, a concentrator-deck mounted to have a reciprocating movement thereon, a two-armed lever fulcrumed on said frame, a draw-rod connected at one end to said deck and its other end resiliently connected with the upper end of the lever, said connection consisting of a spring and a nut screwed on the draw-rod, a friction-roller carried by the lower end of said lever, a wiper-wheel revolubly mounted on the frame and arranged to engage the said friction-roller, a spring engaging with the lower end of the lever to hold it in its normal position and means for adjusting the said spring.

4. In combination, a stationary frame, parallel segmental rocking arms mounted on said frame, a shaft passing through the centers of said rocking arms, means for rocking said shaft, a rocker carried by each end of each rocking arm, a shaft connecting the rockers on each rocking arm together, each rocker having two rounded portions, one engaging with the rocking arm, a deck resting on the other rounded portion of each rocker, and means for reciprocating the deck.

In testimony whereof I have affixed my signature in presence of two witnesses.

MICHAEL CHRISTMANN.

Witnesses:

JAMES GLYNN,

ANDREW P. ADOLPHSON.

COMPLAINANTS' EXHIBIT No. 34

Snyder Patent No. 854,768

ALMON E. HART, Special Examiner

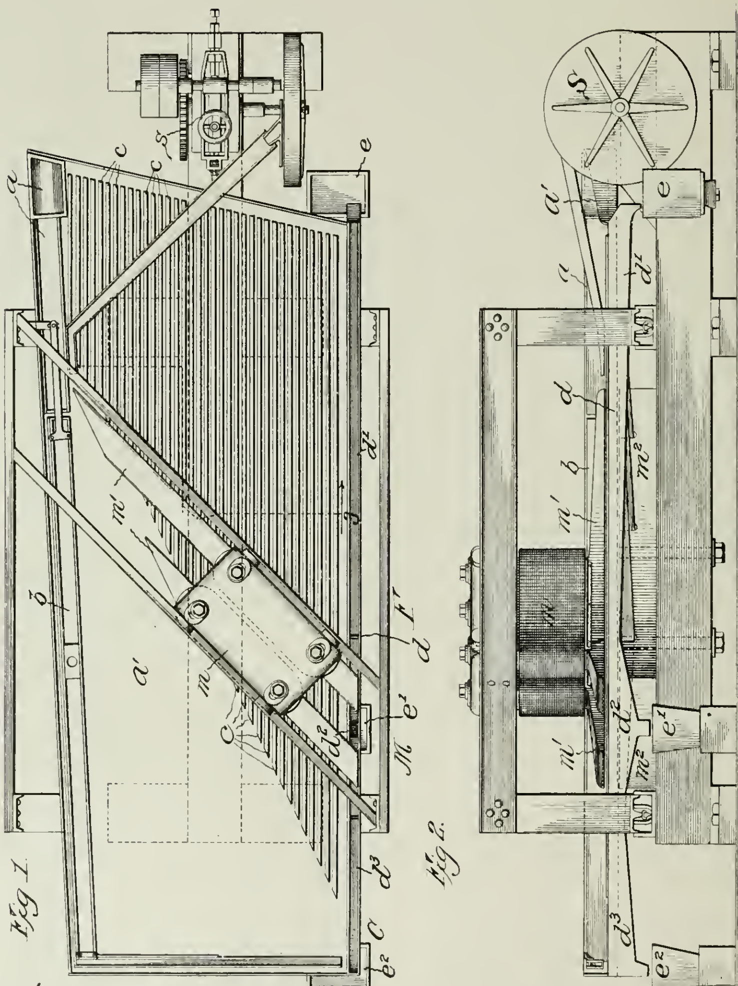
No. 854,768. PATENTED MAY 28, 1907.

F. T. SNYDER.

SHAKING TABLE SEPARATOR.

APPLICATION FILED OCT. 31, 1904.

2 SHEETS—SHEET 1.



Witnesses:
Irving MacDonald.
Alfred H. Moore.

Inventor:
Frederick T. Snyder.
By Barton & Tanner
Att'ys.

No. 854,768. PATENTED MAY 28, 1907.

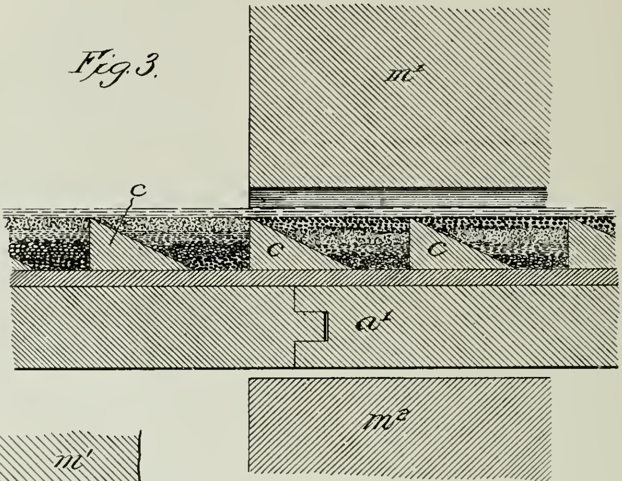
F. T. SNYDER.

SHAKING TABLE SEPARATOR.

APPLICATION FILED OCT. 31, 1904.

2 SHEETS—SHEET 2.

Fig. 3.



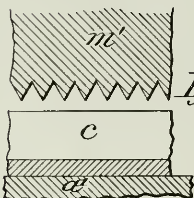
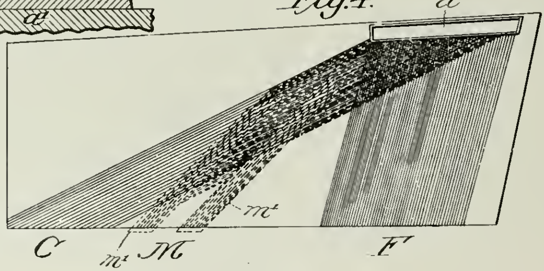


Fig. 5.

Fig. 4.



Witnesses:
Irving Mac Donald.
Alfred H. Moore

Inventor:
Frederick T. Snyder,
By Barton & Tanner
Att'ys.

UNITED STATES PATENT OFFICE.

FREDERICK T. SNYDER, OF CHICAGO, ILLINOIS, ASSIGNOR TO INTERNATIONAL SEPARATOR COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF NEW JERSEY.

SHAKING-TABLE SEPARATOR.

No. 854,768. Specification of Letters Patent. Patented May 28, 1907.

Application filed October 31, 1904. Serial No. 230,640.

To all whom it may concern:

Be it known that I, Frederick T. Snyder, a citizen of the United States, residing at Chicago, Oak Park, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Shaking-Table Separators, of which the following is a full, clear, concise, and exact description.

My invention relates to an ore concentrator, and has for its object to provide improved apparatus for separating magnetically permeable ores from mixtures of materials containing such ores; my invention being more particularly intended to be used in connection with mixtures of ores or materials which have so nearly the same specific gravity that they could not ordinarily be separated by the usual type of shaking table separator which is dependent for its operation upon the different specific gravities of the materials worked upon.

For example, where the mixture is composed of materials whose specific gravities do not differ more than one unit such as a mixture of feldspar, hornblende, magnetite and corundum, the ordinary type of shaking table concentrator is ineffective to separate any one of these materials from the rest.

My invention, broadly speaking, contemplates the application of a magnet to a shaking table concentrator, the magnet being adjusted so as to act upon the materials upon the table to the extent of changing the effective weight of the more permeable particles, so that the relative effective weights of the different materials in the mixture will be readjusted with a view of permitting the separation of the effectively lighter particles from the others.

I will describe my invention particularly by reference to the accompanying drawings, which illustrate the preferred embodiment thereof.

Figure 1 is a plan view of the ore concentrator constructed and equipped in accordance with my invention; Fig. 2 is an elevation thereof; Fig. 3 is a sectional enlarged diagram on line 3—3 of Fig. 1, showing a portion of the table in cross section, together with the materials thereon to illustrate the readjustment in the relative positions of the materials which takes place under the influence of the magnet; and Fig. 4 is a diagrammatic plan view of the table showing the distribution and separation of the materials. Fig. 5 is a detail cross sectional view illustrating teeth or ridges upon the pole face of the magnet.

The same letters of reference indicate the same parts wherever they are shown.

The concentrating table shown in the drawings, except for the magnet and its supporting parts, is a type well known in the art. The material is fed onto the table a' through the feed box a shown in the upper right hand corner of Fig. 1, from which it is gradually caused to move along the table toward the other end. Such movement is caused by the differential reciprocating or shaking movement of the table produced by the mechanism S of the usual type. The return movement of the table at the end of its movement toward the left in Fig. 1 is much quicker than its return from the movement toward the right. This differential reciprocating motion, as is well known, will cause a step-by-step progression of the materials on the table toward the left hand end. This movement may be assisted somewhat by a slight inclination of the table in the same direction. The table is also slightly inclined about its longitudinal axis, so that wash water fed to the table through the clear water box b in the upper right hand portion will flow down the surface of the table in the usual manner. Riffles c c are provided upon the surface of the table, said riffles extending parallel to the direction in which it is reciprocated. As shown, the riffles are successively longer toward the lower part of the table, so that their left hand ends are located in a diagonal line from the upper right hand corner to the lower left hand corner thereof.

The normal operation of such a table is that the materials fed onto the table through the feed box a are gradually moved along the table parallel to the riffles c c, by the differential reciprocating or shaking motion which is imparted to the table by the mechanism S. At the same time dressing water flowing across the table transversely to the riffles carries the lighter material over the tops of the riffles and downward to the lower edge of the table. The heavier material, however, sinks to the bottom of the channels between the riffles and continues its passage down the table parallel to said riffles. The result is that the lighter materials are separated from those which are heavier, the lighter materials coming off near the forward end of the table, while the heavier materials stay on the table until they reach the lower end.

As before stated, however, unless there is a difference of over one unit in the relative specific gravities of the materials in the mixture to be separated, such a separation cannot be properly made in the manner above described; and in accordance with my invention I mount a magnet adjacent to the table and adjust the same to act upon the magnetic particles in the mixture of materials, in such a way as to vary their effective weight, producing in this way a difference in the effective weight of the magnetic and non-magnetic materials sufficient to admit of their separation by the shaking table. This result may be obtained by disposing the magnet m immediately above the table with its pole pieces m' m' extending in lines diagonal to the riffles, with the faces of said pole pieces as close to the surface of the table as practical. The faces of the pole pieces should be roughened or provided with permeable projections to establish convergences of the lines of force toward said poles, since the magnetic particles tend to follow the converging lines of force.

To decrease the reluctance of the magnetic circuit, an iron plate m^2 may be provided underneath the table directly below the magnet poles.

By the means above described, a series of narrow areas of magnetic concentration is established, in lines diagonal to the general direction of passage of the materials upon the table. The effect of the magnetic field thus established is that when the materials upon the table come within the influence of said field, the more permeable particles are so influenced that their effective weight is changed with relation to the non-magnetic materials, the permeable particles in this instance rising to the top of the mixture, where they may be washed off by the dressing water, while the less permeable particles remain at the bottom and are gradually carried along parallel to the riffles by the differential shaking motion of the table.

In the diagram Fig. 3 I have illustrated the rearrangement of the materials in the mixture which is brought about when said materials come within the range of influence of the magnet. The left hand portion of the figure illustrates the relative positions which the different materials in the mixture will assume under normal conditions, while the right hand portion of the figure illustrates the relative positions of the materials when the magnetic particles have been rendered effectively lighter under the influence of the magnet.

The magnet should not be of sufficient strength to actually lift the magnetic particles off the table or draw them out of the mixture, but simply to overcome the force of gravity to such an extent that in the shaking of the table they will be brought to the top where they can readily be washed off by the dressing water.

To give a specific illustration, the ordinary relative weights of feldspar, hornblende, magnetite and corundum under water are indicated by the following figures: feldspar, 1.50; hornblende, 2; magnetite, 4; corundum, 3.

It will be seen that there is not sufficient difference in the specific gravities of these several materials to permit of a ready separation thereof by the ordinary type of shaking table concentrator. With the concentrator of my invention, however, equipped with the magnet, when the materials come within the influence of the magnet, their apparent or effective weights under water become as follows: feldspar, 1.50; hornblende, 1.50; magnetite, 1.50; corundum, 3. That is to say, the corundum is now the heaviest material in the mixture, and there is a difference of one and a half units between its specific gravity and the apparent or effective specific gravity of either of the other materials; whereas without the magnet the magnetite would be heavier than the corundum, but not enough heavier to permit of satisfactory separation by the shaking table. Such a mixture of feldspar, hornblende, magnetite and corundum may therefore be separated by means of my concentrator as above described, the feldspar, hornblende and magnetite under the influence of the magnet being raised to the top of the riffle by the shaking of the table, and washed from the riffles by the dressing water, coming off at the lower edge of the table in the zone marked M, while the corundum will be carried along to the lower end of the table where it will finally come off in the zone marked C.

Under present methods of operation, the different minerals to be separated are also found associated with large quantities of silica or other barren rock, usually equaling from three to ten times the weight of the mineral. The present practice consists in putting the ore over a wet shaking table which separates the gangue from the mineral. The mineral is then dried and put through a magnetic separator for the separation of the different minerals. In my present form of apparatus these second and third steps are avoided, as the material is separated magnetically at the same time that the mineral is concentrated out of gangue. It will be seen that the operation of the magnet interferes in no way with the concentration of the minerals from the gangue. The paths taken by the different materials are illustrated in Fig. 4, the zone marked F being that occupied by the feldspar, which in the illustration selected is the gangue material. The path of the magnetite is indicated at M, and the path of the corundum is indicated at C. A trough is provided along the lower side of the table, and is divided into three compartments d' d^2 d^3. The compartment d' is adapted to receive the feldspar or other light silicates and convey the same to a suitable receptacle *e;* similarly the compartment d^2 receives the magnetite or other magnetic particles, and conveys the same to a box e', while the heaviest non-magnetic material, such as corundum, is conveyed by the compartment d^3 to a box e^2.

Having thus described my invention, I claim:

1. In a concentrator, the combination with a transversely-inclined shaking table having longitudinal channels thereon, of means for feeding a mixture of magnetic and non-magnetic minerals and gangue to the head of the table, means for imparting a differential reciprocating motion to the table parallel to said channels in a direction to cause a travel of the mixture toward the foot of the table, means for flowing water across the table transversely to said channels to remove the gangue from the mixture, and a magnet suspended above the table near the foot thereof and adapted to exert a lifting force upon the magnetic constituents of the mineral concentrate, sufficient to cause said constituents to be washed by the water across said channels into a path divergent from the remainder of said concentrate.

2. In a concentrator, the combination with a table, of means for feeding materials to be separated to said table, means for agitating said table to pass said materials gradually along the table longitudinally thereof, a magnet having pole pieces above the table close to the surface thereof, said pole pieces extending across the table to the lower lateral edge thereof in a direction diagonal to the direction of passage of materials along the table, and means for flowing water across the table, substantially as set forth.

3. In a separator for mixtures of materials of different magnetic permeability, but of nearly the same specific gravity, the combination with a transversely-inclined table and means for feeding the mixtures of materials in a thin layer upon the table, a series of low obstructions extending longitudinally upon the table, means for imparting a differential reciprocating motion to said table in a direction to cause a gradual movement of the materials along the table substantially parallel to said obstructions, means for establishing a flow of water across the table at an angle to said obstructions, and a magnet adapted to act upon the materials upon said table to the extent of changing the effective weight of the more permeable particles relative to the weight of the other materials, whereby the materials having the highest effective weight rise above the level of the other materials and are washed over said obstructions by the water, and so separated.

4. In a concentrator, the combination with a table having longitudinal riffles thereon, of means for feeding materials to be separated to said table, means for imparting a differential reciprocating motion to said table in a direction substantially parallel to said riffles to cause a net travel of the material along the channels between said riffles, means for flowing water across the table transversely to the riffles, and a magnet suspended above the table adapted to exert a lifting force upon the magnetic particles sufficient to enable said particles to be washed by the water across the riffles, whereby said magnetic particles are separated from the heavy non-magnetic materials.

5. In an ore-concentrator, in combination, for effecting selective separation of various mineral values and gangue, a table having a riffled top slightly inclined from the horizontal, means for supplying a flow of water over said table-top, means for feeding onto the higher part of the table-top the mixed materials to be separated, mechanism for differentially agitating said table-top, and a source of magnetic influence of limited intensity so arranged that such of said materials as are of like specific gravity but diverse magnetic properties will have their flotation differentiated while passing through the magnetic field and will be resultantly dispersed and isolated from each other, substantially as specified.

6. In an ore-concentrator, in combination, for effecting selective separation of various mineral values and gangue, a table having a riffled top slightly inclined from the horizontal, means for supplying a flow of water over said table-top, means for feeding onto the higher part of the table-top the mixed materials to be separated mechanism for differentially agitating said table-top, and an electromagnet of limited intensity so arranged that such of said materials as are of like specific gravity but diverse magnetic properties will have their flotation differentiated while passing through the magnetic field and will be resultantly dispersed and isolated from each other, substantially as specified.

7. In an ore-concentrator, in combination, for effecting selective separation of various mineral values and gangue, a table having a riffled top slightly inclined from the horizontal, means for supplying a flow of water over said table-top, means for feeding onto the higher part of the table-top the mixed materials to be separated, mechanism for differentially agitating said table-top, and an electromagnet of limited intensity suspended

slightly above the water-current flowing over said table-top and arranged so as to facilitate the flotation and resultant isolation of such of said materials as are of like specific gravity with others but of higher paramagnetic properties, substantially as specified.

8. In an ore-concentrator, in combination, for effecting selective separation of various mineral values and gangue, a longitudinally movable table having its top slightly inclined from the horizontal and provided with a series of longitudinal riffles successively increasing in length from the upper toward the lower edge of said table, means for supplying a flow of water over said table-top from its upper toward its lower edge, means for feeding onto the higher part of the table-top above the shortest riffle the mixed materials to be separated, mechanism for imparting differential reciprocating movement to said table, and a source of magnetic influence of limited intensity so arranged that such of said materials as are of like specific gravity but diverse magnetic properties will have their flotation differentiated while passing through the magnetic field and will be resultantly dispersed and isolated from each other, substantially as specified.

9. In an ore-concentrator, in combination, for effecting selective separation of various mineral values and gangue, a longitudinally movable table having its top slightly inclined from the horizontal and provided with a series of longitudinal riffles successively increasing in length from the upper toward the lower edge of said table, means for feeding onto the higher part of the table-top above the shortest riffle the mixed materials to be separated, mechanism for imparting differential reciprocating movement to said table, and an electro-magnet of limited intensity so arranged that such of said materials as are of like specific gravity but diverse magnetic properties will have their flotation differentiated while passing through the magnetic field and will be resultantly dispersed and isolated from each other, substantially as specified.

10. In an ore-concentrator, in combination, for effecting selective separation of various mineral values and gangue, a longitudinally movable table having its top slightly inclined from the horizontal and provided with a series of longitudinal riffles successively increasing in length from the upper toward the lower edge of said table, means for supplying a flow of water over said table-top from its upper toward its lower edge, means for feeding onto the higher part of the table-top above the shortest riffle the mixed materials to be separated, mechanism for imparting differential reciprocating movement to said table, and an electro-magnet of limited intensity suspended slightly above the water-current flowing over said table-top and arranged so as to facilitate the flotation and resultant isolation of such of said materials as are of like specific gravity with others but of higher paramagnetic properties, substantially as specified.

In witness whereof, I hereunto subscribe my name this 10th day of October A. D., 1904.

FREDERICK T. SNYDER.

Witnesses:

De Witt C. Tanner,

Winfield W. Leach.

COMPLAINANTS' EXHIBIT No. 35

James Patent No. 874,364

ALMON E. HART, Special Examiner

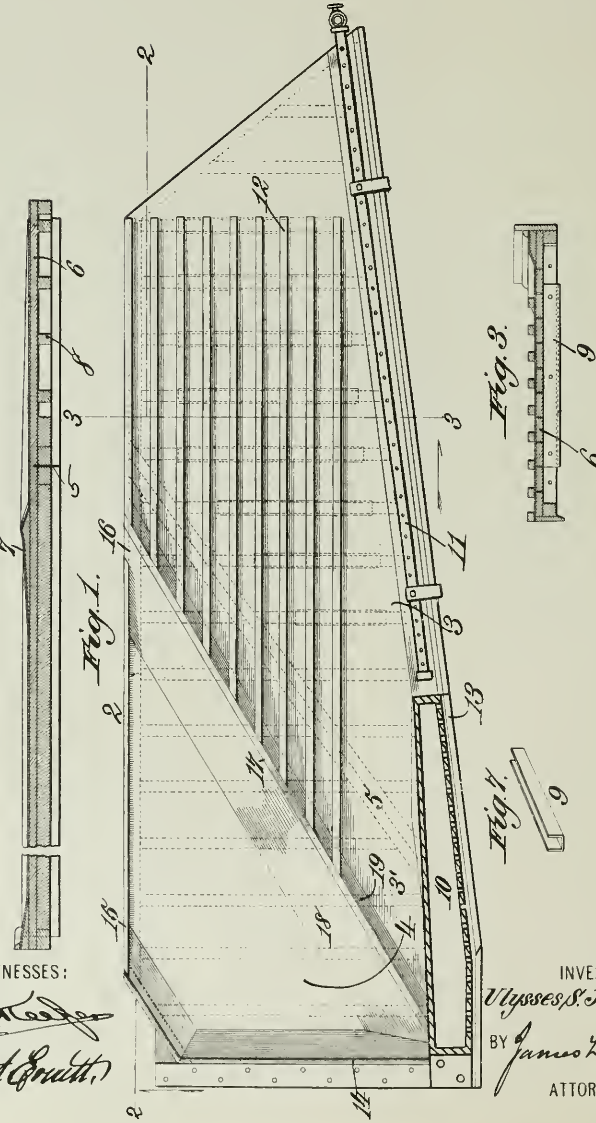
No. 874,364. PATENTED DEC. 17, 1907.

U. S. JAMES.

ORE CONCENTRATOR.

APPLICATION FILED MAR. 26, 1906.

3 SHEETS—SHEET 1.



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No. 874,364. PATENTED DEC. 17, 1907.

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ORE CONCENTRATOR.

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3 SHEETS—SHEET 2.

Fig. 11.

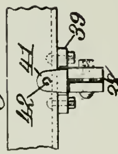


Fig. 4.

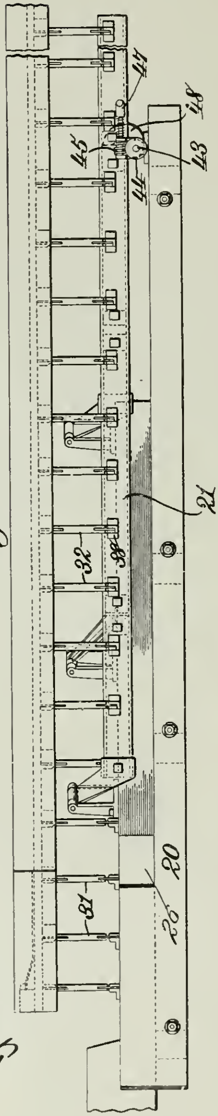


Fig. 10.

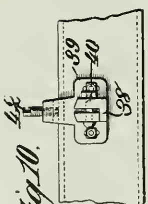


Fig. 9.

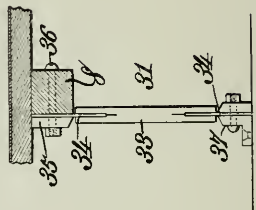
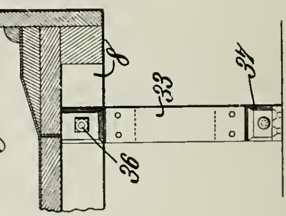


Fig. 8.



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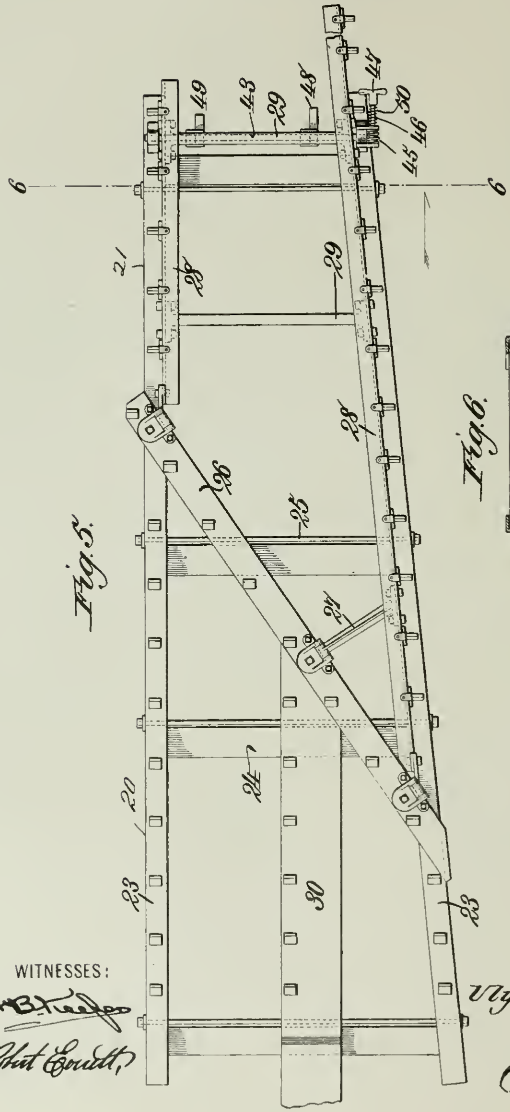
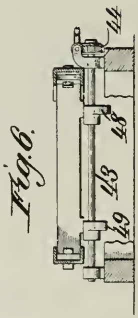
3 SHEETS—SHEET 3.





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UNITED STATES PATENT OFFICE.

ULYSSES S. JAMES, OF NEWARK, NEW JERSEY, ASSIGNOR TO JAMES ORE CONCENTRATOR CO., OF NEWARK, NEW JERSEY, A CORPORATION OF NEW JERSEY.

ORE-CONCENTRATOR.

No. 874,364. Specification of Letters Patent. Patented Dec. 17, 1907.

Application filed March 26, 1906. Serial No. 308,069.

To all whom it may concern:

Be it known that I, Ulysses S. James, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented new and useful Improvements in Ore-Concentrators, of which the following is a specification.

This invention relates to ore concentrators.

The present invention is of the same general type as that disclosed in my pending application, Serial Number 263,064, filed May 31, 1905. The present concentrator possesses all the advantages possessed by that covered in said application.

An ore concentrator made in accordance with my invention involves a longitudinally or endwise reciprocatory table. This table is made up of two sections, one of which is the concentrating portion proper, while the other of which constitutes a slime pan. There is some concentration done on or in the slime portion or pan, but the major part of the concentration is performed upon said concentrating portion, for which reason such designation has been adopted. By virtue of the slime portion I am enabled to save mineral values in the slime delivered into or onto said slime portion, a proceeding which has heretofore, so far as I am aware not been possible. The gangue or refuse matter is discharged over one edge of the concentrating portion of the table, while the concentrates saved from the slimes are discharged over such edge immediately back of the place of discharge of the gangue.

I have briefly alluded to the construction of a table embracing my invention. In the drawings accompanying and forming part of this specification, I show one simple adaptation of said table, which to enable those skilled in the art to practice said invention, I will set forth in detail in the following description, while the novelty of said invention will be included in the claims succeeding said description. The table is of such character that it is not subject to vertical vibration; it and the parts upon which the table is mounted are strongly braced.

The invention has other objects and advantages which with the foregoing will be hereinafter treated at length.

Referring to the drawings, Figure 1 is a top plan view of an ore concentrator involving my invention. Fig. 2 is a longitudinal sectional view of the same, the section being on the line 2—2 of Fig. 1. Fig. 3 is a transverse sectional view, the section being on the line 3—3 of said Fig. 1. Fig. 4 is a side elevation of the table. Fig. 5 is a top plan view of a supporting frame. Fig. 6 is a transverse sectional view on the line 6—6 of Fig. 5. Fig. 7 is a detail view in perspective of a reinforcing or stiffening member. Fig. 8 is a sectional elevation showing part of the table and a supporting member. Fig. 9 is a view of the parts shown in the preceding figure, the section in Fig. 9 being in a plane at right angles to that of Fig. 8. Figs. 10 and 11 are face and top plan views of a bracket, hereinafter more particularly described and showing also a portion of a bed.

Similar numerals refer to like parts throughout the several figures.

My improved concentrator involves a suitable table upon which the concentrating is done. I have shown an advantageous form of table in the drawings, the same being denoted in a general way by 2. In the present case the table consists of two sections as 3 and 4. As the greater part of the concentration of the ore is performed upon the portion 3 of the table, I will designate the same as a concentrating portion, although from what has been hereinbefore stated it will be understood that the slimes are profitably worked over or concentrated upon the slime portion 4. The two sections are connected in a flexible manner, the hinge lying between the two being denoted in a general way by 5 and as represented best in Fig. 1, said hinge or dividing line is oblique to the line of motion of the table, such line of motion being longitudinal. I have not shown any means for longitudinally reciprocating the table 2 for the same constitutes no part of the present invention. This particular mechanism may be of any desirable kind and may be of substantially the same type as that now generally in use which is adapted to give to the table initially on its forward stroke a slow movement, and finally, or on the completion of such stroke, an accelerated motion to drive the mass on the table forward. On the return stroke of the table such mechanism will cause first a rapid and then a slow motion of the table so that the mass on the table will be retained in its advanced position.

The table as shown best in Fig. 2 includes in its make-up a series of longitudinally extending slats as 6 covered with some suitable material as 7 upon which the concentrating is done. The material 7 may be, for example, linoleum. The longitudinally extending slats 6 are crossed on their under sides by cross bars as 8, the slats and cross bars being usually made of wood, whereby the table can be made inexpensively while it is sufficiently strong and stable to withstand the hard usage to which a table is put. Some of the cross bars 8, as clearly shown in Fig. 1, are intersected by the hinge or dividing line 5. Those cross bars 8 which are located directly under or form part of the concentrating portion 3 of the table are subjected to unusual stress which tends to distort or break the same. To prevent distortion of these particular cross bars, I provide stiffening or reinforcing members in connection therewith, and these stiffening or reinforcing members may be of any desirable character, although they are shown as being of channel form as indicated in Fig. 7. The reinforcing members 9 may consist of sheet metal properly shaped, or they may be in the form of castings to closely fit the coöperating cross bars and to be united thereto in any desirable manner. They may be held in place by a driving fit or by friction or positive means may be provided for holding them in assembled relation.

That part of the concentrating portion 3 of the table to the right of the hinge line 5 in Fig. 1 is upwardly inclined from said hinge line and the latter constitutes the base for said upwardly inclined or concentrating portion. In addition to this upward inclination of the concentrating portion, the latter is also oblique to the line of motion of the table. The angularity of such concentrating portion may be varied to adapt the table to the particular character of ore being worked and I will hereinafter describe a simple means for securing this adjustment.

The feed box for supplying pulp onto the table may be of any desirable character and may be mounted in any suitable way. For this purpose, I have shown a feed box 10 as fastened in some convenient way to the slime portion or pan of the table, and as crossing the hinge line between said slime portion and the concentrating portion of the table, whereby the pulp is delivered directly onto the head end of the table so that when it strikes the table it can be advanced therealong and can be also stratified, the mineral values in the mass which are the heavier settling to the bottom of the mass or directly onto the top 7 of the table. The slimes are carried into the slime pan 4 by reason of their semi-fluid condition assisted by the wash water.

The pulp is introduced onto the head end of the table or substantially thereat at the junction between the two portions of the table. When the table is vibrated the mass of pulp thereon will become stratified, the heaviest particles being at the bottom of the pulp and the others being in superposed order in accordance with the specific gravities of the particles forming them, the gangue being on top. On the movement of the table, the pulp is advanced toward the tail thereof and the several constituents in which the pulp has been separated are moved crosswise of the table or toward the front thereof, the gangue moving more rapidly than the other materials. The gangue is, therefore, carried toward the front edge of the table and is discharged thereover between the dividing or hinge line 5 and the tail of the table. The mineral values are carried toward the tail of the table with less lateral movement than the gangue, owing to their greater density and are discharged over the front of the table and over the tail end thereof.

The wash water is supplied to the table along a line oblique to the line of motion thereof and any suitable means may be provided for this purpose. For furnishing the wash water I represent a pipe 11 extending along the angular portion of the upper or rear edge of the table which angular edge as shown in Fig. 1 is at an acute angle to the hinge line 5. Extending longitudinally of the table are parallel riffles as 12 which cross the hinge line 5. These riffles extend in the direction of line of motion of the table and are comparatively shallow so as not to retard the lateral motion of the gangue after the same has been separated from the mineral values.

Along the rear of the table is extended a ledge as 13 which connects with the ledge or flange 14 extending across the head end of the table, the flange 14 having its front end deflected upon a forward angle and extending into the ledge or flange 15 running along the slime portion of the table. The free end of this ledge or flange 15 extends short of the slime portion so as to provide an outlet as 16 for the mineral values concentrated from the slimes which particular mineral values are discharged over the front of the table immediately behind the gangue, the gangue being delivered over the front of the table at a point commencing with the dividing line 5 and ending at a point between the same and the tail of the table. Extending across the table diagonally thereof is a ridge as 17 located in the present instance upon the slime portion 4. This ridge 17 extends approximately from the rear head corner of the table to the front edge thereof substantially centrally of the length of said front edge and near the hinge line 5. The ridge 17 with the flanges 14 and 15 present the marginal portion of the slime pan which has the outlet 16. The ridge 17 has oppositely inclined faces as

18 and 19 both diagonal to the line of motion of the table. The face 18 constitutes really the concentrating or effective part of the slime pan and is wider than the face 19; it extends upward toward the apex of the ridge 17, while the face 19 extends downward from said ridge. This ridge 17 prevents the coarse material from entering the slime pan although it does not prevent the slimes from entering said pan owing to their character. The upper surface of the ridge or flange 15, which in the present case is horizontally disposed, merges into the inclined face 18 as clearly indicated in Figs. 1 and 2. The wash water and the water in the slimes contained within the slime pan 4 is in a quiet or still condition so as not to offer any resistance to the flow of the slimes into said slime pan.

When the slimes enter the slime pan the mineral values therein gravitate toward the bottom of the liquid and on the forward motion of the table are projected onto the inclined surface 18. The ridge 17, however, of which said inclined surface forms a part, prevents the mineral values which have descended in the slimes from being washed over the top of the ridge and this result is aided by the wash water flowing over the top of the ridge. The mineral values in the slimes are after precipitation projected on the forward motion of the table onto the inclined surface and are not carried thereover as previously set forth, but they are moved along said inclined surface and are directed through the outlet 16. The wash water free of mineral values and mixed with tailings or refuse from the slime pan passes over the front ledge 15. By the provision of the slime pan I am enabled to save mineral values in slimes which have not heretofore been saved with concentrating tables as ordinarily constructed.

The framing for supporting the table 2 may be of any desirable character, although in Figs. 4 and 5 I have represented an advantageous form of framing and the same involves in its make up a stationary member denoted in a general way by 20 and a swinging member as 21, the swinging member being hingedly mounted and being directly associated with the concentrating portion 3 of the table by virtue of which the angular adjustment of said concentrating portion may be readily obtained. The portion 20, as best shown in Fig. 5, comprises two stringers, each denoted by 23, which converge toward the tail of the table. These stringers are prevented from inward motion by the cross beams 24 fitted between and suitably secured to the same, while outward motion of the two stringers is prevented by the tie rods or bolts 25 of any desirable number. The two stringers 23 are cut away between their ends as shown for example in Fig. 4 and the diagonally disposed strut or brace 26 rests on the top of the cut away portions and bears near its opposite ends near the forward ends of shoulders produced by said cut away portions. The upper face of the brace or strut 26 is flush with or in the same horizontal plane as the upper surface of the deeper parts of the two stringers. (See Fig. 4). This brace extends in the direction of the hinge line 5 and is located immediately under said line so as to prevent the table tipping in the direction of the said line. In addition to this the brace also strengthens the bed or foundation frame and provides a means for upholding certain links. The hinges, each designated by 27, are also sustained by this brace 26, the hinges uniting the two sections of the frame or bed of the table. The axes of the several hinges 27 are alined and are in a vertical plane intersecting the hinge line 5. The hinge member 21 of the bed or foundation frame, is shown as composed of two steel or other metallic bars, each designated by 28 and which extend in the same general direction as the stringers 23, as illustrated in Fig. 5. Between the two bars or channel irons 28 the cross braces 29 extend, said cross braces having heads at their opposite ends fitted within the channels of said bars 28 and bolted or otherwise suitably fastened to the webs thereof. These cross braces or bars 29 prevent lateral motion both inwardly and outwardly of the two bars or channel irons 28. On the upper side of the two cross pieces 24 at the left in Fig. 5 rests and is suitably fastened a beam 30, the upper face of which is in the same horizontal plane as the upper face of the obliquely disposed brace or strut 26, the two parts last mentioned abutting against each other in order to further strengthen the structure.

I flexibly support the table 2 in an advantageous manner so that it will not be susceptible to shocks or jars, but on the contrary will run smoothly and noiselessly. This result I accomplish by links of a novel character extending between the table and the bed or foundation piece for the table which, as will be understood, comprises stationary and hinged sections as 20 and 21, respectively. There are two series of these links, one series extending between the stationary member 20 and the table, and I will designate each in a general way by 31, while the other series, each of which I will designate in a general way by 32, extends between the swinging member 21 and said table. All of the links are of the same general character so that a detailed description of one will suffice for the remainder, and in this connection particular reference may be had to Figs. 8 and 9, wherein one of the links which extends between the member 20 and the table is shown in detail. In these two figures, I have shown a way of connecting the links with the respective parts. The links shown in these two figures involve a body portion as 33 made of some suitable stiff material as wood to prevent upward displacement of the table and flexible strips as 34 extending from the opposite ends of said wooden body. These flexible strips 34 may be of any suitable material, rubber belting so known being quite suitable for the purpose. The strips 34 are set into notches or slots in the opposite ends of the wooden body and are fastened to the latter in some suitable way as by rivets. The upper flexible strips 34 are fitted flatwise against one of the side faces of the respective cross bars 8 and laid against the flexible strips are facing pieces as 35 of wood for example, bolts 36 serving as a suitable means connecting the facing members 35, upper flexible strips 34, and cross bars 8. The lower strips 34 are fitted between the sections of clamps as 37, the sections of which are held together by bolts or any other suitable manner, and one section of each of which clamps is fastened to the sections of the stationary bed or foundation member 20.

With respect to the series of links 32 they are connected at their upper ends with the angularly adjustable or concentrating portion of the table 2 exactly as are the upper ends of the links 31 connected with the slime portion of the table. The links 32, however, are connected at their lower ends adjustably with the swinging section 21 so that should there be any imperfection in the irons 28, such imperfections will not prevent the concentrating portion of the table from being brought to an absolutely horizontal position when the table as a whole is set up. The lower flexible strips 34 of the links 32 are held in place by clamps as 38 forming parts of brackets as 39 supported for vertical adjustment by the sides of the swinging member 21. In the bodies of the several brackets 39 are formed vertically disposed longitudinal slots through which screws as 40 are passed (see Figs. 10 and 11) by which vertical adjustment of the several brackets can be obtained, this being accomplished by loosening up the screws. After the adjustment is secured it can be maintained by tightening up the screws. To facilitate the elevation of the respective brackets they may be provided, as shown in Fig. 11, with heads as 41 which overhang the upper edges of the sides of said member 21, and through which are tapped adjusting screws as 42 to engage said sides.

Any desirable means may be employed for elevating or lowering the swinging section 21 thereby to regulate the angular position of the concentrating portion 3 through the intervention of the intermediate links 32 as will now appear. Supported by suitable bearings upon the stringers 23 near the tail end of the table is a shaft as 43 having at one end thereof a worm-gear as 44 meshing with a worm as 45 on the shaft 46, said shaft being provided with a head as 47 at one end, as shown in Figs. 4 and 5. By turning the head 47, the shaft 46 and consequently the shaft 43, through the intermediate worm gearing described, can be turned so as to carry cams as 48 and 49 against the outer cross bar 29 to angularly adjust the concentrating portion 3 of the table. The cam 48 has a greater throw than cam 49, as it is necessary to elevate the rear side of the table slightly more than the front side of the table to preserve the obliquity to which I have hereinbefore referred. The shaft 46 is shown as surrounded by a spring 50 bearing at its ends against the head 47 and against the bearing for said shaft, the spring serving to positively prevent backward motion of the two shafts, while the table is in action. Were not the spring present the two shafts would be turned backward while the table is in motion, and thereby affect the adjustment of the concentrating portion thereof.

The table involving my invention comprises really main and auxiliary concentrating portions. Practically the major part of the concentrating is done upon the main portion. In other words, the pulp or heavier material is worked over on this main concentrating portion, while the finer particles making up the slimes are worked on the auxiliary portion. Both portions of the table, therefore, are simultaneous in action. The main or concentrating portion 3 of the table has between the ridge 17 and the hinge line 5 a horizontal portion 3′, as shown clearly in Fig. 1 on which the material when it is first delivered onto the table can freely spread out, this insuring the clean separation of the gangue from the mineral values.

What I claim is:

1. An endwise reciprocatory ore concentrating table having a concentrating portion flexibly joined along a line diagonal to the line of motion of the table and a slime portion, the concentrating portion being adapted to concentrate the pulp and the slime portion being adapted to receive the slime from the pulp and having an inclined ledge extending obliquely thereacross, provided with a face inclined upward toward the tail of the table and oblique to the line of motion thereof combined with means for adjusting said concentrating portion angularly with respect to the slime portion.

2. An endwise reciprocatory ore concentrating table having a concentrating portion flexibly joined along a line diagonal to the line of motion of the table and a slime portion, the concentrating portion being adapted to concentrate the pulp and the slime portion being adapted to receive the slimes, said

slime portion having a ridge extending angularly across the same, said ridge having an inclined face oblique to the line of motion and upwardly inclined toward the tail of the table, said slime portion also having means to hold the wash water supplied thereto substantially in a quiet condition combined with means for angularly adjusting said concentrating portion with respect to the slime portion.

3. An ore concentrating table having a concentrating portion and a slime portion, the concentrating portion being adapted to concentrate the pulp and the slime portion to concentrate the slimes, said slime portion having a ridge extending angularly across the same provided with an inclined face oblique to the line of motion of the table and upwardly inclined toward the tail of said table, said slime portion having flanges extending along the head and front thereof, the front flange merging into said inclined face and extending short of the apex of the same to provide an outlet for mineral values between said front flange and the apex of said inclined face.

4. The combination of a supporting bed involving a stationary and a swinging member, a concentrating table involving two flexibly related sections, and supporting links connected flexibly with the sections of the supporting bed and with the sections of the table.

5. The combination of a supporting bed involving a stationary and a swinging section, a concentrating table comprising flexibly related sections, and supporting links extending between the sections of the table and the sections of the supporting bed.

6. The combination of a supporting bed involving a stationary and a swinging member, a concentrating table involving two flexibly related sections, supporting links extending between one of the sections of the table and said swinging member, and supporting links extending between the other section of the table and the stationary member and adjustably connected with the latter.

7. The combination of a bed or foundation member composed of a stationary part and a swinging part, links composed of stiff bodies and flexible strips extending oppositely therefrom, the lower strips being connected with said stationary part, other links also composed of stiff bodies provided with flexible strips at opposite ends of the same, the lower strips being adjustably connected to said swinging part, and a table composed of flexibly related sections connected respectively with the two upper series of flexible strips.

8. The combination of a bed or foundation member composed of a stationary part and a swinging part, links composed of stiff bodies and flexible strips extending oppositely therefrom, the lower strips being connected with said stationary part, other links also composed of stiff bodies provided with flexible strips at opposite ends of the same, the lower strips being adjustably connected to said swinging part, hand operated mechanism for raising and lowering said swinging part and a table composed of flexibly related sections connected respectively with the upper series of flexible strips.

9. The combination of a bed or foundation piece consisting of a stationary part and a swinging part, a table composed of flexibly related sections, supporting links connected with the sections of the table and with the parts of said bed or foundation member, a shaft provided with cams, having different throws, to actuate said swinging part, and hand operated mechanism for turning said shaft.

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

ULYSSES S. JAMES.

Witnesses:
CHAS. S. HYER,
HEATH SUTHERLAND.

COMPLAINANTS' EXHIBIT No. 36

Kohlman Patent No. 885,349

ALMON E. HART, Special Examiner

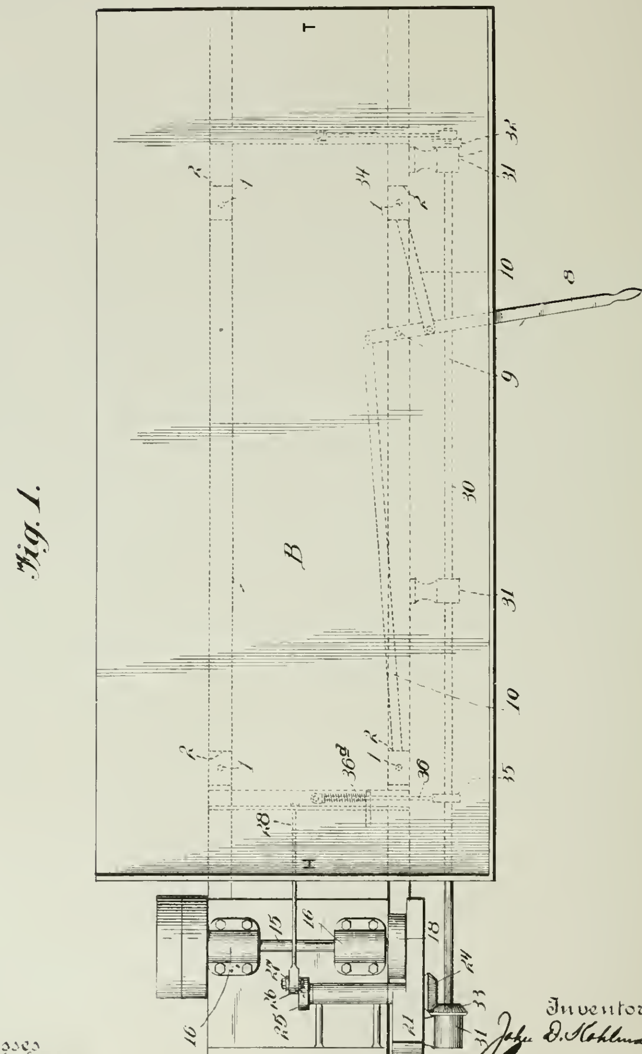
No. 885,349. PATENTED APR. 21, 1908.

J. D. KOHLMANN.

CONCENTRATING TABLE.

APPLICATION FILED FEB. 9, 1905.

4 SHEETS—SHEET 1.



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Inventor
John D. Kohlmann

by Vernon E. Hodges
his Attorney

No. 885,349.

PATENTED APR. 21, 1908.

J. D. KOHLMANN.

CONCENTRATING TABLE.

APPLICATION FILED FEB. 9, 1905.

4 SHEETS—SHEET 2.

Fig. 2.

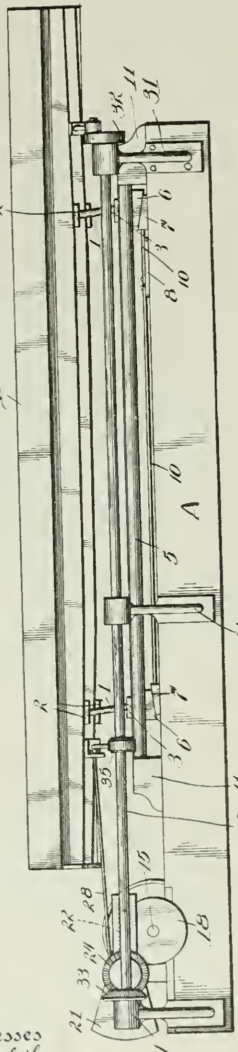
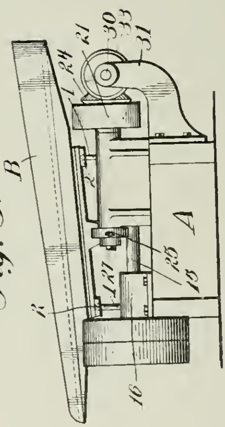


Fig. 3.



Witnesses

Milton O. Lenoir

Watts T. Estabrook

Inventor

John D. Kohlmann

by Vernon E. Hodges

his Attorney

No. 885,349. PATENTED APR. 21, 1908.

J. D. KOHLMANN.

CONCENTRATING TABLE.

APPLICATION FILED FEB. 9, 1905.

4 SHEETS—SHEET 3.

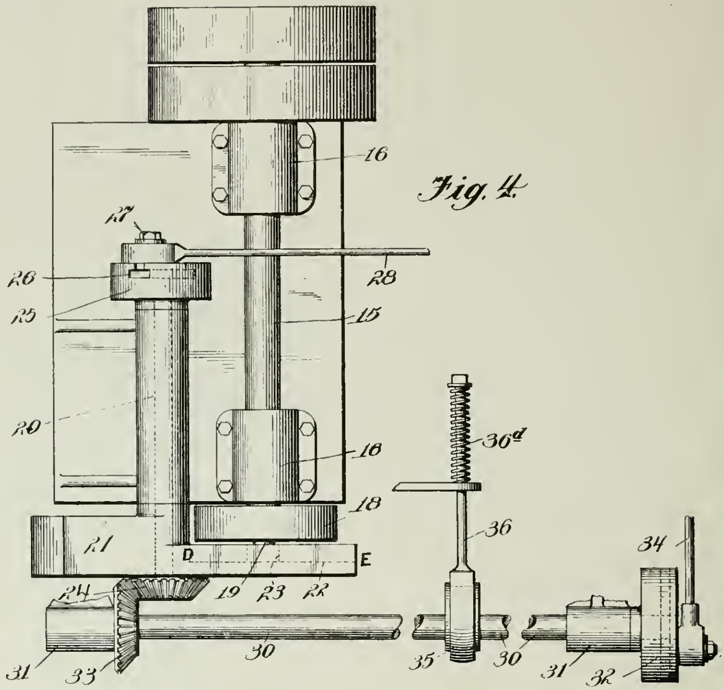
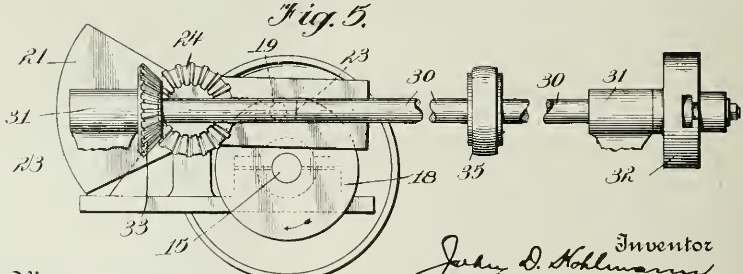


Fig. 4.

Fig. 5.



Witnesses

Hilton C. Spencer

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Inventor

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No. 885,349.

PATENTED APR. 21, 1908.

J. D. KOHLMANN.

CONCENTRATING TABLE.

APPLICATION FILED FEB. 9, 1905.

4 SHEETS—SHEET 4.

Fig. 6.

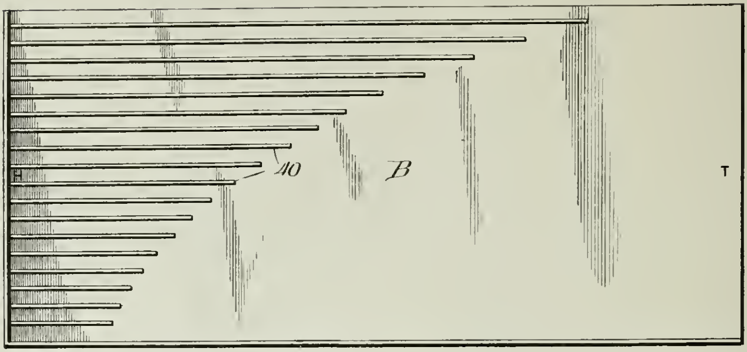
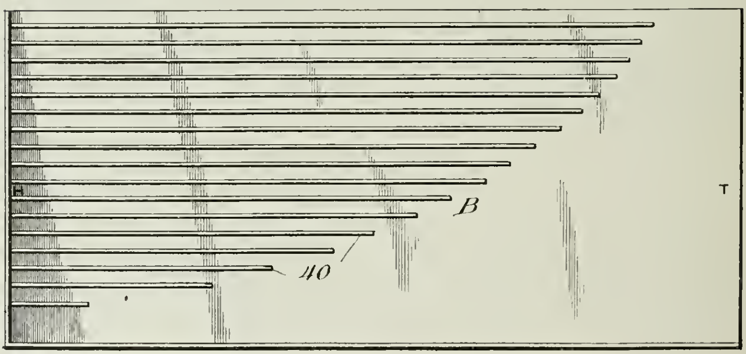


Fig. 7.



Witnesses
Milton C. Lenoir
Watts T. Estabrook

John D. Kohlmann Inventor
by Vernon E. Hodges
his Attorney

UNITED STATES PATENT OFFICE.

JOHN D. KOHLMANN, OF MILWAUKEE, WISCONSIN.

CONCENTRATING-TABLE.

No. 885,349. Specification of Letters Patent. Patented April 21, 1908.

Application filed February 9, 1905. Serial No. 244,954.

To all whom it may concern:

Be it known that I, JOHN D. KOHLMANN, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Concentrating-Tables, of which the following is a specification.

My invention relates to an improvement in concentrating tables, and the object is to provide a table for separating, mechanically, the various minerals, differing from each other in specific gravity, from the rock bearing said minerals, the rock having been previously crushed and reduced to a size best suited for the purpose.

With the foregoing objects in view, my invention consists in a table having either a smooth or riffled surface, resting upon suitable supports, capable of being adjusted from a horizontal to a tilting position and adapted to receive a reciprocatory motion from the end and side whereby the operator is enabled to obtain at will, a motion ranging from a straight-way thrust of variable magnitude in the direction of the length of the table, without side thrust, to a straight-way thrust of variable magnitute at the head end, at the tail end, at both head end and tail end or a combination of either, or both, with the motion in the direction of the length of the table, the various combinations resulting in motions ranging in direction from 0° to 90° with the direction of length of table, any given setting producing a motion of fixed angularity.

My invention further consists in certain novel features of construction and combinations of parts which will be hereinafter described and pointed out in the claims.

In the accompanying drawings, Figure 1 is a plan view, Fig. 2 is a side elevation, Fig. 3 is an end view, Fig. 4 is an enlarged plan view of the driving gear or head motion, Fig. 5 is a side view of the latter figure on the same scale, and Figs. 6 and 7 are views of two forms of riffles.

A, represents the base or bed of the machine, and B is the table resting upon supports 1, 1, four or six in number. The ends of these supports are spherical and rest in correspondingly shaped sockets 2, 2, on the lower surface of the table, and similar sockets 3, 3, located respectively on the base or bed, and on a bar 5 on the rear side of the machine, thereby permitting any given point on the table to describe a circle, its surface remaining a horizontal or inclined plane. The bar 5 is provided on its lower surface with oppositely inclined blocks 6, 6 with their inclining surfaces inward or toward each other, and these blocks rest upon oppositely inclined wedges 7, 7, which are capable of being simultaneously thrust outward to raise the edge of the table beneath which they are located, or inward to lower it by swinging the hand lever 8 on its pivot 9, it being connected on opposite sides of its pivot or fulcrum to the wedges by means of connecting rods 10, 10. Stationary abutments 11, 11 on the base or bed prevent endwise movement of the bar 5 by confining the latter between them. In this way, the operator is enabled to tilt the table more or less by actuating the hand lever 8 governing the position of the wedges, the supports 1, 1, two or three in number on the opposite side of the machine serving as the fulcrum, while this adjustment is made or taking place.

The head motion and driving gear for imparting endwise and lateral motion to the table will now be described. A main drive shaft 15 is journaled in boxes 16, 16 at the head end of the table, which end by the way is marked H to distinguish it from the tail end, which is marked T. Fast and loose pulleys are located on one end of the shaft 15, and a crank disk 18 on the opposite end. This crank disk has a wrist-pin 19. A secondary shaft 20 parallel with shaft 15 is journaled a short distance therefrom at the head end of the concentrator, and this secondary shaft is provided with a weighted or balanced lever 21 at one end. This lever has on the shaft side a planed slot 22 extending from the points D to E, said slot receiving the wrist pin 19, and a sliding block 23 which latter fits and slides in the slot while the wrist pin turns in it, the block being bored to fit the wrist or crank pin aforesaid. The opposite side of this lever 21 has a bevel-gear or segment 24 cast or fastened thereon concentric with its axis. The opposite end of the shaft has a crank 25 with a T-slot or dove tail slot 26 formed therein which permits the setting of the crank pin 27 at dead center, at the outer periphery or at any intermediate point, and from this crank pin the connecting rod 28 extends to the table whereby endwise motion is imparted thereto.

From the foregoing it will be seen that as the main shaft revolves and when the sliding block 23 and wrist-pin 19 are in the position indicated at E a slow motion is being transmitted to the table, but when at D a quick return results.

Running at right angles to the main shaft and parallel to the table is the auxiliary shaft 30, it being journaled in suitable bearings 31, 31. At the tail end of the machine this shaft is provided with a crank 32 similar to the crank 25 previously described, while near its opposite end it is provided with a bevel-gear 33 which meshes with the teeth of the bevel-gear 24 of the secondary shaft 20 from which it derives its motion. From the crank 32 a connecting rod 34 extends to the tail end of the machine, while near the head end of the table, either an eccentric or a lever 35 is secured on the shaft 30 which also transmits motion to the table at the head end in a side direction through the connecting rod 36. A spring 36^d mounted on the connecting rod 36 serves to prevent undue pounding. The three connecting rods 28, 34 and 36 transmit the three motions to the table from the two crank disks and the eccentric or lever, and as these cranks make only a part revolution they produce an oscillating effect.

From the foregoing it will be seen that I provide a table simple in mechanism and producing any and all motions required for mechanical concentration. By suitable adjustment of the crank pin at the tail end of the table such side thrust may be obtained as to permit of separating minerals having different specific gravities, from each other, such as zinc blende from pyrites, etc. While I may use riffles or not, the motion resultant from the side thrust obviates the necessity of having riffles on the table.

In Figs. 6 and 7 I have illustrated tables having riffles 40, 40. The ends of these riffles terminate in points which go to make up a curve, as indicated, which curve may be either a catenary, a parabola or an hyperbola or even a circle, whichever may give the best results for a given work. The origin of the curve may be at the head end or the tail end of the table as illustrated in the two views of the drawings, experiment again determining which is most efficient. Fig. 6 shows the riffles with the origin of the curve at the head end of the table, and Fig. 7 shows a set of riffles with the origin at the tail end.

It is evident that slight changes might be resorted to in the form and arrangement of the several parts described without departing from the spirit and scope of my invention, and hence I do not wish to limit myself to the exact construction herein set forth, but

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

1. A laterally inclined and differentially reciprocating table adapted to discharge concentrates at one end and gangue over the side, in combination with a driving shaft, a secondary shaft imparting a direct reciprocating motion to the table independent of lateral motion, means for transmitting motion to the secondary shaft, an auxiliary shaft, and an independently adjustable arm connected therewith and with the table for imparting lateral motion to said table.

2. In combination, a laterally inclined and differentially reciprocating table adapted to discharge concentrates at one end and gangue over the side, a driving shaft, a secondary shaft imparting a direct reciprocating motion to the table independent of lateral motion, means for transmitting motion to the secondary shaft, an auxiliary shaft, and independently adjustable means connected with the latter and with the head and tail ends of the table, respectively, for imparting lateral motion.

3. In combination, a laterally inclined and differentially reciprocating table adapted to discharge concentrates at one end and gangue over the side, a driving shaft, a secondary shaft imparting a direct reciprocating motion to the table independent of lateral motion, means for transmitting motion to the secondary shaft, an auxiliary shaft, gears on the secondary and auxiliary shafts, and independently adjustable arms connected with the auxiliary shaft and with the head and tail ends, respectively, of the table, for imparting lateral motion.

4. In combination, a laterally inclined and differentially reciprocating table adapted to discharge concentrates at one end and gangue over the side, a driving shaft, a secondary shaft imparting a direct reciprocating motion to the table independent of lateral motion, a balanced slotted lever on the secondary shaft engaging a crank disk on the driving shaft, an auxiliary shaft, a gear thereon meshing with a gear on the secondary shaft, and an independently adjustable arm connected with the auxiliary shaft and with the table, for imparting lateral motion thereto.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN D. KOHLMANN.

Witnesses:

J. S. BRODHEAD,

F. G. HOLTMAN.

COMPLAINANTS' EXHIBIT No. 37

Deister Patent No. 895,168

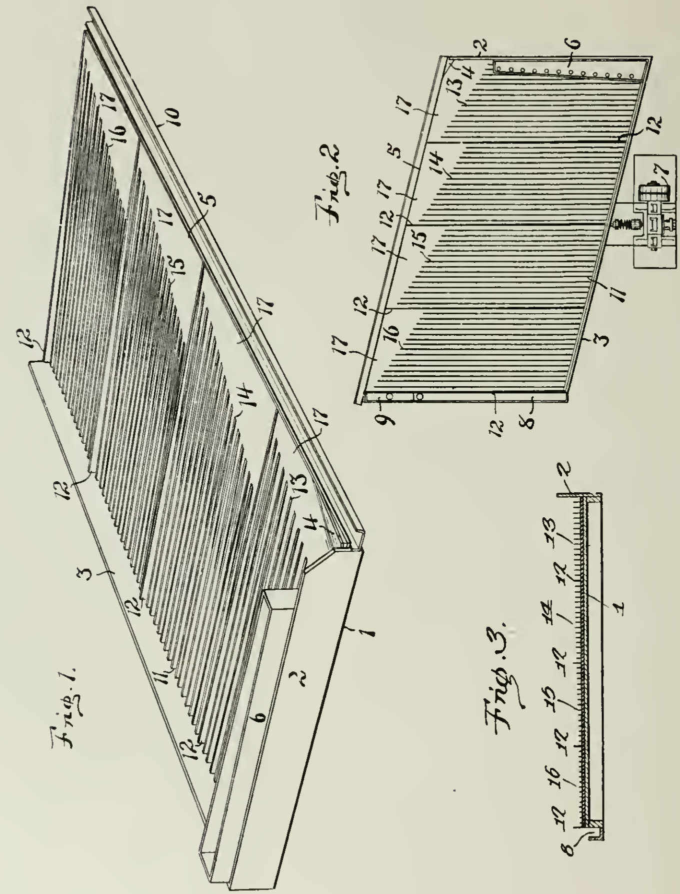
ALMON E. HART, Special Examiner

No. 895,168. PATENTED AUG. 4, 1908.

E. DEISTER.

ORE CONCENTRATING TABLE.

APPLICATION FILED MAR. 3, 1906.



WITNESSES:

M. Mattler

William H. Buisman

Emil Deister INVENTOR

BY H. G. Burns

ATTORNEY

UNITED STATES PATENT OFFICE.

EMIL DEISTER, OF FORT WAYNE, INDIANA, ASSIGNOR TO THE DEISTER CONCENTRATOR COMPANY, A CORPORATION OF INDIANA.

ORE-CONCENTRATING TABLE.

No. 895,168. Specification of Letters Patent. Patented Aug. 4, 1908.

Application filed March 3. 1906. Serial No. 303,951.

To all whom it may concern:

Be it known that I, EMIL DEISTER, citizen of the United States of America, and resident of Fort Wayne, in the county of Allen and State of Indiana, have invented certain new and useful Improvements in Ore-Concentrating Tables, of which the following is a specification.

This invention relates to improvements in ore-concentrating tables, and the object thereof is to provide a concentrating table which will effect efficient separation of mineral from ore-pulp and require but slight attention of the operator.

The above object is accomplished by the construction illustrated in the accompanying drawings, in which

Figure 1 is a perspective view showing my concentrating table and the particular arrangement of riffles thereon; Fig. 2 is a plan view showing the rhomboidal form of the table, the relation of the driving mechanism in connection therewith, and the arrangement of the riffles; Fig. 3 is a cross section of Fig. 2 on the line x—x.

Similar numerals of reference indicate corresponding parts in each view, and referring now to the same:

1. is a concentrating table preferably of rhomboidal form and provided at one end with a head-board 2 and along one side with a projecting breast-board 3. The concentrating surface of the table is of suitable material, such as linoleum, and ranges in a flat plane throughout, except that portion 4 at the juncture of the mineral discharge edge 5 and the head-board 2, where it is slightly raised. A feed box 6 is secured to the head-board 2 and overhangs the surface of the table adjacent thereto. It is the intention that the table shall have differential reciprocating movement in a line parallel with its ends, and suitable driving mechanism 7 is arranged in connection therewith to impart thereto the desired lateral motion. The table is suitably mounted by any well known means, and when in proper position for use ranges upon a decline from its end at the head-board to its opposite or tailings discharge end, and also upon lateral incline from the breast-board side to its opposite or mineral discharge side. At the lower end of the table are arranged a tailings launder 8 and middlings launder 9, and along the mineral discharge side of the table, beneath the corresponding edge thereof, is arranged a mineral launder 10 to receive the discharged concentrates therefrom.

The particular feature of this invention is in the character and relative arrangement of riffles 11 and 12 in connection with the table: The riffles are all relatively parallel and are arranged laterally, respecting the table, and oblique to the mineral discharge edge 5 thereof, in successive groups 13, 14, 15 and 16 respectively. Each riffle tapers from its inner end at the breast-board to its outer end, and the riffles of each group vary directly in length successively toward the low end of the table, the respective end riffles 12 extending to the mineral discharge edge 5 thereof, the other riffles 11 of the groups terminating at points suitably distant therefrom and affording a washing surface 17 adjacent the outer ends of the riffles of each group. The projections of the riffles 11 at the breast-board vary inversely and successively from the upper end of the table to the tailings discharge end thereof, and the projections of the end riffles 12 at the breast-board increase successively toward the latter end of the table.

In the operation of this invention, the table is set in rapid differential oscillating motion laterally, and ore-pulp is fed into the feed box from whence it gravitates upon the adjacent surface of the table, and flows toward the low end thereof. The mineral portion of the pulp becomes directed from beneath the overlying gangue toward the washing surfaces at the high side of the table because of the differential motion thereof and the lateral range of the riffles. The mineral which passes out upon the washing surfaces is treated thereon to the action of dressing water suitably supplied in any well known manner, and is directed to the discharge edge, by the extending end riffles, from whence it gravitates into the mineral launder.

The gradual decrease in the height of the riffles toward the low end of the table affords relief for the overlying gangue which accordingly moves at a broad angle away from the high side of the table to the discharge end thereof because of its slant; and the variation in the lengths of the riffles of each group has the effect of similarly relieving the overlying gangue at the outer margin of the body of pulp so that it does not crowd to the mineral discharge edge of the table and become discharged with the mineral, the end riffles being higher than the other riffles of the corresponding groups, and each being also successively of greater height from the surface of the table toward the low end thereof, has the effect of retarding the longitudinal flow of pulp, and bodies of water are thereby maintained which flood the respective groups of riffles, the depth of which bodies are correspondingly greater over each succeeding group toward the low end of the table, and the settlement of fine mineral particles is facilitated thereby; and by the arrangement of the riffles in groups together with the extension of the end riffles to the discharge end of the table, the heavy and coarse mineral is expelled from the table at the head portion thereof and hence does not mingle with and disturb the finer mineral particles which settle later on the table nearer the lower end thereof, and thus the efficiency of the machine is thereby enhanced.

The form and arrangement of the table proper herein set forth is similar to that shown in previous applications filed by me Feb. 19, 1906, Sr. No. 301,728 and March 1, 1906, Serial No. 303,585, but is distinguished therefrom particularly by the arrangement of riffles. The table in the present instance is provided with riffles arranged especially for treating ore-pulp containing fines and slime, but it may also be used for treating coarser grades of ore by reducing the height of the end riffles to correspond with the general plane of the other riffles.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a device of the class described, a reciprocating table; a projecting breast-board along the rear side thereof; and a series of riffles upon the surface of the table arranged in successive similar groups, the end riffle of each group extending to the mineral discharge edge of the table, the other riffles of the respective groups increasing in length successively toward the corresponding end riffle thereof, all of said riffles being tapered from their inner ends at the breast-board to their outer ends, the said end riffles increasing and the other riffles decreasing in height successively toward the tailing discharge end of the table.

2. In a device of the class described, a reciprocating table; a projecting breast-board along the rear side thereof; and a series of riffles upon the table arranged in successive similar groups, the riffles of each group increasing in length successively toward the corresponding end riffle thereof, said end riffles being tapered at their inner ends at the breast-board toward their outer ends and projecting higher than the adjacent riffles, each end riffle increasing in height with the other end riffles successively toward the low end of the table.

3. In a device of the class described, a reciprocating table; a projecting breast-board along the rear side of the table; and a series of riffles arranged upon the table in similar successive groups, the end riffle of each group extending from the breast-board to the concentrates discharge edge of the table and being adapted to direct concentrates that issue from the riffles of the corresponding group to the discharge edge, and the riffles which intervene between said end riffles each commencing its course at the breast-board and being of increasing length successively toward the end riffle of the corresponding group, there being a washing surface at the concentrates discharge edge of the table adjacent each group of riffles, each washing surface being separated from the adjacent washing surface by the corresponding end riffle.

In testimony whereof I affix my signature, in presence of two witnesses.

EMIL DEISTER.

Witnesses:
W. G. Burns,
M. Mettler.

COMPLAINANTS' EXHIBIT No. 38

Deister Patent No. 895,167

ALMON E. HART, Special Examiner

No. 895,167. PATENTED AUG. 4, 1908.

E. DEISTER.

ORE CONCENTRATOR.

APPLICATION FILED FEB. 19, 1908.

3 SHEETS—SHEET 1.

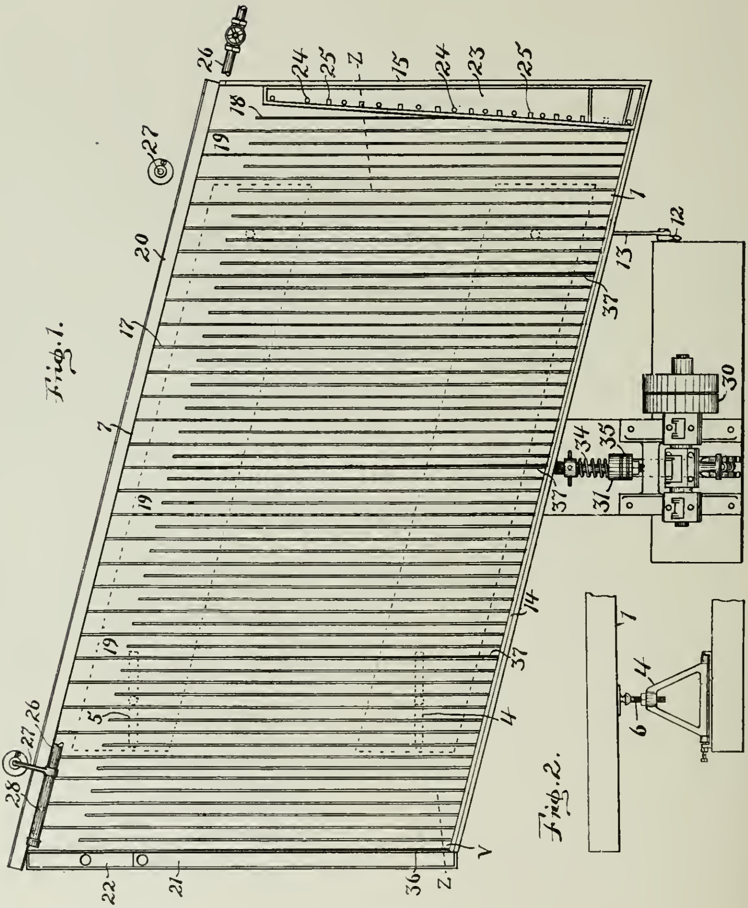


Fig. 1. Fig. 2.

WITNESSES:

M. Mattler

William H. Brennan

Emil Deister INVENTOR

BY N. G. Burns

ATTORNEY

No. 895,167. PATENTED AUG. 4, 1908.

E. DEISTER.

ORE CONCENTRATOR.

APPLICATION FILED FEB. 19, 1906.

3 SHEETS—SHEET 2.

Fig. 3.

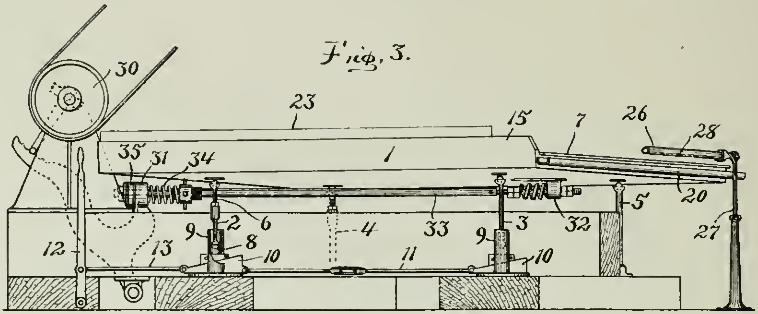


Fig. 4.

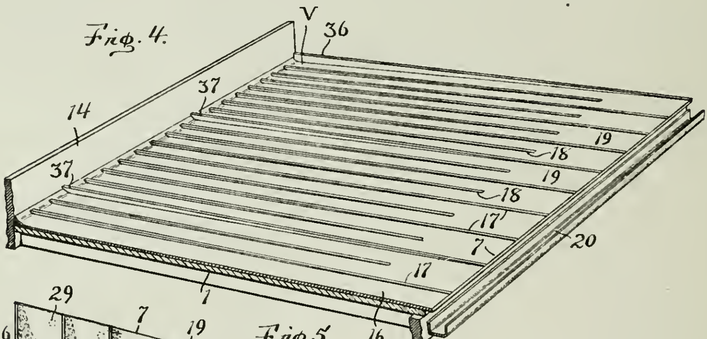


Fig. 5.

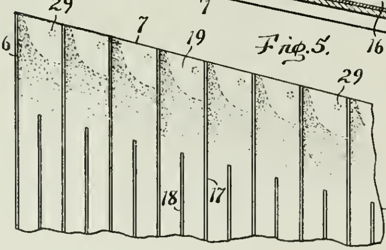
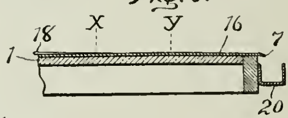


Fig. 6.



WITNESSES:

M. Mettler.

William H. Brueman

Emil Deister INVENTOR

BY J. G. Burns

ATTORNEY

No. 895,167. PATENTED AUG. 4, 1908.

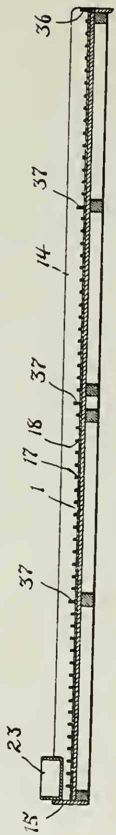
E. DEISTER.

ORE CONCENTRATOR.

APPLICATION FILED FEB. 19, 1906.

3 SHEETS—SHEET 3.

Fig. 7.



WITNESSES:

Mathilda Mattler.

Wm. H. Bruemann

Emil Deister INVENTOR

BY W. G. Burns

ATTORNEY

UNITED STATES PATENT OFFICE.

EMIL DEISTER, OF FORT WAYNE, INDIANA, ASSIGNOR TO THE DEISTER CONCENTRATOR COMPANY, A CORPORATION OF INDIANA.

ORE-CONCENTRATOR.

No. 895,167. Specification of Letters Patent. Patented Aug. 4, 1908.

Application filed February 19, 1906. Serial No. 301,728.

To all whom it may concern:

Be it known that I, EMIL DEISTER, citizen of the United States of America, and resident of Fort Wayne, in the county of Allen and State of Indiana, have invented certain new and useful Improvements in Ore-Concentrators, of which the following is a specification.

This invention relates to improvements in ore-concentrators, and the object thereof is to effect the removal of mineral from the concentrating table as rapidly as the same becomes clean, and this is done by providing local washing surfaces adjacent the mineral discharge side of the table, and suitably supplying the same with dressing water; and also by the particular form of the concentrating table.

My object is accomplished by the construction illustrated in the accompanying drawing, in which:

Figure 1 is a plan view of my invention, a portion of the dressing water supply pipe being shown cut away; Fig. 2 is a detail view showing an elevation of one of the adjustable supporting struts for the table; Fig. 3 is an end elevation of Fig. 1; Fig. 4 is a detail in perspective showing the lower portion of the concentrating table, and particularly showing the arrangement of riffles; Fig. 5 is a detail plan view showing part of the mineral discharge side of the table, and approximately showing the course of ore matter where dressing water is applied; Fig. 6 is a detail view showing a central cross-section through a portion of the concentrating table; Fig. 7 is a sectional view of the table in a vertical plane adjacent to and parallel with the breast-board, showing the relative heights of the riffles.

Similar numerals of reference indicate corresponding parts throughout the several views, and referring now to the same: 1 is a concentrating table of rhomboidal form and suitably supported upon swinging struts 2, 3, 4, and 5 respectively. The struts 4 and 5 are made wide at the base to prevent the table from moving longitudinally, and the struts 2 and 4 are made vertically adjustable by means of screw-threaded shanks 6 so that the table may be adjusted to have proper incline toward the mineral discharge side 7 thereof. The struts 2 and 3 are supported at their lower ends respectively upon blocks 8 which are contained in corresponding cylinders 9, and said blocks are adapted to be adjusted vertically by means of corresponding wedges 10 which extend through said cylinders. These wedges are connected together by a rod 11, and are adapted to be moved in unity by means of the lever 12 which is connected with one of the wedges by the rod 13. When the struts 2 and 3 are thus moved vertically the table will thereby be adjusted accordingly with more or less longitudinal decline. A breast-board 14 extends along the lower side of the table, and a head-board 15 is similarly arranged across the upper end of the table. The table has a covering 16 of suitable material, such as linoleum, upon which are arranged numerous riffles 17 and 18. The riffles 17 extend from the breast 14 across the table to the mineral discharge edge 7 thereof, and the riffles 18 intervene between the riffles 17 and extend from the breast, parallel with the former riffles, and terminate upon the surface of the table a suitable distance from the mineral discharge edge 7 thereof. All of said riffles are highest at the breast side of the table, and taper therefrom to a feather-edge at their outer ends. Thus it will appear that a uniform series of local washing surfaces 19 is provided between the ends of the short riffles 18 and the mineral discharge edge of the table.

A feed box 23 is secured to the head board 15, and overhangs the upper end of the table. The feed box is provided with openings 24 in its bottom, and vertically disposed ribs 25 are secured to the inner side of the feed box at points intervening between the openings 24 and serve to prevent pulp from banking toward the outer end of the feed box.

A feed pipe 26, for dressing water, is suitably supported upon standards 27 and ranges over the mineral discharge portion of the table. This feed pipe has suitable perforations 28 located respectively so that dressing water from the feed pipe will be discharged upon the local washing surfaces approximately at points indicated by the dotted circles 29 in Fig. 5.

A suitable driving mechanism 30, having a reciprocating driving head 31, is connected to a fixed lug 32 which depends from the table, the connection being made by means of a driving rod 33 which has in connection therewith a spring 34 and a buffer 35, the spring acting against one side of the driving head 31, and the buffer acting against the opposite side thereof so that a differential reciprocating motion will be imparted to the table. The driving mechanism is so located in relation to the table that the motion of the latter will be transverse, or directly in line with the length of the riffles.

In the operation of this invention the table is set in rapid differential oscillating motion laterally, and is adjusted to range upon an incline from the breast toward the mineral discharge edge, and upon a decline from the head board toward the lower, or tailings discharge, end thereof. Ore pulp is then fed into the feed box, from whence it passes through the openings 24 onto the surface of the table. Because of the longitudinal decline of the table, the pulp will move toward the lower end thereof, and because of the differential motion and lateral incline of the table, together with the riffles, the mineral portion of the pulp will be directed from beneath the pulp out upon the local washing surfaces 19 where it is subjected to treatment by dressing water. The extending riffles 17 conserve the mineral upon the adjacent local washing surfaces and further serve to direct the mineral to the edge 7 of the table from whence it is discharged into the concentrates launder. By this arrangement the partially concentrated mineral is treated locally in masses to the action of dressing water, in contra-distinction to the common practice of applying dressing water to the partially concentrated mineral in general.

A feature of this invention is that the table is so shaped, proportioned, and arranged that the gangue moves lengthwise over the table and becomes discharged from its lower end, and the mineral is conveyed to and discharged from the upper side of the table, and it should be particularly noted that the mineral discharge side of the table is proportionately of much greater length as compared with the tailings discharge end thereof. Thus the gangue is made to travel the full length of the table while the mineral moves the breadth of the table, which arrangement facilitates settlement of values contained in the pulp and the final treatment by dressing water.

I have found that by placing a high riffle 36 at the lower end of the table, and occasional high riffles 37 among the other riffles upon the table, the flow of pulp along the breast side of the table will be retarded somewhat, and the ore-matter will thereby become suspended in the bodies of water occasioned by the high riffles, and this has the effect of facilitating settlement of mineral contained therein.

All of the high riffles taper from their inner ends at the breast to their outer ends, and are successively of increased height from the surface of the table, the highest riffle 36 of which is located at the low or discharge end thereof. All the riffles, 17 and 18, other than the former high riffles taper from their inner ends at the breast to their outer ends and are successively of less height toward the low end of the table. That is, the taper of the riffles decreases successively toward the low end of the table, so that all of the latter riffles will have an equal projection from the surface of the table approximately along the line Z—Z. This arrangement of riffles has the effect of relieving the overlying ore-matter so that it will move toward the lowest corner of the table (indicated at V) and away from the washing surfaces 19, while the high riffles maintain bodies of water which flood the low riffles and thereby prevent the latter from causing eddies.

In Fig. 6 is shown a transverse central section through the mineral discharge side of the table. In this view the table is shown to have an incline of slightly less degree from the point Y to the discharge edge 7 as compared with the incline from the breast to the point Y. The point Y is located between the outer ends of the short riffles 18 (indicated at X) and the discharge edge 7. The decrease in the incline of the table is coincident with the local washing surfaces and is made to facilitate the discharge of mineral.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In an ore-concentrator, a rhomboidal table having in connection therewith driving mechanism to actuate the same laterally and being arranged with longitudinal decline and lateral incline; a series of riffles arranged laterally upon the table, some of which extend from the breast at the low side of the table to its edge at the high side thereof, the other riffles of the series being shorter and which intervene between the former riffles and extend from the breast and terminate respectively at points suitably distant from the edge of the table at its high side and afford a corresponding series of local washing surfaces adjacent said edge of the table; and suitable means to supply dressing water to said washing surfaces.

2. In an ore-concentrator, a rhomboidal table having in connection therewith suitable driving mechanism to actuate the same laterally, and being arranged with longitudinal decline and lateral incline; a series of lateral riffles arranged upon the table, some of said riffles extending entirely across the table, and the riffles which intervene between the former riffles being short and terminating at their outer ends at points suitably distant from the edge of the table at its high side, and occasional high riffles dividing the table into several low riffled sections; a series of local washing surfaces adjacent the edge of the table along the high side thereof; and

suitable means to supply dressing water to said washing surfaces.

3. In an ore-concentrator, a rhomboidal table having in connection therewith suitable driving mechanism to actuate the same laterally, and being arranged with longitudinal decline and lateral incline, and having thereon a series of lateral riffles which taper to a feather-edge at their outer ends, the riffles being alternately of different length, the long riffles of which extend to the edge of the table at its high side, those portions of the table between the outer ends of the long riffles affording local washing surfaces.

4. In an ore-concentrator, a rhomboidal table having in connection therewith suitable driving mechanism to actuate the same laterally, and being arranged with longitudinal decline and lateral incline; a series of low riffles arranged laterally upon the table, each tapering from its inner end at the breast to its outer end, the riffles of said series being successively of less height toward the low end of the table; and occasional tapering high riffles located among the low riffles, and each being successively higher toward the low end of the table.

In testimony whereof I affix my signature, in presence of two witnesses.

EMIL DEISTER.

Witnesses:
M. Mettler,
W. G. Burns.

COMPLAINANTS' EXHIBIT No. 39

Deister Patent No. 895,169

ALMON E. HART, Special Examiner

No. 895,169. PATENTED AUG. 4, 1908.

E. DEISTER.

ORE CONCENTRATOR.

APPLICATION FILED JUNE 23, 1906.

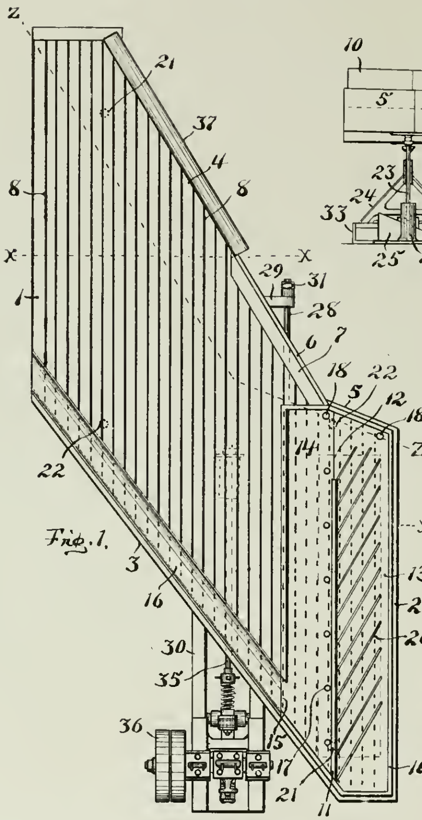


Fig. 1.

Fig. 2.

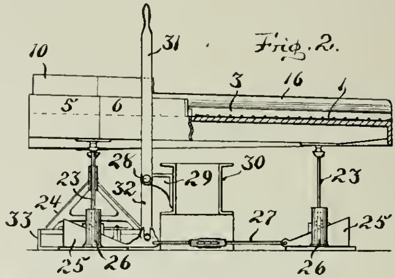


Fig. 3.

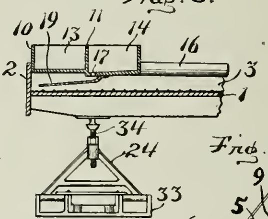


Fig. 4.

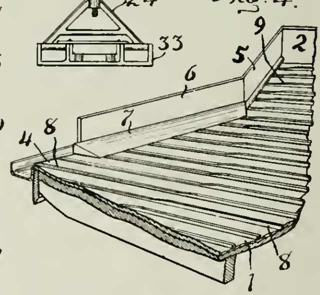


Fig. 5.

WITNESSES:

Mathilda Mittler

C. M. Havell

Emil Deister INVENTOR

BY W. G. Burns

ATTORNEY

UNITED STATES PATENT OFFICE.

EMIL DEISTER, OF FORT WAYNE, INDIANA, ASSIGNOR TO THE DEISTER CONCENTRATOR COMPANY, A CORPORATION OF INDIANA.

ORE-CONCENTRATOR.

No. 895,169. Specification of Letters Patent. Patented Aug. 4, 1908.

Application filed June 23, 1906. Serial No. 323,160.

To all whom it may concern:

Be it known that I, Emil Deister, a citizen of the United States of America, and resident of Fort Wayne, in the county of Allen and State of Indiana, have invented certain new and useful Improvements in Ore-Concentrators, of which the following is a specification.

This invention relates to improvements in ore concentrators, and the objects thereof are, first: to construct a machine of its class of less size and weight as compared with ordinary concentrators, and at the same time capable of efficiently treating an equal quantity of ore matter; and second: to so construct the machine as to compensate for variations in the quantity of material fed to the machine, without the serious loss of mineral which ordinarily occurs when tables of ordinary construction become overloaded. The first object is accomplished principally by the form and arrangement of the table in connection with its various parts; and the second object is attained chiefly by the peculiarly constructed feed box and the manner of distributing the feed upon the table. The construction by which these objects are attained is illustrated by the accompanying drawings in which

Figure 1 is a plan view of this invention; Fig. 2 is a transverse section of the same on the line x—x of Fig. 1; Fig. 3 is a detail view showing a transverse section through a portion of the table and the feed box on the line Y; Fig. 4 is a detail view in perspective showing the bucking board and that portion of the table, which lies adjacent thereto; and Fig. 5 is a detail showing a side view of one of the riffles, somewhat exaggerated in height.

Similar numerals of reference indicate corresponding parts throughout the several views, and referring now to the same: 1 is a concentrating table, having at one side thereof an upwardly projecting head-board 2, and along its rear end a similarly projecting breast-board 3. The opposite sides of the table are parallel and the rear end of the table ranges in a line oblique to the sides thereof, as also does a portion of its mineral discharge edge 4. An upwardly projecting bucking-board 5 extends along a part of the fore end of the table adjacent to and connecting with the corresponding end of the head-board 2, and; in effect, forms a continuation of the latter. That portion of the bucking-board adjacent the head-board 2 ranges at a sharper angle respecting the latter than does the other portion 6 thereof which extends to the mineral discharge edge 4 of the table. At the juncture of the bucking-board and the adjacent surface of the table is secured a shoal 7 which serves to spread dressing water fed thereon.

Upon the surface of the table is arranged a series of riffles 8 all of which are parallel with the sides of the table, and each riffle extends across the corresponding surface of the table to the opposite end thereof. These riffles taper from their rear ends toward their forward ends, and each has an off-set 9 where it decreases suddenly in height. The respective off-sets of the riffles are located approximately on the line Z—Z. Thus it will be understood that the section of the table bordering its forward edge has shallow riffles thereon, each of which is a continuation of the corresponding riffle on the rear portion of the table.

A feed box 10 is secured over that portion of the table adjacent the head-board 2, and a vertical partition 11 extends lengthwise in the feed box from its rear end to a point therein suitably distant from its forward end where it terminates and thus affords a passage-way 12 for pulp to flow from its one section 13 to the other section 14 thereof. The bottom of the feed box ranges upon a gradual descent from the rear end of the section 13 to the passage way 12, and from thence to the rear end of the section 14, and that portion of the bottom in the section 14 slants transversely downward toward the partition 11. A passage way 15 is made in the outer wall of the feed box adjacent the rear end of section 14, and a launder 16 is secured to the breast-board 3 and is connected with the feed box to receive the overflow therefrom through said passage way 15. A series of openings 17 are made in the bottom of the feed box in a line adjacent the partition 11, and other openings 18 are made in the bottom of the feed box at its forward end. An apron 19 is secured to the bottom of the feed box beneath the openings 17, and serves to direct material discharged therethrough toward the head-board 2. A series of diagonal riffles 20 are arranged upon the bottom of the section 13 of the feed box which serve to direct underlying mineral toward the opening 18 nearest the head-board.

The table is supported from beneath at points indicated at 21—21 and 22—22, at the latter by means of movable posts 23, and at the former by rocking standards 24. The posts 23 are respectively supported upon oppositely disposed wedges 25 mounted in corresponding base castings 26, and the wedges are connected together by a rod 27 by means of which they are moved in unity. An adjusting shaft 28 is supported by brackets 29 which extend from the side of the base 30, and upon said shaft is fixed a lever 31 and a depending arm 32, the lower end of the latter having connection with the wedges 25 to actuate the same. Thus it will appear that by moving the lever 31, the table will be given more or less longitudinal incline. The standards 24 are made wide at the base and are mounted upon castings 33, and are adapted to permit longitudinal action of the table and prevent lateral motion thereof. Each of the standards 24 has an adjustable screw post 34 by means of which the table may be adjusted to have more or less lateral decline. The table thus mounted is connected, by means of a driving rod 35, with a suitable actuating mechanism 36 such as to impart differential reciprocating motion to the table.

In the operation of this invention, pulp is fed to the feed box at the rear end of section 13, from whence it passes over the riffles 20 therein, through the passage way 12 into the section 14, and while so passing, more or less of the mineral portion of the pulp is directed by the riffles 20 so as to pass through the openings 18, and the other portion of the pulp is discharged from the feed box through the openings 17, except surplus water which overflows through the passage-way 15 and is carried by the launder 16 to the tailings discharge side of the table. By this operation the heaviest and cleanest portion of the mineral is fed to the table at points nearest its forward end, while the lighter mineral and pulp is carried through the openings 17 and deposited upon the table along the head-board which is farthest from the tailings discharge side of the table. The motion of the table and the arrangement of riffles thereon are such as to cause the mineral to move toward the forward end of the table, and that portion thereof which comes into contact with the bucking-board is subjected to more or less vigorous action because of the obstruction afforded thereby, which affects a tendency to displace the sand while the mineral passes along the bucking-board toward the mineral edge 4 over which it is discharged into the mineral launder 37. The portion 6 of the bucking-board acts upon the adjacent mineral with less force than the other portion thereof, because of its lesser angle to the direction of driving motion; and in passing along the shoal 7 the mineral is treated by the action of dressing water which is suitably fed upon the shoal and upon the table along the mineral discharge edge 4 thereof.

The off-sets of the riffles afford relief for the overlying gangue so that it tends to move downwardly toward the tailings discharge side of the table, while the underlying mineral portion of the pulp, thus relieved of the overlying gangue, is carried by the shallow extensions of the riffles outward to the mineral launder, and while being directed by said extensions, is treated to the action of dressing-water and thereby further relieved of gangue.

By providing an overflow outlet for surplus water from the feed box and conducting it therefrom without discharging it upon the table, the body of pulp upon the table is not affected thereby and the variations in the quantity of material fed upon the table is not so pronounced as would otherwise be the case, and consequently a corresponding improvement in the treatment of pulp is effected.

Having described my invention what I claim as new and desire to secure by Letters Patent is:—

1. In an ore concentrator, a shaking table having an oblique forward end; a shoal along part of said end of the table adjacent the feed side thereof and extending out bnto the table; and a series of riffles, those adjacent the shoal terminating at its inner edge, and the other riffles extending beyond the shoal to the concentrates discharge edge of the table.

2. In an ore concentrator, a shaking table having an oblique forward end and an upward projection extending along its rear end, feed side, and part-way along its forward end adjacent its feed side; a shoal adjacent the projection at the forward end of the table extending to the concentrates discharge portion thereof; and a series of riffles, those adjacent the shoal terminating at its inner edge, and the other riffles extending beyond the shoal to the concentrates discharge edge of the table.

3. In an ore concentrator, a shaking table; a feed box secured to the table having feed openings adapted to discharge onto the table; and having also an overflow outlet; and means in connection with the overflow outlet to convey the overflow therefrom away from the table.

4. In an ore concentrator, a shaking table; and a feed box in connection with the table, having two parallel sections with a passage-way connecting the sections at their forward ends, the bottom of the feed box ranging upon a gradual decline from the rear end of the outer section to said passage way and from thence to the rear end of the inner sec-

tion, and having also feed openings at its forward end, the inner section having feed openings along the side thereof adjacent the outer section and also an overflow outlet at its rear end.

5. In an ore concentrator, a shaking table; and a feed box connected to the table, having two compartments which communicate with one another at their forward ends, and riffles on its bottom adapted to direct underlying mineral toward said openings, the inner section having an overflow outlet near its rear end, and a series of feed openings located between its overflow outlet and its forward end.

6. In an ore concentrator, a shaking table; and a feed box connected to the table, having a central longitudinal partition dividing it into sections which communicate with one another at their forward ends, the feed box having also feed openings, and the inner section thereof having an overflow outlet.

7. In an ore concentrator, a shaking table having a feed box extending along its head side, the said feed box having feed openings in its bottom and an overflow outlet through its inner side; and a launder leading from said overflow outlet to the tailings end of the table where it is adapted to discharge the overflow from said feed box.

8. In an ore concentrator, a shaking table; and a feed box connected to the table, having a partition which divides the feed box vertically into two longitudinal sections which communicate with one another at their forward ends by means of a lateral passage-way, and having feed openings near the forward end of its outer section and a series of feed openings leading from its inner section.

9. In an ore concentrator, a shaking table; a feed box connected to the table, having a vertical partition dividing it into two longitudinal sections which communicate with one another by means of a suitable lateral passage-way, and having feed openings at its forward end and a series of feed openings leading from its inner section; and a series of riffles in the outer section adapted to direct underlying mineral therein toward the feed openings at the forward end of the feed box.

10. In an ore concentrator, a shaking table; and a feed box connected to the table, having a vertical partition, and also feed openings at its forward end; means to direct underlying mineral in the feed box toward said openings, the feed box having also another series of feed openings which are sheltered from the former feed openings by said partition.

In testimony whereof I affix my signature, in presence of two witnesses.

EMIL DEISTER.

Witnesses:

MATHILDA METTLER,

W. G. BURNS.

COMPLAINANTS' EXHIBIT No. 40

Deister Patent No. 921,090

ALMON E. HART, Special Examiner

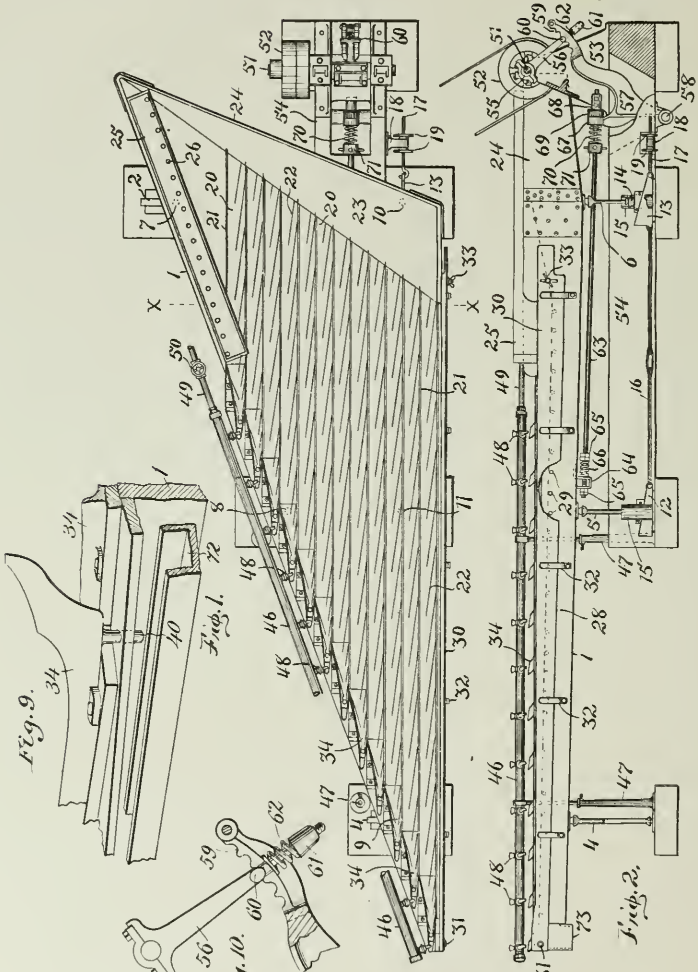
E. DEISTER.

ORE CONCENTRATOR.

APPLICATION FILED OCT. 9, 1905.

921,090. Patented May 11, 1909.

3 SHEETS—SHEET 1.



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APPLICATION FILED OCT. 9, 1905.

921,090. Patented May 11, 1909.

3 SHEETS—SHEET 2.

Fig. 3.

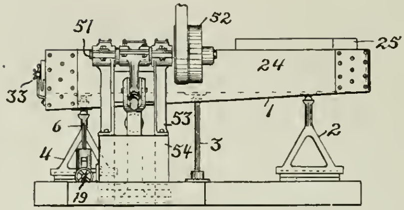


Fig. 4.

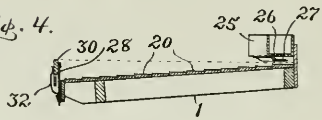


Fig. 5.

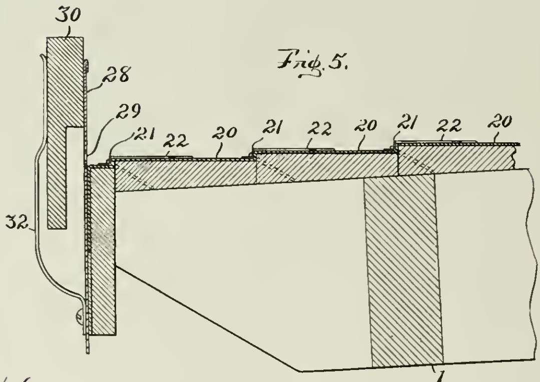
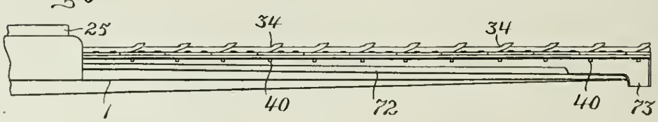


Fig. 6



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ORE CONCENTRATOR.
APPLICATION FILED OCT. 9, 1905.

921,090. Patented May 11, 1909.

3 SHEETS—SHEET 3.

Fig. 7

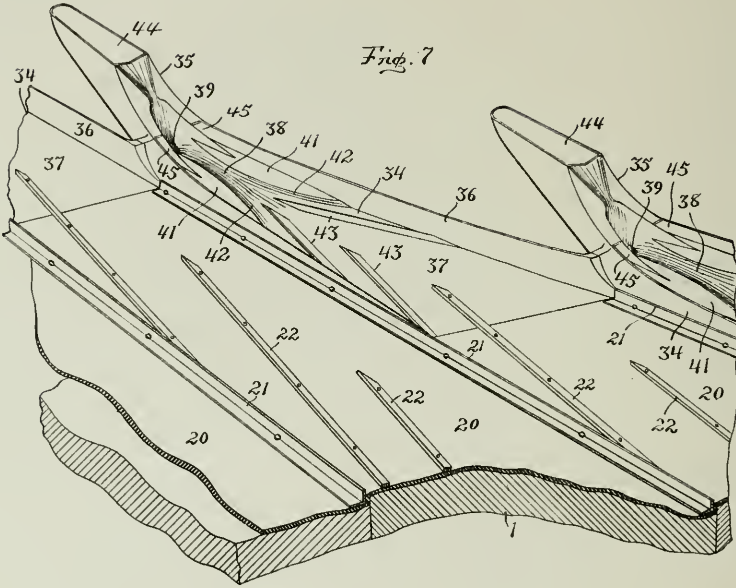
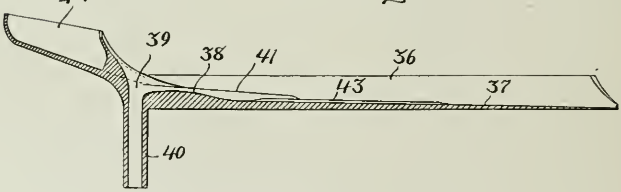


Fig. 8.



WITNESSES:
Wm. H. Bruoman
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Emil Deister INVENTOR

BY H. G. Burns

ATTORNEY

UNITED STATES PATENT OFFICE.

EMIL DEISTER, OF FORT WAYNE, INDIANA, ASSIGNOR TO THE DEISTER CONCENTRATOR COMPANY, A CORPORATION OF INDIANA.

ORE-CONCENTRATOR.

No. 921,090. Specification of Letters Patent. Patented May 11, 1909.

Application filed October 9, 1905. Serial No. 282,043.

To all whom it may concern:

Be it known that I, EMIL DEISTER, a citizen of the United States of America, and resident of Fort Wayne, in the county of Allen and State of Indiana, have invented certain new and useful Improvements in Ore-Concentrators, of which the following is a specification.

This invention relates to improvements in ore concentrators, and the objects thereof are to facilitate settlement of the metallic portion of ore pulp upon the concentrating surface of the table; and to effect a more perfect final separation of mineral values from the partially concentrated mass of pulp than is ordinarily attained; and further to effect the discharge of concentrates from the concentrating table as they become clean.

The above objects are accomplished by the construction illustrated in the accompanying drawings, in which:

Figure 1, is a plan view of the invention, a portion of the dressing water supply-pipe being cut away; Fig. 2, is a side elevation of the same, a portion of the adjustable dam being cut away for showing discharge openings for tailings; Fig. 3. is a head end elevation of the machine; Fig. 4. is a cross section of the concentrating-table on the line $x—x$ of Fig. 1; Fig. 5. is a detail view showing a cross section, upon an enlarged scale, of a portion of the concentrating-table on the line $x—x$ of Fig. 1; Fig. 6. is a detail view showing a portion of the side of the concentrating table where concentrates are discharged; Fig. 7. is a detail view in perspective, upon an enlarged scale, showing the relative position of one shoal with the adjacent shoals; Fig. 8, is a longitudinal section, upon an enlarged scale, of one of the shoals. Fig. 9 is a detail perspective view of one of the shoals and concentrates launder; and Fig. 10 is a detail view showing the connecting rod and spring for holding it in connection with the lever, the latter being shown cut away.

Similar numerals of reference indicate corresponding parts throughout the several views, and referring now to the same: 1 is a concentrating table, preferably of triangular form, mounted upon swinging props 2, 3, 4, 5, and 6, respectively, which admit longitudinal, reciprocating motion to be imparted to the table. The props 2, 3, and 4, are arranged in alinement beneath the table along the longest side thereof and support the same, respectively, at points indicated by the dotted circles 7, 8, and 9: and the props 5 and 6 are similarly arranged beneath the table and support the same at points adjacent the tailings discharge side of the table as indicated respectively by the dotted circles 10 and 11. The two props 2 and 4 are made wide at the base in order to prevent the table from moving laterally respecting the line of motion: and the two props 5 and 6 are made adjustable by means of wedges 12 and 13 so that the tailings discharge side of the table may be elevated or lowered as desired to give the table a suitable decline toward its tailings discharge side. Each of the props 5 and 6 rest upon a movable block 14 which is loosely arranged in a corresponding cylinder 15, the block being adapted to be raised or lowered accordingly as the corresponding wedge is adjusted. The wedges 12 and 13 are connected by a rod 16, and the wedge 13 has in connection therewith a screw-threaded rod 17 which extends through a fixed bracket 18; and the rod 17 has mounted thereon adjusting wheels 19 upon either side of the bracket, so that the wedges may be adjusted and held in a desired position by manipulating the wheels 19.

The concentrating surface of the table is composed of a series of steps 20 arranged in parallel relation with each other, and each successive step is lower than the adjacent preceding step, the lowermost step being nearest the tailings discharge side of the table, and the upper surfaces of all of said steps are approximately level in cross section and range upon a uniform incline toward the concentrates-discharge portion of the table. Along the discharge edge of each step is an upwardly projecting lip 21 which extends throughout the length of the corresponding step, and upon each step is secured a uniform series of riffles 22, each riffle commencing its course at the corresponding lip and ranging diagonally upon the adjacent surface of the corresponding step; and all the riffles are disposed in the direction of the concentrates-discharge side of the table.

At the head end of the table is a gradually sloping breast 23 which extends from the lower ends of the steps upward toward the head-board 24; and a feed-box 25, having feed-openings 26 in the bottom thereof, is mounted in connection with the table along the forward portion of the longest side thereof. An inclined shelf 27 is attached to the underside of the feed-box and serves to more or less distribute the ore-pulp as it passes from the feed-openings onto the table.

Along the tailings-discharge edge of the table is secured an apron 28 consisting of a plate which extends both above and below the adjacent edge of the table, and a series of tailings-discharge openings 29 are made in the apron in line with the adjacent concentrating surface of the table. A vertically adjustable dam 30 rests against the outer face of the apron 28, and extends throughout the length of the apron to the rear end of the table where it is pivotedly connected to the latter as indicated at 31. The dam is held in place against the apron by means of springs 32, and is held in adjusted position by means of a suitably mounted thumb-nut 33.

At the rear end of each step is fixed a shoal 34, the upper surface of which gradually ascends from the adjacent concentrating surface of the corresponding step toward its head 35. The outer edge of each shoal has an upturned flange 36 which extends from its head to the head of the next preceding shoal, where it connects with the adjacent innermost side thereof. The said flanges thus arranged, in connection with the heads of the respective shoals, constitute a levee which prevents an overflow of pulp from the table at its concentrates-discharge side. The concentrating surface 37 of each shoal narrows toward its upper rear portion and leads up to the throat 38 which communicates with the concentrates-discharge opening 39, and the latter opens into a discharge-spout 40. Upon either side of the throat 38 is a miniature plateau 41, each of which extends to the corresponding side of the shoal and has a gradually rounded inner margin 42. Upon the concentrating surface of the shoal are several riffles 43 which lead toward the throat from the corresponding sides of the shoal and extend toward the entrance of its throat, the upper ends of the two rear riffles ranging between the plateaus. The head 35 of each shoal is hollow and has an elongated opening 44 at its top, and has also discharge-ports 45 which lead respectively out upon the corresponding plateaus 41. The shoals are all located in the same horizontal plane, the height of each at the throat being approximately in line with the level of water, upon the table, which is maintained by adjusting the dam accordingly as the tailings-discharge side of the table is raised or lowered. A pipe 46 is supported by suitable standards 47 and extends along the concentrates-discharge side of the table, adjacent the shoals; and a series of cocks 48 connect with the pipe 46, and are adapted respectively to discharge dressing water into the corresponding openings 44 of the corresponding shoals. The pipe 46 is connected with a suitable head of water by means of a connecting pipe 49, the latter having a valve 50.

The actuating mechanism consists of a rotative shaft 51 which has mounted thereon tight and loose pulleys 52, and is mounted in a supporting casting 53 which is secured upon a bed 54. An eccentric 55 on the shaft 51 has driving relation with the connecting rod 56. A lever 57 is connected at its lower end to a shaft 58 which is suitably supported in connection with the bed, and the upper end of the lever is bifurcated and has a series of notches 59 made therein in which the ends of the cross head 60 are adapted to be seated. The cross head 60 is adapted to be shifted from one pair of notches in the bifurcated end of the lever to the other pairs of notches and thus cause the lever to be actuated with a greater or less range of movement, and the cross head is held in position in said notches by means of a screw-threaded hand-piece 61 which is mounted upon the projecting end of the connecting-rod 56. The said hand-piece has in connection therewith a coil spring 62 which acts against the adjacent face of the lever.

A driving rod 63 extends at its rear end through a bracket 64 which is rigidly fixed to the underside of the table, and upon said rod is secured two sets of jam-nuts 65, one set upon either side of said bracket 64; and a stiff coil spring 66 is interposed between one set of said jam-nuts and the bracket, which serves to prevent play between the driving-rod and table. The forward end of the driving-rod extends loosely through a lug 67 which projects from the lever 57, and has mounted upon its extreme end a collar 68. A rubber buffer 69 is interposed between the collar and the adjacent face of the lug 67, and a yielding coil spring 70 is interposed between the opposite face of the lug 67 and an adjacent collar 71 which has screw-threaded relation with the driving-rod. By adjusting the collar 71 so as to increase or decrease the stress upon the spring 70, the degree of differential motion imparted to the table may be varied.

In the operation of this invention, the table is set in differential reciprocating motion lengthwise respecting the steps, and a suitable quantity of dressing water is supplied to the shoals from the cocks 48. Ore pulp is then supplied to the feed-box in the usual manner. It is the intention to maintain a suitable depth of water upon the table, and to effect this the dam 30 is raised sufficiently so that the water will rise upon the table to a height approximately in line with the throats of the shoals. The tailings - openings 29, in the apron, are numerous and of a size capable of passing the solids of the tailings, but are not such as to drain the table of its body of water so as to prevent the water overflowing the dam while the contemplated quantity of pulp is being supplied to the machine. Because of the buoyancy afforded the pulp by the detained body of water upon the table, the mineral values of the pulp quickly settle upon the concentrating surface of the table, and thereupon are carried toward the shoals because of the differential motion of the table. The pulp tends to move toward the tailings-discharge side of the table, and the underlying portion of the settled ore-matter is moved toward the shoals, while the overlying portion thereof falls from step to step successively to the discharge edge of the table where it becomes discharged through the tailings-openings 29, or is carried over the dam with the overflow water. The underlying portion of the settled ore-matter is detained upon the steps more or less because of the projecting lips 21, and is further conserved upon the steps by the diagonally disposed riffles thereon, and as such underlying ore-matter reaches the shoals it will have become more or less separated from the gangue and may be said to have been partially concentrated. This partially concentrated material enters the shoals and masses at the entrance of the throats thereof, and is there shaken and simultaneously subjected to the washing action produced by the discharge of dressing water from the ports 45. The effect of this treatment is such as to cause the lighter portions of the partially concentrated masses to pass backward from the throats of the shoals and fall over the inner edges thereof upon the next succeeding steps respectively. The heavier portions of the partially concentrated masses, thus freed from the lighter portions, pass onward through the throats and into the openings 39 and are discharged through the spouts 40. A launder 72 is secured to the table immediately beneath the spouts 40 to receive the discharge of concentrates therefrom, and the discharge end 73 of the launder is preferably located at the rear end of the table.

A particular feature in the operation of this invention is that the partially concentrated material is treated in the shoals to a shaking and washing action in masses, in contradistinction to the common practice of spreading the partially concentrated material in a thin layer over a smooth and unprotected, or unriffled, washing surface; and in the present invention the concentrates become discharged from the table as they become cleaned, instead of being conveyed over a long course to a common concentrates-discharge place as on ordinary tables, thus avoiding a loss of mineral values occasioned by protracted contact with the dressing water as usually applied. Another feature of this invention is in the position of the adjustable props 5 and 6 relative to the table and the non-adjustable props 2, 3, and 4: It will be obvious that by raising or lowering the former props, the table will thereby become tilted so that the longitudinal incline of the steps will be decreased or increased accordingly without altering the horizontal position of the concentrates-discharge side of the table, and therefore, the shoals will be maintained at a uniform height; and when the table is tilted by lowering or raising the adjustable props, movement of pulp toward the tailings-discharge side of the table will accordingly be accelerated or retarded.

Matter somewhat similar in character is contained in a previous application, Sr. No. 274,515, filed by me August 17, 1905, for "ore concentrators", the similarity residing particularly in the shoals.

Having described my invention what I claim as new and desire to secure by Letters Patent, is:

1. In an ore concentrator, a transversely inclined reciprocating concentrating table, having a level concentrates-discharge portion, the concentrating surface of the table being composed of a series of steps arranged longitudinally and in parallel relation with each other and in line with the direction of the motion of the table; approximately, and all the steps ranging upon an incline toward the said concentrates-discharge portion; an upwardly projecting lip secured along the discharge edge of each step; a series of riffles secured upon the concentrating surface of each step, each riffle commencing its course at the corresponding lip and ranging diagonally upon the adjacent surface of the corresponding step; a shoal located at the rear end of each step, the concentrating surface of each shoal ascending from the concentrating surface of the corresponding step, each shoal having a throat and discharge opening; means for supplying each shoal with dressing water at the sides of its throat; and a dam in connection with the tailings-discharge side of the table adapted to maintain a water level upon the table approximately in line with the throats of the shoals.

2. In an ore concentrator, a transversely inclined reciprocating concentrating table, the concentrates-discharge side of which ranges in a horizontal plane, having thereon a series of riffles adapted to direct underlying ore-matter toward its concentrates-discharge side; a series of shoals arranged along the concentrates-discharge side of the table, each

ranging upon an incline from the adjacent concentrating surface thereof, and each having a throat and discharge opening; means for supplying dressing water to each shoal at the sides of its throat; and a dam in connection with the tailings-discharge side of the table adapted to maintain a water level over the table approximately up to the throats of the shoals.

3. In an ore concentrator, a transversely inclined reciprocating concentrating table having riffles thereon adapted to direct underlying ore-matter toward its concentrate discharge side; a series of shoals located along the concentrates discharge side of the table, each having a discharge opening near its head, and throat leading from its concentrating surface to its opening, the outer edge of each shoal being higher than its inner edge; and means for supplying dressing water to each shoal at the sides of its throat.

4. In an ore concentrator, a transversely inclined reciprocating concentrating table, the concentrates-discharge side of which ranges in a horizontal plane, having thereon a series of riffles adapted to direct underlying ore-matter toward its concentrates-discharge side; a series of shoals arranged in successive order along the concentrates-discharge side of the table, the outer edge of each shoal having an upturned flange, the said flanges constituting a levee adapted to prevent an overflow of pulp from the table at its concentrates-discharge side, and each shoal having also a throat and discharge opening; means for supplying dressing water to each shoal at the sides of its throat; and a dam in connection with the tailings-discharge side of the table adapted to maintain a water level over the table approximately up to the throats of the shoals.

5. In an ore concentrator, a transversely inclined reciprocating concentrating table having riffles thereon adapted to direct underlying ore-matter toward its concentrates-discharge side; a series of shoals located along the concentrates-discharge side of the table, each having a throat at its discharge end and plateaus upon each side of its throat; and means for supplying dressing water to each shoal upon its plateaus.

6. In an ore concentrator, a transversely inclined reciprocating concentrating table of triangular form, and having riffles thereon adapted to direct underlying ore-matter toward its concentrates-discharge side, the said concentrates-discharge side ranging in a horizontal plane; a series of shoals, at the concentrates-discharge side of the table, adapted to receive ore-matter directly from the adjacent concentrating surface of the table, each shoal having a discharge opening, and throat leading from its concentrating surface to its opening, the outer edge of each shoal being higher than its inner edge; and means for supplying dressing water to each of said shoals at the sides of its throat.

7. In an ore concentrator, a transversely inclined reciprocating concentrating table having riffles thereon adapted to direct underlying ore-matter toward its concentrates-discharge side; a series of shoals located along the concentrates-discharge side of the table, each having a throat and discharge opening; an upwardly projecting apron, secured along the tailings-discharge side of the table, having tailings openings therein in line with the adjacent concentrating surface of the table; a dam in connection with the apron adapted to maintain a water level over the table approximately up to the throats of the shoals; and means for supplying dressing water to each shoal at the sides of its throat.

8. In an ore concentrator, a transversely inclined reciprocating concentrating table of triangular form, the concentrates-discharge side of which is level, and the tailings-discharge side of which ranges upon an incline toward its rear end, and the concentrating surface of which is composed of a series of steps which extend lengthwise up to the concentrates-discharge side thereof; a series of shoals located along the concentrates-discharge side of the table, one at the end of each step, and being adapted for the purpose set forth; means for supplying dressing water to each shoal; and a dam in connection with the tailings-discharge side of the table adapted to maintain a water level over the table approximately up to its concentrates-discharge side.

9. In an ore concentrator, a transversely inclined reciprocating concentrating table of triangular form, the concentrates-discharge side of which is level, and the tailings-discharge side of which ranges upon an incline toward its rear end, and the concentrating surface of which is composed of a series of steps which extend lengthwise up to the concentrates-discharge side thereof, each step having an upwardly projecting lip along its discharge edge; a shoal located at the rear end of each step adapted for the purpose set forth; a series of diagonally disposed riffles upon each of said steps, each riffle commencing its course at the corresponding lip; means for supplying dressing water to each shoal; and a dam in connection with the tailings-discharge side of the table adapted to maintain a water level over the table approximately up to its concentrates-discharge side.

10. In an ore concentrator, a transversely inclined reciprocating concentrating table of triangular form, the concentrates-discharge side of which is level, and the tailings-dis-

charge side of which ranges upon an incline toward its rear end, and having thereon a series of riffles adapted to direct underlying ore-matter toward its concentrates-discharge side; a series of shoals located along the concentrates-discharge side of the table; means for supplying dressing water to each shoal; and a dam in connection with the tailings-discharge side of the table adapted to maintain a water level over the table approximately up to its concentrates-discharge side.

In testimony whereof I affix my signature, in presence of two witnesses.

EMIL DEISTER.

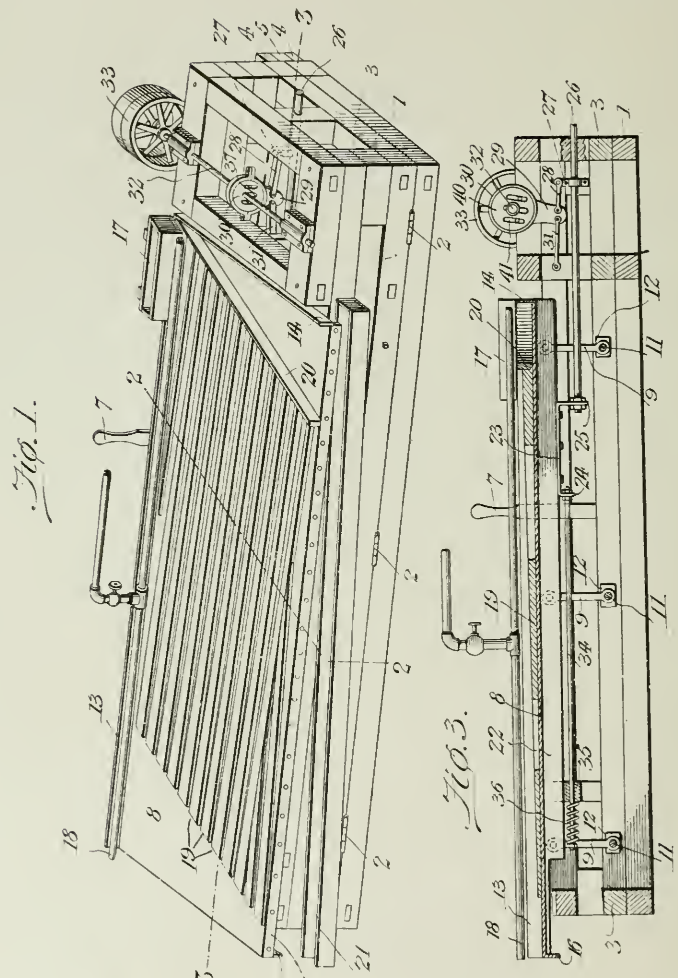
Witnesses:
Wm. H. Bensman,
Herman J. Lampke.

COMPLAINANTS' EXHIBIT No. 41
Kirksey Patent No. 906,535
ALMON E. HART, Special Examiner

J. G. KIRKSEY.
ORE SEPARATOR.
APPLICATION FILED FEB. 28, 1903.

906,535. Patented Dec. 15, 1908.

2 SHEETS—SHEET 1



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Attorneys

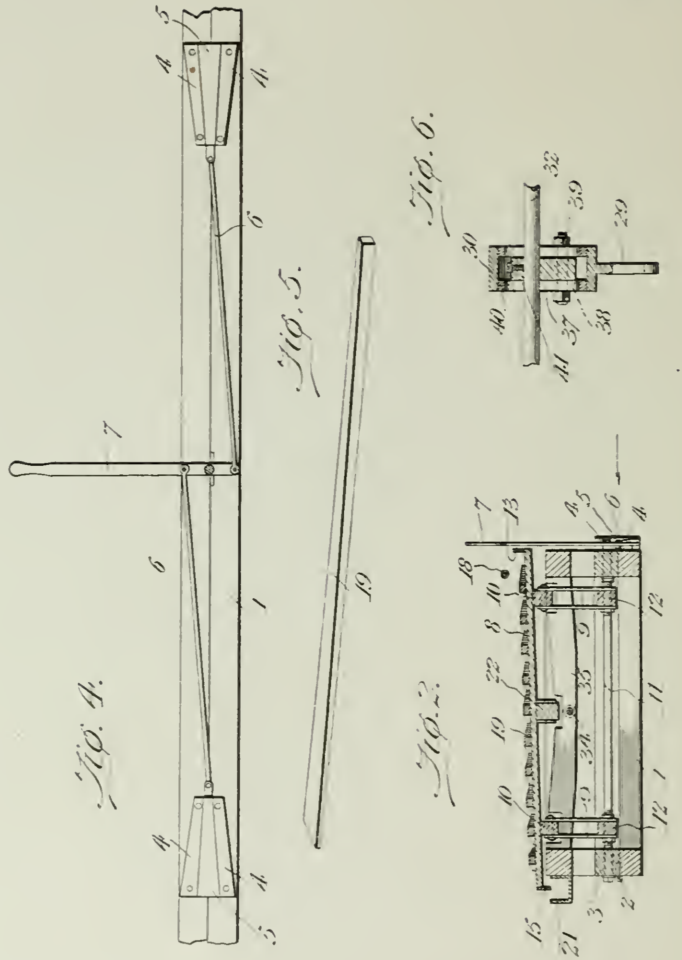
J. G. KIRKSEY.

ORE SEPARATOR.

APPLICATION FILED FEB. 23, 1903.

906,535. Patented Dec. 15, 1908

2 SHEETS—SHEET 2



Witnesses

John G. Kirksey, Inventor

by C. A. Snow & Co. Attorneys

UNITED STATES PATENT OFFICE.

JOHN GIDEON KIRKSEY, OF CARTHAGE, MISSOURI.

ORE-SEPARATOR.

No. 906,535. Specification of Letters Patent. Patented Dec. 15, 1908.

Application filed February 28, 1903. Serial No. 145,870.

To all whom it may concern:

Be it known that I, JOHN GIDEON KIRKSEY, a citizen of the United States, residing at Carthage, in the county of Jasper and State of Missouri, have invented a new and useful Ore-Separator, of which the following is a specification.

My invention relates to ore separators, and is especially directed to that class of devices in which the ore or material to be separated is washed over the surface of a transversely inclined vibratory table and is concentrated according to its varying specific gravity, and is delivered in its separated condition at the delivery end of the table.

The invention has for its objects to produce a device of this character in which the ore, after first spreading transversely of the table in strata of varying degrees of purity, will, during the further separating action, be moved longitudinally of the table and, to some extent, in opposition to the current of water, and in which the lighter particles of the material will, during this longitudinal movement, travel in advance of the heavier particles, be separated therefrom, washed transversely across the table, and be concentrated in turn, while the gangue and other impurities will be finally delivered at the lower side of the table. Thus the material will be delivered in a thoroughly separated condition, and the employment of conveying mechanism for returning it to the table for a second treatment will be obviated.

To these ends the invention comprises the novel details of construction and combination of parts more fully hereinafter described.

In the accompanying drawings,—Figure 1 is a perspective view of my improved device. Fig. 2 is a vertical transverse section through the same on the line 2—2 of Fig. 1. Fig. 3 is a longitudinal sectional elevation on the line 3—3 of Fig. 1. Fig. 4 is a side elevation as viewed in the direction of the arrow in Fig. 2. Fig. 5 is a perspective view of one of the riffle strips. Fig. 6 is a detail view of the adjustable eccentric.

Referring to the drawings, 1 indicates the main or base frame of my improved separator, which has hinged thereto, at its front longitudinal edge, as at 2, a supplemental frame 3. These parts may be of any suitable or desired material, but are preferably composed of wood, and in the form of rectangular frames consisting of longitudinal bars united at their ends by transverse bars, as clearly shown in Fig. 1. The main and supplemental frames have secured to the rear side thereof, as illustrated in Fig. 4, wings 4 arranged in pairs and oppositely inclined longitudinally. Mounted between the wings are longitudinally slidable wedge-shaped blocks 5 which are pivotally connected by rods 6 with an operating lever 7 by means of which the blocks may be actuated to adjustably tilt or incline the supplemental frame transversely from its back toward its front for the purpose more fully hereinafter described.

Disposed over the supplemental frame is a vibratory table 8, preferably of rectangular form, composed of any suitable material, and movably sustained by means of vertical links 9 pivoted at their upper ends to sills 10 which extend longitudinally of the under face of the table and at their lower ends pivotally mounted on transverse rods 11 sustained at their ends by the supplemental frame 3. The links 9 are arranged in pairs and have interposed between their lower ends on the transverse rods 11 spacing blocks 12. In this connection it is to be noted that there are three of the rods 11 and that each carries two sets of links 9 arranged respectively adjacent to the front and rear sides of the table, and further, that the rear links are of a greater length than the front links, which imparts to the table an initial inclination downward from its rear toward its front transversely, which inclination may be varied according to the varying materials treated by means of the sliding blocks 5 and their attendant mechanism, as will be readily understood.

Secured to and constituting a vertical upwardly extending flange along the higher longitudinal side of the table is a plate 13, a similar plate 14 forming a projecting flange at the front or receiving end of the table, while the lower longitudinal side and rear discharge end of the same are provided with similar plates 15 and 16 which extend downward from and constitute depending flanges.

Mounted at the front upper corner of the table is a box or hopper 17 which is secured in any suitable manner to the table and receives the material to be separated and delivers the same onto the table through suitable discharge openings formed in its bottom. The material, which is delivered at the higher side of the table, is washed transversely across the same by water discharged from a suitably perforated pipe 18 which extends longitudinally of the table and is connected in any suitable manner with the vertical flange 13.

Secured to the upper face of the table in any suitable manner is a series of guides or riffles 19, constructed preferably of wood, and which extend longitudinally of the table, and are disposed slightly diagonally of the same from the lower side of its receiving end toward the higher side of its discharge end, are uniformly spaced apart, and at the receiving end of the table abut against a transversely and slightly diagonally disposed rail or flange 20. The ends of the riffles which abut against the flange 20 and which receive the material when first discharged from the hopper, are comparatively high and narrow and from the receiving end of the riffles gradually decrease in height and increase in width toward the rear or discharge end of the table. Thus the discharge end of the riffles is comparatively wide and flat, being, in fact, almost flush with the surface of the table when in position thereon.

When the material is first delivered onto the table, it will be washed transversely across the same and received in the spaces between the riffles, and, in its travel across the table, will be automatically separated, owing to the variation in its specific gravity, into strata of varying degrees of purity, the heavier or purer ores settling upon the table at its higher level, those next in purity and weight at a lower level, and so on until the gangue and other light impurities are delivered at the lower side of the table into a receiving trough 21. After this first primary separation of the ore, the same travels longitudinally of the table in its separated condition from the receiving toward the delivery end of the table, and a further and more thorough concentration follows, due to the fact that the spaces between the riffles converge toward the discharge end of the table and, owing to the gradually increasing friction and compression of the material between the sides of the riffles, retards the heavier and purer ores and permits the lighter and less pure particles to travel forward in advance of the same, and when these lighter particles reach a point of the riffles sufficiently low they are washed transversely across the table and concentrate with ores of a similar quality at a lower level. A still further separation of the ores results from the diagonal disposition of the riffles from the lower portion of the receiving end of the table toward the higher portion of its discharge end, which necessitates the material, during its longitudinal movement, traveling to a certain extent against the current of the water. Thus the ore will, owing to these three separate and distinct concentrating actions, be delivered at the discharge end of the table in a thoroughly separated condition and in strata of varying degrees of purity. The material is caused to travel longitudinally of the table owing to a constant vibratory motion which is positively imparted to the same by mechanism now to be described.

Secured to the underside of the table in any suitable manner is a central longitudinal sill 22, and bolted to the sill is a metal plate having depending ends 24—25. This plate is situated some distance from the receiving end of the table and has secured to its depending end portion 25 one end of a horizontal rod 26 which extends parallel with the table and has its outer end slidingly mounted in suitable bearings formed in the supplemental framework of the machine at the front end of the latter, the other end portion of the rod having clamped to it an arm 27 formed of two metal plates. This arm, which is adjustable longitudinally of the rod, extends vertically upward from the same and has pivotally attached to its upper end one end of a link 28, which is pivotally connected at its other end with a vertically depending arm 29 carried by an eccentric 30. The arm 29 of the eccentric has also pivoted thereto one end of a link 31 which is pivoted at its other end to the framework of the machine. The eccentric 30 is mounted upon and operated by a drive shaft 32 journaled in suitable bearings transversely of the machine and provided with driving pulleys 33 in belt connection with any suitable source of power. As the shaft operates, the eccentric will, through the medium of its link connection with the shaft 26, reciprocate the latter longitudinally and impart to the table 8 a vibratory reciprocating motion which, owing to the connection of the shaft to the table at a point distant from its receiving end, will be more thoroughly and equally distributed throughout the surface of the table, thus insuring a uniform concentration of the material under treatment.

In order to compensate for lost motion and a consequent irregularity in the vibratory motion of the table, I secure to the arm 24 of plate 23 one end of a rod 34 which has its other end slidingly mounted in a block 35 fixedly sustained by the framework of the device and mounted upon the rod between the block and a head 35 secured to its outer end, a buffer spring 36 which is normally expanded and against the action of which the table is reciprocated.

In order that the vibratory motion of the table may be suitably regulated or adjusted according to the quality of the material under treatment, I provide for a vertical adjustment of the eccentric 30 relative to the shaft 32. For this purpose the end plates of the eccentric are slotted, as at 37, for the reception of the shaft, and are further slotted, as at 38, for the reception of adjusting bolts 39 connected at their inner ends to an inner adjusting member 40 disposed upon the interior of the eccentric and are perforated, as at 41, to receive the shaft. From this it will be seen that by operating the bolts 39 in their slots 38 to adjust the members 40, the eccentric may be moved to vary its eccentricity relative to the shaft, thus varying its throw and consequently the longitudinal reciprocation of rod 26 and the table, which can consequently be adjusted to a nicety.

It will be noted that the table utilized in the present construction is of uniform thickness and that the riffles are fastened upon the upper flat face of the table. The top of the table forms the bottom of the grooves, whereas the edges of the riffles constitute the side walls thereof. By providing riffles which are fastened to the top of the table it is not necessary to go to the expense of constructing a special form of table. Riffles of the construction shown and described can be readily attached upon the flat surface of any table. These riffles can be made as articles of manufacture and can be substituted by the user for riffles which are broken or otherwise injured upon the table. It will be noted that the bottom and top faces of each riffle are counter parts so that the riffle can be secured upon the table with either face downward, thus making it easy to manufacture and apply. Moreover, should the upper edges and surfaces of the riffle become worn as a result of constant use the riffle may be detached and inverted and the worn face pressed tightly upon and secured to the surface of the table.

From the foregoing it will be seen that I produce a device in which there will be a thorough and perfect concentration of the ores, one in which the ores will be delivered in a separated and graded condition from the discharge end of the table, while the gangue and other impurities will be delivered transversely of the table at its lower side, and that, owing to the perfect separation of the ores attendant upon my device, the employment of conveying mechanism to return the ore to the table for a second treatment, and, in fact, a second treatment of the ores, is obviated. In attaining these ends it is to be understood that I do not limit or confine myself to the details of construction herein shown and described inasmuch as various minor changes such as would suggest themselves to the skilled mechanic may be made therein without departing from the spirit or scope of my invention.

Having thus described my invention, what I claim is:—

1. As an article a riffle for ore separators comprising a flat elongated strip gradually increasing in width and diminishing in thickness toward one end, the side edges of the strip being straight from end to end and perpendicular to the faces thereof, the two faces of the strip being duplicates.

2. The combination with an inclined table having a flat uninterrupted upper surface; of a plurality of similar riffles secured upon and disposed entirely above the upper surface of the table, said riffles being inclined upwardly toward the discharge end of the table and each riffle comprising a flat elongated strip gradually increasing in thickness toward one end, the side edges of the strip being straight from end to end and perpendicular to the faces thereof, the upper and lower faces of the riffle being duplicates, said riffles forming grooves therebetween, the top of the table constituting the bottom of the grooves.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

JOHN GIDEON KIRKSEY.

Witnesses:
H. L. Shannon,
W. G. Moore.

COMPLAINANTS' EXHIBIT No. 42

Sherwood Patent No. 906,464

ALMON E. HART, Special Examiner

C. SHERWOOD.

ORE CONCENTRATING TABLE.

APPLICATION FILED NOV. 5, 1907.

906,464. Patented Dec. 8, 1908.

Fig. 1.

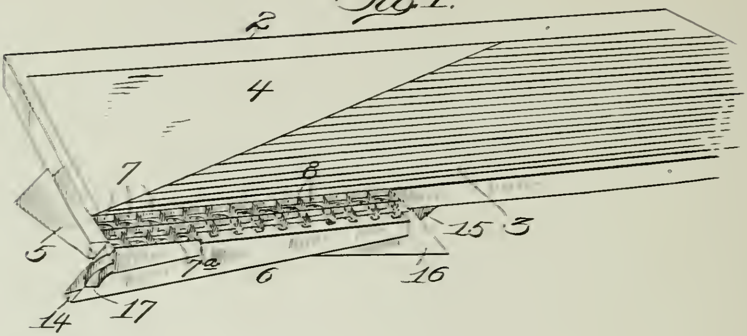


Fig. 2.

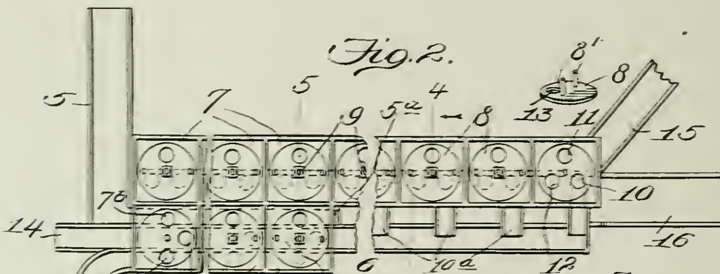


Fig. 3.

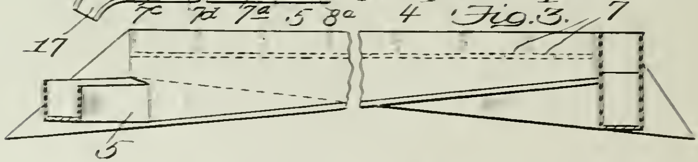


Fig. 4.

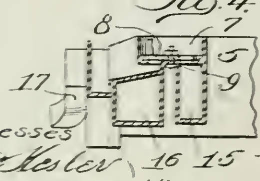
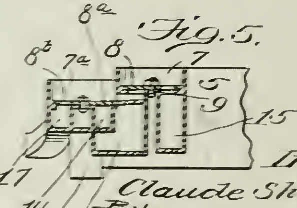


Fig. 5.



Witnesses

C. E. Kesler

[illegible]

Inventor

Claude Sherwood

By James L. Norris

Atty

UNITED STATES PATENT OFFICE.

CLAUDE SHERWOOD, OF BLACK BEAR, IDAHO, ASSIGNOR OF ONE-HALF TO ISRAEL WALKER, OF TAFT, MONTANA.

ORE-CONCENTRATING TABLE.

No. 906,464. Specification of Letters Patent. Patented Dec. 8, 1908.

Application filed November 5, 1907. Serial No. 400,876.

To all whom it may concern:

Be it known that I, CLAUDE SHERWOOD, a citizen of the United States, residing at Black Bear, in the county of Shoshone and State of Idaho, have invented new and useful Improvements in Ore-Concentrating Tables, of which the following is a specification.

This invention relates to ore concentrating tables, and particularly to an attachment to effect in a rapid and thorough manner proper grading or separation of metallic values without possibility of their subsequent accidental mixtures, waste, or the necessity of changing the adjustment or set of the table. The attachment may be employed with advantage in connection with various types of tables, but is of especial utility when used in connection with an endwise reciprocatory, transversely inclined table.

In the drawings: Figure 1 is a perspective view of a concentrating table provided with an attachment embodying my invention. Fig. 2 is a top plan view of the attachment detached from the table, one of the valves, hereinafter particularly described, being separated from said attachment and in perspective. Fig. 3 is a view of the attachment as seen from the table, two of the troughs thereof being in section. Figs. 4 and 5 are cross-sectional views on the lines 4—4 and 5—5, respectively, of Fig. 2.

Like characters refer to like parts throughout the several figures of the drawing.

In Fig. 1 a table of known type is shown and generally designated by the numeral 2, and is transversely inclined and given an endwise or longitudinally vibratory or reciprocatory motion by any suitable means for the purpose of stratifying the pulp supplied thereto. This table has on its upper side longitudinally disposed riffles with their forward ends arranged in step order or are upon a line extending diagonally of the table so as to leave a clear space, as 4, along which the lead separated from the pulp on the motion of the table is fed, the lead, when it leaves the table, falling into an inclined trough 5 secured to the head end of the table in any suitable manner. This trough is one feature of the improvement and directs the lead delivered thereinto into any suitable receptacle. The other feature of the improvement is designated in a general way by 6 and comprises several troughs, hereinafter more particularly described.

In addition to troughs, the member 6 includes an inner row of connected pockets 7 of any desirable number and disposed along the lower side of the table 2 commencing at the head end and extending toward the tail end of said table. Into these pockets lead and zinc middlings and other constituents are delivered and disposed of by means within the control of an attendant, as will be hereinafter made clear. The pockets or compartments may be made in one piece of any desirable metal or other suitable material, and while they may be of any shape they are represented as being substantially square. Each pocket 7 is shown as having countersunk in the bottom thereof a disk valve 8 provided with a pivot 9. The several valves 8 are operated by diametrically opposite handles 8′ connected thereto and are held in their adjusted positions preferably by friction. By countersinking the valves in the bottoms of the respective pockets or partitions 7, said bottoms will not present on their upper surfaces any projections or protrusions upon or against which mineral values or the like might lodge or catch. In the bottom of each pocket or compartment 7 are three holes 10, 11 and 12. Each rotary disk valve 8 has through it a single hole or perforation 13 adapted to register with any one of the three holes or openings 10, 11 or 12 in the bottom of its respective pocket or compartment 7 for a purpose that will hereinafter appear.

In addition to the inner series of pockets 7 there is a second or outer series of pockets 7^a, and these pockets 7^a may be of any number; for instance, if thirteen of the pockets 7 are provided, four of the pockets 7^a would be preferably used. The numbers of the two series of pockets are simply mentioned, however, by way of illustration and will depend somewhat upon the size of the table and dimensions of the pockets. The pockets 7^a are constructed like the pockets 7 in all particulars, including the bottom openings, but to avoid confusion and facilitate an understanding of the apparatus, the openings in the pockets 7^a are designated by the characters 7^b, 7^c and 7^d, respectively, the pockets 7^a containing valves 8^a each provided with a single opening 8^b and operating and constructed exactly like the valves 8. The pockets 7^a are coincident with the first four of the pockets 7, by virtue of which the first four pockets 7 can discharge respectively into the pockets 7^a. The primary purpose of the pockets 7^a is to provide for the proper disposal of the iron that passes over the lower side of the table near the front end thereof, although these pockets can be used to dispose of the zinc or lead which may be therein by manipulating the valves 8. The valve 8 of each pocket 7 will be turned to register the opening 13 of the valve with the openings 10, 11 and 12 in accordance with the character of the material flowing into the several pockets, and if zinc flows into the pockets the opening 13 of the valve 8 will be caused to register with the opening 10; if middlings of zinc and lead are directed into the pockets the openings 13 of each valve will be placed in registration with the openings 11, and if tailings flow into the pockets the openings 13 of the valves will be caused to register with the openings 12. In other words, the several valves 8 will be positioned to relieve the pockets of their contents in relation to the several troughs in accordance with the particular character of the material flowing into the pockets from the table. The registration of the opening 13 with any one of the bottom openings 10, 11 and 12 will result in a closure of the remaining two openings. It is the custom to return the middlings back onto the table to be worked over, while the tailings can be deposited in a heap and also worked over at desired intervals.

Practically the same operation may be effected in the pockets 7^a as above noted or when materials of different kinds solely occupy these latter pockets and under this condition of sole occupation of the pockets when the opening 8^b of each valve 8^a registers with the opening 7^d, this is for the purpose of directing zinc through said opening 7^d. When the opening 8^b in said valve 8^a registers with the opening 7^b, this is for the purpose of permitting lead to pass through said opening 7^b, and when the opening in said valve 8^a registers with the opening 7^c, this is for the purpose of causing iron to pass through said opening 7^c. By the manipulation, therefore, of the several valves or any one or more of them, the proper grading of the values and other materials that pass off the table can be obtained.

The member 6 is provided with four longitudinally extending troughs 14, 15, 16 and 17, the trough 14 being adapted to receive the pure zinc, the trough 15 the zinc and lead middlings, the trough 16 the tailings, and the trough 17 the iron. The trough 14 discharges the mass within it forwardly or toward the head end of the table; the trough 16 discharges the tailings therein toward the rear or tail end of the table; the trough 15 discharges into the middlings elevator, not shown, and the rear end of said latter trough is represented as somewhat deflected or inwardly disposed for this purpose, and the trough 17 causes the delivery of the iron in a forward and slightly lateral direction. The four troughs and the trough 5 hereinbefore described are separated from each other in a watertight manner so as to prevent possibility of mixture of the materials therein, and the said troughs may be disposed in coöperative relation to the pockets 7 and 7^a of the attachment in any desirable manner.

From the under side of the openings 10 in all the pockets 7, except the first four of the latter, spouts 10^a project for the delivery of zinc which may pass through said openings 10 into the zinc trough 14. When the openings 13 of the several valves 8 register with the openings 11 of the pockets 7, lead middlings will be directed into the trough 15. When the openings 13 of said valves 8 register with the openings 12, the tailings will be delivered into the trough 16. When the openings 13 of the valves 8, except the first four thereof, register with the openings 10, zinc will be directed by way of the spouts 10^a into the trough 14, and when the openings 13 of the first four valves 8 register with the openings 10, the contents of said first four pockets 7 will be directed into the companion or outer pockets 7^a. The materials delivered into the outer pockets 7^a will, therefore, be released and recovered in accordance with the positions of the valves 8^a. Should the opening 8^b in one or all of the valves 8^a register with a coöperating opening or openings 7^d, zinc will be directed from the pocket or pockets 7^a into the trough 14. Should the opening 8^b in any one of said valves 8^a register with the coöperating opening 7^b, lead will be delivered from the first four pockets into the trough 5, said trough 5 having an angular extension 5^a, as shown in Fig. 2, which extends under the several openings 7^b. Should the openings in the four valves 8^a register respectively with the openings 7^c, this will be for the purpose of directing iron into the trough 17. Therefore, by the manipulation of the several valves the constituents discharged from the table may be separately recovered or properly graded. Should the valves 8^a be set for effecting the discharge of iron into the trough 17, and should it be seen by an attendant that zinc or lead is being delivered into the pockets 7^a, such latter materials can be directed into the proper troughs by a simple manipulation of the valves 8^a without changing the adjustment or set of the table, with respect to the pockets 7 and the valves 8.

From the foregoing description relating

to the discharge of the individual materials or substances through the outlets of the pockets 7 and 7[a] and into the several troughs mentioned, it is not to be understood that different materials are simultaneously liberated from each pocket, but that when one kind of material is flowing into each pocket, that material may be liberated into the proper trough which has been devised for the purpose.

Having thus described the invention, what is claimed as new, is:

1. The combination of a concentrating table, a series of separate pockets extending along the discharge side of the table and each having a series of distinct outlets, a series of separate troughs to receive different classes of material from the outlets of the individual pockets, and shiftable means with an opening to register with the respective outlets for directing the different materials entering each pocket through the outlets into separate troughs.

2. The combination of a concentrating table, a lead receiving trough extending across the head end of said table, a series of separate pockets extending along a side edge of the table and each provided with a series of distinct outlets, separate troughs for receiving different materials from the individual pockets, and shiftable means in the pockets and provided with an opening for registering with the respective outlets for effecting the delivery of different materials through the said outlets into separate troughs.

3. The combination of a concentrating table, a series of pockets extending along an edge of said table for receiving material discharged therefrom, each pocket having several openings, a valve in each pocket having an opening therein to register successively with the respective openings in said pockets, and troughs to receive material discharged through the openings in said pockets.

4. The combination of an ore concentrating table, a series of separate pockets extending along the discharge edge thereof, each pocket having at least three openings, a valve in each pocket having an opening adapted to register in succession with the respective three openings, two troughs discharging toward the rear end of the table for receiving material passing through certain of said openings, a third trough for discharging toward the front of the table, and spouts for conducting material from the pockets into said third trough.

5. The combination of an ore concentrating table, separate pockets to receive materials discharged from said table and each provided with a series of distinct outlets, and rotatable means in each of the pockets having a single opening and adapted to register in succession with said outlets for regulating the discharge of different materials through the outlets.

6. The combination of a concentrating table, a series of separate pockets extending along the discharge edge of the table for receiving materials from the latter and each having a plurality of bottom openings, and shiftable means in each pocket provided with a single opening to register with the respective bottom openings of the pockets for controlling the discharge of different materials therefrom, the shiftable means closing the bottom openings not in registration with the single opening therein.

7. An attachment for ore concentrating tables comprising a series of non-communicating pockets arranged in a row and each having a plurality of outlets, and movable means in the pockets for controlling the delivery of material from the several outlets, each of the means having an opening to register with the outlets and when in registration with one of the outlets closing the remaining outlets.

8. An attachment for ore concentrating tables comprising a series of pockets arranged in a row and each having a plurality of outlets, a rotary valve in each pocket having an opening to register with the outlets in succession, and separate means for receiving materials discharged through the outlets of the several pockets.

9. An attachment for ore concentrating tables comprising an inner series of pockets arranged in a row and each having a plurality of outlets, an outer series of pockets to receive materials from certain of the inner series of pockets and also having a plurality of outlets, and rotary valves having openings therein and disposed in the two series of pockets for controlling the discharge of materials from the latter, the openings in the valves being adapted to successively register with the outlets of the pockets.

10. The combination of a concentrating table, a series of pockets extending along the discharge side of the table, the pockets being non-communicating and provided with a plurality of outlets for discharging various materials at different points therefrom, and apertured means in the several pockets for successively opening and closing the outlets with relation to the interior of the pockets and to regulate the discharge of the various materials from each pocket.

11. The combination of a concentrating table, a series of pockets extending along the discharge side of said table, and a second series of pockets arranged beside the first mentioned series of pockets, each of the pockets being provided with a plurality of

outlets and adjustable apertured means for discharging various materials from the lower portions thereof at different points, a part of the first mentioned series of pockets having communication with the second series of pockets.

12. An attachment for ore concentrating tables comprising a series of pockets each having a plurality of outlets for discharging various materials at different points therefrom, apertured means movable within each of the pockets for successively opening and closing the outlets of the latter and to control the delivery of different materials from the said outlets, and a plurality of separate troughs into which the outlets of the pockets individually discharge.

13. An attachment for ore concentrating tables comprising a series of pockets each having a plurality of outlets, means operable at will for controlling the delivery of material from the several outlets, and a second series of pockets coincident with certain of the first mentioned series of pockets and adapted to receive materials from the latter through certain of said outlets, and means operable at will for controlling the discharge of materials from the second series of pockets.

14. An attachment for ore concentrating tables comprising a series of pockets each having a plurality of outlets, means for controlling the delivery of materials from the several outlets, and troughs corresponding in number with the outlets of each pocket, one trough being adapted to receive material from one outlet, and another trough being adapted to receive material from another outlet.

15. An attachment for ore concentrating tables comprising a series of pockets each having a plurality of outlets, means for controlling the delivery of material from the several outlets, and troughs corresponding in number with the outlets of each pocket, one trough being adapted to receive material from one outlet, and another trough being adapted to receive material from another outlet, said troughs being out of communication with each other.

16. An attachment for ore concentrating tables comprising a series of pockets each having a plurality of outlets, and rotary valves countersunk in the bottoms of the respective pockets, each valve having an opening, and the valves rotatable to effect registration of the openings with certain of the outlets.

17. An attachment for ore concentrating tables, comprising two series of pockets arranged in rows side by side and each having a plurality of outlets, means for controlling the delivery of material from the several outlets, and troughs to receive such material, at least one of the troughs being common to both series of pockets.

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

CLAUDE SHERWOOD.

Witnesses:
ELMER M. SUITER,
S. D. LEMIMX.

COMPLAINANTS' EXHIBIT No. 43

James Patent No. 906,433

ALMON E. HART, Special Examiner

U. S. JAMES.

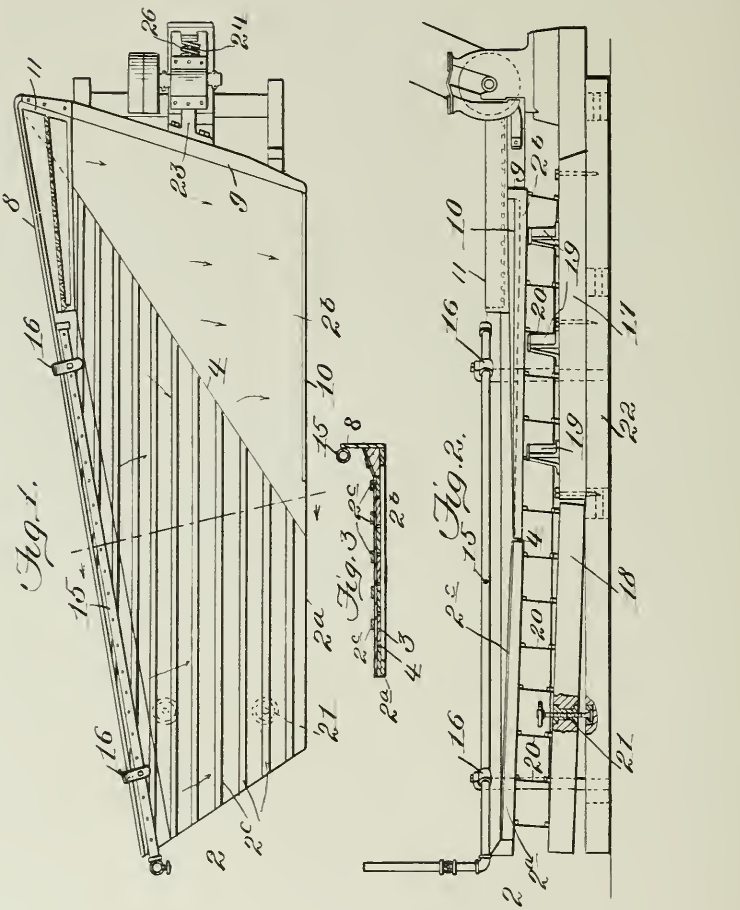
ORE CONCENTRATOR.

APPLICATION FILED MAY 31, 1905.

906,433.

Patented Dec. 8, 1908.

3 SHEETS—SHEET 1.



Witnesses.

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James L. Norris, Jr.

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Atty.

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ORE CONCENTRATOR.

APPLICATION FILED MAY 31, 1905.

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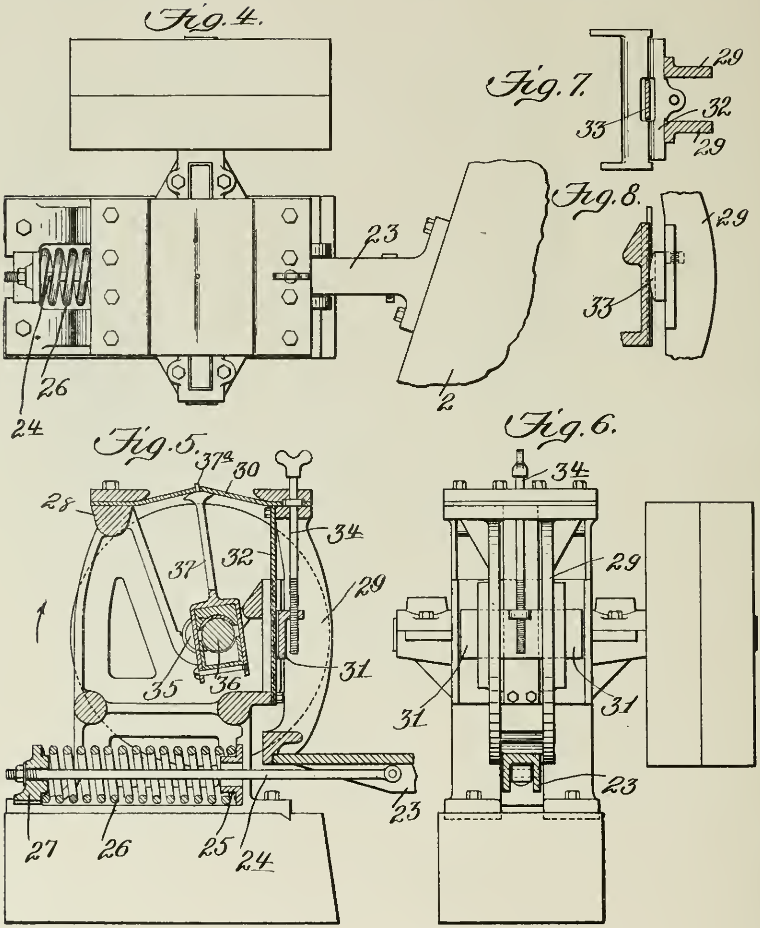
3 SHEETS—SHEET 2.



Witnesses:

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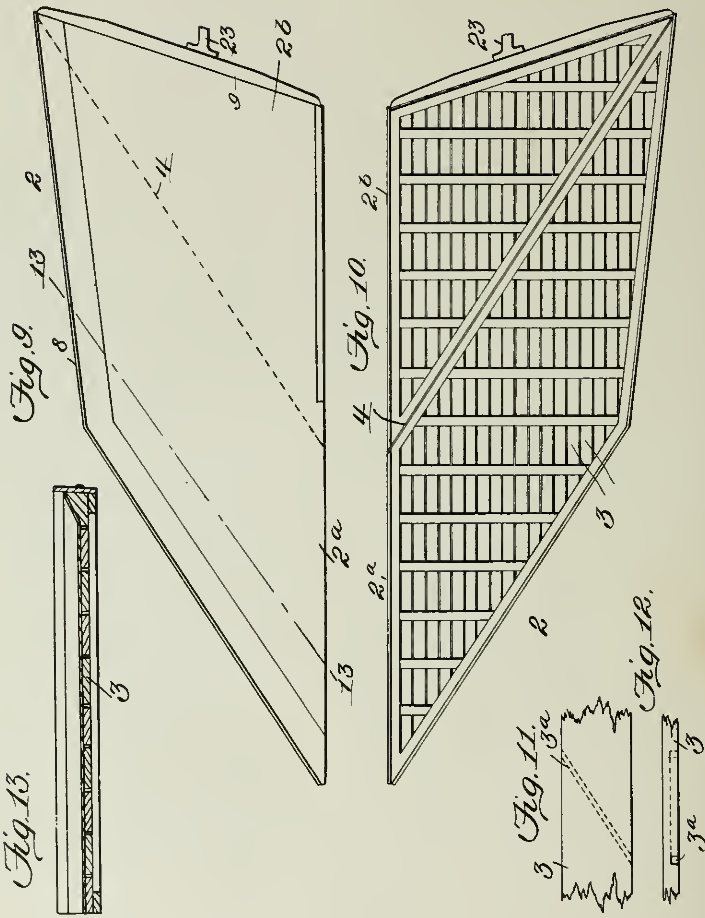
3 SHEETS—SHEET 3.



Witnesses:

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Inventor

Ulysses S. James

By James L. Norris.

Atty.

UNITED STATES PATENT OFFICE.

ULYSSES S. JAMES, OF NEWARK, NEW JERSEY, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO JAMES ORE CONCENTRATOR CO., A CORPORATION OF NEW JERSEY.

ORE-CONCENTRATOR.

No. 906,433. Specification of Letters Patent. Patented Dec. 8, 1908.

Application filed May 31, 1905. Serial No. 263,064.

To all whom it may concern:

Be it known that I, ULYSSES S. JAMES, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented new and useful Improvements in Ore-Concentrators, of which the following is a specification.

This invention relates to ore concentrators, the object of the invention being to provide an effective apparatus of this character adapted to quickly and thoroughly separate mineral values from gangue and other foreign matter and to effect the separation of the various mineral values from one another.

In order to enable those skilled in the art to practice the invention, I have illustrated a simple and convenient form of embodiment thereof in the accompanying drawings forming a part of this specification, which I will set forth in detail in the following description, while what I claim as new will be included in the claims succeeding said description.

In the drawings: Figure 1 is a top plan view of a concentrator involving my invention. Fig. 2 is a side elevation of the same. Fig. 3 is a transverse section on the line 3—3 of Fig. 1. Fig. 4 is a top plan view of mechanism for vibrating the table. Fig. 5 is a vertical sectional view, and Fig. 6 is an inside view of the same. Figs. 7 and 8 are details hereinafter more particularly described, showing parts of said driving mechanism. Fig. 9 is a top plan view of a modified shape of table. Fig. 10 is a bottom plan view of the same. Figs. 11 and 12 are detail views of a slat. Fig. 13 is a transverse section on the line 13—13 of Fig. 9.

The concentrating table shown in the drawings is denoted in a general way by 2, and it may take the external shape shown in Figs. 1 and 2, or that represented in Figs. 9 and 10. The said table is composed of two hinge connected portions, 2^a and 2^b, respectively. The structure of the table shown in Figs. 1 and 2 is the same as that illustrated in detail in Figs. 9 and 10, so that if I describe in full the construction of the latter form of table, the same will apply to the other. The table shown in said Figs. 9 and 10 includes in its makeup a plurality of slats or strips, as 3, extending longitudinally thereof and which are cut partially through or kerfed on the bias, as shown at 3^a in Figs. 11 and 12, which figures represent one of the slats. This cutting through the slats produces a hinge in the table, which I will denote by 4. The hinge, as will be clearly evident upon an inspection of the drawings, is disposed obliquely of the table, extending from a point near the head corner of the table to a point on the opposite margin of the table between the ends. The slats on their upper sides are covered by some suitable flexible fabric, as 3^b, which may be linoleum, and which of course extends across the hinge line 4. The hinge line constitutes the base line or one of the sides of the concentrating portion 2^a of the table. This concentrating portion may be either plain or riffled. In Figs. 1 to 3 I have shown it as riffled, while in Figs. 9, 10 and 13 it is represented as being plain. The riffles, when employed, are parallel with the line of motion of the table, and are quite shallow, so as not to check the movement of the gangue on the concentrating portion 2^a after such gangue has been separated from the mineral. The portion 2^b of the table serves several offices, as will hereinafter appear, it being of such construction as to present a slime pan.

The concentrating portion 2^a of the table is inclined upwardly from the base line toward the tail of the table, and the portion 2^b of the table, which serves as a slime pan, has a downward inclination from the base line toward the opposite corner, the inclination of this portion of the table being less than that of the concentrating portion.

The table is so constructed that the pulp is held in a limited area adjacent to the place where it is deposited upon the concentrating portion of the table and is prevented from crossing the base line separating the concentrating portion of the table from the slime pan. The construction of the table is also such that when longitudinal, vibratory or reciprocatory motion is imparted to the table in the proper manner, the mass of pulp will become stratified upon the concentrating portion of the table, the heaviest particles forming the stratum at the bottom and the other strata being arranged in the order of the specific gravities of the particles forming them, the gangue, which is of the least density, lying on top. The vibratory movement imparted to the table causes the gradual advance of the pulp toward the tail of the table and also causes a lateral movement of the several strata into which the pulp becomes separated, the lateral movement of the gangue being most rapid and the lateral movement of the lower strata being roughly inversely proportional to their densities. In this way the gangue is carried comparatively rapidly toward the front margin of the table in a direction substantially parallel to the base line, but without ever being carried across the base line, which would cause the bleeding of the pulp. The mineral values are carried onward toward the tail of the table with less lateral movement than the gangue, owing to their greater density, and are discharged over the tail of the table and over the front margin adjacent to the tail end.

As previously indicated, the portion 2^b of the table, in connection with the forward motion thereof, prevents the pulp from crossing said base line. This result is aided in the present instance by the quiescent or stagnant wash water in the panlike slime portion of the table.

By referring to Figs. 1 and 9, it will be seen that along the back edge of the concentrating portion 2^a of the table, there is a ledge 8 rising therefrom, said ledge converging at its head end into the base line 4 of the concentrating portion 2^a of the table, so that when pulp is introduced onto the head end of the table, it falls into a narrow space, the head end of the ledge, in connection with the forward motion of the table and the slime portion 2^b thereof, serving to pocket the pulp or positively retain it in a reduced area. As the table vibrates, the pulp mass is stratified and is advanced along the concentrating portion, so that it can gradually or progressively spread out, the mineral values descending according to their specific gravities or weights, while the gangue will be on the top, together with other undesirable constituents in the pulp. As the mass moves forward, the mineral values will be gradually panned down, and the gangue will gradually move away from the mineral values toward but not across the base line 4, and when riffles, as 2^c, are present on the concentrating portion, they will not be at such a height as to check or impede the free spreading motion of the gangue, so that, when once the gangue has been separated from the mineral values, it cannot again come in contact therewith.

As will hereinafter appear, the angularity of the portion 2^a of the table can be adjusted, so that in case the gangue does not flow properly toward the base line of the concentrating portion, the latter can be raised or its angularity increased in order to promote the desired result, or, if it flows too freely, the back end of the concentrating portion will be lowered. It will be understood that as the pulp mass is advanced, it is stratified, the heavy particles or mineral values taking a straight line, although not exactly in the direction of the length of the table, toward the tail of the table, where they are discharged in lines properly separated according to their specific gravities, over the tail of the table, the gangue being discharged over the forward side of the concentrating portion between the hinge line 4 and the tail of the table in a solid stream, not mixed with minerals.

I have designated the portion 2^b of the table as a slime portion. Along the head of the same there is shown as extending a ledge 9, which converges into the ledge 8 along the back of the table, while on the front side of the slime portion there is a flange or ledge 10, tapering from its highest point next the ledge or flange 9 to, and merging into, the surface of the slime portion 2^b, in proximity to, but separated from, the hinge line 4. Into this slime portion 2^b, which is downwardly inclined from the hinge line 4 toward the head of the table so as to produce, in connection with the flanges or ledges 9 and 10, a pan, there is discharged the wash water which flows over the front ledge 10. The motion of the table precipitates any mineral values that may be in this wash water onto the bottom thereof, and such mineral values are gradually worked toward the hinge or base line 4, so that they can pass out of the outlet between the tail end of the ledge 10 and the hinge line 4, by reason of which I am enabled to save all that is desirable in the pulp.

Any convenient means may be employed for delivering the pulp onto the table, for example, a hopper or feed box, as 11, arranged over the acute angular head of the concentrating portion of the table. The hopper itself directs the pulp onto the said acute angular portion, where, by the joint action of the ledge 8 and the slime portion 2^b, augmented by the forward motion of the table and the inclination of the concentrating portion, the pulp is held in a narrow area. As the table is vibrated, the mass is panned, the heavy matter descending to the bottom of the mass and below the gangue, so that, as the pulp mass is advanced with the forward motion of the table, the gangue on top of the mineral values can roll over the same without disturbing or becoming mixed with them. The hopper of feed box is fixedly mounted upon the table, for which purpose its base or foot can be bolted or otherwise fastened to the slime portion 2^b of such table.

The wash water for the pulp may be supplied by a pipe as 15, arranged over the concentrating portion 2^a of the table and supported by suitable stationary bearings, as 16. The said pipe may be supplied with water in any suitable way.

Upon reference to Fig. 1 of the drawings, it will be seen that the flow of wash water is diagonal to the line of motion of the table, but is at right angles to the base line 4 of the concentrating portion 2^a of such table, so that the motion of the mass on said concentrating portion is, as nearly as possible, opposed to the pressure of the water, by reason of which the water will not mix the mineral values with the gangue, which latter has previously passed free of the former. In other words, the motion of the mineral values is opposed to the pressure of the water, so that such pressure will not tend, as indicated, to mix the minerals and gangue, while, at the same time, the water can freely and thoroughly wash the minerals and simultaneously wash the gangue toward the base line of the concentrating portion, the motion of the gangue toward said base line being due to the water, augmented by the inclination of said concentrating portion.

In Figs. 1, 9 and 10 of the drawing, the table is so constructed that its forward or concentrate discharge end is arranged obliquely, this edge in Fig. 1 forming an acute angle with the feed side of the table. By so constructing the table, the concentrate discharge end thereof is kept wet from the flow of the dressing water without the aid of a spray pipe across such end of the table. If this end of the table becomes dry, it causes the concentrates to bank at this point, and the same cannot be discharged. To avoid this difficulty, certain tables use what is known as a spray pipe. This spray pipe is continually liable to stoppage owing to the accumulation of leaves and dirt, thus requiring considerable attention. By the simple means which I have adopted of cutting the concentrate discharge end of the table at an acute angle, the use of such a spray pipe with its attendant objections is obviated, and a proper discharge of the concentrates is insured at all times. It will be understood, of course, that the direction of flow of the dressing water relatively to the table may be varied. In fact, in practice the inclination of the table may be varied to meet different conditions, the invention not being limited in this regard. For instance, in some cases, an inclination of one quarter inch in six feet may be sufficient, while in some cases, it may be necessary to set the table at an inclination of three quarters of an inch to six feet. In most cases, however, an inclination of one-half an inch in six feet is most satisfactory, and the water in such cases will flow almost at right angles to the line of motion of the table.

I will describe hereinafter a means for imparting a vibration of a peculiar character to the table, the table initially, on its working stroke, being given a slow movement, and finally an accelerated or rapid motion, to drive the mass on the concentrating portion 2^a thereof forward, and on its return movement, being given an initially rapid but finally slower motion, so that the pulp will be retained in its forward position. This forward motion of the table, as will be understood from what I have hereinbefore stated aids, in connection with the portion 2^b of the table, in preventing the pulp mass on the concentrating portion from crossing the base line 4, and in so doing, serves to hold the pulp in a narrow or reduced area, and finally permits its gradual spreading in area so that the gangue can get free of the mineral values or those which are to be saved.

Arranged under the table are two frames, as 17 and 18, respectively, (see Fig. 2) said frames being connected by hinges, each designated by 19, the axes of the hinges being in common and coincident vertically with the hinge line 4 between the sections of the table. Between the frames 17 and 18, and the two sections of the table, are links, as 20, connected flexibly in some suitable manner at their opposite ends with the table sections and frames respectively, in order to permit the requisite vibratory motion of the table. The frame 18, as will be understood, is connected with the table section 2^a, and it is arranged for tipping motion, so that a corresponding motion can be obtained with respect to said table section 2^a, in order to adjust the angularity of the latter. To secure the tipping motion in question, of the said frame 18, I tap through the same screws 21, having hand wheels at their upper ends, and the bases of which engage the base frame 22. By the manipulation of the wheels, the frame 18 can be raised or lowered and a corresponding adjustment secured with respect to the concentrating portion or section 2^a of the table.

It will be evident that when the concentrating portion of the table is raised or lowered, the hinge line between said concentrating portion and the slime portion is not varied, but throughout the various adjustments of said concentrating portion said hinge line remains in a uniform position which in the present case is horizontal.

In Figs. 4 to 8 inclusive, I have shown in detail a means for vibrating or reciprocating the table longitudinally. The head end of the table is shown as furnished with an arm 23, to which is pivoted a rod 24 extending through a guide sleeve 25 and also through a coiled spring 26 bearing at one end against said guide sleeve 25 and at the other against a slide 27 suitably guided for longitudinal movement upon the base 22, the outer end of the rod passing through, and having a nut bearing against, said slide. A rocker 29, consisting of two complemental side bars, bears at its lower end against the extreme outer end of the arm 23, and rigidly fastened to the upper end of the rocker is a flexible strap 30, connected at its other end to the frame 28. Guided vertically by the rocker is a plate 31, such vertical movement being for adjustment in order to vary the stroke of the rocker. Connected with the head of the rocker and with the framing is a flexible connection, as 32, which may be of spring metal in order to hold the rocker down. The plate 31 is provided with a shoe 33 constituting the fulcrum portion of the rocker and having a rounded working surface which bears against the framing 28. The rocker is provided with a vertically disposed screw 34, the threaded portion of which is tapped through a flange on the plate 31 in order to raise the plate and consequently vary the stroke of the rocker by the operation of the said screw, which latter is provided with a thumbpiece at its upper end. The screw is vertically immovable, and for this purpose it may have a fixed shoulder clamped within the head of the rocker. It will be understood that the rocker 29 imparts an advancing motion to the table 2 in opposition to the coiled spring 26. Supported by the frame 28 is a shaft 35 provided with an eccentric 36 for operating a pitman 37 connected at its upper end in some fixed manner with the flexible strap 30 between its point of attachment with the frame 28 and rocker 29. By the construction described, the eccentric 36 imparts, as its position varies, at first a slow advancing movement through the intervening mechanism, to the table, and finally an accelerated or very rapid motion, in order to forcibly or positively advance the pulp along the table. During the advancing motion of the table, the spring 26 is put under compression, so that on the return motion of the eccentric, the spring can first impart a very rapid and then a slower return motion to the table, the return motion being controlled of course by the eccentric.

Hereinbefore I have spoken of the head and tail end of the table. The head of the table is at the right in Figs. 1, 2, 9 and 10, while the tail is at the left in said figures. The front of the table is that over which the wash water is discharged, while the back of the table is that along which the ledge or flange 8 extends.

I deem it expedient to describe more in detail the novel construction of eccentric and spring mechanism for effecting the hereinbefore described action of the concentrating table. The ends of the strap 30 are adapted, as will be apparent upon an inspection of Fig. 5, to work against upwardly curved faces upon the head of the rocker 29 and frame 28 respectively, while the said strap, between its ends, is adapted to act against the curved top of the head of the pitman 37, said pitman having a pin 37ª extending through a perforation substantially centrally of the flexible strap 30, so that, as the position of the eccentric 36 varies, I can, in connection with the spring 26, secure the desired motion of the table. Upon the shaft 35, provided with the eccentric, is a driver, which may be a pulley.

Having thus described the invention, what I claim is:

1. A longitudinally vibratory concentrating table having two portions flexibly joined with each other at opposite sides of a horizontally disposed hinge line extending obliquely to the direction of motion of the table, one of said portions of the table being upwardly inclined from said line and oblique to the line of motion of the table, and means for varying the angular position of said upwardly inclined portion without changing the horizontal disposition of said hinge line.

2. A longitudinally vibratory concentrating table having concentrating and slime portions situated at opposite sides of a line disposed diagonally to the direction of motion of the table, said concentrating portion being upwardly inclined from said line and oblique to said direction of motion, and means for supplying pulp on to the head end of said concentrating portion.

3. A longitudinally vibratory concentrating table having concentrating and slime portions flexibly joined with each other and at opposite sides of a line disposed diagonally to the direction of motion of the table, said concentrating portion being upwardly inclined from said line and oblique to said direction of motion, and means for supplying pulp on to the head end of said concentrating portion.

4. A longitudinally vibratory concentrating table having flexibly united concentrating and slime portions at opposite sides of a line disposed oblique to the line of motion of the table, said concentrating portion being upwardly inclined from the line dividing the said portions and oblique to said line of motion, means for supplying pulp on to the head end of said concentrating portion, and a pipe for wash water extending along the concentrating portion for directing wash water toward the line between the two portions and in a direction oblique to the line of motion of the table.

5. A longitudinally vibratory concentrating table having concentrating and slime portions at opposite sides of a dividing line extending oblique to the line of motion of the table, said concentrating portion being upwardly inclined from said dividing line and oblique to the said line of motion, and means carried by the table for supplying pulp directly onto the head end of said concentrating portion.

6. A longitudinally vibratory concentrating table sub-divided into connected concentrating and slime portions, the dividing line between the two being oblique to the line of motion of the table, said concentrating portion being upwardly inclined from said divid-

ing line and oblique to the said line of motion, means carried by the table for supplying pulp onto the head end of the said concentrating portion, and a pipe for wash water extending along the upper edge of said concentrating portion for directing wash water towards said dividing line and in a direction oblique to the said line of motion.

7. A longitudinally vibratory concentrating table having its concentrating surface upwardly inclined from a base line oblique to the line of motion of the table and having a slime pan separated from the concentrating surface by said base line, the concentrating portion of the table being provided with pulp feeding devices discharging directly thereon, and its concentrating surface being oblique to said line of motion.

8. A longitudinally vibratory concentrating table having its concentrating portion upwardly inclined from a base line oblique to the line of motion of the table and having a slime pan separated from the concentrating portion by said base line, the concentrating portion of the table being provided with pulp feeding devices discharging directly thereon and with means for supplying wash water in such a way as to cause a flow substantially perpendicular to said base line.

9. A longitudinally vibratory concentrating table divided on a hinge line diagonal to the direction of motion of the table to present portions at opposite sides of the said line, one portion being upwardly inclined from the other, the upwardly inclined portion having a flange at its back, converging into the hinge line at the head of said concentrating portion, and the other portion of the table having a ledge along its head and side, the last mentioned ledge having its tail end extending short of the hinge line.

10. A longitudinally vibratory concentrating table divided on a line diagonal to the direction of motion of the table to present portions at opposite sides of said line, one portion being upwardly inclined from the other, means for introducing pulp onto the head end of said inclined portion of the table, the other portion being downwardly inclined and at a less inclination than the concentrating portion and having a flange along its head and front, the last mentioned flange tapering from its head end toward its tail end, the latter extending short of the hinge line.

11. An endwise reciprocatory concentrating table having separate concentrating portions flexibly joined along a line oblique to the line of motion of the table, to independently and simultaneously concentrate coarse and fine materials, the portion of the table upon which the coarse materials are concentrated having a discharge for the gangue over the front of the table and the portion of the table on which the finer materials are concentrated having a discharge for the mineral values between the head of the table and the place at which said gangue is discharged.

12. An endwise reciprocatory concentrating table having separate concentrating portions to independently and simultaneously concentrate coarse and fine materials, the portion of the table upon which the coarse materials are concentrated having a discharge for the gangue over the front of the table and the portion of the table on which the finer materials are concentrated having a discharge for the mineral values between the head of the table and the place at which said gangue is discharged, the two portions of the table being flexibly joined along a line oblique to the line of motion of the table for preventing thereby the coarse and fine materials from being brought together on the table when once they are separated thereon.

13. An endwise reciprocatory concentrating table having concentrating and slime portions flexibly joined at opposite sides of a line oblique to the line of motion of the table, to independently and simultaneously concentrate the pulp and slimes, the concentrating portion having a discharge for the gangue at the front of the table, and the slime portion having means for maintaining water delivered thereinto in a substantially quiet condition and also having an outlet for mineral values between the head of the table and the place at which the gangue is discharged.

14. An endwise reciprocatory concentrating table having pulp and slime concentrating portions flexibly connected along a line oblique to the line of motion of the table, the slime concentrating portion having water retarding means along its head and front sides which on the front of the slime concentrating portion extend short of said line to provide an outlet for mineral values.

15. A concentrator deck comprising a plurality of relatively inclined planes each of constant area, said planes meeting in a line extending from the rear end of the table towards the front end thereof in a general diagonal direction, and means for varying the relative inclination of said planes.

16. A concentrator deck comprising a plurality of relatively inclined planes, which meet in a line extending diagonally of the table from the rear end towards the front end thereof, one of said planes being adapted to decrease the transverse flow of pulp towards the tailings side of the table, said transverse flow being induced by another plane of greater inclination.

17. A concentrator table comprising a plurality of independent planes each of constant area, said planes meeting in a line extending from the rear end of the table towards the front end thereof in a general diagonal direction and one of said planes being inclined downwardly towards the tailings side of the

table at a less inclination than the other, and means for adjusting the relative inclination of said planes.

18. The combination of a concentrator table or deck comprised of a plurality of independently adjustable planes of constant area, which meet in a line extending from the rear end of the table towards the front end thereof in a general diagonal direction, and means for adjusting the relative inclination of the said planes.

19. A concentrator table comprised of a plurality of adjustable planes of constant area, said planes meeting in a line which extends diagonally downward from the rear end and feed side of the table towards the front or concentrate end and tailings side of the table, the concentrate or front end of the table forming an acute angle with the feed side of the table.

20. A concentrator table the front end of which extends obliquely from the upper or feed side of the table towards the rear end thereof.

21. A concentrator deck the front or concentrate discharge end of which is on a line forming an acute angle with the feed side of the deck.

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

ULYSSES S. JAMES.

Witnesses:
HEATH SUTHERLAND,
DAISY TAYLOR.

COMPLAINANTS' EXHIBIT No. 44

Flood Patent No. 919,709

ALMON E. HART, Special Examiner

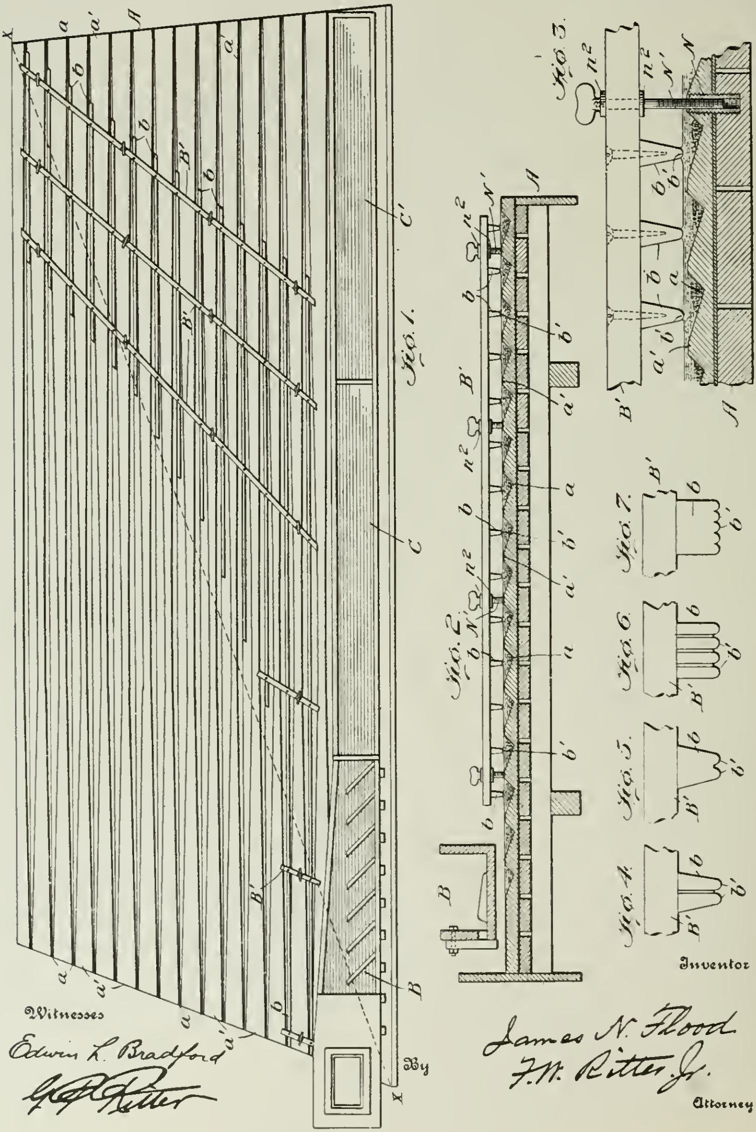
J. N. FLOOD

METHOD AND APPARATUS FOR SAVING SLIMES IN ORE CONCENTRATION.

APPLICATION FILED NOV. 23, 1908.

919,709. Patented Apr. 27, 1909.

3 SHEETS—SHEET 1.



Witnesses

Edwin L. Bradford

G. P. Ritter

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James N. Flood

By F. W. Ritter, Jr.

Attorney

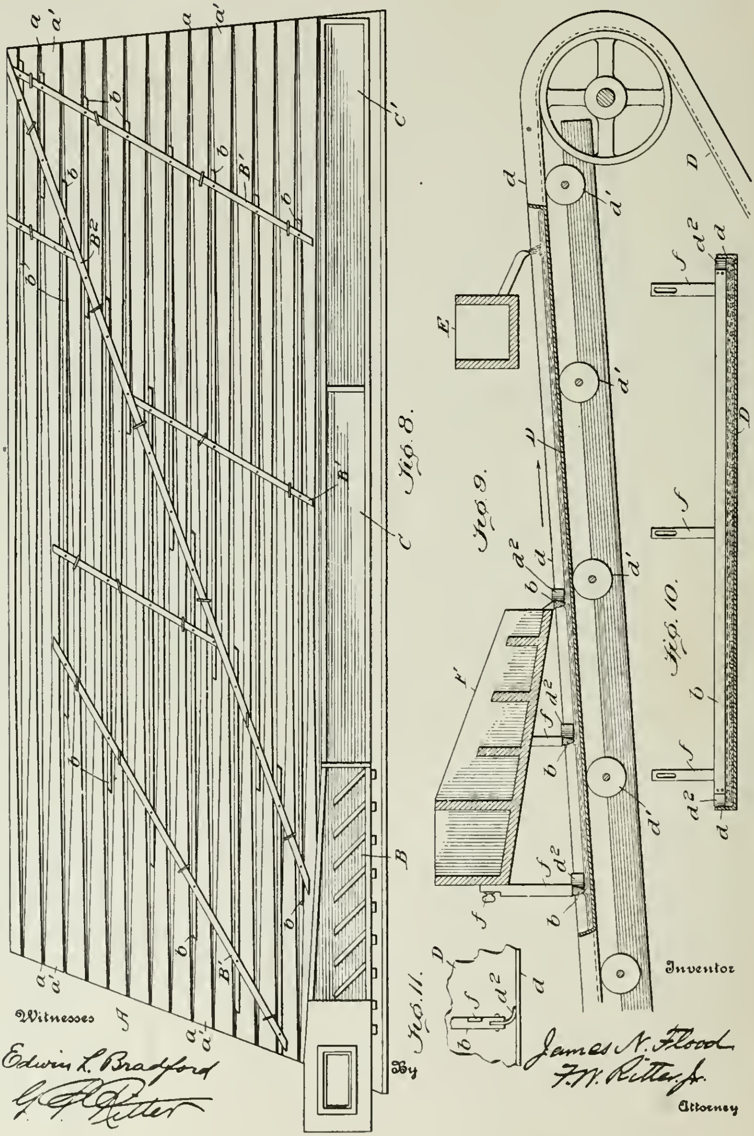
J. N. FLOOD.

METHOD AND APPARATUS FOR SAVING SLIMES IN ORE CONCENTRATION.

APPLICATION FILED NOV. 23, 1908.

919,709. Patented Apr. 27, 1909.

3 SHEETS—SHEET 2.



Witnesses

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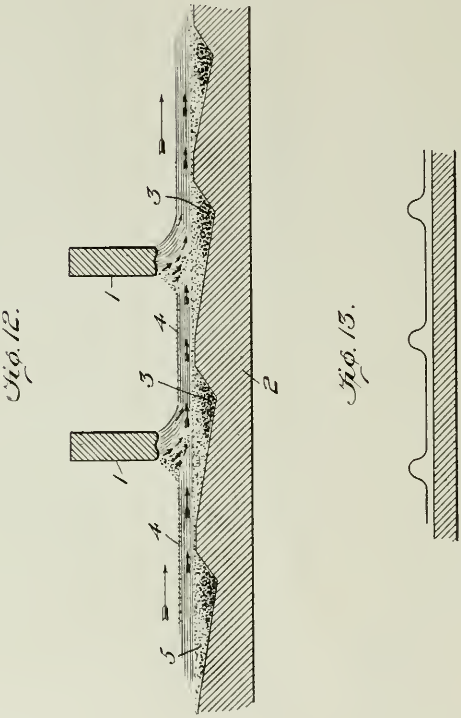
3 SHEETS—SHEET 3.



Witnesses

Edwin L. Bradford

G. P. Ritter

Inventor

James N. Flood

By F. W. Ritter Jr.

Attorney

UNITED STATES PATENT OFFICE

JAMES N. FLOOD, OF DENVER, COLORADO.

METHOD AND APPARATUS FOR SAVING SLIMES IN ORE CONCENTRATION.

No. 919,709. Specification of Letters Patent. Patented April 27, 1909.

Application filed November 23, 1908. Serial No. 463,981.

To all whom it may concern:

Be it known that I, JAMES N. FLOOD, a citizen of the United States, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Methods and Apparatus for Saving Slimes in Ore Concentration; 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.

My invention relates to a method and apparatus for saving slimes and float metal in concentrating processes wherein a flow of dressing water is employed, as for instance in operating what are known as the Rittinger type of tables and the Vanner or belt types of concentrators. In each of said types of concentrators the separation of the values and gangue is effected by gravity in the presence of a flow of current of dressing water which carries off the gangue or lighter constituents of the pulp while the values are precipitated upon the table or belt and delivered therefrom by the movement of said table or belt.

The finely comminuted particles of metallics present in all crushed ore are held either in suspension near the surface of the water or float upon the surface, the surface tension and superficial viscosity of the water operating to support the very fine metallic particles. A large percentage of values is consequently inevitably lost with, or carried off in the tailings by the dressing water. In order to save such slimes or float mineral, I establish upon the surface of the dressing water employed a series of waves or upraised lines of water which intersect the direction of flow of the dressing water on the table, thus promoting precipitation of the floating metallic particles. These waves or upraised lines of water may be conveniently established by means of capillary attraction, the devices chosen for that purpose being so arranged that their lower edges are located above the normal level of dressing water.

As a special apparatus suitable for use in carrying out the main feature of my invention, I preferably employ a bar or series of bars of tapering cross section having the apex or apices thereof disposed above the surface of the dressing water, and in case of a channeled concentrator table, the bars are preferably located in alinement with the channels thereof; and said features constitute secondary or subordinate features of my invention.

There are other, minor, features of invention, involved in the elemental constructions and particular arrangements of the several parts of the apparatus, all as will hereinafter more fully appear.

In the drawings referred to herein and forming part of this specification, Figure 1 is a plan view of what is known as the Card construction of a Rittinger type of concentrator, the same having applied thereto apparatus adapted to the performance of my method of saving slimes; Fig. 2 is an end elevation of the apparatus, showing a transverse section of the table where the channels are widest; Fig. 3 is an enlarged detail sectional view of a portion of the apparatus and table shown in Figs. 1 and 2; Figs. 4, 5, 6 and 7 are detail views of modifications of the floats or bars which I prefer to employ as apparatus in practicing my method of concentration; Fig. 8 is a plan view of a table and the slime saving apparatus, showing an arrangement wherein the float bars are applied the whole length of a table having a diagonal line of flexure; Fig. 9 is a view of the front end of a Frue Vanner type of concentrator, showing, partly in side elevation and partly in vertical section, the application of the floats or bars thereto; Fig. 10 is a transverse sectional view of the Vanner belt showing the relation of the float thereto and to the dressing water flowing thereover; Fig. 11 is an enlarged detail plan view of a portion of the Vanner belt and one end of a float; Fig. 12 is a diagrammatic view similar to Fig. 3, illustrating the apparent effect produced upon the fine metallic particles; and Fig. 13 is a diagrammatic view illustrating a series of waves upon a plane concentrating surface.

Like symbols refer to like parts wherever they occur.

I will now proceed to describe my invention more fully, so that others skilled in the art to which it appertains may apply the same.

In the drawings, A indicates a concentrator table which may have a plain surface as in the case of the old Rittinger style, or may, as in the present instance, have concentrate channels a, either formed in the bed or created by riffles corresponding to the lands a' between the channels or grooves a, a. For purposes of illustration the table selected is one in which the cross section of the channels a, a is formed by a long incline on the upper or feed side, and a short, abrupt incline on the lower or tailings side of the table, the two inclines meeting in an obtuse angle; but the character of the channel is not a material matter or one of the limitations of this invention. The diagonally disposed dotted line x—x appearing in Fig. 1 is employed to indicate a line of flexure in the table; but said line of flexure is no part of the present invention, nor is it material thereto, or to this description, except in so far as it assists, when taken in connection with Fig. 8 of the drawings, in showing how the slime saving apparatus may be readily applied to a table having such a line of flexure.

B indicates the feed box, and C, C′ the dressing water boxes located on the upper or feed side of the table in the usual manner. The table will have the usual lateral inclination to induce the transverse flow of the dressing water and the discharge of the gangue, and will have a longitudinally reciprocating movement imparted to it by suitable mechanism (not shown) to discharge the concentrates, as is common to concentrators of this class.

b, b indicate a series of bars which are supported or suspended above the table with their lower edges above the normal level of the dressing water surface, in order to produce by capillary attraction the raised water lines, ridges or waves. While the under side of said bars may be brought approximately into the plane of or in contact with the normal surface of the dressing water, in no instance should they be allowed to dip beneath the water level, as the effect would be to set up deleterious underflowing-water currents. By such an arrangement of the bars b the dressing water adjacent to the lower edges thereof is raised above its natural level to form a series of what may be termed capillary waves, as indicated diagrammatically in Fig. 13. For the purposes of this specification and as indicative that these bars are never submerged, I shall hereinafter term these elements b "floats" These floats b, b are preferably of tapering cross section so as to have a limited line or rounded edge b' presented toward the surface of the dressing water, and said edges may be single or multiple for each float b, as indicated in Figs. 4, 5, 6 and 7 of the drawings. As will be readily apparent, it is desirable that the floats should be vertically adjustable.

B′, B′ indicate coupling bars or cleats to the under surfaces of which the floats b, b are secured at intervals, preferably at intervals corresponding to the distance between the channels of a channeled or riffled table. As will be noted, said floats are arranged longitudinally of the table and consequently transversely of or across the flow of the dressing-water. Where a channeled or riffled table is used, as shown in the drawings, the floats are preferably located in line with and over the channels a, a. Any suitable means for supporting and adjusting the floats may be provided, as for instance those shown in the drawings, which consist of an internally and externally threaded sleeve or nut N embedded in the table and a threaded bolt N′ which is plain where it passes through the cleat or coupling bar B′ and is provided with collars n^2 for securing the coupling bar thereto so that the latter will be movable vertically with said bolt. The number of said adjusting devices N, N′, and their location will depend on the number and arrangement of the floats b and coupling bars B′ that the constructor desires to employ.

In Fig. 1 of the drawings the floats b, b are shown as confined to the dressing zone of the table, but they may be extended to the stratifying zone of the table, as indicated in Fig. 8 of the drawings, by simply arranging one of the coupling bars B^2 on the diagonal line of flexure (indicated by the dotted line, Fig. 1) and lapping the ends of the floats b, b thereon. In such a case, however, it is preferred to omit each alternate float, so that they will occupy a staggered relation on opposite sides of the line of flexure, as shown in Fig. 8.

In the case of the Vanner type of concentrator illustrated in Figs. 9 to 11 of the drawings, the form of the floats b and their relation to the surface of the dressing water are the same as in the case of the table heretofore described, that is to say, the lower edges of the floats are arranged to produce capillary waves transversely of the dressing water flow. In these figures of the drawings D indicates the belt of the concentrator which is provided with the usual upturned flanges d, and is supported in an inclined position, by the rollers d', d' in the customary manner. E indicates the dressing water distributer and F the pulp distributer. The arrow shown in Fig. 9 indicates the direction of travel of the belt, which is contrary to the flow of the dressing water, so that while the gangue is carried backwardly and downwardly by the dressing water, the concentrates are carried forwardly and upwardly by the belt and are discharged into a suitable receptacle.

The floats b, b shown in Figs. 9, 10 and 11 are suspended by means of suspension bars or straps f, f that are adjustably secured to the pulp distributer F by means of set screws f' which pass through elongated slots in the suspension bars. In order to prevent any slimes from passing between the ends of the floats and the upturned flanges d, d of the belt, the ends of the floats are provided with pieces d^2 of any suitable flexible material, preferably rubber, which sweep against or bear upon the upturned flanges d of the belt D. The pulp feeder F forms a ready and advantageous means of suspending the floats; but such location or attachment of the floats is not essential or even material, as independent means of support for the floats may be provided and located over the belt at any point or points back of the pulp feeder.

The construction and arrangement of the apparatus being substantially such as hereinbefore pointed out its operation will be as follows: The pulp from the feeder B is distributed along the rearward upper side of the table or deck A and the dressing water is supplied to the table from the dressing water boxes C, C' in the usual manner. If the table is one capable of flexure on the diagonal line, the zone at the rear end and tailings side is slightly elevated to retard the transverse flow of the dressing water and facilitate the longitudinal forward travel of the concentrates. The usual longitudinal motion is imparted to the table. As soon as the level of the dressing water is established, the capillary floats b, b are adjusted so that their lower edges cause the formation of waves or ridges above said level, whereupon the slimes and float metals, instead of passing off with the tailings or gangue, will be affected by said waves and will be guided to and with the concentrates to the concentrate discharge end of the table, their travel being influenced by the endwise motion of the table, instead of by the flow of the dressing water as heretofore. The adjustment and operation of the floats are substantially the same in the Vanner type of concentrator as in the table. Where float mineral exists in excess, as in the case of sylvanite, petzite, chalcocite, tetrahedrite, stephanite and the like, only a portion of the arrested float mineral may be thrown down upon the belt, the remainder being held by the capillary floats until it extends to and passes over the upper roller with the other concentrates. The apparent effect of the capillary waves, as I have observed their action in this mode of concentrating upon a concentrator table, will be understood from an examination of Fig. 12 of the drawings, wherein 1 is a capillary float, 2 the concentrator deck, 3 a stratum of the coarser metallics, 4 float mineral, and 5 gangue. The feathered arrows show the direction of flow of the dressing water transversely of the table, and the featherless arrows indicate currents within the capillary wave. The capillary waves not only form upraised lines or ridges of water the crests of which contact the lower edges of the floats, but establish and maintain, both on the surface and internally, currents which capsize the floating particles and, wetting all their surfaces, carry them down to the bottom of the stream, from whence such wave induced currents are not strong enough to again raise the fine metallics, although they do raise the fine gangue matter and hold it in suspension so that it may pass off as waste.

By the practice of my invention, it will be noted, the percentage of slimed metallics in the tailings is at once largely reduced, as is also the amount of slimed silica in the concentrates, while the volume of the concentrates is materially increased.

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

1. The method of saving slimes in concentrating processes wherein dressing water is employed to separate comminuted metallic particles from the accompanying gangue, which consists in effecting a flow of an aqueous mixture of the particles to be separated and establishing an upraised wave on the surface of said mixture without obstructing the flow of the mixture below the normal level thereof.

2. The method of saving slimes in concentrating processes wherein dressing water is employed to separate comminuted metallic particles from the accompanying gangue, which consists in effecting a flow of an aqueous mixture of the particles to be separated and raising the surface of said mixture at one or more places by capillary attraction without obstructing the flow of said mixture below the normal level thereof.

3. The method of saving slimes in concentrating processes wherein dressing water is employed to separate comminuted metallic particles from the accompanying gangue, which consists in effecting a flow of an aqueous mixture of the particles to be separated and impeding the flow of said mixture by the interposition of an obstruction just above the normal level of said mixture.

4. The combination with a concentrator and a dressing water supply therefor, of a float extending in a direction intersecting the direction of the dressing water flow, said float having at its lower surface capillary contact with the normal surface of the dressing water.

5. The combination with a concentrator and a dressing water supply therefor, of a bar float arranged transversely of the dressing water flow with its lower edge above the normal surface level of the dressing water and in such proximity to said surface as to establish capillary contact therewith.

6. The combination with a concentrator

deck having longitudinally disposed channels, and a pulp feeder and dressing water supply, of a plurality of longitudinally disposed float bars arranged in line with and over the channels and having at their lower surfaces capillary contact with the normal dressing water surface.

In testimony whereof I affix my signature, in presence of two subscribing witnesses.

JAMES N. FLOOD.

Witnesses:

FRANK S. CARD,
WILLIAM S. CARD.

COMPLAINANTS' EXHIBIT No. 45

Dallemagne Patent No. 953,900

ALMON E. HART, Special Examiner

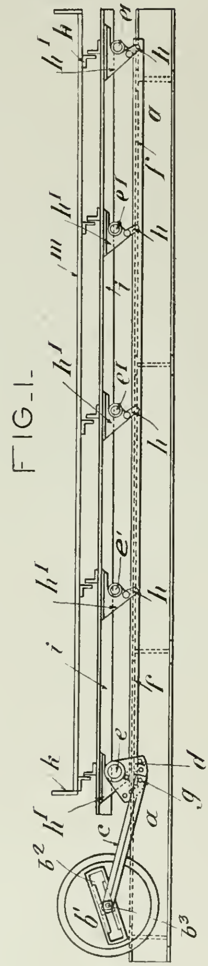
F. DALLEMAGNE.

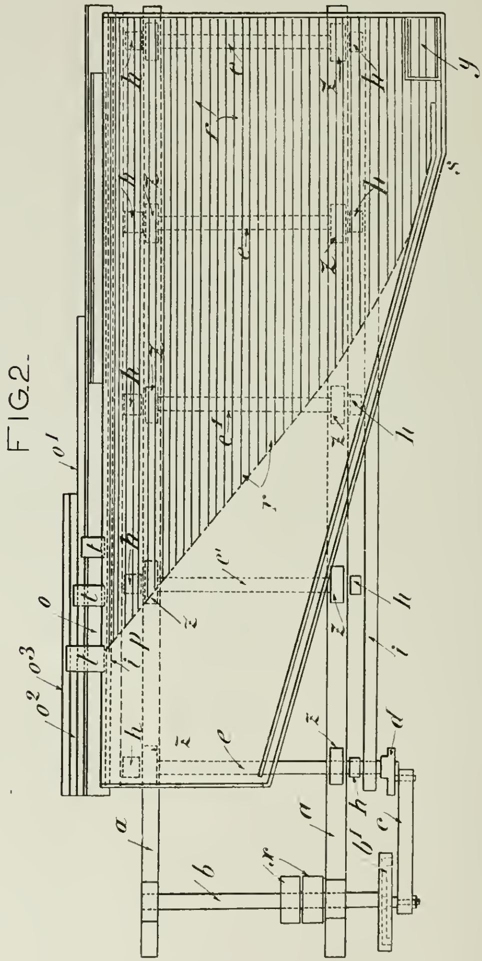
ORE CONCENTRATING AND SEPARATING APPARATUS.

APPLICATION FILED APR. 15, 1908.

953,900. Patented Apr. 5, 1910.

2 SHEETS—SHEET 1.





Witnesses:-
C. M. Crawford
E. Schallinger

Inventor:
François Dallemagne
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Attorney

F. DALLEMAGNE.

ORE CONCENTRATING AND SEPARATING APPARATUS.

APPLICATION FILED APR. 15, 1908.

953,900. Patented Apr. 5, 1910.

2 SHEETS—SHEET 2.

FIG_4_

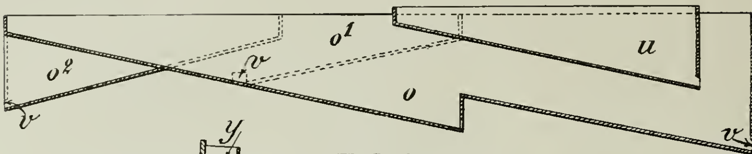


FIG_3_

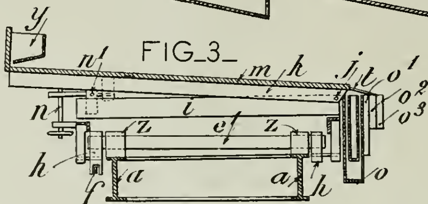


FIG_5_

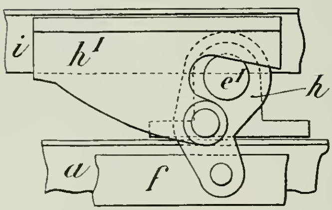


FIG_6_

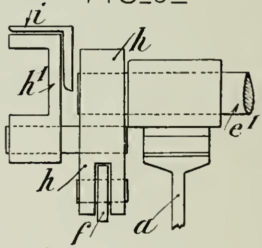


FIG_8_

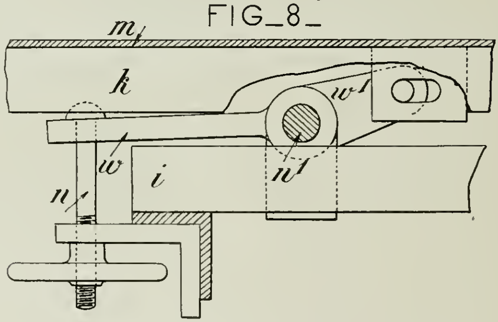
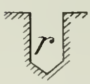


FIG_7_



Witnesses:

C. M. Crawford

E. Schallinger

Inventor:—

François Dallemange

by B. Singer.

Attorney

UNITED STATES PATENT OFFICE.

FRANCOIS DALLEMAGNE, OF IRUN, SPAIN.

ORE CONCENTRATING AND SEPARATING APPARATUS.

953,900. Specification of Letters Patent. Patented Apr. 5, 1910.

Application filed April 15, 1908. Serial No. 427,147.

To all whom it may concern:

Be it known that I, François Dallemagne, citizen of France, residing at Irun, in the Kingdom of Spain, have invented new and useful Improvements in Ore Concentrating and Separating Apparatus, of which the following is a specification.

This invention relates to an apparatus for separating by very simple mechanical means, complex ores finely mixed and having a difference of density of only the two thousandths part of the unit. In such system of separation, the differences of density and equivalence of ores are brought into use and it has been endeavored to obtain the sorting by employing the first moment of the fall of the particles to be separated.

To this end, a grooved platform is used, to which is imparted, through a special device, an alternating oscillatory circular movement which can impart to the materials to be sorted a number of oscillations reaching to 2,000 per minute. A grain of the material may thus receive up to 100,000 oscillations before leaving the platform. This power of sorting is precisely that which allows of the separation of very fine materials, whose densities approach very much one to the other.

The device allows of modifying the form of the circular movement and thus to utilize either the horizontal movement or the vertical movement or any combination of the two.

In the accompanying drawings: Figure 1 is a front view of the apparatus; Fig. 2 is a plan view; Fig. 3 is a cross sectional view; Fig. 4 is a longitudinal section through the recuperator; Fig. 5 is a detail front view on a large scale of certain parts for the transmission of motion; Fig. 6 is an end view of the parts shown in Fig. 5; Fig. 7 is an enlarged section of one of the grooves in the platform of the apparatus; Fig. 8 is a view on a large scale of the device allowing of regulating the inclination of the platform.

The base of the apparatus is formed by an appropriately strutted rigid metallic frame *a*. The driving shaft *b* and its fly-wheel *b'* actuated by pulleys *x x* impart the alternative motion to the sector *d*, and to the shaft *e* through the connecting rod *c*. The fly-wheel *b'* is provided with a slot b^2 in which the pin b^3 of connecting rod *c* is adjustable. The simple displacement of the pin *g* on the sector *d* allows of varying the form of the motion as will be seen hereinafter. The shaft *e*, through the medium of the crank *h* and the connecting rod *f*, communicates its motion to other cranks *h* and to other parallel shafts *e'* on which are keyed the cranks *h*. On said cranks *h*, are pivoted levers *h'* to which is secured a rigid frame *i* which follows the alternative circular motion. On said frame *i* rests another movable frame *k*, which may be suitably inclined, by means of a screw *n*. This screw acts on a lever *w*, keyed on a longitudinal shaft *n'*, mounted on supports secured to the frame *i*. On said shaft *n'* are keyed at convenient distances, five small crank-arms *w'* the pins of which are engaged in eyes formed in the supports secured to the frame *k*. It will be understood that by either rotating the shaft *n'* in one direction or in the opposite direction, the small crank arms *w'* will cause the platform *m* to ascend or descend. The rotation of said shaft *n'* is insured by the screw *n* which, when unscrewed in its support, draws down the lever *w* and, when screwed, allows such lever to rise by reason of the weight exerted by the platform on such lever. This operation may be easily understood by reference to Fig. 8.

The frames *i* and *k* are movably secured one to another through an axle *j* which connects in pairs each of the five angle-iron cross-pieces which acts as struts for said frame. On the frame *k* is a platform *m*, of any rigid material and of rectangular, trapezoidal or any other shape. Such platform *m* is provided with longitudinal parallel grooves *r*, whose section is shown in Fig. 7. The depth of such grooves diminishes as it approaches the curve *p s* which ends them. A perforated pipe *q* supplies the platform *m* with the water required for working. The separated materials fall into a recuperator *o* which is composed of several distinct channels *o* *o'* o^2 o^3 which severally receive a single material. Their bottoms are inclined so that the materials be discharged through the orifices *v*. The inner channel *u* is movable and may be situated at the desired point for discharging a certain class of materials. The materials enter through a distributer *y* and are conducted from the platform *m* to the channels *o*, *o'*, o^2 and o^3 of the recuperator by means of rigid plates *t* which may be placed at the desired points and be of size necessary for the work.

The function of grooves r, whose section is indicated in Fig. 7, is to be filled with materials of greater density, which through the oscillatory motion imparted by the apparatus, sort themselves as in a screen, and as the materials advance lengthwise, the grooves being shallower, the upper part of the materials, that is to say the lighter materials, rise above the level of the platform and are carried into the next groove, which is parallel, and which will effect the same operation until the materials of same density, meet in the same groove or grooves, which they then follow to the end, and fall at a same place of the discharge channels o o' o^2 o^3.

The motion of the platform m may be varied according to the nature of the ores to be sorted, by moving the pin g on the sector d. It will be understood that by such movement, the operative angle of the crank shafts h and accordingly the form of the motion of levers h', of frame i and of platform m will be modified. By this means a vertical oscillatory motion, or a horizontal oscillatory motion, or a combination of both, may be imparted to the platform m. In addition to this the amplitude of all said motions may be varied by displacing the pin b^3 of the connecting rod c in slot b^2 of the fly-wheel b'.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In an ore concentrating and separating apparatus, the combination of a stationary frame, a movable frame arranged above said stationary frame, a platform secured to said movable frame, cross shafts parallel one with each other journaled in the stationary frame, means for imparting to the first cross shaft an alternating rotary motion, cranks keyed on the cross shafts, a rod connecting said cranks, and levers pivoted on said cranks and fixed to the movable frame, substantially as described and for the purpose set forth.

2. In an ore concentrating and separating apparatus, the combination of a stationary frame, a movable frame arranged above said stationary frame, a platform connected to said movable frame, means for inclining said platform with relation to the movable frame, cross shafts parallel one with each other journaled in the stationary frame, a sector fixed on the first cross shaft, a pin adjustably secured on said sector, a driving shaft journaled on the stationary frame, a crank fly wheel fixed on said driving shaft, a rod connecting the pin to an adjustable point of the crank fly wheel, cranks keyed on the cross shafts, a rod connecting said cranks, and levers pivoted on said cranks and fixed to the movable frame, substantially as described and for the purpose set forth.

3. In an ore concentrating and separating apparatus, the combination of a stationary frame, a movable frame arranged above said stationary frame, a platform connected to said movable frame, a screw mounted on said movable frame, a longitudinal shaft journaled on said movable frame, a lever keyed on said longitudinal shaft and engaging the screw, small crank arms keyed on said longitudinal shaft, supports secured to the platform and provided with elongated eyes in which are engaged the pins of the small crank arms, cross shafts parallel one with each other journaled in the stationary frame, a sector fixed to the first cross shaft, a pin adjustably secured on said sector, a driving shaft journaled on the stationary frame, a crank fly wheel fixed o said driving shaft, a rod connecting the pin to an adjustable point of the crank fly wheel, cranks keyed on the cross shafts, a rod connecting said cranks, and levers pivoted on said cranks and fixed to the movable frame, substantially as described and for the purpose set forth.

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

FRANCOIS DALLEMAGNE.

Witnesses:
ANTOINE LAVOIS
H. C. COXE.

COMPLAINANTS' EXHIBIT No. 46

Look Patent No. 678,793

ALMON E. HART, Special Examiner

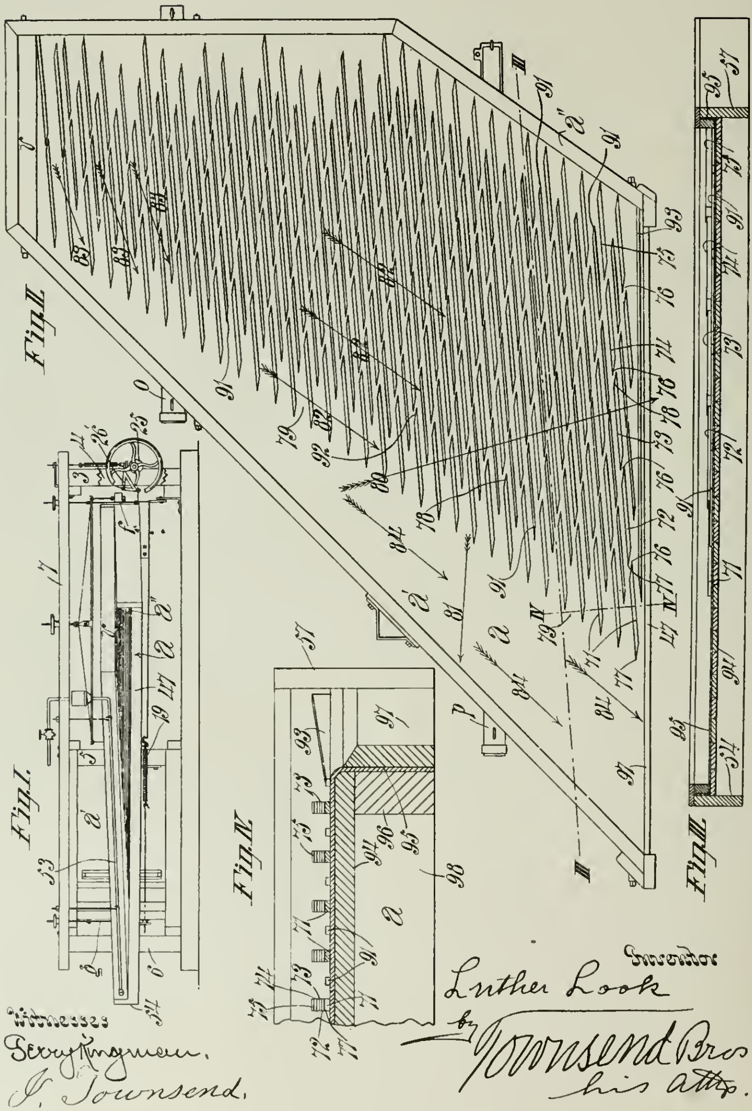
No. 678,793. Patented July 16, 1901.

L. LOOK.

ORE CONCENTRATOR.

(Application filed Aug. 14, 1900. Renewed June 22, 1901.)

(No Model.)



UNITED STATES PATENT OFFICE.

LUTHER LOOK, OF LOS ANGELES, CALIFORNIA, ASSIGNOR TO THE NEW STANDARD CONCENTRATOR CO., OF SAME PLACE.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 678,793, dated July 16, 1901.

Application filed August 14, 1900. Renewed June 22, 1901. Serial No. 65,692. (No model.)

To all whom it may concern:

Be it known that I, LUTHER LOOK, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in Ore-Concentrators, of which the following is a specification.

The object of this invention is to provide superior means for separating the heavy mineral from the light portions of the ore.

My present invention more particularly relates to the construction of the concentrating-table and the combination thereof with the means for moving the table. Various means may be employed for operating the table, and in the accompanying drawings I have only indicated such means in a general way.

The accompanying drawings illustrate my invention.

Figure I is a front elevation of a machine embodying my invention. Fig. II is a plan view of my newly-invented concentrating-table. Fig. III is a section of the table on line III III, Fig. II, diagonally across the table and alongside a row of riffles. Fig. IV is a section on line IV IV in a larger scale.

a indicates the table, which is swung from a frame 7 by links *f g* and slopes from the feed end *v* of the table to the discharge end 47 and also slopes from the percussion side *a'* to the power side *a''*.

25 indicates a cam to operate a lever 26 to operate the spring-balanced table *a*. The table-operating mechanism is not claimed in this application, for the reason that it is described and claimed in a separate application, Serial No. 26,887, filed August 14, 1900, and pending in the United States Patent Office contemporaneously herewith.

71, 72, 73, 74, and 75 indicate riffles of different thicknesses or depths, respectively, arranged coaxially—*i. e.*, endwise relative to each other in rows or lines extending diagonally across the table from the power side toward the percussion side and discharge end at a slant of about one inch in twelve. The riffles of each of these diagonal crosswise rows of coaxial riffles are set at a slight distance apart to leave communicating channels 76 between the abutting ends of the riffles, respectively. The ends 77 78 of each of the riffles are beveled substantially in parallel lines, so that the front end 77 of each riffle is beveled on the side which is away from the feed end of the table, and the other end 78 is beveled on the side which is toward the feed end *v* of the table. By this means the channels 76 between the abutting ends of the riffles of any of said rows extend from the lower or power side of the table *a''* toward the upper or percussion side *a'* thereof and away from the discharge end 47 of the table. The table slopes from the feed end *v* toward the discharge end 47 and also from the percussion side *a'* toward the power side *a''*.

53 indicates a clear-water pipe extending along the percussion side of the table to feed clear water onto the plain portion of the table.

The arrow 80 indicates the direction of maximum slope of the table—that is to say, the direction in which the clear water would flow across the table if the table were at rest and devoid of riffles.

The arrow 81 indicates the path and direction of the table as it moves toward the percussion side to produce the bump.

The arrows 82 indicate the general course of the pulp when the table is in operation.

The arrows 83 indicate the general course of the heavy mineral on the riffle portion of the table when the table is in operation.

The arrows 84 indicate the course of the mineral separated from the lighter material.

The riffles 71 at the percussion side of the table are preferably of slight height, say about one-sixteenth of an inch or slightly more The riffles 71 are also preferably arranged sidewise parallel with each other in a row extending from the feed end *v* of the table to the discharge end 47 along the line which is oblique to the direction of every force at work in the table—that is to say, oblique to the direction of bump and to the courses the pulp and the clear water would flow in if free to act alone. This line is determined from the resolution of the forces at work and extends in the direction indicated by arrows 82, in which the lighter material travels when the table is in operation. This is diagonally across the lines of greatest slope of the table and toward the percussion side of the discharge end.

The riffles 72 are slightly thicker than the riffles 71 and are arranged sidewise parallel with each other in an oblique row, corresponding to the row in which the riffles 71 are arranged. The riffles 73 are slightly thicker than the riffles 72 and are arranged parallel with each other in oblique rows. The riffles 74 and 75 are arranged in a similar manner, each being thicker than the preceding in the order named, so that in the preferred form the riffles 75 are about one-half to five-eighths of an inch in thickness. By this arrangement the surface of the table is furnished with channels 79, which extend obliquely across the table, slanting from the power side a'' toward the plain discharge-way at a', percussion side, and toward the discharge end 47 of the table. These channels 79 intercommunicate with each other through the channels 76.

91 indicates riffles in the channels 79 between the endwise rows of riffles. These riffles 91 are substantially of the same height as the riffles 71, so that their top faces are below the level of the riffles 72, 73, 74, and 75. The riffles 91 are arranged parallel with the riffles 71 72, &c., and are pointed at the ends and are set with slight spaces 92 between the ends of the several riffles to form in the channels 79 communicating channels corresponding to the channels 76, but offset or stepped with relation to such channels 76. Preferably the channels 76 and the channels 92 are in alinement with each other in diagonal rows, as clearly shown in Fig. II, which extend from the power side toward the percussion side upwardly toward the feed end of the table in lines corresponding to the bevels of the ends of the riffles. These lines extend upwardly in a slight measure diagonally of the direction of the bump—that is to say, diagonally of the path of the table.

The purpose of the shallower riffles 91 is to prevent sluicing across the channels 79 and through the communicating channels 76. Another use of the intermediate shallow riffles 91 is to catch the mineral at the bottom and direct it toward the percussion side of the table and at the same time to allow the lighter material to pass freely down the table toward the discharge end of the table and to flow through the communicating channels 76. By the provision of the intercommunicating channels 79 and 76 the capacity of the table for freeing itself of the lighter material is greatly increased, and by the use of the offset shallow riffles 91 any sluicing action through the communicating channels 76 does not operate to carry the mineral down through said channels 76.

By operating the table in the path indicated by the arrow 81 diagonally of the riffles the action of the table causes the mineral to move along the line of the communicating channels 76 and to throw the mineral toward the lower side of the several riffles, and in actual practice the mineral travels beneath the lighter material up through the communicating channels 76 and 92 between the ends of the riffles and against the course of both the pulp and the clear water and issues onto the plain discharge-way of the table at a' from a channel which is nearer the feed end of the table than the channel in which the mineral finally reached the face of the table. By this construction and arrangement of the machine the silica and lighter portions of the pulp are carried down the table with great freedom and rapidity and without disturbing the course of the mineral toward the percussion side of the table. The mineral after it has reached the plain space of the table at the percussion side a' moves downward along said space under the combined action of the percussion and the clear water and discharges at the percussion side of the discharge end of the table.

93 indicates a tapering equalizing cleat at the discharge end of the table to preserve a practically level discharge-surface and to prevent the water from escaping too freely from the lower or power side of the table.

The riffles in each endwise or coaxially arranged row extend at such a slant relative to the slope of the table and to the depths of the riffles that the tops of all the riffles in any one row of coaxial riffles will substantially be on one level. This arrangement causes an even action and flow of the material over the riffled surface.

o p indicate the pumping-beams, fastened to the table, and 5 6 indicate the posts against which said beams bump.

19 indicates a spring, and 25 26 indicate a cam and a lever which serve as means for operating the table.

94 indicates the table-top, and 95 the linoleum or canvas cover for the same, which is bent down over the front member 96 of the frame and clamped by the strip 97 and is bent up at the sides and fastened by the side pieces 54 and 57, respectively.

In practical operation the sharp points 77 and 78 of the riffles avoid any undesirable agitation or stirring of the pulp by the ends of the riffles, which otherwise might occur when the table is in operation.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. An ore-concentrator comprising a table having in its surface main channels which have a substantially common direction and channels communicating between the main channels; and means for shaking the table diagonally of the main channels.

2. An ore-concentrator comprising a table having in its surface parallel main channels and communicating channels connecting said parallel channels; and means for shaking the table diagonally of the main channels.

3. An ore-concentrator comprising a table having in its surface parallel main channels

and oblique communicating channels connecting the parallel main channels; and means for shaking the table diagonally of the main channels.

4. An ore-concentrator comprising a table having a slanting surface furnished with main channels arranged at an angle to the slope of said surface; and communicating channels extending between the main channels; and means for shaking the table diagonally of the main channels.

5. An ore-concentrator comprising a table having a slanting surface furnished with main channels arranged at an angle to the slope of said surface; and communicating channels extending obliquely between the main channels; and means for shaking the table diagonally of the main channels.

6. An ore-concentrator comprising a table having a slanting surface furnished with main channels arranged at an angle to the slope of said surface, and communicating channels extending upward obliquely between the main channels; and means for shaking the table diagonally of the main channels.

7. An ore-concentrator table having a slanting surface furnished with main channels arranged at an angle to the slope of said surface and extending obliquely down the table; communicating channels extending obliquely upward between the main channels; a discharge-way along the upper edge of the table; a pipe for feeding water at the upper edge of said way; and means for vibrating the table; the main channels at the side of the table opposite the discharge-way being deeper than the main channels at the discharge-way.

8. An ore-concentrator comprising a table furnished with riffles extending obliquely across the table and arranged coaxially in rows lengthwise of the riffles, with open spaces between the ends of the riffles, and being also arranged parallelly in rows extending obliquely from the feed end toward the discharge end of the table, with spaces between the sides of the riffles; and means for shaking the table diagonally of the riffles.

9. An ore-concentrator table furnished with short riffles arranged in rows coaxially of the riffles and also in parallel rows, and being of successively increasing heights from the percussion side of the table to the opposite side of the table and having spaces between the riffles, and a tapering, equalizing cleat at the discharge end of the table, substantially as set forth.

10. An ore-concentrating table furnished with riffles pointed at the ends and spaced apart in rows coaxially and parallelly; and means for shaking the table diagonally of the riffles.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, at Los Angeles, California, this 2d day of August, 1900.

LUTHER LOOK.

Witnesses

JAMES R. TOWNSEND,

JULIA TOWNSEND.

COMPLAINANTS' EXHIBIT No. 47

Overstrom Patent No. 763,783

ALMON E. HART, Special Examiner

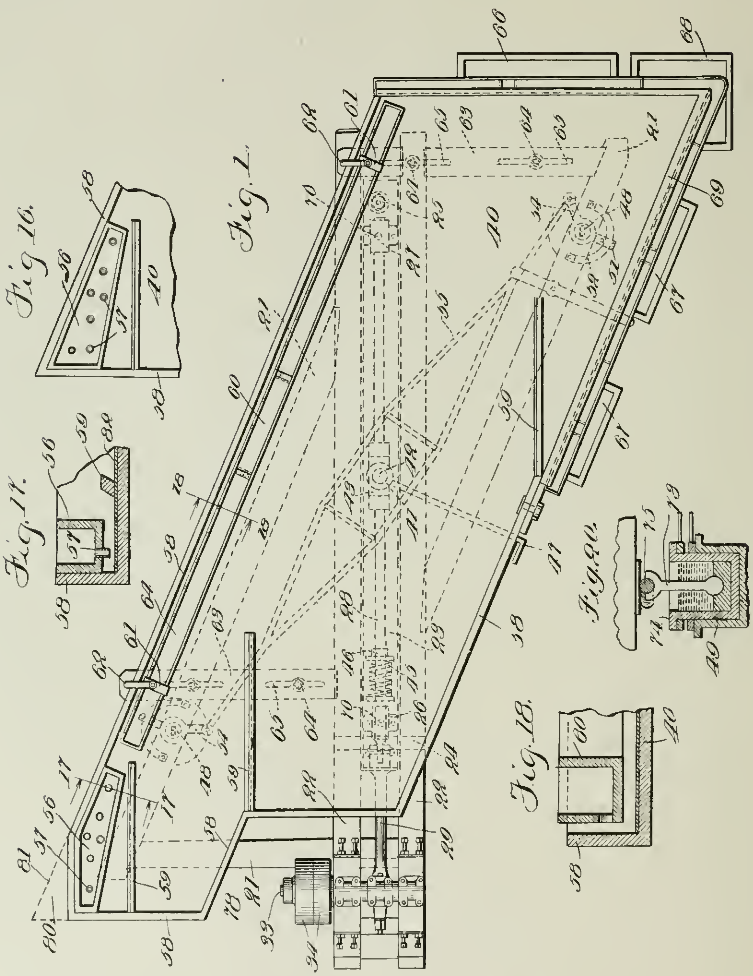
No. 763,783. PATENTED JUNE 28, 1904.

G. A. OVERSTROM.

CONCENTRATING TABLE.

APPLICATION FILED DEC. 3, 1900.

NO MODEL. 5 SHEETS—SHEET 1.



Witnesses
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Attys

No. 763,783.

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G. A. OVERSTROM.

CONCENTRATING TABLE.

APPLICATION FILED DEC. 3, 1900.

NO MODEL.

5 SHEETS—SHEET 2.

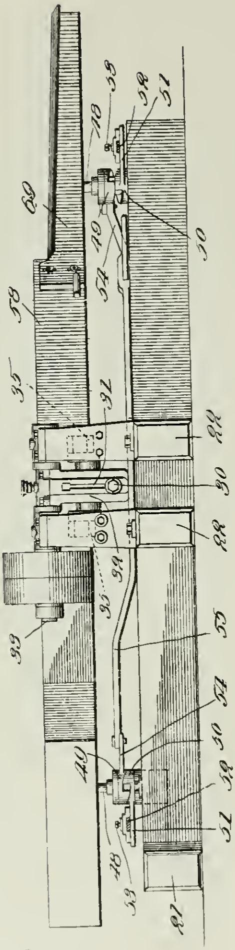

Fig. 2.

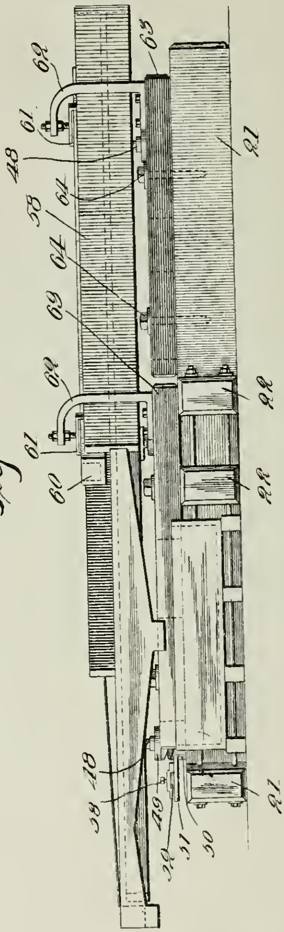

Fig. 3.

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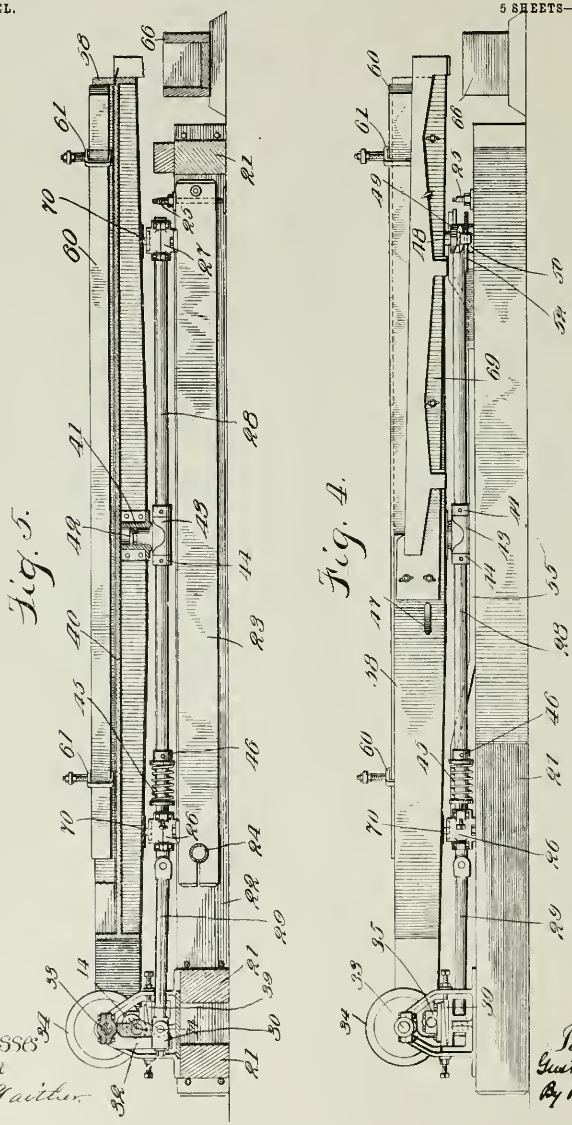
CONCENTRATING TABLE.

APPLICATION FILED DEC. 3, 1900.

NO MODEL. 5 SHEETS—SHEET 3



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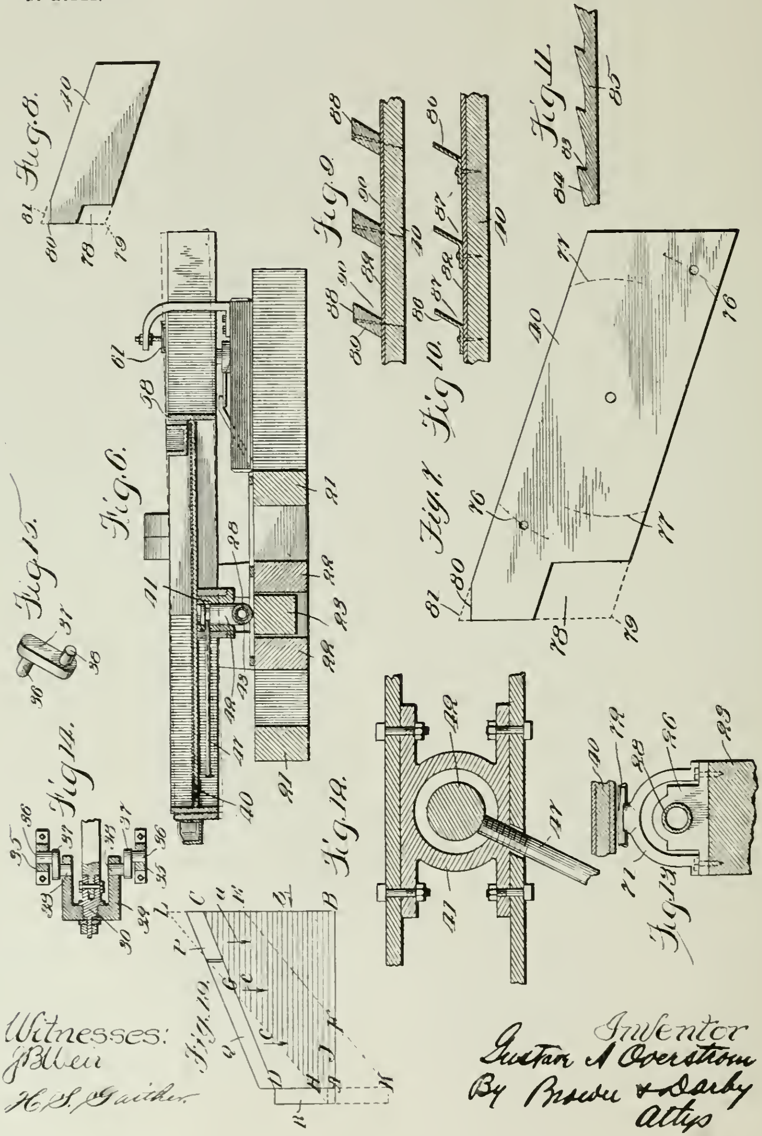
NO MODEL. 5 SHEETS—SHEET 4.



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APPLICATION FILED DEC. 3, 1900.

NO MODEL. 5 SHEETS—SHEET 5.

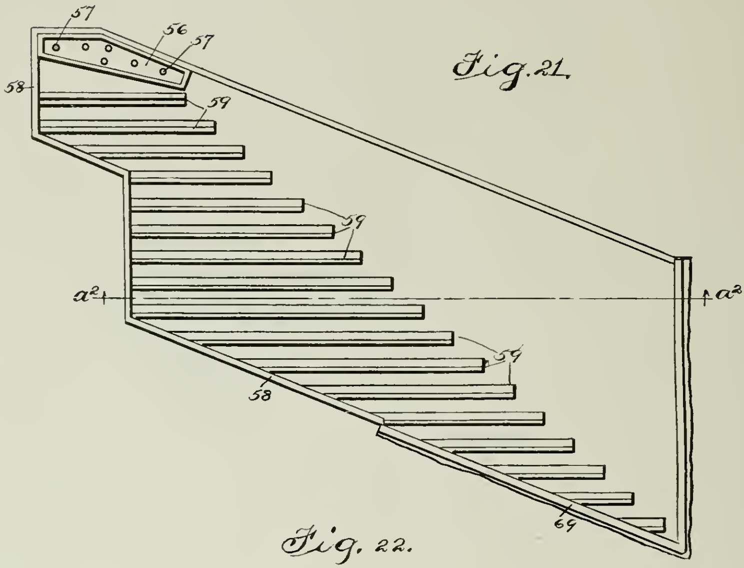
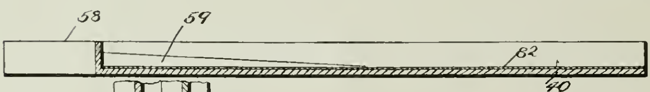


Fig. 21.

Fig. 22.



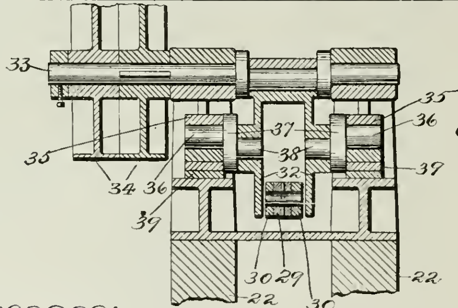


Fig. 23.

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UNITED STATES PATENT OFFICE.

GUSTAVE A. OVERSTROM, OF ANACONDA, MONTANA.

CONCENTRATING-TABLE.

SPECIFICATION forming part of Letters Patent No. 763,783, dated June 28, 1904.

Application filed December 3, 1900. Serial No. 38,435. (No model.)

To all whom it may concern:

Be it known that I, GUSTAVE A. OVERSTROM, a citizen of the United States, residing at Anaconda, in the county of Deerlodge and State of Montana, have invented a new and useful Concentrating-Table, of which the following is a specification.

This invention relates to concentrating-tables.

The object of the invention is to provide a construction and arrangement of concentrating-tables for ores, minerals, and the like and operating means therefor which is simple and efficient.

A further object of the invention is to provide a construction of concentrating-table and operating means therefor wherein the motion of the table under the influence of its actuating means is diagonal with respect to the table.

A further object of the invention is to provide means whereby the movement of the table in one direction consumes less time than its movement in the opposite direction.

A further object of the invention is to provide an arrangement of concentrating-table in which the table is adjustable with reference to its line of movement.

A further object of the invention is to provide means for adjustably regulating the lateral tilt or inclination of the table.

Other objects of the invention will appear more fully hereinafter.

The invention consists, substantially, in the construction, combination, location, and arrangement of parts, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally pointed out in the appended claims.

Referring to the accompanying drawings and to the various views and reference-signs appearing thereon, Figure 1 is a plan view of an ore-concentrating table and its operating mechanism embodying the principles of my invention. Fig. 2 is a front end elevation. Fig. 3 is a rear end elevation. Fig. 4 is a side elevation. Fig. 5 is a longitudinal central section. Fig. 6 is a transverse central section. Fig. 7 is a diagrammatic plan view. Fig. 8 is a view similar to Fig. 7. Fig. 9 is a broken detail view in section, showing an arrangement of riffles embodying the principles of my invention. Fig. 10 is a similar view showing a modified arrangement of riffles. Fig. 11 is a view similar to Figs. 9 and 10, illustrating another modified form of riffles embodying the invention. Fig. 12 is a broken detail view, in horizontal section, showing the means for adjusting the table relative to the line of reciprocation thereof. Fig. 13 is a broken detail view in section, showing a construction of roller bearing or support for the table. Fig. 14 is a broken detail view in section of the actuating mechanism for the table on the line 14 14, Fig. 5. Fig. 15 is a detached detail view in perspective of the swinging link employed in connection with the actuating mechanism. Fig. 16 is a broken detail view in plan of the upper corner of the table, showing the feed-box. Fig. 17 is a broken detail view in section on the line 17 17, Fig. 1, looking in the direction of the arrows. Fig. 18 is a similar view on the line 18 18, Fig. 1. Fig. 19 is a diagrammatic plan view illustrative of features which are avoided in my invention. Fig. 20 is a broken detail view in section, showing a special arrangement of bearing-support for the table involving the principles of my invention. Fig. 21 is a view in plan similar to Figs. 7 and 8, but on an enlarged scale, of a concentrating-table embodying my invention. Fig. 22 is a detail view in section on the line a^2 a^2, Fig. 21. Fig. 23 is a central vertical sectional view through the operating mechanism, taken longitudinally with respect to the operating-shaft.

The same part is designated by the same reference-sign wherever it occurs throughout the several views.

In the operation of separating mineral from ore it is the usual custom to crush the ore to a desirable degree of fineness and then placing the crushed ore, either with or without first subjecting the same to hydraulic or other sizers by which the crushed ore is separated or divided, according to the size of the particles thereof, upon a table or other machine for separating the mineral from the gangue or barren rock. The present invention relates particularly to a machine or table for thus separating and concentrating the crushed ore.

Before entering upon a detailed description of the construction and mode of operation embodying my invention I will first direct attention to different objectionable defects in machines of this character which my invention is designed to overcome, reference being had to the diagrammatic view shown in Fig. 19, which illustrates one of the most successful forms of concentrating-tables at present in use. In this form of concentrating-table the ore is fed to the table or the ore-box, (indicated at P,) and by reason of the lateral inclination of the table and the force or power employed in the delivery of the ore to the table such ore is carried down a short distance in the direction indicated by the arrow a. A reciprocatory motion is imparted to the table in the direction and along the line indicated by the arrow at b. By reason of this reciprocatory movement the particles of ore are moved toward the rear end D A of the table, the reciprocatory movement imparted to the table being parallel with the side A B of the table. During this travel of the particles of ore toward the delivery or rear end D A of the table due to the reciprocatory movement of the table such ore is subjected to the action of wash-water supplied from a suitable box or other receptacle or source, (indicated at Q,) and which wash-water traverses the table laterally in the direction indicated by the arrows c. This wash-water tends to carry the particles in a direction transverse with respect to the line of reciprocation of the table. Thus the particles of ore, gangue, and the like are subjected to forces operating thereon in intersecting lines, and hence under the well-known law of components of forces the particles will be carried in a diagonal direction E F and G H. By reason of its lightness as compared with the ore the rock is carried by the wash-water farther toward the side A B of the table than the mineral, and by reason of its greater weight the mineral is carried by the reciprocatory movement imparted to the table until such mineral is finally delivered over the end of the table along the line H A into a receptacle R, and the barren rock or gangue, called "tailings," is carried over the side of the table between the points J F. "Middlings," so called, but which in this case are mostly free particles of mineral and tailings, are carried over the lower edge of the table between the points A J. It has been the usual custom to provide a suitable elevator for the table to return these middlings again to the feed-box for retreatment. I have found that middlings proper and comprising mineral and rock hanging together are also deposited with the "middlings," so called, above referred to, and are returned by the elevator for retreatment. It has been my experience in practice that middlings proper, as above defined, and from which the mineral is not separated by retreatment upon the table continue to accumulate by continually returning the same to the table until finally the table is unable to take care of the same, and consequently these middlings proper are finally forced into the tailings and the valuable mineral contained therein is wasted.

It is one of the purposes of my invention to provide means and an arrangement such that the middlings proper are efficiently separated by the table, so that they may be recrushed instead of merely being returned over and over again to the table, thus effecting a material saving in valuable mineral matter which has heretofore been wasted and lost, the recrushing of the middlings operating to free the particles of mineral from the rock, and thus permitting separation thereof when fed upon the same or another table. Thus I contemplate not only saving and recrushing the middlings, but also propose to avoid the use of the additional machinery necessary for the middling-elevator.

Again referring to the diagram of Fig. 19, it will be seen that the particles of ore and rock or gangue begin their travel or progression toward the rear end of the table at a point diagrammatically indicated at E and then continue such progressive movement at least until they attain the point indicated at F. Consequently the space E F B of the table is not utilized for any useful purpose, merely the dirty wash-water flowing thereover. Moreover, the space G D H is also wasted so far as practical purposes are concerned, merely the fresh or clean water flowing thereover, and the length of table, at the rear end of which the concentrates are carried, is too short for the purpose, hence resulting in an accumulation of more than the necessary amount of "middlings," so called, and a material proportion of the concentrates are thus deposited in the receptacle which receives such middlings. Thus in the tables at present employed too much floor-space is taken up for the amount of work done, and it is one of the purposes of my invention to provide a construction wherein this objection is avoided and wherein the greatest amount of floor or space on the table is utilized in the performance of the work required of it, and to this end I provide a table in which the waste space F E B of the tables at present in use is placed at another point (indicated by dotted lines at A K F) and the space H D G, which is vacant space, as above explained, and not utilized for any useful purpose in the tables of ordinary construction, I place at the point indicated at G L C. Moreover, in the former construction of tables as above indicated and as illustrated in Fig. 19 the reciprocatory movement imparted to the table has been parallel with the lower side of the table. The result of this arrangement, and particularly where the same rate of movement of the table in both directions is maintained, has been that but very little action or tendency is developed to move the mineral faster than the rock or gangue, except so far as the wash-water acts as a holdback on the rock, which is lighter than the mineral, and not so much as a holdback on the mineral, which is heavier.

In carrying out my invention I propose to move the mineral forward or toward the rear end of the table at a greater rate of speed than the rock or gangue, and hence enabling the rock or gangue to remain a longer period of time on the table, and hence is subjected for a longer period of time to the action of the wash-water, thereby enabling the mineral and the rock to be separated more thoroughly and efficiently. To accomplish this result, I propose to employ a table of substantially diagonal or diamond shape in outline or having a concentrating area so defined and to impart a reciprocatory movement to the table about on the line E H of the diagram or parallel therewith or practically on a diagonal line with respect to the table—that is, on a line which is inclined with respect to the lower edge of the table. In this manner I avoid any vacant or waste space in the operating-surface of the table and I secure a longer distance at D K to accommodate the concentrates.

Again referring to Fig. 19, in the prior construction nothing but waste water and tailings flows over the edge of the table between the points J B. This dirty water and tailings have usually been wasted. I have found, however, that this water and slime frequently contains as high as from two to three per cent., and possibly higher, of certain kinds of ore treated of valuable mineral which it is desirable to save. Therefore in carrying out my invention I propose to arrange a receptacle between the points F E to receive and retain this slime and dirty water and from which this mineral may be collected and saved.

Having now outlined generally some of the important features of improvement of my invention, I will now describe a specific construction and arrangement thereof embodying the principles of my invention, but to which, however, I do not desire to be limited or restricted, as many changes therein and variations therefrom would readily suggest themselves to persons skilled in the art and still fall within the spirit and scope of my invention.

Referring to the drawings, reference-signs 21 22 designate a suitable frame upon which the operating parts of the machine are mounted. The sills 22 of the framing are arranged to extend parallel with respect to the line of application of the reciprocatory movement imparted to the table. Between the sills 22 is arranged a beam 23, pivotally mounted or hinged at one end, as at 24, and adjustably supported at its opposite end by a screw-rod 25 or in any other suitable or convenient manner. By suitably adjusting the screw support 25 the beam 23 may be readily adjusted vertically. Upon beam 23 and adjacent to the respective ends thereof are mounted boxes 26 27, in which is arranged to operate a rod or pipe 28, through which reciprocatory motion is imparted to the table. Pivotally connected to the head end of this rod is a connecting-rod 29, said connecting-rod being pivotally connected at its other end to a sliding block, (indicated at 30, Figs. 2 and 14,) said block being adjustably mounted in a slot 31 in a pitman 32, adapted to be reciprocated from an eccentric or main operating shaft 33. Upon this shaft are mounted the usual fast and loose pulleys 34, adapted to receive rotation from any convenient source of power. In suitable boxes 35 are fulcrumed the crank-arms 36 of a swinging link 37, said link being provided with crank arms or pintles 38, pivotally connected or journaled in the pitman 32 about midway the length of the latter. If desired, the boxes 35, in which the links are fulcrumed, may be vertically adjusted to accommodate for wear or for other purpose by means of the wedge-blocks 39, as most clearly shown in Figs. 4 and 5.

By the construction of operating mechanism above described it will be readily seen that I not only provide means for imparting a reciprocatory movement to connecting-rod 29 and to operating-rod 28, but I am also enabled to vary the length of the stroke thereof and to secure a more rapid movement of said rods in one direction than in the other. Thus by adjusting the block 30 to a point in line with the point of pivotal connection of pintles 38 in said pitman I secure the same rate of speed of reciprocation of rods 28 and 29 in one direction as in the other, and by varying the point of adjustment of block 30 relative to the point of pivotal connection of arms 38 in pitman 32 I am enabled to vary the speed of reciprocatory movement of the operating-rods 29 28 in one direction with reference to the speed of movement of said rods in the opposite direction. Thus I am enabled to readily secure the desired variation to accommodate any particular class or character of ore being treated. It is obvious that other constructions varying in the specific details thereof from the construction above described may be employed for securing the same object. I do not desire, therefore, to be limited to the specific details shown and described. The construction shown, however, I have found to be practical and admirably answering the desired purpose.

The table proper (indicated at 40) may be constructed of the usual or any convenient or suitable material. Upon the under side of the table and at a point approximately at the geometric center thereof is formed or secured a socket 41, adapted to receive a pin or projection 42, formed with or attached to a sleeve 43, mounted upon rod 28 and held between collars 44. The pin or stud 42 forms a swivel connection between rod 28 and the table, whereby the table is permitted a swinging movement laterally or in a horizontal plane, and by reason of the sleeve 43 being mounted on rod 28 the table is permitted of a lateral tilting to secure the desired adjustments thereof, as will presently be explained more fully, while at the same time said pin-and-socket connection affords means of attachment of the table to the rod 28, whereby reciprocations are imparted to the table when the rod 28 is reciprocated. If desired, a spring 45 may be interposed between guide-box 26 and a collar 46 on rod 28 to take up any lost motion or wear.

The table 40 may be held in any position of horizontal or swinging adjustment in any suitable or convenient manner, as by means of the screw-rod 47, and the object of this swinging or horizontal adjustment of the table about stud 42 as a pivot or axis is to properly adjust the inclination of the table relative to the line of reciprocation thereof, or rather to adjust the inclination of the lower edge of the table to such line of reciprocation, according to the quality or character of the ore being treated.

It is desirable to provide means for laterally adjusting or tilting the table. This lateral tilt or adjustment may be effected in many specifically different ways. I have shown a simple and efficient construction and arrangement for securing the desired result, but to which I do not desire my invention to be limited or restricted. In the construction shown I arrange the table to be supported at the upper and lower diagonally opposite corners thereof upon bearings (indicated at 48) carried by a support upon cam-sleeves 49, the cam-surfaces of which rest upon coöperating cam surfaces or sleeves 50. The cam-sleeves 49 50 at the diagonally opposite corners of the table are adjustable relatively to each other and are arranged for independent or for coöperating or coincident adjustment. The independent adjustment at either corner of the table may be secured by means of a crank-arm 51, connected to one of the cam-sleeves. These cam-arms operate over segment-plates 52. The crank-arms 51 may be held in any desired position of adjustment by means of the set-screw 53. Thus by loosening the set-screw for one or the other of the crank-arms 52 and rocking said arm the desired independent adjustment of the diagonally opposite corners of the table may be effected. The coincident or simultaneous adjustment of the diagonally opposite corners of the table may be effected by means of crank-arms 54, respectively connected to the cam-sleeves 49 of supports 48, said crank-arms being connected together by connecting-bars 55, so that when said connecting-bars are shifted the cam-sleeves 49 are simultaneously actuated, thus simultaneously adjusting the diagonally opposite corners of the table. It is obvious that the adjustment of one corner of the table may be an elevating adjustment and of the other corner a lowering adjustment, thereby quickly securing the desired tilt or angle of inclination of the working surface of the table.

The ore to be treated may be delivered upon the table from any suitable source of supply and in any suitable manner. Where such ore is delivered to the table from hydraulic sizers, I employ a feed-box 56 at the extreme upper corner of the table, said feed-box delivering to the surface of the table. I have shown said feed-box provided with short sections of delivery-pipes 57 through the bottom thereof and which extend nearly to the surface of the table, as most clearly shown in Fig. 17, for a purpose presently to be explained. I provide a rib or flange 58 to extend several inches above the top surface of the table along the upper edge thereof and the head end and to a point about midway the length of the lower edge, as most clearly shown in Fig. 1, and adjacent to the feed-box I place one or more stops, (indicated at 59.) The purpose of this construction is to enable some of the fine mineral associated with the crushed ore and which is carried in suspension in the feed-water to settle upon the surface of the table by reason of the first rush of the water through the feed-box being arrested by the stop or stops 59 and the flange 58, thus permitting such fine mineral, which would otherwise be carried on into the waste or tailings of the ordinary construction, to become deposited or settle upon the surface of the table and to be carried by the combined action of the reciprocations of the table and of the wash-water. These are features of my invention which coöperate with the arrangement shown and described, wherein the lower side of the table is diagonal or oblique to the line of reciprocation of the table, as provision of the stop or stops 59, and especially of the rib or flange 58, would be of no special utility if the lower side or edge of the table were parallel with the line of reciprocation of the table. This is an important and valuable feature of my invention, as thereby I am enabled to successfully treat ores of finer mesh than is possible otherwise. The wash-water may be supplied to the table-surface in any suitable or convenient manner or from any convenient source. I have shown a receptacle or launder 60, loosely suspended in stirrups 61, carried by the gooseneck-supports 62, said gooseneck-supports being fastened to supporting-blocks 63, adjustably secured by means of lag-screws 64, operating through slots 65 in said blocks 63, whereby said blocks are secured to a supporting-beam 21 of the frame of the machine. By this construction the wash launder or receptacle 60 may be readily moved or shifted endwise to conform to the requirements of the ore, and by adjustably supporting the gooseneck 62 upon the sills 21 said goosenecks may be suitably adjusted to accommodate the swinging or horizontal adjustment of the table, the loose suspension of the launder avoiding binding thereof during such swinging adjustment.

At the rear end of the table I arrange a suitable receptacle 66 to receive the concentrates, and along the lower portion of the lower edge of the table I arrange a suitable receptacle 67 to receive the wash and feed water and tailings, it being understood that the tailings are lighter than the mineral, and hence are carried farther by the action of the wash-water transversely across the table, and hence are delivered from the table over the lower edge thereof, while the mineral, being heavier, is carried farther and faster by the reciprocations of the table and is carried over the rear end of the table and delivered into the receptacle 66 as concentrates. The "middlings," properly called, being heavier in weight than the tailings and lighter in weight than the mineral, are carried more nearly in a diagonal line and are delivered from the table at a point adjacent to the lower corner thereof, and hence at this point I arrange a receptacle 68 to receive the same and from which such middlings may be collected and recrushed before further treatment.

I have found in practice that it is desirable to build up a bed of ore on the surface of the table, which bed will serve the purpose of permitting some of the fine mineral to be covered by the gangue or tailings, thereby decreasing the liability of such fine mineral being carried over the lower edge of the table by the wash-water. To accomplish this result, I adjustably attach a strip 69 at the lower edge of the table and extending from the termination of flange 58 to the lower corner of the table, as clearly shown, said strip projecting a decreasing extent above the top surface of the table from the end of flange 58 to the corner. In this manner I am enabled to regulate the depth of the bed of ore on the table as desired, the depth of said bed being nothing at the extreme corners of the table and increasing in depth toward the head of the table, and by so providing and adjustably regulating the depth of bed of ore on the table I am able to run the feed of material from the feed-box underneath such bed, and this is the purpose of the short pipe-sections 57, extending through the bottom of the feed-box 56 to a point in proximity to the top surface of the table. Thus the feed material carrying fine particles of mineral is delivered to the table underneath the bed of previously-introduced ore, the overflowing bed of ore serving to hold or retain such fine particles until they settle or become deposited upon the surface of the table. This feature of my invention is a most important and valuable one in the practical operation in devices of this character, as it results in effecting a saving of a material proportion of mineral which is not saved by the ordinary construction.

In addition to the supports for the table afforded at 48, as above explained, said table may also be supported at other points—as, for instance, upon bearings 70. These bearings may be similar to the bearings 48, and, if desired, and as shown in Figs. 1, 4, and 5, said bearings may consist of balls resting in seats provided therefor on the top of guide-boxes 26 27, thus not only forming bearing-supports for the table, but permitting the movements of the table above described.

In Fig. 13 I have shown a modified arrangement of bearing-support for the table and comprising a bracket 71, suitably supported and having a seat to receive a ball or bearing 72 upon the table.

In Fig. 20 I have shown another form of bearing-support for the table which I have found effective and wherein is employed a rocking support 73, loosely journaled or stepped in a sleeve or case 74 and provided with a seat to receive a bearing or roller support 75, upon which the table rests. If desired, the step-sleeves 74 may contain a lubricant, as clearly indicated.

It is obvious that the construction shown in Figs. 13 and 20 may be employed at any desired point as a support for the table. The construction illustrated in Fig. 13 is shown as applied to the bearing for the table in the line of beam 23 and in the vicinity of a bearing-box for the operating-rod 28, the bracket 71 being arranged to straddle said box, while in Fig. 20 I have shown the bearing-support as applied at the diagonal corners of the table and wherein the adjusting cam-sleeve 49 forms a support for the bearing-sleeve 74. Where roller-bearings are provided for the table, said bearings should be curved on a radius struck from the axis of horizontal rotation or adjustment of the table, as indicated in dotted lines at 76 77, Fig. 7.

I have shown a portion of the table at its head end cut out at 78 in order to accommodate the operating mechanism. This portion of the table is not of material consequence and does not materially reduce the effective operating-surface of the table, inasmuch as the main operations of the table occur diagonally with respect thereto, and by omitting the portion which would otherwise fill the space indicated at 78 to accommodate the gearing I am enabled to shorten the space occupied by the table. If desired, however, this part of the surface of the table may be retained, as indicated in dotted lines at 79. (See Figs. 7 and 8.)

It is desirable to provide ample space between adjacent tables erected in the same room in order to permit ready movement of employees therebetween. In order to secure as much space for this purpose as possible, I may, if desired, omit the extreme upper corner of the table, as indicated at 80. If desired, however, this portion of the table may be retained, as indicated in dotted lines at 81.

It is usual to form the table of material which is impervious to water. The same result, however, may be obtained by lining or covering the top surface of the table with a suitable impervious material—such, for instance, as linoleum, sheet metal, waterproof, or the like—as indicated at 82. It is sometimes desirable to employ riffles and arrange the same upon the upper surface of the table. These riffles form lags or holding projections for the ore and for the wash-water and aid in effecting the proper separation of the mineral from the gangue or barren rock. In cases where riffles are employed in connection with the table of my invention I prefer to so construct such riffles as to present an inclined upper surface, over which the ore and wash-water may readily pass, and rearwardly-inclined lower surface and diminishing in height toward the tail end of the table. This result may be secured by suitably grooving or undercutting the top surface of the table 85, as indicated at 83, the top or upper surface 84 being inclined in the direction of flow of the wash-water, while the undercut portion 83 is rearwardly inclined with respect to the direction of flow of the water. (See Fig. 11.) The same result may be obtained by providing flanged strips 86, suitably secured upon the top surface of the table 40 and inclined in the direction of the lower edge of the table, thus forming rearwardly-inclined pockets 87. (See Fig. 10.) Similarly, the same result may be secured by means of strips 88, suitably secured upon the top surface of the table, (see Fig. 9,) said strips being inclined on the surface thereof, as indicated at 89, which is presented toward the direction from which the wash-water flows and are similarly inclined on the opposite side thereof to form similar pockets 90. (See Fig. 9.) If desired, the stops 59 may be similarly inclined, as clearly shown in Fig. 17. By such constructions and arrangements of the riffles the tailings are more readily and easily washed over the riffles, and fine particles of mineral would become deposited or would settle in the pockets 83, 87, or 90, as the case may be, in which pockets the water flowing over the riffles forms an eddy or is not materially agitated by the flow of the wash-water, thereby permitting the particles of mineral to settle upon the surface of the table, and thus materially aiding in the separation of the mineral from the ore and adding to the material effectiveness in practical use and operation of a table embodying my invention.

In Fig. 8 I have shown in diagrammatic plan a preferred arrangement of riffles, where such devices are employed, and wherein the riffles (indicated diagrammatically at 91) are arranged to extend from the head end of the table and from the lower edge thereof substantially parallel with the line of reciprocation of the table and said riffles respectively terminating on a diagonal line from the upper and lower corners of the table. By this arrangement of riffles in connection with a table having its lower edge inclined relative to the line of reciprocation of the table it will be observed that the riffles are shorter in length toward the lower corner of the table.

It is believed that the operation of a concentrating-table embodying the principles of my invention, as above explained, will be readily understood and comprehended by persons skilled in the art when taken in connection with the foregoing description and the accompanying drawings.

It will be obvious that many variations in the details of construction and arrangement would readily suggest themselves to persons skilled in the art and still fall within the spirit and scope of my invention. I do not desire, therefore, to be limited or restricted to the exact details shown and described; but

What I claim as new and useful and of my own invention, and desire to secure by Letters Patent of the United States, is—

1. A concentrating-table, in combination with means for imparting a reciprocatory movement thereto, said table having an unobstructed tailings-delivery edge, said edge being inclined away from the line of reciprocatory movement from the head end of the table toward the opposite end thereof, and riffles arranged in diagonal relation with respect to said table, as and for the purpose set forth.

2. A concentrating-table having parallel upper and lower edges, said lower edge forming the tailings-discharge edge of the table and being unobstructed, and means for rectilinearly reciprocating said table in a line from the end of one edge to the diagonally opposite end of the other edge, as and for the purpose set forth.

3. A concentrating-table, in combination with means for rectilinearly reciprocating the same, the tailings-delivery edge of said table being unobstructed and throughout the length thereof inclined away from the line of rectilinear movement from the head end of the table toward the opposite end thereof, said reciprocating means operating to move the table faster in one direction than in the other, as and for the purpose set forth.

4. The combination with an operating-shaft having an eccentric, a pitman operated by said eccentric, swinging bearings for said pitman,

in combination with a concentrating-table, and a rod directly connecting said table and pitman, whereby less time is consumed in the forward stroke than is consumed in the backward stroke, as and for the purpose set forth.

5. The combination with a drive-shaft, having an eccentric, a pitman operated by said eccentric, swinging bearings for said pitman, a receiving-table, a rod directly connecting said table and pitman, said rod being adjustable with respect to said pitman, whereby a reciprocatory movement is imparted to said table, such movement consuming less time in one direction than in the other, as and for the purpose set forth.

6. The combination with a main drive-shaft having an eccentric, a pitman actuated by said eccentric, a swinging bearing for said pitman, a block mounted on said pitman for adjustment lengthwise thereof, a concentrating-table, and direct connections between said table and block, as and for the purpose set forth.

7. The combination with a main drive-shaft having an eccentric, a pitman actuated by said eccentric, said pitman being longitudinally slotted, a swinging bearing for the free end of said pitman, a block adjustably mounted in the slot in said pitman, a concentrating-table, and connections between said table and block, as and for the purpose set forth.

8. The combination with a main drive-shaft having an eccentric, a pitman actuated by said eccentric, a fulcrumed link pivotally connected to said pitman, a connecting-rod adjustably connected to said pitman, a concentrating-table, and connections between said table and connecting-rod, as and for the purpose set forth.

9. The combination with a main drive-shaft having an eccentric, a pitman actuated thereby, a bearing-block, a link fulcrumed in said block and pivotally connected to said pitman, a concentrating-table, and connections independent of said link between said table and pitman, as and for the purpose set forth.

10. The combination with a main drive-shaft having an eccentric, a pitman actuated thereby, a bearing-block, means for adjusting said block, a link fulcrumed in said block and pivotally connected to said pitman, a concentrating-table and connections between said table and pitman, as and for the purpose set forth.

11. A concentrating-table, and means for rectilinearly reciprocating the same, said table having a tailings-discharge edge inclined with respect to the line of reciprocatory movement of said table, and means for adjusting the position of said table to vary the degree of inclination of said tailings-discharge edge with respect to the line of reciprocation, as and for the purpose set forth.

12. A concentrating-table, and means for rectilinearly reciprocating the same, said table having a tailings-discharge edge inclined with respect to the line of reciprocatory movement of said table, in combination with swivel connections between said table and its reciprocating means to permit adjustment of said table to vary the angle of inclination of said tailings-discharge edge with respect to the line of reciprocation of said table, as and for the purpose set forth.

13. A concentrating-table having a tailings-discharge edge, and means for rectilinearly reciprocating said table on a line inclined with respect to said tailings-discharge edge, said means including a reciprocating rod, and swivel connections between said table and rod to permit the angle of inclination of said tailings-discharge edge relative to the line of reciprocatory movement of said table to be adjustably varied, as and for the purpose set forth.

14. A concentrating-table, and means for rectilinearly reciprocating the same, said table having a tailings-discharge edge inclined with respect to the line of movement of the table, said reciprocating means including a reciprocating rod, a casting carried by said rod and forming a pivotal support for said table to permit of the lateral adjustment of said table to adjustably vary the inclination of said tailings-discharge edge relative to said line of reciprocation, as and for the purpose set forth.

15. A concentrating-table, and means for rectilinearly reciprocating the same, said table having a tailings-discharge edge inclined with respect to the line of reciprocatory movement of said table and riffles upon the upper surface of said table and arranged to extend in the line of operation of said reciprocating means, said means including a reciprocatory rod, a casting carried upon said rod for movement therewith, said casting arranged to pivotally engage said table to permit of the lateral adjustment of said table to vary the inclination of said tailings-discharge edge with respect to the line of reciprocatory movement of said table, as and for the purpose set forth.

16. A concentrating-table having parallel sides and ends, and means for reciprocating said table on a line diagonal with respect to said sides, said means including a reciprocatory rod, a casting loosely sleeved upon said rod and carrying a stud arranged to engage said table, means for laterally tilting said table about said stud to vary the angle of inclination of the sides of said table relative to the diagonal line of reciprocation, as and for the purpose set forth.

17. A concentrating-table having a socket or seat at the axial center thereof, a rectilinearly-reciprocating rod for reciprocating said table, a stud carried by said rod and arranged to be received in said socket or seat, means for adjusting said table about said stud and

means for locking said table in adjusted position, as and for the purpose set forth.

18. A concentrating-table having parallel sides and ends, and means for reciprocating said table in a line diagonal with respect to said parallel sides, in combination with bearing-supports upon which the upper and lower corners of said table rest, said supports being arranged respectively on opposite sides of said reciprocating means, and means for adjusting said bearing-supports to adjustably vary the tilt of the surface of said table, as and for the purpose set forth.

19. A concentrating-table having sides parallel with respect to each other, and means for reciprocating said table on a line diagonal with respect to said parallel sides, said means including an actuating-rod connected to said table, adjustable bearing-supports for the extreme upper and lower diagonal corners of said table, said bearing-supports being arranged respectively on opposite sides of said actuating-rod, and connections between said bearing-supports for simultaneously adjusting the same to vary the inclination or tilt of the surface of the table, as and for the purpose set forth.

20. A concentrating-table, means for rectilinearly reciprocating said table, including an actuating-pitman, bearing-supports for the diagonally opposite corners of said table, said supports arranged on opposite sides of said pitman, connections between said bearing-supports for simultaneously adjusting the same, and means for independently adjusting said bearing-supports, as and for the purpose set forth.

21. A concentrating-table having parallel sides or edges, means for reciprocating said table on a line diagonal with respect to said parallel sides or edges, and means for adjusting said table laterally with respect to its line of reciprocation to vary the inclination of said edges with reference to the line of reciprocatory movement, in combination with stirrups, means for adjustably supporting the same adjacent to the upper edge of said table, and a wash-water-supply box loosely suspended in said stirrups, as and for the purpose set forth.

22. A concentrating-table having its upper and lower sides or edges substantially parallel with each other, and means for reciprocating said table in a diagonal direction, whereby the lower or tailings-discharge edge of said table is inclined with respect to the line of reciprocation, supports for the extreme upper and lower diagonally opposite corners of said table, said supports arranged respectively on opposite sides of the reciprocating means and comprising cam-sleeves, and means for moving said cam-sleeves for adjustably varying the angle of inclination of the surface of said table, as and for the purpose set forth.

23. A concentrating-table having its upper and lower sides substantially parallel with each other, a rod connected to said table in a line diagonal with respect to said parallel sides, and means for longitudinally reciprocating said rod, in combination with supports for the extreme upper and lower diagonally opposite corners of said table and arranged respectively on opposite sides of said rod, each support comprising a pair of cam-sleeves, and means for moving one member of each pair of cam-sleeves with respect to the other member, whereby the tilt or inclination of the surface of the table may be adjustably varied, as and for the purpose set forth.

24. A concentrating-table having its upper and lower sides substantially parallel with each other, a rod connected to said table in a line diagonal with respect to said parallel sides, and means for reciprocating said rod longitudinally, in combination with supports for the extreme diagonally opposite corners of said table, and arranged respectively on opposite sides of said rod, each of said supports comprising a pair of coöperating cam-sleeves, the members of each pair of said sleeves being relatively adjustable, as and for the purpose set forth.

25. A concentrating-table and means for reciprocating the same, in combination with bearing-supports for said table, said bearing-supports each comprising an upper and lower cam-sleeve, means for independently adjusting said cam-sleeves, and connections between said cam-sleeves whereby said table may be adjusted independently at each bearing-support or coincidently, as and for the purpose set forth.

26. A concentrating-table, means for reciprocating the same, the tailings-discharge edge of said table throughout its length being inclined away from the line of reciprocation from the head end of the table toward the opposite end thereof, and riffles or projections upon and in diagonal relation with respect to the table-surface, said riffles or projections being arranged in substantially parallel relation to the line of reciprocation of the table, as and for the purpose set forth.

27. A concentrating-table having riffles upon the upper surface thereof, the lower or tailings-discharge edge of said table being unobstructed and inclined with respect to said riffles, and means for imparting a reciprocatory movement to said table in the direction of the length of said riffles, as and for the purpose set forth.

28. A concentrating-table of substantially diamond shape, in combination with means for imparting reciprocatory movements to said table in a direction diagonal with respect to said table.

29. A concentrating-table of diamond shape in outline, in combination with means for imparting reciprocatory movements to said ta-

ble in a direction diagonal with respect to said table, and riffles arranged upon the surface of said table and extending in the direction of the reciprocatory movements imparted to the table.

30. A concentrating-table having a substantially diamond-shaped concentrating area, means for reciprocating such table in the direction of the diagonal of such area, and riffles arranged on said concentrating area and parallel with each other and with the line of reciprocating movement of the table.

In witness whereof I have hereunto set my hand, this 24th day of November, 1900, in the presence of the subscribing witnesses.

GUSTAVE A. OVERSTROM.

Witnesses:
GEO. A. LONG.
C. M. SAWYER.

COMPLAINANTS' EXHIBIT No. 48

Dodd Patent No. 694,005

ALMON E. HART, Special Examiner

No. 694,005. Patented Feb. 25, 1902.

W. G. DODD.

ORE CONCENTRATOR.

(Application filed Mar. 18, 1901.)

(No Model.)

Fig. 1.

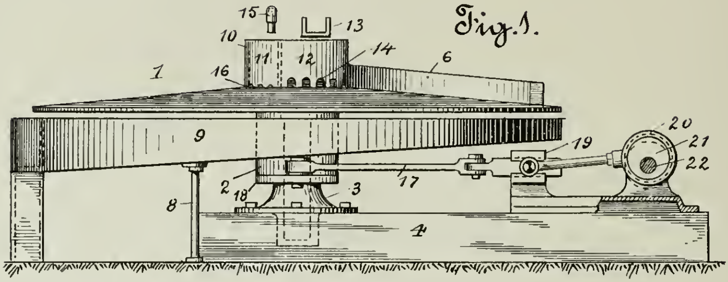
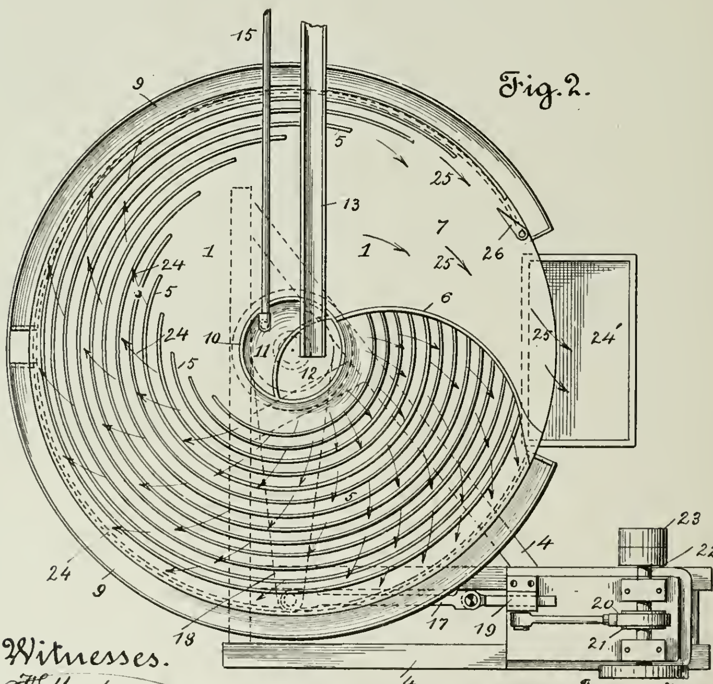


Fig. 2.



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UNITED STATES PATENT OFFICE.

WILLIS G. DODD, OF SAN FRANCISCO, CALIFORNIA.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 694,005, dated February 25, 1902.

Application filed March 18, 1901. Serial No. 51,619. (No model.)

To all whom it may concern:

Be it known that I, WILLIS G. DODD, a citizen of the United States, residing in the city and county of San Francisco, State of California, 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 same.

The invention relates more especially to that class of concentrators known as "shaking-tables" in contradistinction to the endless-belt concentrators; and the object of the invention is the production of a machine which having large capacity shall occupy but small floor-space and a machine capable of effecting approximately perfect separation of the valuable particles of mineral from its attendant gangue while the pulp is traveling over the surface of the table on what may be termed "natural" lines due to the forces acting upon it. In this class of ore-concentrators the reciprocating concentrating-tables have ordinarily been constructed in the shape of a parallelogram, upon the surface of which are placed longitudinal riffles, the valuable particles of mineral to be separated from the gangue carried by the pulp fed onto the table being caught in the riffles and carried longitudinally toward the tail or discharge end of the table, while the worthless portion of the pulp or gangue flows transversely over the table and is discharged at the bottom side of the table and permitted to escape. When the pulp is treated with said form of table, a material loss occurs in the escape of fine particles of mineral, which loss takes place for the following reasons: The path of the valuable particles of mineral, due to the motion given the table, is along the upper sides of the longitudinal riffles toward the tail or discharge end of the table. The path of the gangue or worthless material of the pulp, due to gravity, is transversely across the table. These two paths intersecting each other, as they do, at approximately a right angle, a disturbance is caused and loss of fine material caught by the riffles takes place.

In the present invention the face of the table is of such construction that the path of the mineral and the path of the gangue in their movement over the face of the table intersect each other at a very oblique angle, causing little or no disturbance to the mineral caught by the riffles. Consequently the loss of the mineral sought to be saved is reduced to a minimum.

In order to comprehend the invention, reference should be had to the accompanying sheet of drawings, wherein—

Figure 1 is a side view in elevation of the improved concentrator, and Fig. 2 is a plan view of the mechanism disclosed by Fig. 1 of the drawings.

In the drawings the numeral 1 is used to indicate the circular concentrating-table, which in the present case consists of a circular cone centrally supported by a vertical shaft 2, which works in bearing or box 3, secured to the base or platform 4. The table-surface or working face is provided with a series of riffles 5, concentric to each other, but preferably with reference to the center of the table, each describing the involute of a circle. These riffles start from the curved partition 6, which may be termed the "head" of the circular table for the purpose of the riffles' starting-point, and are run, preferably, on regular concentric involute curves described around the center of the table, said riffles being of such length as to make the discharge end of the lower riffle extend a slight distance beyond the one above.

The table may be constructed of any suitable material and the riffles be formed integral therewith in the form of depressions or separate therefrom and secured thereto in any suitable manner.

The table is provided with a plain or unriffled portion 7, onto which portion of the table the valuable particles of the material are discharged from the riffles for final treatment.

To the standards 8 is secured the gangue-receiving trough 9, which is circular in form and arranged below the periphery of the concentrating-table. This trough receives the gangue or worthless material discharged from or washed off of the table, and the length of said trough is equal to or slightly greater than that of the lowermost riffle of the table.

At the apex or near the center of the table is arranged the feed-box 10, which box is divided by a central partition into compartments 11 12. Compartment 12 is the ore or pulp receiving compartment, into which the ore or pulp to be distributed over the table is delivered by the feed-chute 13. From this compartment the pulp escapes onto the table through outlet or escape openings 14, formed therein. Compartment 11 acts as a reservoir for the water to be distributed onto the plain or unriffled portion of the table, the water being delivered into said compartment by means of the water-supply pipe 15 and escaping from said compartment onto the unriffled portion of the table through the minute outlet-openings 16.

Any suitable form of mechanism may be employed for imparting an oscillatory motion to the table 1. In the present case the table is illustrated as being operated through the medium of the jointed connecting-rod 17, connected at one end to the outer end of arm 18, projecting from the vertical shaft 2. The free end of the connecting-rod works through guide-bearing 19 and is attached to the eccentric-strap 20, surrounding cam 21, secured to the drive-shaft 22. Motion is imparted to the drive-shaft from any suitable source of power by means of power-belt (not shown) working over belt-wheel 23, attached to the drive-shaft.

The operation of the machine is as follows: Power is applied to the drive mechanism by any suitable means, setting same in motion, which movement is communicated to the table by means of the connecting-rod 17, causing the table to oscillate or reciprocate around its central support or bearing-gudgeon 3. Finely-crushed ore mixed with water, usually designated as "pulp," is conveyed into compartment 12 of the feed-box 10, from which it is fed onto the table 1 through suitable outlet-openings 14, made for the purpose. The pulp, due to the inclination or cone shape of the table, flows down radially toward the circumference, coming in contact with the obstructing-riffles 5, where the valuable particles of the mineral are caught and due to the reciprocating or oscillating motion given the table are moved around the table and onto the unriffled portion 7, where any particles of gangue contained in the concentrates are washed out by means of clear water discharged upon the table from the water-compartment 11 of box 10. This water also serves to lubricate the smooth unriffled portion of the table, permitting the concentrates to continue traveling around the table until they are discharged into the box 24′, which receives the concentrates. The gangue, the mineral being eliminated, flows downward over the riffles and is discharged at the periphery of the table into the trough or waste-launder 9.

The construction of the concentrating-table, together with the motion imparted to it, effects a separation of the mineral from the gangue upon lines entirely different from those of any machine of its class, due to the following reasons: The motion or agitation given to the pulp is variable, being very slight at or near the center of the table and rapidly increasing toward the periphery. The pulp is subjected to a series of impulses due to the centrifugal action caused by the oscillation of the circular table. The riffles being on a spiral or involute of a circle form a pathway of travel for both gangue and mineral, at all points a gentle downward grade, which enables the mineral to settle and the gangue to separate therefrom while both are traveling at approximately the same velocity, their paths diverging at an angle so oblique as to cause little or no disturbance, and consequently no loss of the valuable particles sought to be saved. The flow of the gangue is indicated by arrows 24 and that of the mineral by arrows 25. It will be observed that the path of the gangue while transverse of the table is at an oblique angle to the path of the mineral at the intersection of the paths. Consequently there is little, if any, disturbance at such point.

There is hinged to the unriffled portion of the table at the extremity of the lowermost riffle a deflecting-finger 26. This finger serves to guide such of the gangue as may escape from said riffle onto the plain or unriffled portion of the table into the launder or circular trough for the gangue, thus preventing same discharging into the box located to receive the mineral discharged from the plain or unriffled portion of the table.

Having thus described the invention, what is claimed as new, and desired to be protected by Letters Patent, is—

1. An ore-concentrator comprising an oscillatory inclined table having an unriffled or plain surface adjacent its discharge portion for the separated mineral, a series of curved riffles upon the working face of the table, said riffles extending from approximately a radial division and terminating at and discharging onto the plain or unriffled surface of the table, and means whereby an oscillating motion is imparted to the table whereby the mineral and gangue travel within the riffles at approximately the same velocity until separation takes place.

2. An ore-concentrating apparatus comprising an oscillatory table inclined outwardly from its center, means for imparting an oscillating motion to the table during the treatment of the ore, a plain or unriffled portion to the table, a series of curved riffles arranged on the working face of the table eccentric to its center, each riffle increasing in length and extending a greater distance into the unriffled portion of the table than the riffle immediately above.

3. A concentrating apparatus comprising an oscillatory concentrating-table, means whereby an oscillating motion is imparted to the table, a series of concentric riffles arranged upon the working face of the table,

each riffle being the involute of a circle, and of a plain or unriffled portion to the table intermediate the ends of the riffles.

4. A concentrating apparatus comprising an oscillatory concentrating - table, means whereby an oscillating motion is imparted to the table, a series of concentric riffles arranged upon the working face of the table, each riffle being the involute of a circle and its discharge end terminating at a point beyond that of its preceding riffle and a plain or unriffled surface to the table onto which the riffles discharge.

5. The combination in a concentrating apparatus, of a circular concentrating-table, of means whereby an oscillating motion is imparted to the table, and of a series of curved riffles arranged upon the working face of the table, said riffles being concentric, and a plain or unriffled portion to the table onto which the riffles discharge.

6. In an ore-concentrating apparatus, the combination with a cone-shaped concentrating-table, having a plain or unriffled portion, of means for imparting an oscillating motion to said table, and a series of concentric involute curved riffles arranged on the working face of the table, the discharge end of each riffle terminating at a point beyond that of the riffle immediately above the same.

7. In an ore-concentrator, the combination with the cone-shaped table mounted to oscillate around a central vertical axis, a plain or unriffled portion to the table, a pulp and water distributing box arranged to distribute the pulp and water at the apex of the cone, a series of downwardly-inclined curved riffles arranged on the working face of the table and extending onto the plain or unriffled portion thereof, the discharge end of each riffle being beyond that of the riffle immediately above, and means whereby an oscillating motion is imparted to the concentrating-table.

8. In an ore-concentrator, the combination with the circular cone-shaped table having a plain or unriffled portion, of means for imparting an oscillatory motion to the table, a pulp and water distributer arranged to distribute at the center of the table, a partition-wall secured to the working face of the table, and a series of concentric curved riffles extending from said partition-wall across the working face of the table.

9. In an ore-concentrating machine, the combination with the circular concentrating-table having an upper radially-sloping face, of devices for supplying water and pulp to said table, a central support for the table, a bearing for the support, a plain or unriffled portion to the table, means for imparting an oscillating motion to the table, and a series of downwardly-inclined curved riffles arranged upon the working face of the table, each riffle extending and discharging onto the plain or unriffled portion of the table.

10. In an ore-concentrator, the combination with the concentrating-table having a plain or unriffled portion, of means for imparting an oscillating movement to the table, a series of concentric riffles arranged on the working face of the table, each of which discharges onto the plain or unriffled portion of the table, devices for supplying water and pulp to the table, and a circular trough or launder arranged to receive the gangue discharged from the table.

11. In an ore-concentrator, the combination with the concentrating-table having a plain or unriffled portion, of means for imparting an oscillating motion to the table, a series of curved riffles arranged on the working face of the table, each riffle discharging onto the plain or unriffled portion of the table, devices for supplying water and pulp to the surfaces of the table, a circular trough or launder for receiving the gangue discharged from the table, and a deflecting-finger secured to the unriffled portion of the table at a point beyond the discharge end of the bottom riffle.

In witness whereof I have hereunto set my hand.

WILLIS G. DODD.

Witnesses:
N. A. ACKER,
D. B. RICHARDS.

COMPLAINANTS' EXHIBIT No. 49

Dodd Patent No. 666,002

ALMON E. HART, Special Examiner

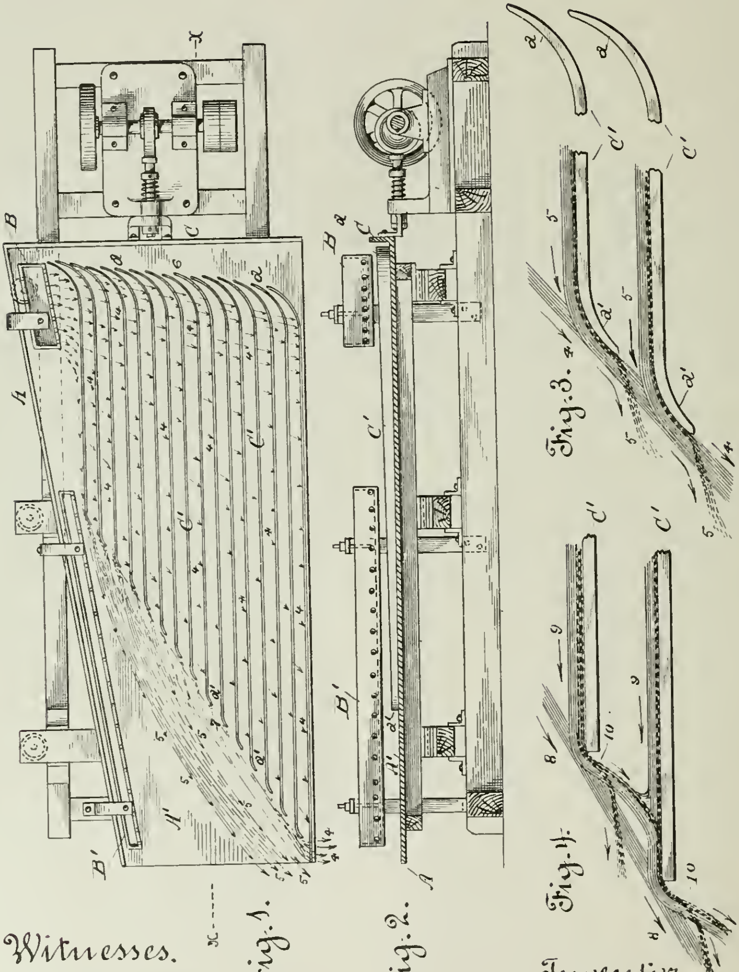
No. 666,002. Patented Jan. 15, 1901.

W. G. DODD.

ORE CONCENTRATING TABLE.

(Application filed June 22, 1900.)

(No Model.)



Witnesses.

H. Monteverde.

D. B. Richards

Inventor

Willis G. Dodd

by N. A. Acker

his atty.

UNITED STATES PATENT OFFICE.

WILLIS G. DODD, OF SAN FRANCISCO, CALIFORNIA.

ORE-CONCENTRATING TABLE.

SPECIFICATION forming part of Letters Patent No. 666,002, dated January 15, 1901.

Application filed June 22, 1900. Serial No. 21,134. (No model.)

To all whom it may concern:

Be it known that I, WILLIS G. DODD, a citizen of the United States, residing in the city and county of San Francisco, State of California, have invented certain new and useful Improvements in Ore-Concentrating Tables; and I do hereby declare the following to be a full, clear, and exact description of the same.

The invention relates more especially to that class or type of concentrating-tables known as "transversely-inclined" concentrating-tables, and it resides more particularly in the arrangement of the riffles upon the working face of the said table. In this particular class of concentrating-tables—that is, the transversely-inclined ones—the separation of the valuable particles from the gangue takes place during the downward travel of the material over the working face of the table. The separation is due to the longitudinal action or reciprocating motion of the table and the downward flow of a body of water over the face thereof. The downward or transverse travel of the material to be or being treated is retarded by means of a series of riffles arranged longitudinally of the table, which riffles catch and confine the heavier or valuable particles separated from the gangue and divert the travel thereof from a path crosswise of the table to one longitudinal thereof. It is mainly due to the diverting of the crosswise travel of the material into a travel approximately longitudinally of the table that the separation of the valuable particles from the gangue is successfully accomplished. However, the recovery of the valuable particles is only partial where the table is provided upon its working face with a series of longitudinal riffles of equal or unequal length, for while the larger or heavier particles will be separated from the gangue and saved a considerable quantity of the lighter valuable particles or "float-gold" will be carried off with the flow of the gangue. It is the recovery of this grade of material which the present invention is designed to accomplish, while at the same time securing a better and more efficient separation of the valuable particles carried by the gangue upon the table.

The object of the present invention is to so construct the concentrating-surface of the table that the material fed thereon or delivered thereto may be "deflected," so to speak, from a transverse travel or path to a longitudinal travel or path with the least possible disturbance, thus allowing of the heavier particles separated from the gangue being conveyed longitudinally of the table with the least agitation and friction and in a compact form and upon such lines as the material would traverse the surface of the table of its own accord, resulting in an increased capacity of the machine, the making of a cleaner concentrate, and enhancing the value of the product obtained from the working of the table.

In order to comprehend the invention, reference should be had to the accompanying sheets of drawings, forming a portion of the present application, wherein—

Figure 1 is a plan view of the improved concentrating-table. Fig. 2 is a longitudinal section view of the table in side elevation. Fig. 3 is a detail enlarged plan view of a portion of the table, illustrating the discharge ends of the riffles and the paths taken by the gangue and valuable particles as they leave the riffles; and Fig. 4 is a similar view illustrating the paths of the gangue and valuable particles as discharged from the ends of the ordinary straight or longitudinal riffles.

In the drawings the letter A is used to indicate a transversely-inclined concentrating-table, and A′ the unriffled or plain discharge end thereof. At the head-end corner of the table is arranged the feed-box B, from which the ore or pulp to be worked is delivered onto the table. It will be understood that the table is a longitudinally-reciprocating one, being driven by any suitable form of mechanism designed for this purpose, preferably that form of drive mechanism fully set forth and described in Letters Patent No. 650,673, granted me on the 29th day of May, 1900, for an improved ore-concentrator.

At the upper edge of the table, near its discharge end and above the plain or unriffled portion A′, is arranged the perforated water-distributer B′, by means of which clear water is delivered onto the plain or unriffled portion of the table in order to lubricate the same and wash from the valuable material such gangue as may adhere thereto as discharged from the riffles onto this portion of the table.

Intermediate the head end C of the table and the plain or unriffled portion A' thereof is arranged a series of parallel riffles C'. Each riffle is formed with an upwardly curved or inclined portion a near the head end of the table and a downwardly curved or inclined portion a' near the plain or unriffled portion of the table. The portion of the riffles intermediate the upwardly and downwardly curved or inclined ends a a' are approximately straight and longitudinal with the table or its working face. These riffles gradually decrease in height from their upwardly inclined or curved ends a toward their downwardly inclined or curved ends a'.

In Figs. 1 and 3 of the drawings the arrows 4 are used to indicate the travel or path of the gangue, its direction being transverse of the working face of the table, while arrows 5 indicate the travel or path of the heavier or valuable particles, which is longitudinally of the face of the table and at approximately a right angle to the travel of the gangue. The surface of the table between numerals 6 and 7 may be said to constitute the zone of the gangue.

The pulp or finely-crushed ore containing the mineral to be saved is delivered upon the table from the feed-box B, located at the head-end corner of the table, Fig. 1. The course or direction of travel of the material at this point is transverse of the table. As soon as the heavier particles come in contact with the upwardly curved or inclined portion or head end of the riffles this transverse travel of the valuable particles is gradually and gently changed into a longitudinal travel, due to the natural curve or inclination of the riffles at this point and the reciprocating motion given the table. The mineral or heavier particles are then moved longitudinally along the riffles toward the foot or unriffled portion of the table. During this travel of the mineral or valuable particles the gangue is gradually eliminated and washed over the riffles transverse of the table. When the mineral or valuable particles reach the end of the riffles, the velocity at which it has been moving is accelerated, due to the downward curvature or inclination of the riffles at this point, and it is guided into its natural trajectory, approximating a parabolic curve, at a velocity approximately coincident with the velocity of the gangue at the outward boundary 7 of the zone of flow, causing little or no disturbance of the particles of mineral collected. The gangue being much lighter than the mineral has an inclined trajectory. The final separation of the mineral from the gangue takes place as the mineral is discharged from the riffles onto the plain or unriffled portion of the table. Now as the trajectory of the gangue and the trajectory of the mineral intersect each other at the point of the mineral's discharge, Fig. 3 of the drawings, and the mineral crosses or passes through and out of the zone covered by the gangue and enters upon the smooth or unriffled portion of the table it continues in its course or natural trajectory until it passes over the tail or foot of the machine into a receptacle located at such point for its reception. While making this passage over the unriffled portion of the table it is subjected to the action of a very slight spray of clear water delivered from the water-distributer B'. This spray is for the purpose of lubricating the smooth surface of the table and for washing out any small particles of gangue that may have become entangled with the mineral during its passage through the outward boundary of the gangue zone. The gangue passes downward over the riffles and across the table, being discharged over its lower edge and allowed to run to waste.

The improved riffles have two distinct features and perform two distinct functions in the operation of separating the mineral from the gangue. By reference to Fig. 1 of the drawings it will be seen that the upper or receiving end of the riffle has a gradual upward curve or inclination, while the lower or discharge end has a reverse or downward curve or inclination. The mineral when first delivered upon the table has a transverse direction, with a high velocity, which direction of the mineral's travel must be changed to a longitudinal direction with the least possible disturbance. This is accomplished by the inclination or curvature given to the riffles at this point. After the mineral or valuable particles have been collected within the riffles it is necessary that the mineral be carried forward longitudinally with as little agitation as possible and in a compact form, so as to enable it to cross and pass through the outward boundary of the gangue zone. The downward curvature or inclination of the discharge end of the riffles is such as to discharge the mineral on its natural trajectory in a compact form with a velocity sufficient to enable the compact body of mineral to cross and pass through the gangue without undue agitation or disturbance and without being carried downward by the flow of the gangue. The construction of the described riffles serves, first, to divert the transverse travel of the mineral into a travel longitudinally of the table, and, secondly, to enable the mineral to be discharged upon the plain or unriffled portion of the table on its natural trajectory. By thus imparting a natural discharge to the collected or separated mineral undue agitation or disturbance of the solid mass is obviated and a more perfect concentration obtained. Again, by confining the material between the riffles intermediate the inclined or curved ends thereof the material is subjected to the concentrating action of the table for a greater period than if the riffles were formed upon a common curvature throughout their length and the mineral thus permitted to settle or collect in a body. As the transfer of the transverse travel of the material into a longitudinal travel of the table is a gradual one at the head end of the riffles, undue agitation or disturbance at this end of the riffles is overcome and to a certain extent the material is assisted in its longitudinal travel. The prevention of excessive agitation at this point prevents the finer or lighter particles of the valuable material being carried off with the gangue.

In Fig. 4 of the drawings I have illustrated the disturbance and agitation which take place at the discharge end of the riffles when the table is provided with the ordinary straight riffles. In this view the arrow 8 indicates the flow of the gangue and 9 the flow of the mineral, which meet or intersect at the point 10. It will be noticed that in such case the "mineral," so to speak, is dropped from one riffle onto the next lowest riffle and the material broken and the finer particles liberated from the solid mass. Being thus liberated, the finer particles will be carried off with the gangue and lost unless the waste material be treated as middlings and be returned to the tables by means of an elevator or otherwise to again undergo the process of separation.

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

1. A reciprocating ore-concentrating table having a plain or unriffled tail or foot portion, an obstructing-riffle arranged upon the working face of said table intermediate its head end and its plain or unriffled foot or tail portion, said riffle having an upward inclination at its head end and a downward inclination at its discharge end, the portion of the riffle intermediate the upwardly and downwardly inclined ends being approximately longitudinal with the working face of the table.

2. A reciprocating ore-concentrating table having a plain or unriffled tail or foot portion, an obstructing-riffle arranged upon the working face of said table intermediate its head end and its plain or unriffled foot or tail portion, said riffle being upwardly inclined at its head end and downwardly inclined at its discharge end.

3. A reciprocating ore-concentrating table having a plain or unriffled tail or foot portion, a series of obstructing-riffles arranged upon the working face of said table intermediate its head end and its plain or unriffled foot portion, said riffles having an upward inclination at their head ends and a downward inclination at their foot or discharge ends, the portion of the riffles intermediate the upwardly and downwardly inclined ends being approximately longitudinal with the working face of the table.

4. A reciprocating ore-concentrating table having a plain or unriffled tail or foot portion, a series of obstructing-riffles arranged upon the working face of the table intermediate its head end and its plain or unriffled foot portion, said riffles being upwardly inclined at their head ends and downwardly inclined at their discharge ends.

5. A reciprocating ore-concentrating table having a series of obstructing-riffles arranged upon its working face, said riffles having an upward inclination at their head ends and a downward inclination at their discharge ends, as and for the purpose set forth.

6. A reciprocating ore-concentrating table having a plain or unriffled foot or tail portion, an obstructing-riffle arranged upon the working face of said table intermediate its head end and its plain or unriffled foot or tail portion, the riffle being upwardly inclined at its head end and downwardly inclined at its discharge end and having that portion intermediate its upwardly and downwardly inclined ends approximately longitudinal with the working face of the table, said riffle gradually decreasing in height from its head end toward its foot or discharge end.

7. A reciprocating ore-concentrating table having a plain or unriffled tail or foot portion, a series of riffles arranged upon the working face of said table intermediate its head end and its plain or unriffled foot portion, said riffles being downwardly inclined at their discharge end, the portion of the riffles intermediate the head end of the table and its foot or tail end being approximately longitudinal with the working face of the table.

8. A concentrating-table having a plain or unriffled foot or tail portion and provided on its working face with an obstructing-riffle, the body portion of said riffle being approximately longitudinal with the face of the table and its head end upwardly inclined, whereby the material fed onto the table for separation has its path of travel diverted from a transverse direction into a travel longitudinal of the working face of the table.

9. A concentrating-table having a plain or unriffled foot or tail portion and provided on its working face with an obstructing-riffle, the body portion of said riffle being approximately longitudinal with the face of the table and its discharge end downwardly inclined.

10. A reciprocating ore-concentrating table having a plain or unriffled tail or foot portion, a series of obstructing-riffles arranged upon the working face of the table intermediate its head end and its foot portion, said riffles having an upward inclination at their head end and having their body portion approximately longitudinal with the working face of the table.

In testimony whereof I affix my signature, in the presence of witnesses, this 13th day of June, 1900.

WILLIS G. DODD.

In presence of—
N. A. ACKER,
D. B. RICHARDS.

COMPLAINANTS' EXHIBIT No. 50
Dodd Design Patent No. 33,011
ALMON E. HART, Special Examiner

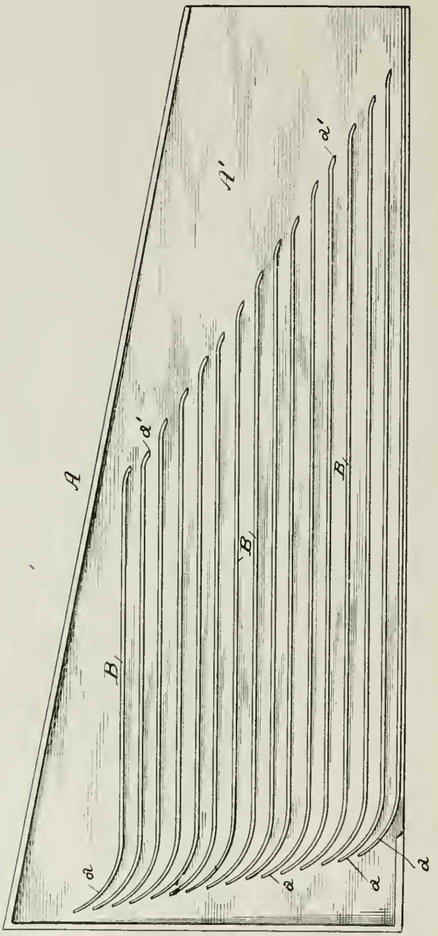
DESIGN.

No. 33,011. Patented July 24, 1900.

W. G. DODD.

ORE CONCENTRATING TABLE.

(Application filed June 22, 1900.)



Witnesses.
F. E. Monteverde.
D. B. Richards

Inventor.
Willis G. Dodd
by N. A. Acker
his atty.

UNITED STATES PATENT OFFICE.

WILLIS G. DODD, OF SAN FRANCISCO, CALIFORNIA.

DESIGN FOR AN ORE-CONCENTRATING TABLE.

SPECIFICATION forming part of Design No. 33,011, dated July 24, 1900.

Application filed June 22, 1900. Serial No. 21,244. Term of patent 14 years.

To all whom it may concern:

Be it known that I, WILLIS G. DODD, a citizen of the United States, residing in the city and county of San Francisco, State of California, have invented and produced a new and original Design for Ore-Concentrating Tables, of which the following is a full, clear, and exact specification, reference being had to the accompanying sheet of drawings, forming a part thereof.

As shown in the drawings, the leading or material features of the design consist of the concentrating-table A, having a plain or unriffled portion A' at its tail or discharge-end portion. On the working face of the table are arranged a number or series of parallel riffles B, each riffle having an upwardly-inclined portion a at the head end of the table, while the discharge-end portion a' of each riffle is downwardly inclined. The portion of the riffles intermediate the upwardly and downwardly inclined ends a and a' is approximately longitudinal with the working face of the table.

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

The design for an ore-concentrating table, as herein shown and described.

In testimony whereof I affix my signature, in the presence of witnesses, this 7th day of June, 1900.

WILLIS G. DODD.

In presence of—

N. A. ACKER,

D. B. RICHARDS.

COMPLAINANTS' EXHIBIT No. 51

Monell Patent No. 661,886

ALMON E. HART, Special Examiner

No. 661,886. Patented Nov. 13, 1900.

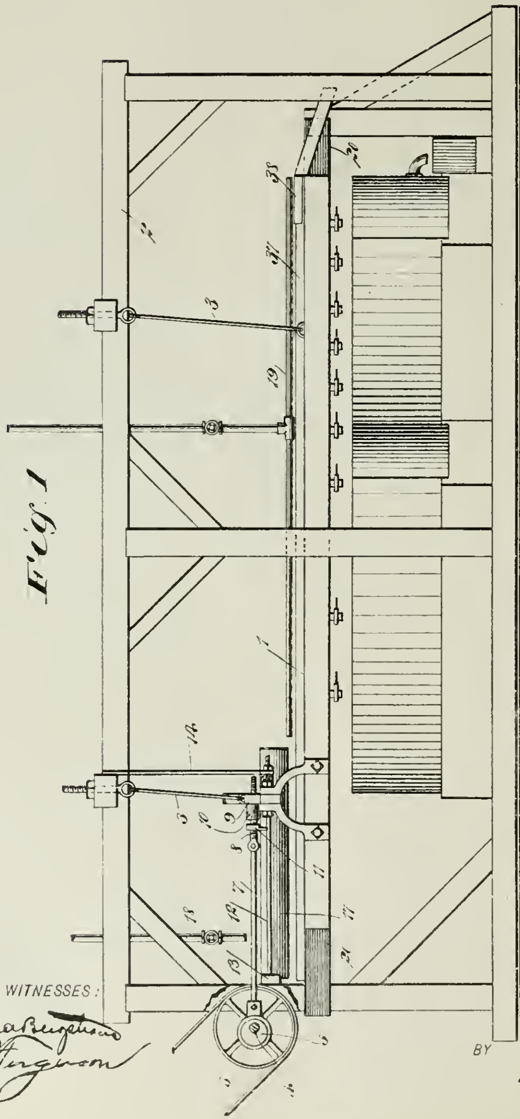
I. F. MONELL.

CONCENTRATING TABLE.

(Application filed June 9, 1899)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1



WITNESSES:

John A Bergstrom

R. Ferguson

INVENTOR

I. F. Monell

BY

Munn & Co

ATTORNEYS

No. 661,886. Patented Nov. 13, 1900.

I. F. MONELL.

CONCENTRATING TABLE.

(Application filed June 9, 1899.)

(No Model.) 2 Sheets—Sheet 2.

Fig. 2

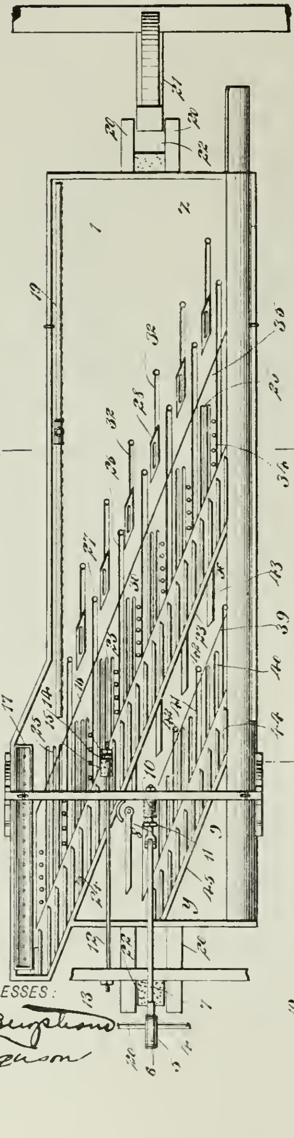


Fig. 3

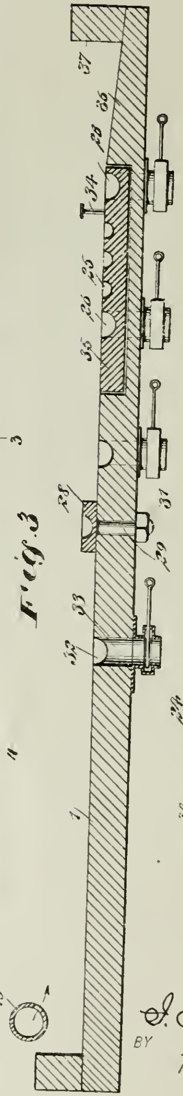
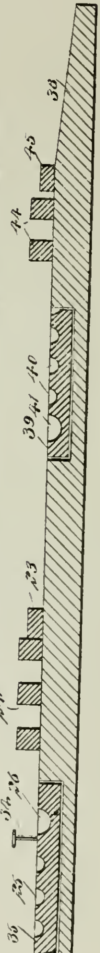


Fig. 4



WITNESSES:

John A. Bergstrom

C. R. Ferguson

INVENTOR

I. F. Monell

BY

Munn & Co

ATTORNEYS

United States Patent Office.

IRA FERRIS MONELL, OF BOULDER, COLORADO.

CONCENTRATING-TABLE.

SPECIFICATION forming part of Letters Patent No. 661,886, dated November 13, 1900.

Application filed June 9, 1899. Serial No. 719,913. (No model.)

To all whom it may concern:

Be it known that I, IRA FERRIS MONELL, of Boulder, in the county of Boulder and State of Colorado, have invented a new and Improved Concentrating-Table, of which the following is a full, clear, and exact description.

This invention relates to improvements in ore-concentrators; and the object is to provide a concentrator having a large surface area over which the crushed or pulverized material may pass and by one operation effectually separate the mineral from the sand or pulp.

I will describe a concentrating-table embodying my invention and then point out the novel features in the appended claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a front elevation of a concentrator embodying my invention. Fig. 2 is a plan view thereof. Fig. 3 is a section on the line 3 3 of Fig. 2 on an enlarged scale; and Fig. 4 is a section on the line 4 4 of Fig. 2 and also on an enlarged scale.

Referring to the drawings, 1 designates the concentrating-table, mounted to swing in a frame 2. It is designed that the table shall have a lateral movement imparted to it either by direct application of power or by means of concussion. I have here shown the table as suspended from the upper cross-bars of the frame by means of rods or hangers 3, and these rods are of such a length with relation to each other that the table has a downward inclination from its feeding side to its outlet side.

At one side of the table is a driving-shaft 4, on which an eccentric 5 is mounted, and from an eccentric-strap 6 on the eccentric 5 an eccentric-rod 7 extends to a pivotal connection with a bolt 8, movable through an opening in a bar 9, which extends over the top of the table from its rear to its front side. Surrounding the bolt 8 and abutting at one end against the bar 9 is a buffer-sleeve 10, of rubber or similar material, and against which a tappet 11 on the bolt 8 is designed to engage as the table is moved in one direction by the eccentric. This tappet 11 is made in the form of a nut adjustable on a threaded portion of the bolt 8, so that the degree of throw of the table may be regulated. The table is moved in the opposite direction by means of a rod 12, connected at one end to a fixed portion 13 of the frame and having its other end extended loosely through an opening in a spring-plate 14, depending from an upper cross-bar of the frame. The rod 12 also passes through a buffer-sleeve 15, of rubber or similar material, which abuts against the outer side of the spring-plate 14, and a nut 16 on the threaded end of the rod 12 is designed to engage with the spring-plate during a movement of the table. By adjusting the nut 16 the throw of the table in this direction may be regulated.

It is to be understood that I do not confine my invention to the particular means above described for imparting movements to the table.

Arranged above the head of the table and near one side thereof is a feed-trough 17, which is V-shaped in cross-section and has perforations through its bottom portion, and the pulp or the material to be operated upon is fed to the trough 17 through a pipe 18. Also arranged along the head of the table and extended from a point near one end of the trough 17 to the opposite side of the table is a perforated water-supply pipe 19.

The table is guided in its back-and-forth movement by guide-bars 20, extended from the ends of the table and movable against the sides of buffer-heads 21, and to relieve the table from too great a shock cushions 22 are provided to engage against the buffer-heads. The table is practically divided into two sections, which may be designated as x and y. At the junction of the section x with the section y and extended diagonally from the feed end to the outlet end of the table is a tail-strip 23, and extended from this tail-strip 23 parallel with the front and rear of the table is a series of riffles 24. While these riffles extend parallel with the front and rear of the table, they are shown as arranged diagonally from one side of the table to the other side. The object of the riffles 24 is to form sand cushions through which the mineral will settle and to allow the excess of water to pass out between the riffles to the back end over the tailpiece 23. This water carries the slime and can be partly concentrated in the section y of the table, as will be hereinafter described.

Forward of the riffles 24 and extended in the same direction thereof is a series of shallow or fine grooves 25. These shallow grooves are formed in sets, and at the end of each set is a cleaning-space 30. The motion of the table will settle the fine material into the grooves 25 and move it forward to the cleaning-spaces 30, when it will move diagonally across the said cleaning-spaces into larger grooves 26, which extend beyond the ends of the grooves 25 and each one of which terminates in an opening 27 through the table. If the material be clean, it will be let out into a receiving-trough through a valve-controlled pipe connected with the opening. If not clean, the valves must be closed, and the products will be passed over to adjustable riffles 28. These adjustable riffles are made in the form of blocks, and each one is mounted on a bolt 29, which passes through the table and upon the lower end of which is a clamping-nut 31. By loosening the nut 31 the riffle carried thereby may be swung to any desired angle on the table. From the riffles 28 the clean material will be carried to channels or grooves 32, formed in the table, and discharged through valve-controlled pipes 33, with which the ends of the channels or grooves 32 communicate. The material will discharge into a suitable receptacle arranged under the table. Ordinarily the adjustable riffles will not have to be used for the first four or five sections of grooves 25, and for some ore it is not necessary to use them at all.

At the upper side of each large groove or channel 26 is a row of upwardly-extended pins 34. These pins are designed to split the sand cushion and give the mineral mixed with the sand a chance to settle in the small grooves or channels. The several grooves or channels 25 and a part of each groove or channel 26 are formed in a plate 35, removably seated in a recess formed in the table 1. This plate may consist of any suitable material—such as wood, metal, asphalt, or the like—and has its top flush or even with the top surface of the table. The object in making this plate removable is so that another plate may be substituted, having channels or grooves of different depths depending upon the material to be concentrated.

The outlet edge of the table 1 has a greater incline than has the main portion of the table, as indicated at 36. This gives more flow to the sand as it leaves the riffles 24 and a more rapid discharge. On the edge of this portion 36 is a riffle 37, designed to catch any material that the operator may think worth saving. At one end this riffle is provided with a vertically-adjustable portion 38, which may be raised or lowered, as desired, by means of a liner or a shim placed underneath said portion 38.

On the section y of the table is a removable plate 39, similar to the plate 35, and in this plate 39 is formed a series of grooves or channels 40, and also below each set of grooves or channels 40 is a deeper groove 41, which communicates with a discharge-opening 42, which connects with a valve-controlled pipe for discharging material into a tank or other receiving vessel underneath the table. Extended outward on the table from the tailpiece 23 and above each opening or outlet 42 is a guard-strip 43. These guard-strips are designed to prevent sand from passing into the outlets. Upon one side of the plate 39 and arranged on the table-section y is a series of riffles 44, which form the sand cushions and through which the excess of water passes. These riffles 44 abut against a tailpiece 45, which extends diagonally on the table.

In the operation of the machine the tendency of movement of the heavier particles will be toward the side Z of the table. The very light material, with the water, however, will pass over the tailpiece 23 and into the fine channels or grooves on the section y of the table, and from these fine grooves the material will be deposited into the larger or deeper grooves 41. Some of the material and sand, however, will pass to the upper sides of the riffles 44 and form sand cushions through which the excess of water will pass and discharge over the tailpiece 45.

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

1. In an ore-concentrator, a table having a series of channels in its top, the said channels having valve-controlled outlets through the table, and an adjustable riffle at one end of each of said channels, substantially as specified.

2. A concentrator, having a series of shallow channels and deeper channels, the series of channels being arranged diagonally on the table and the deeper channels having communication with valve-controlled outlets, a series of riffles at one side of the series of channels, the said riffles also being arranged diagonally, and means for imparting swinging motion to the table, substantially as specified.

3. A concentrator-table, having a diagonally-disposed recess formed in it, a plate adapted to be removably seated in said recess, the said plate having a series of channels formed in it, certain of said channels having communication with discharge-pipes, a series of riffles arranged at one side of the recess, a tailpiece against which the ends of said riffles abut, and means for imparting motion to the table, substantially as specified.

4. A swinging concentrating-table arranged on an incline, a series of riffles on the table, the riffles being arranged diagonally, a tailpiece against which the riffles abut, and the table having a series of channels formed in it at each side of the riffles, the series of chan-

nels being arranged diagonally and certain of the channels being deeper than the other channels and communicating with outlets, and another series of riffles arranged on the table at one side of the first-named series of riffles, substantially as specified.

5. A concentrating-table mounted to swing and arranged in an inclined position, the said table having a series of channels formed in it, the said series of channels being arranged diagonally, and certain of the channels being deeper than the others and having communication with outlets, a series of fixed riffles at one side of the series of channels and also arranged diagonally, and a series of adjustable riffles arranged diagonally at the opposite side of the series of channels, substantially as specified.

6. A concentrating-table mounted to have a lateral motion and having a series of channels formed in it, the said series of channels being arranged diagonally and in sets, pins extended upward from the table above each set of channels, and fixed riffles arranged at one side of the series of channels, substantially as specified.

7. A concentrating-table, a number of series of riffles on the table, each series being arranged in a diagonal direction, each riffle in a series being parallel with the front and rear of the table, and a tailpiece extended diagonally on the table adjacent to an end of each series of riffles, substantially as specified.

8. A concentrating-table having a recess arranged diagonally in its top, a channeled plate adapted to be placed in said recess, the channels of the plate being arranged in sets each set consisting of a number of channels having a cleaning-space at one end, and a larger channel which extends beyond the ends of the other channels of a set, substantially as specified.

IRA FERRIS MONELL.

Witnesses:
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COMPLAINANTS' EXHIBIT No. 52

Pinder Patent No. 812,520

ALMON E. HART, Special Examiner

No. 812,520. PATENTED FEB. 13, 1906.

J. W. PINDER.

ORE CONCENTRATOR.

APPLICATION FILED NOV. 25, 1904.

2 SHEETS—SHEET 1.

FIG. 1.

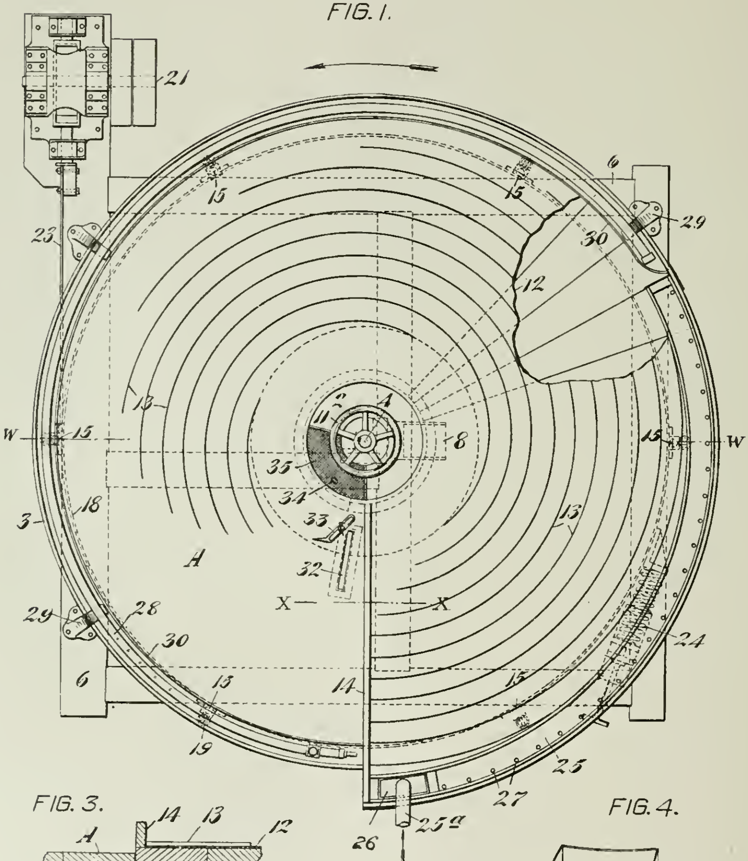


FIG. 3.

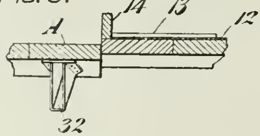
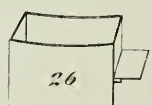


FIG. 4.



WITNESSES,

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No. 812,520. PATENTED FEB. 13, 1906.

J. W. PINDER.

ORE CONCENTRATOR.

APPLICATION FILED NOV. 25, 1904.

2 SHEETS—SHEET 2.

FIG. 2.

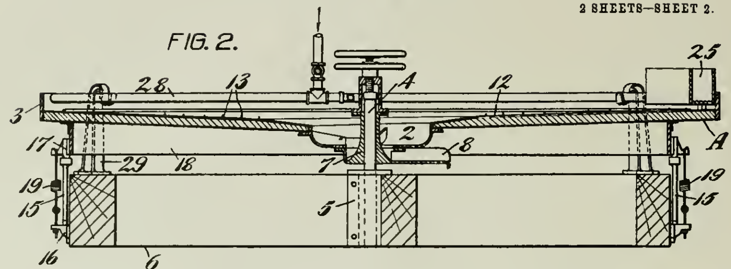


FIG. 5.

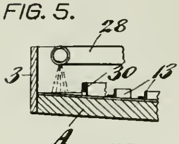


FIG. 6.

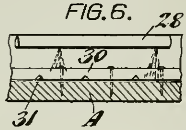


FIG. 7.

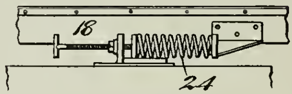


FIG. 8.

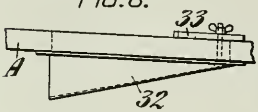


FIG. 9.

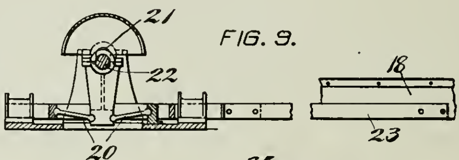


FIG. 10.

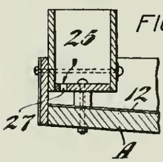


FIG. 11.

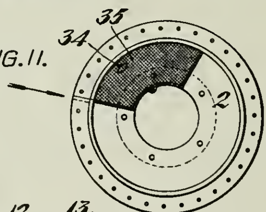


FIG. 13.

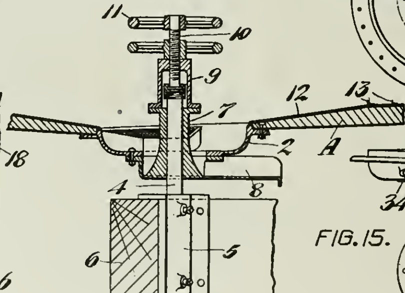


FIG. 12.

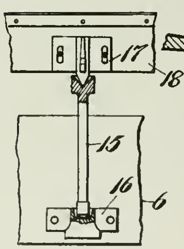


FIG. 14.

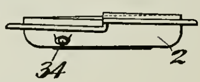
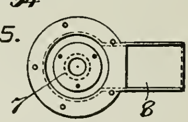


FIG. 15.



WITNESSES,

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INVENTOR,

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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 inverted 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.

COMPLAINANTS' EXHIBIT No. 53
Pinder Re-issue Patent No. 12,590
ALMON E. HART, Special Examiner

No. 12,590. REISSUED JAN. 8, 1907.

J. W. PINDER.
ORE CONCENTRATOR.
APPLICATION FILED FEB. 28, 1906.

3 SHEETS—SHEET 1.

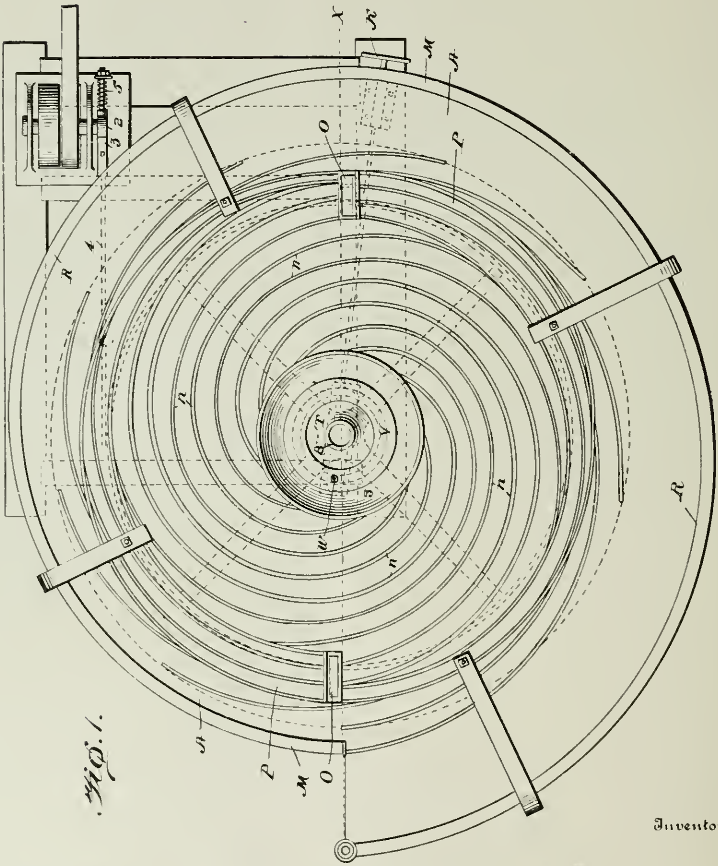

Fig. 1.

Witnesses
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By George H. Strong
his Attorney

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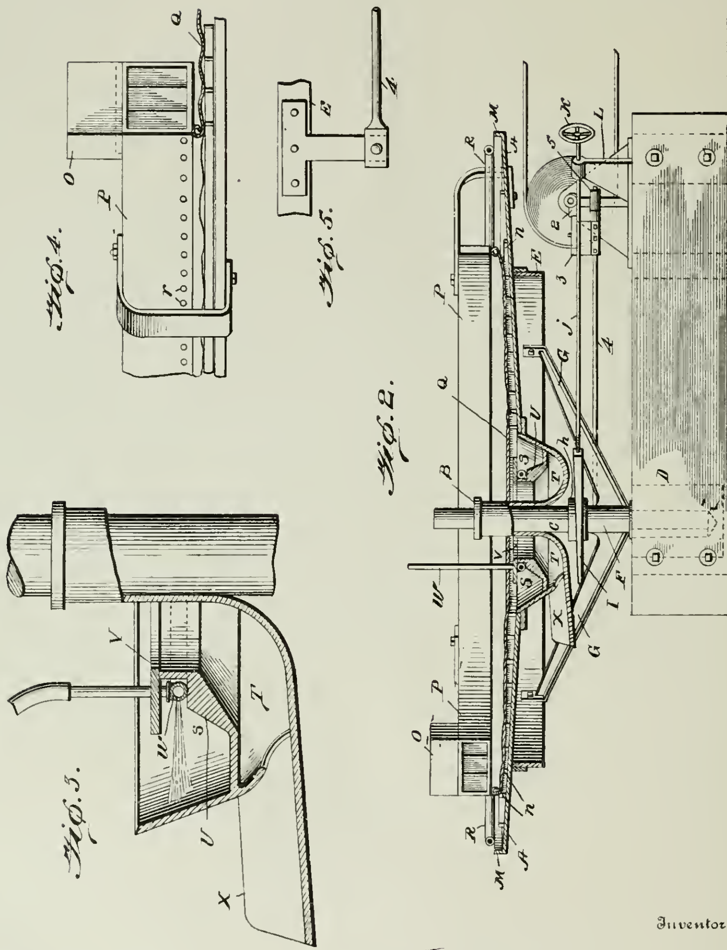

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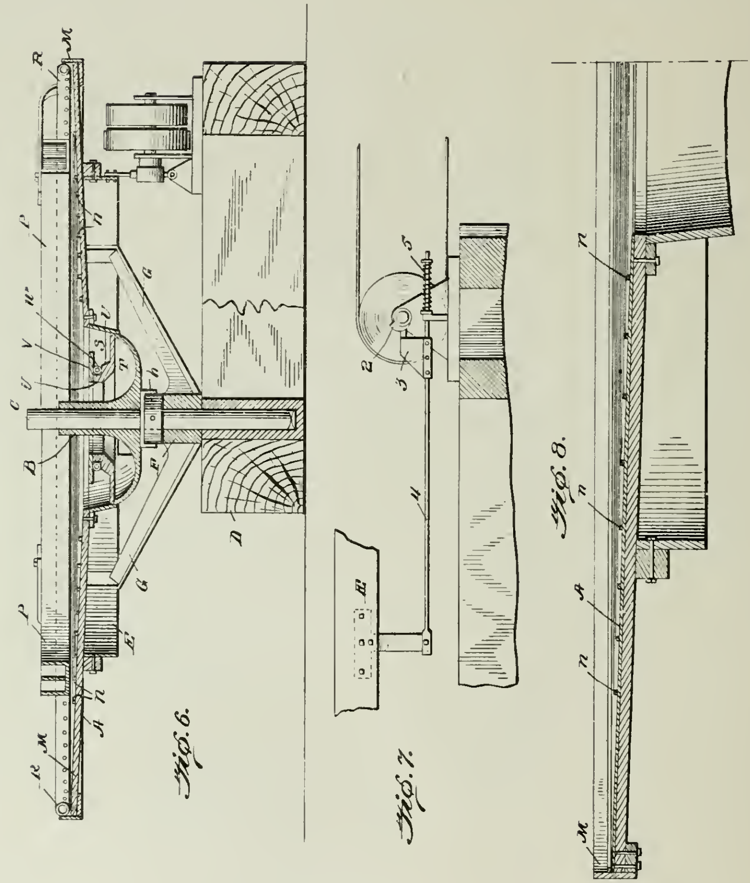
3 SHEETS—SHEET 3.



Witnesses
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UNITED STATES PATENT OFFICE.

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ORE-CONCENTRATOR.

No. 12.590. **Specification of Reissued Letters Patent.** **Reissued Jan. 8, 1907.**

Original No. 744,229, dated November 17, 1903. Application for reissue filed February 28, 1906. Serial No. 264,201.

To all whom it may concern:

Be it known that I, JOSEPH W. PINDER, a citizen of the United States, residing in the city and county of San Francisco, State of California, 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 said invention, such as will enable others skilled in the art to which it most nearly appertains to make, use, and practice the same.

My invention relates to that class of ore-concentrators for separating and saving the heavy particles of metal contained in earthy deposits or ore-pulp in which a shallow pan or concave table is mounted on a central vertical shaft and connected with operating mechanism by which a reciprocating rotary motion accompanied with a jolt or jar at the termination of each reciprocation is imparted to the pan or table.

My improvements relate to the surface construction of the pan or table, whereby the separation and concentration of the heavy particles are accomplished; and it consists principally in the arrangement of spiral riffles on the upper surface of the pan or table, whereby the motion and jar of the pan compel the particles to work in a circle outward toward the periphery of the pan and between rather than athwart the riffles, whereby the particles are not wholly arrested in their progression, and the invention also comprehends making the pan evolute in outline, whereby different points on the perimeter travel at different rates of speed and the sulfurets in one stage of concentration are subjected to a different shake than those in another stage of concentration on another part of the table. In connection with this riffle and table construction I combine a system of pulp-distribution and water-spraying devices by which the separation and cleaning of the particles are accomplished during their travel. It also includes a central trap or basin of peculiar construction for the purpose of catching and saving any escaping mercury or amalgam that may pass downward over the riffles, all as hereinafter more fully described.

Referring to the accompanying drawings, Figure 1 is a plan view of my pan or table. Fig. 2 is a vertical section of the pan, taken through the line x x, Fig. 1. Fig. 3 is an enlarged sectional view of the central trap or basin. Fig. 4 is an enlarged perspective view of a section of the distributing-trough, and Fig. 5 is a side view of the connection of the reciprocating rod with the depending rim of the pan. Fig. 6 is a cross-section of the pan and its support, taken at a right angle to x x, Fig. 1. Fig. 7 is a side view of the actuating mechanism, and Fig. 8 is a partial vertical section showing the construction of the pan.

Let A represent a circular pan or table which is slightly concave on its upper surface. The bottom or floor of this pan or table may be made solid and fixed or it may be made of independent triangular-shaped sections with their widest portions at the outer rim and their apices at the center. I prefer to make it of these independent sections, so that the incline or concavity of the upper surface of the pan can be varied and regulated, as hereinafter described. This floor when made solid can be supported directly from a central socket B, which fits over and rests upon the upper end of a stationary spindle C. This latter spindle is fixed in and secured to the framework or base D, upon which the pan is mounted; but when the floor is made up of independent triangular sections, as above specified, it is supported on a shallow vertical rim E, which extends around underneath the floor of the pan at a point between the middle and outer edges of the sections. This rim is then supported by bracing-arms G from a loose sleeve F, so that by raising or lowering the sleeve on the spindle the center or apex ends of the floor-sections can be raised or lowered like an umbrella, and thus vary the pitch or incline of the floor. To provide for raising or lowering this sleeve, I form or secure to it a collar h, in the outer face of which is a circular groove. A wedge-shaped bar I then enters this groove and is connected by a rod j with a hand-wheel K. The outer end of the rod is threaded and passes through a threaded hole in a block L, which forms a part of the framework or base, so that by turning the hand-wheel the wedge can be moved back or forth, and thus raise or lower the sleeve.

The outer edge of the pan A has the form of an evolute, so as to carry its rim on one side outward to a distance, and the terminus of this evolute is connected in a straight or radial line a with the commencement of the evolute. A shallow rim M passes entirely around this evolute edge except the straight radial portion above described, which forms the point of discharge for the sulfurets.

The floor of the pan should be perfectly smooth before the riffles are applied, and when I use the independent triangular sections I cover and stretch tightly over it some smooth material, preferably linoleum.

In the central portion of the pan surrounding the supporting-socket I construct my improved amalgam-trap, which will be hereinafter described. Commencing at the outer edge of this amalgam-trap, I then secure upon the smooth bottom of the pan a series of shallow riffles *n n n*, which are made in evolute form and here shown as terminating at different points at regular intervals on the same outer circle at the outer edge of the concentrating part of the pan, so that the space between each two riffles will discharge its burden at a separate interval into the outer track at the periphery of the pan, which leads to the point of discharge. These riffles, it will be observed, open out or expand around the pan in the direction in which the concentrates are to travel. This permits the concentrates to move between rather than across the riffles, thereby preventing their banking up behind the riffles.

The pulp is distributed at proper intervals on the table and at points proximate to the outer ends of the riffles by means of the distributing-troughs P P, which are supported on brackets *p p* from the outer edge of the table. The material for distribution is delivered to troughs P P through the boxes O O. Secured to the outer lower corners of the troughs is a carpet Q, with its nap side down, and this carpet passes loosely over and rests upon the top of all the riffles down to the amalgam-trough. The ore-pulp is fed through holes *r r* in the outer side of the distributing-troughs P, so as to pass underneath the carpet as it flows downward over the riffles toward the center of the table. A water-pipe R surrounds the outer edge of the pan lying just above the shallow rim M, and this pipe is perforated on its inner side, so as to cast a spray of numerous jets of clear water upon the outer edge of the table. This water passes down the floor and carries the pulp over the riffles and underneath the carpet. At the same time a jigging motion is imparted to the pan by mechanism hereinafter described, by which the light and heavy particles are caused to be separated by the combined action of the riffles, the flow of water, and the motion, so that the heavy particles will settle between the riffles according to their specific gravity and be carried around between the riffles by the movement of the pan and be delivered into the outer discharge-track, whence they are carried to the discharge-opening of the pan. The water continually flowing downward carries the lighter particles toward the center discharge and trap, and the sweeping action of the carpet as the pulp flows underneath it causes its nap to gather any fine floating particles or slimes that may come in contact with it until they aggregate or become saturated sufficiently to sink of their own gravity.

The amalgam-trap consists of two compartments—to wit, an outer shallow compartment or trough S—into which the overflowing tailings are first received. This compartment or trough is separated from the discharge-compartment T by a partition U, which is somewhat lower than the outer edge of the trough S, so that the tailings will overflow the partition into the discharge-compartment T. The partition U has a narrow horizontal shelf V projecting over it into the trough S, and a perforated water-pipe W extends around under this shelf into the trough. The action of this spray is to cause an ebullition in the trough and a consequent eddy below the pipe, so that any amalgam or mercury that enters the trough will be settled and caught, while the light and worthless portions will overflow the partition into the discharge-compartment T and pass off through the waste-spout X.

The motion which I impart to the pan or table is a slow motion in one direction and a quick motion or jolt in the opposite direction. This is accomplished by means of a cam 2, acting upon a tappet 3, which is attached to the actuating-rod 4. This is a horizontally-sliding rod, the opposite end of which is connected with the vertical rim E, as shown at Fig. 5, or it may be connected with some other part of the pan. The cam 2 pushes the rod slowly in one direction until the tappet is released from the end of the cam, when a spring 5 on the outer end of the rod gives it a quick return motion, accompanied with a jar, which motion being imparted to the table causes the heavy particles which are caught between the riffles to travel outward by reaction in the path of the riffles until they are discharged in regular order at the end of the discharge-track.

This pan will separate and concentrate the heavy particles in a clean condition and they will be delivered by the evolute riffles in the order of their specific gravity. The carpet or other fabric will sweep the surface of the flowing pulp clear of floating particles of value and hold them until they are in a condition to settle and be caught by the riffles, while the amalgam-trough will catch and save any particles of mercury or amalgam that attempt to escape through the depressed center of the pan.

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

1. A concentrating pan or table having a concave upper surface mounted on a center support that permits it to oscillate in a horizontal plane: a mercury and amalgam trap at the center of said table: spiral or evolute riffles secured to the upper surface of said

table and terminating at stated intervals on the same circle near the outer periphery of the pan: distributing-boxes adapted to deliver the pulp at or near the outer edge of the series of riffles: means for imparting to said pan an oscillatory motion: and a perforated water-pipe surrounding the outer edge of the pan or table, substantially as above described.

2. A concentrating pan or table having a concave upper surface, the circumference of said pan having the form of an evolute: a central support for the pan which permits it to oscillate in a horizontal plane: a mercury and amalgam trap at the center of said pan: spiral or evolute riffles secured upon the bottom of the pan and terminating at their outer ends at intervals on the same circle near the outer edge of the pan: distributing-boxes adapted to deliver the pulp at the outer edge of the riffles: a water-pipe surrounding the outer edge of the pan and adapted to deliver a spray of clear water upon the outer edge of the table and means for imparting to the pan a rotary oscillation in a horizontal plane, substantially as described.

3. In a concentrating-pan having a concave upper surface, spiral or evolute riffles terminating at intervals on the same circle near the outer edge of the pan: a track surrounding said riffles on the outer periphery of the pan: means for imparting to the pan a slow rotary movement in one direction and a quick motion in the opposite direction so as to cause the particles to travel outward between the riffles: and a central mercury and amalgam trap at the center of the pan, substantially as described.

4. In a concentrating-pan having a concave upper surface spiral or evolute riffles on the upper surface of the pan: a track surrounding said riffles at the outer periphery of the pan: distributing-boxes arranged to deliver the pulp between the outermost riffles: means for imparting to said pan an oscillatory motion: a mercury or amalgam trap at the center of said pan and a water-pipe surrounding the outer edge of the pan and adapted to spray the water upon the outer circle of the pan.

5. A concentrating-pan the exterior outline of which is in the form of an evolute said pan being mounted on a pivotal center: a rim surrounding the exterior of the evolute except at the straight line which connects the outer end of the evolute with its commencement: a mercury or amalgam trap at its center: spiral or evolute riffles commencing at the central trap and terminating at intervals on the same circle near the outer edge of the pan: a track surrounding the riffles at the outer periphery of the pan and terminating at the straight line which connects the terminals of the evolute: a water-pipe surrounding the outer rim of the evolute and adapted to deliver a spray of water upon the table and means for imparting to the table a slow oscillating movement in one direction and a quick movement in the opposite direction, substantially as described.

6. In a concentrating-pan a concave upper surface: a mercury or amalgam trap at the center of the pan: spiral riffles surrounding the amalgam-trap: distributing-boxes adapted to deliver the pulp between the outermost riffles of the series: a carpet spread over said riffles with its nap side down and attached at its outer edge to the distributing-boxes so that the pulp will pass underneath it: a water-pipe surrounding the outer edge of the pan and adapted to deliver a spray of water on the outer edge of the pan and means for imparting to the pan a slow oscillating movement in one direction and a quick return movement in the opposite direction, substantially as described.

7. In a circular concentrating-pan having a reciprocating motion, and provided with spiral riffles on its concave upper surface, a central trap consisting of an outer shallow trough and an inner discharge chamber or passage; a partition lower than the outer edge of the trough separating said trough from the discharge-passage; a narrow shelf on top of the partition and projecting into the trough, and a perforated water-pipe below the shelf and adapted to deliver a spray of water into the trough, substantially as described.

8. A concentrating pan or table having a concave upper surface mounted on a center support that permits it to oscillate in a horizontal plane: a mercury and amalgam trap at the center of the table; spiral or evolute riffles secured to the upper surface of said table and opening outwardly toward the periphery of the table: distributing-boxes adapted to deliver the pulp at or near the outer edge of the series of riffles: means for imparting to said pan an oscillatory motion: and a perforated water-pipe surrounding the outer edge of the pan or table.

9. In a concentrating-pan having a concaved upper surface, spiral or evolute riffles extending from points substantially central of the pan toward the periphery thereof: a track surrounding the riffles approximate to the periphery of the pan: means for imparting an oscillatory movement to the pan to cause the particles to travel outward between the riffles, and said pan having a central water and gangue discharge.

10. A concentrating-pan, the exterior outline of which is essentially evolute in outline, said pan having means for centrally supporting it for oscillatory movement in a horizontal plane, and means for oscillating said pan.

11. A concentrating-pan, the exterior outline of which is essentially evolute in outline, said pan having means for centrally support-

ing it for oscillatory movement in a horizontal plane, spiral riffles on the pan opening outward toward the periphery of the pan, and means for oscillating said pan.

12. A concentrating-pan having a concaved upper surface, the exterior outline of said pan being essentially evolute in outline, the wider and narrower portions of said pan being connected by an approximately radial line, a support for the pan, and means for oscillating said pan.

13. A concentrating-pan, the exterior outline of which is essentially evolute in outline, said pan having means for centrally supporting it for oscillatory movement in a horizontal plane, means for oscillating said pan to cause material to tend to travel around the pan in one direction, and spiral riffles on the pan expanding outward toward the periphery of the pan and extending substantially in the direction of the tendency of travel of the material.

14. A concentrator-table mounted for oscillatory movement in a horizontal plane, spiral riffles on the table expanding outward toward the periphery of the pan, and means to impart an oscillatory movement to the pan to cause the heavier particles on the table to travel between the riffles.

15. A concentrating pan or table having a concaved upper surface and mounted upon a central support for oscillatory movement in a horizontal plane: said table being essentially evolute in outline, riffles on the table having their outer ends relatively more remote from the center of the table than their inner ends are, means for delivering material and water upon the table, and means for giving the table an oscillatory movement.

In witness whereof I have hereunto set my hand.

JOSEPH W. PINDER.

Witnesses:

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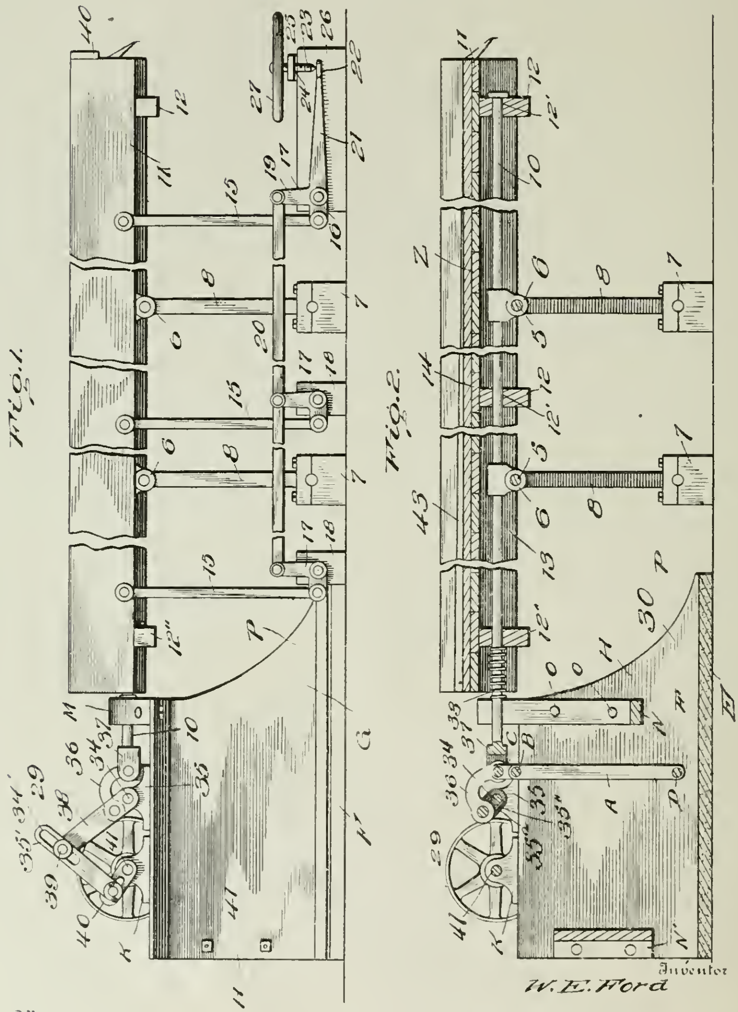
COMPLAINANTS' EXHIBIT No. 54
Ford Patent No. 830,425
ALMON E. HART, Special Examiner

No. 830,425. PATENTED SEPT. 4, 1906.

W. E. FORD.
ORE CONCENTRATOR.
APPLICATION FILED MAY 10, 1905.

4 SHEETS—SHEET 1.



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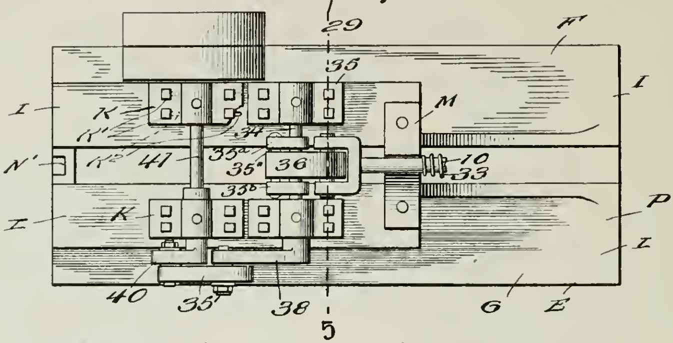
APPLICATION FILED MAY 10, 1905.

4 SHEETS—SHEET 2

Fig. 3.



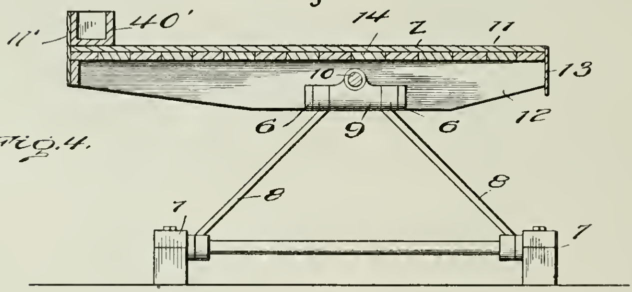
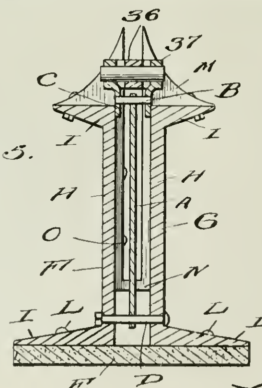


Fig. 4.

Fig. 5.



WITNESSES:

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No. 830,425. PATENTED SEPT. 4, 1906.

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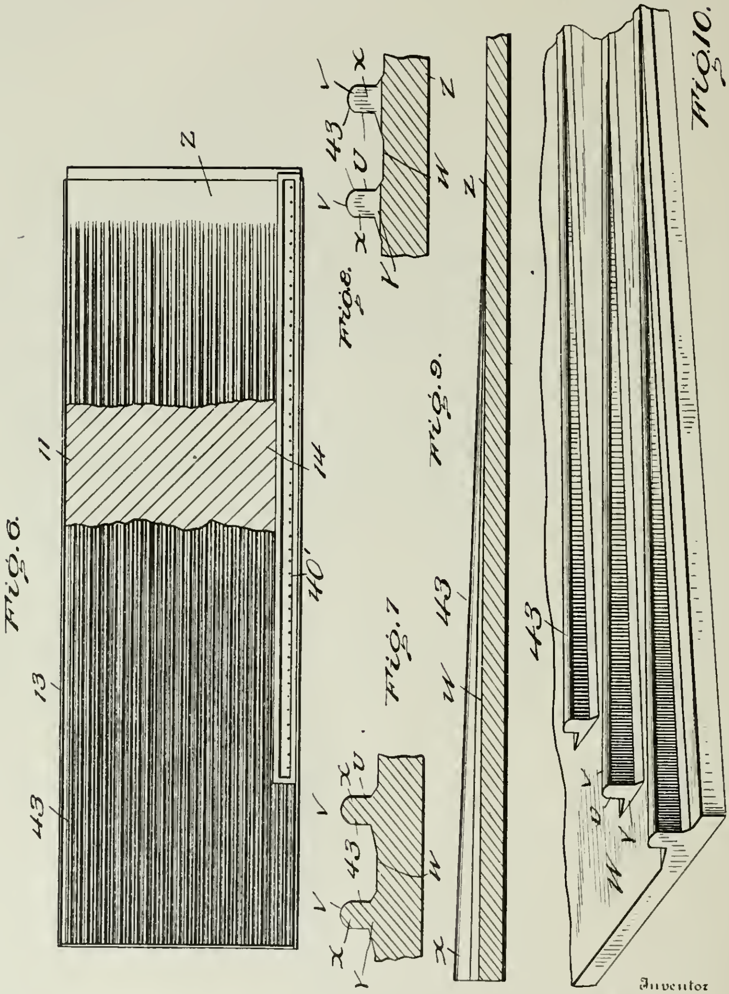
APPLICATION FILED MAY 10, 1905.

4 SHEETS—SHEET 3.



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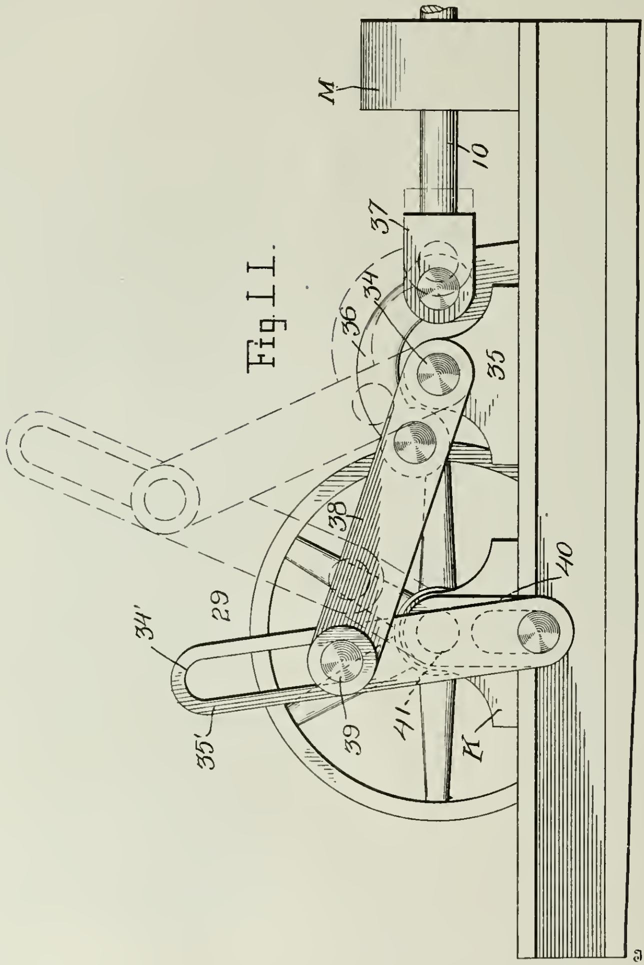

Fig. 11.

Witnesses

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ORE-CONCENTRATOR.

No. 830,425. Specification of Letters Patent. Patented Sept. 4, 1906.

Application filed May 10, 1906. Serial No. 259,746.

To all whom it may concern:

Be it known that I, WILLIAM E. FORD, a citizen of the United States, residing at Carthage, in the county of Jasper, State of Missouri, 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 relates to ore-treating machines, and more particularly to those known as "concentrators," and has for its object to provide a machine of this nature which will be arranged to separate matter of various specific gravities.

Another object is to provide a machine of this kind which will be susceptible of adjustment and which will include a movable bed and means for moving the latter.

Another object is to provide a bed equipped with the ribs known as "riffles," these riffles being arranged in a novel manner.

Other objects and advantages will be apparent from the following description, and it will be understood that changes in the specific construction shown and described may be made within the scope of the claims and that any suitable materials may be used without departing from the spirit of the invention.

In the drawings forming a portion of this specification, and in which like characters of reference indicate similar parts in the several views, Figure 1 is a side elevation. Fig. 2 is longitudial section. Fig. 3 is a top plan view of the reciprocating mechanism. Fig. 4 is a transverse section of the bed. Fig. 5 is a transverse section on line 5 5 of Fig. 3. Fig. 6 is a top plan view of the bed. Fig. 7 is a detail sectional view showing two of the riffles at the feed end of the bed. Fig. 8 is a sectional view showing two of the riffles adjacent to the discharge end of the bed. Fig. 9 is a longitudinal section of the bed, showing one of the riffles in side elevation. Fig. 10 is a perspective view showing a portion of a bed embodying a modified form of the invention. Fig. 11 is a side elevation of the invention, showing the table-actuating mechanism in full lines at one limit of its movement and in dotted lines at the other limit of its movement,

Referring now to the drawings, the present invention comprises a plurality of transversely-extending shafts 5, journaled at their ends in brackets 6. Mounted upon these shafts there are supporting members 7, which include upwardly and inwardly directed side pieces 8, having horizontally-extending members 9, journaled therebetween at their upper ends. A longitudinally-extending shift-rod 10 is mounted in these members 9, and pivoted upon this shift-rod there is a bed 11, including spaced transversely-extending beams 12, having openings 12′, in which the shift-rod is revolubly engaged and to which at the ends are secured longitudinally-extending sills 13, having a floor 14 secured thereupon, this floor being formed of diagonally-disposed planks.

The shift-rod 10 is located at one side of the central longitudinal axis of the bed, and pivoted to the sill 11′, which lies farthest from the shift-rod, there are a plurality of depending links 15, which are pivoted at their lower ends to the horizontally-extending arms 16 of bell-crank levers 17, which are pivoted upon brackets 18. The remaining arms 19 of the bell-crank levers extend upwardly and are connected by a rod 20. A horizontal arm 21 extends oppositely from the arm 16 of one of the levers and has an outer end 22, against which rests one end of a threaded bar 23, which is engaged in the threaded perforation 24 of a block 25, the latter being secured upon a suitable support 26, which may be a horizontally-extended portion of the bracket 18, to which the last-mentioned bell-crank lever is attached. The bar 23 is provided with a horizontal hand-wheel 27, and it will thus be seen that the just-described portion of the machine may be operated to vary the transverse pitch of the bed.

The beam 12, which lies adjacent to the rearward or feed end 28 of the bed, is indicated at 12″, and located at this end of the bed there is an actuating mechanism 29, mounted upon a foundation 30, consisting of a concrete base E, upon which are secured a pair of longitudinally-extending spaced channel-irons F and G, their webs H being disposed vertically and their flanges I being directed outwardly, the upper flanges being somewhat narrower than the lower flanges. Cast integral with the upper flanges of a channel-iron adjacent to the forward ends thereof are boxings 35, in which a rock-shaft 34 is journaled, and mounted upon the upper flanges I adjacent to the rearward ends thereof are boxings K, in which is journaled a power-shaft 41, and these boxings are adjustable longitudinally of the channel-irons to permit of variation of the positions of the arm 38 and link 35′ with respect to each other.

The channel-irons F and G are secured to the concrete base E by means of anchor-bolts L. Extending upwardly from the channel-irons forwardly of the boxings 35 there are projections M, which are connected by a yoke N, extending downwardly between the channel-irons, and these projections are held in position by bolts O engaged therein and in the upper flanges I of the channel-irons. The projections M receive thereagainst the rearward end of a helical spring 33, which surrounds the shift-rod 10 and which rests at its forward end against the beam 12″, this spring forming a buffer to prevent lost motion between the working parts.

The channel-irons F and G have a yoke N′ secured therebetween adjacent to their rearward ends, and this yoke has its spaced portions fastened to the webs H of the channel-irons by means of suitable bolts, the yokes M and N′ thus acting to connect the channel-irons and strengthen the structure. The forward ends of the channel-irons are slanted downwardly and forwardly, as shown at P.

The rock-shaft 34 extends transversely and has an upwardly-extending crank 35″ therein, which is connected by means of a curved link 36 with the adjacent end of the rod 10 this rod having spaced arms 37 connected therewith, between which the link 36 is pivoted. At one end the shaft 34 has an upwardly-extending arm 38, having a laterally-projecting pin 39 at its upper end, which is adjustably engaged in a slot 34′, formed longitudinally in the upper portion of a link 35′, which extends downwardly and which is pivoted to a crank 40, carried by the horizontally-extending power-shaft 41.

The arm 38, as mentioned above, is pivoted to the link 35′ above the planes of the shafts 34 and 41, and it will be seen from the drawings that as the shaft 41 revolves the crank 40, revolving therewith, will rock the arm 38 through the medium of the link 35′, and the arc through which this arm moves is one of approximately eighty degrees. By reason of the fact that the crank 35″ and the arm 38 occupy a common plane longitudinally of the shaft 34, as shown, the crank 35″ also moves through an arc of approximately eighty degrees, and the arrangement is such that when the crank is at the forward limit of its movement in the direction of the bed it occupies a nearly-vertical position, the crank occupying an approximately horizontal position when at the rearward limit of its movement. It will thus be seen that this crank moves through a portion of a circle described concentrically with the shaft 34, and this portion of the circle is the upper portion of that half of the circle which lies farthest from the bed.

It will of course be seen that when the crank 35″ moves through its arc the shift-rod 10 will be moved through the medium of the link 36, and it will also be apparent that when the crank is moved rearwardly its horizontal movement is constantly decreased and the rate of horizontal movement of the shift-rod is proportionately decreased, the rate of movement of the shift-rod being increased when the crank is moved upwardly and forwardly until the crank has reached the forward limit of its movement, when the maximum of speed of the shift-rod and therewith the bed will have been reached. When the crank has reached the forward limit of its movement, its motion and that of the shift-rod and bed are reversed, and this reversal takes place when the bed is moving at its greatest rate of speed. By reason of the fact that the speed of the shift-rod 10 is constantly decreasing during the rearward movement thereof, the power of this shift-rod is constantly increased, and it will be seen that the buffer-spring 33 is compressed during this increase of power. By reason of the proportionate lengths of the link 35′ and the arm 38 the crank 40 moves through a greater portion of its circle when the arm 38 is being moved rearwardly than when the arm is being moved forwardly, so that the bed 11 is moved forwardly at a greater rate of speed than when it is moved rearwardly. By reason of the fact that the rearward movement of the bed is at a rate of speed less than that of the forward movement thereof, the power exerted by the shaft is further increased during its rearward movement, and this increase of power also occurs during the compression of the spring 33.

The shaft 34 is unbroken, the crank 35″ being formed by spaced arms 35^a and 35^b, which extend at right angles to the shaft, and the link 36 is concave at that surface which lies in the direction of the shaft 34 to receive into its concavity the portion of the shaft extending between the arms 35^a and 35^b. It will thus be seen that a structure is provided the strength of which is materially increased by the fact that the shaft is unbroken.

A supporting-link A is pivoted at its upper end upon a pin B, extending laterally from an arm C, which depends from the rearward end of the shift-rod 10, this pivot-point being in a horizontal plane with the pivot-points of the supporting members 7 and the members 9, and at its lower end the link A is pivoted on a bolt D, engaged in the webs of the channel-irons, this bolt occupying a common plane with the shafts 5. The link A thus supports the rearward end of the shift-rod 10.

Located above the floor 14 of the bed there are a plurality of longitudinally-extending planks Z, which form the working surface of the bed, and formed integral with these planks there are a plurality of upwardly-projecting longitudinally-extending riffles 43 of equal width, which extend parallel to each other and in spaced relation. Each of these riffles consists of a base portion Y and an upper central portion X, the former being somewhat wider than the latter and having its upper surface at opposite sides of the central portion slanted downwardly and outwardly to the working surface W of the bed. The upper portions X of the riffles are reduced in height gradually from their rearward to their forward ends and the upper surfaces of these central portions are curved transversely throughout their entire lengths, as shown at V. Throughout their rearward portions the central portions X of the riffles have vertical side surfaces U; but by reason of the fact that the central portions of the riffles are slanted downwardly toward their forward ends these vertical surfaces are constantly reduced in height until they disappear, and the arcs V terminate at the slanted surfaces of the base portions Y. It will be readily seen that between this point and the forward ends of the riffles the arcs are of constantly lessening convexity, due to the further reduction of the height of the central portions of the riffles until the arcs disappear entirely, these arcs being merged into the slanted surfaces of the base portions, and it will also be seen that the height of these base portions is reduced until they terminate at their forward ends at the working surface W, the forward ends of the riffles being spaced from the forward end of the bed.

At the side edge of the bed 11, which lies farthest from the rod 12, there is a water-supply box 40', arranged to discharge water upon the bed.

In operation the shaft 41 is rotated upwardly and away from the bed, which causes the bed to move quickly forwardly and then slowly rearwardly, the speed being constantly increased during its forward movement and constantly decreased during its rearward movement, as described above, and it will be seen that when the bed is at the forward limit of its movement the crank 35″ will extend at a lesser angle to the plane of movement of the bed than when the bed is at the rearward limit of its movement, this being due to the fact that the crank moves through the portion mentioned above of a circle described concentrically with the shaft 34. Ore to be separated is placed upon the bed at the rearward or feed end thereof and the movement of the bed causes the ore to be thrown toward the discharge end thereof. At the same time water from the discharge-box 40' passes over the surface of the bed transversely and the particles of matter of lesser specific gravity are carried off thereby, the particles of greater specific gravity falling between the riffles. It will thus be seen that the heaviest matter will be deposited between the riffles which lie nearest to the water-box and that the particles of lessening weight will extend toward the opposite side of the bed, the light waste matter being carried off entirely.

As will be readily understood, the transverse pitch of the bed may be varied as described above to suit different conditions, and by means of the slot 34' of the link 35' the mechanism is susceptible of adjustment to vary the length of the arc through which the arm 38 moves. By reason of the fact that the power-shaft 41 is adjustable toward and away from the shaft 34 the relative length of time consumed by the bed in its forward and rearward movements may be varied.

In Fig. 10 there is shown a modified form of the invention, in which the riffles 43 from the water-supply side of the bed to the discharge side thereof lie with the points at which the vertical side faces of their central portions Y disappear forwardly of these points of the preceding riffles, so that these points lie in a diagonal line extending transversely of the bed and the riffles terminate at their rearward ends on a diagonal line parallel to the line at which the vertical faces of the riffles disappear.

What is claimed is—

1. In a mechanism of the class described, the combination with a reciprocating bed, means for reciprocating the bed, said means comprising an unbroken rock-shaft, a crank carried by the rock-shaft, a curved link pivoted to said crank and disposed with its concaved side toward the said rock-shaft and being arranged to receive the said shaft in its concavity, and connections between the said link and the bed to reciprocate the latter when the crank is rocked, said crank being arranged to extend when at the limit of its movement toward the bed, at a lesser angle to the plane of movement of the bed than when the crank is at the limit of its movement away from the bed.

2. In a mechanism of the class described, the combination with a reciprocating bed, of means for reciprocating the bed comprising an unbroken rock-shaft, a crank carried by the rock-shaft and movable toward and away from the bed, a curved link pivoted to said crank and disposed with its concaved side toward the said rock-shaft and being arranged to receive said rock-shaft in its concavity, connections between the link and the bed to reciprocate the latter when the crank is rocked, said crank being movable to increase the angle between it and the plane of movement of the bed when the crank is

moved away from the bed and to decrease said angle when the crank is moved toward the bed.

3. In a mechanism of the class described, the combination with a reciprocating bed, of means for reciprocating the bed, said means comprising an unbroken rock-shaft, a crank carried by the rock-shaft, a curved link pivoted to the crank and disposed with its concaved side toward the rock-shaft and being arranged to receive said shaft in its concavity, and connections between the link and the bed for reciprocation of the latter when the shaft is rocked, said crank and link being movable with respect to each other to increase the angle between the crank and the link when the crank is moved toward the bed, and to decrease said angle when the crank is moved away from the bed.

4. In a mechanism of the class described the combination with a reciprocating bed, of means for reciprocating the bed comprising an unbroken rock-shaft, means for rocking the shaft, a crank carried by the rock-shaft, a curved link pivoted to the crank and operative connections between the curved link and the bed, said link being disposed with its concave side directed toward the rock-shaft and being arranged to receive the shaft in its concavity, said shaft extending at opposite sides of the link.

5. In a mechanism of the class described, the combination with a reciprocatory bed, of a shift-rod carried by the bed, and means for reciprocating the bed, said means comprising an unbroken rock-shaft, a crank carried by the rock-shaft and movable toward and away from the bed, means for rocking the shaft—and a curved link connected with the crank and with the shift-rod to reciprocate the latter when the shaft is rocked, said link having its concaved side directed toward the said rock-shaft and arranged to receive the said shaft in its concavity, said crank being arranged to lie at the least angle to the path of movement of the shift-rod when at the limit of its movement in the direction of the shift-rod.

6. The combination with a reciprocating body having a forward and a rearward end, of means for reciprocating the body comprising an unbroken rock-shaft, means for rocking the shaft, a crank carried by the rock-shaft and movable therewith forwardly and rearwardly in an arc, a curved link pivoted to said crank and disposed with its concaved side toward said rock-shaft and being arranged to receive the said shaft in its concavity, and connections between the crank and the reciprocating body for movement of the latter when the crank is rocked, said crank being arranged to lie at the least angle to the plane of movement of the body when the crank is at its forward limit of its movement.

7. In a mechanism of the class described, the combination with a reciprocatory bed, of means for reciprocating the bed comprising a power-shaft, an unbroken rock-shaft, a crank carried by the rock-shaft, a crank carried by the power-shaft, a curved link connected with the first-named crank, said link being adapted to receive the said rock-shaft in its concavity, an arm carried by the rock-shaft and pivoted to the link, the distance between the pivot-point of the link and arm and the pivot-point of the link and the crank being less than the distance between the first-named pivot-point and the rock-shaft, a crank carried by the rock-shaft, and operative connections between the crank and bed.

8. An ore-concentrator comprising a bed means for giving the bed a longitudinal differential shake and spaced upwardly-extending riffles carried by the bed, each of said riffles having a base portion and an upper central portion, the former being slanted upwardly from the surface of the bed to the central portion, said central portion having vertical side walls throughout a portion of its length and having an upper transversely-curved surface, said riffles being reduced in height from one end to the other, the points of termination of the side surfaces of the several riffles being disposed in a diagonal line transversely of the bed.

9. An ore-concentrator comprising a bed, means for giving the bed a longitudinal differential shake, spaced riffles carried by the bed and extending upwardly therefrom, each of said riffles having a base portion and an upper central portion, the base portion extending laterally beyond the central portion and being slanted upwardly from the surface of the bed to the central portion, said central portion having vertical side surfaces throughout a portion of its length and having a transversely-curved upper surface, said riffles being reduced in height throughout their entire lengths.

10. An ore-concentrator comprising a bed, means for giving the bed a longitudinal differential shake, spaced upwardly-extending riffles carried by the bed, each of said riffles having a base portion and an upper central portion, the base portion being slanted upwardly from the surface of the bed to the central portion, said riffles being gradually reduced in height from one end to the other, the entire portions of the riffles having vertical side surfaces terminating short of one end of the riffles and having transversely-curved upper surfaces.

11. An ore-concentrator comprising a bed arranged for longitudinal movement, means for reciprocating the bed, said means comprising an unbroken rock-shaft, means for rocking the shaft, a crank carried by the rock-shaft, a curved link pivoted to the crank and operative connections between the curved link and the bed, said link being

disposed with its concaved side toward the rock-shaft and being arranged to receive the said shaft in its concavity, said bed-reciprocating means being arranged to move the bed faster forwardly than rearwardly.

12. In a mechanism of the class described, the combination with a reciprocating bed, and a shift-rod connected thereto, of means for reciprocating the bed, said means including a suitable frame, a power-shaft mounted on said frame and adjustable longitudinally thereof, a rock-shaft, a crank carried by said power-shaft, a link adjustably connected to said crank, an arm carried by said rock-shaft and adjustably connected to said link, a crank carried by said rock-shaft, a curved link pivoted to said crank at one of its ends and connected at the other of its ends to said shift-rod, and a supporting-link pivoted in said frame at its lower end and pivoted at its upper end to the said shift-rod.

13. In an ore-concentrator, the combination with supports, of a rod mounted in the supports, said supports being arranged for longitudinal rocking movement to permit of longitudinal movement of the rod, a bed pivotally mounted upon the rod for transverse rocking movement with respect thereto, said rod lying at one side of the central longitudinal axis of the bed, a bed-moving mechanism connected therewith at the opposite side of said axis from the rod, said mechanism being arranged for operation to move the bed and vary the transverse pitch thereof, and means for adjusting said bed longitudinally of the said rod.

14. In an ore-concentrator, the combination with supports, of a rod mounted in the supports, said supports being arranged for pivotal movement to permit of longitudinal movement of the rod, a bed-reciprocating mechanism connected with the rod, a bed pivotally mounted upon the rod for transverse movement with respect thereto, said rod lying at one side of the central longitudinal axis of the bed, bell-crank levers, links connected at one of their ends to said bed at the side opposite the said axis from the rod and at the other of their ends to one of the arms of said bell-crank levers, a rod connecting the other of the arms of said bell-crank lever, a third arm carried by one of said bell-crank levers, and means for adjusting said arm to adjust the pitch of said bed.

15. In an ore-concentrator, in combination, rock-shafts, standards mounted upon said rock-shafts, a rod mounted upon said standards, said standards being arranged for longitudinal rocking movement to permit of longitudinal movement of the rod, a bed pivotally mounted upon the rod for transverse movement with respect thereto, said rod lying at one side of the central longitudinal axis of the bed, and a bed-moving mechanism connected therewith at the opposite side of said axis from the rod, said mechanism being arranged for operation to move the bed and vary the transverse pitch thereof.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM E. FORD.

Witnesses:

FRANK C. HALL,

E. M. COLFORD.

COMPLAINANTS' EXHIBIT No. 55

Dynan Patent No. 676,534

ALMON E. HART, Special Examiner

No. 676,534.

Patented June 18, 1901.

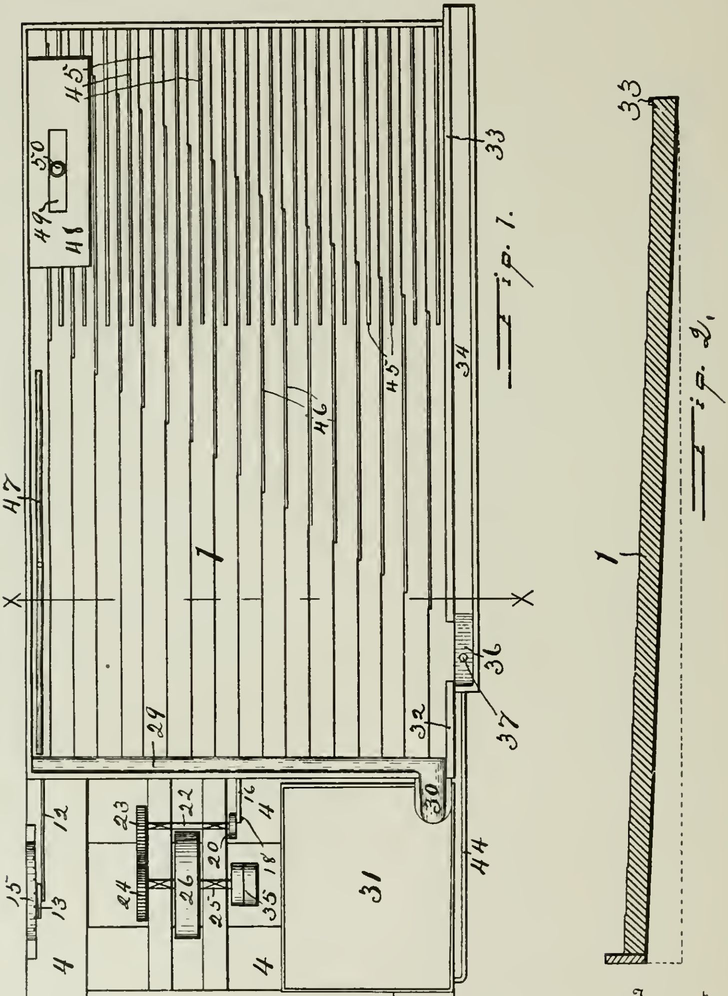
T. DYNAN.

ORE CONCENTRATOR.

(Application filed Dec. 24, 1900.)

(No Model.)

2 Sheets—Sheet 1.



Witnesses

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Thomas Dynan

By Joshua B. Webster

Attorney

No. 676,534.

Patented June 18, 1901.

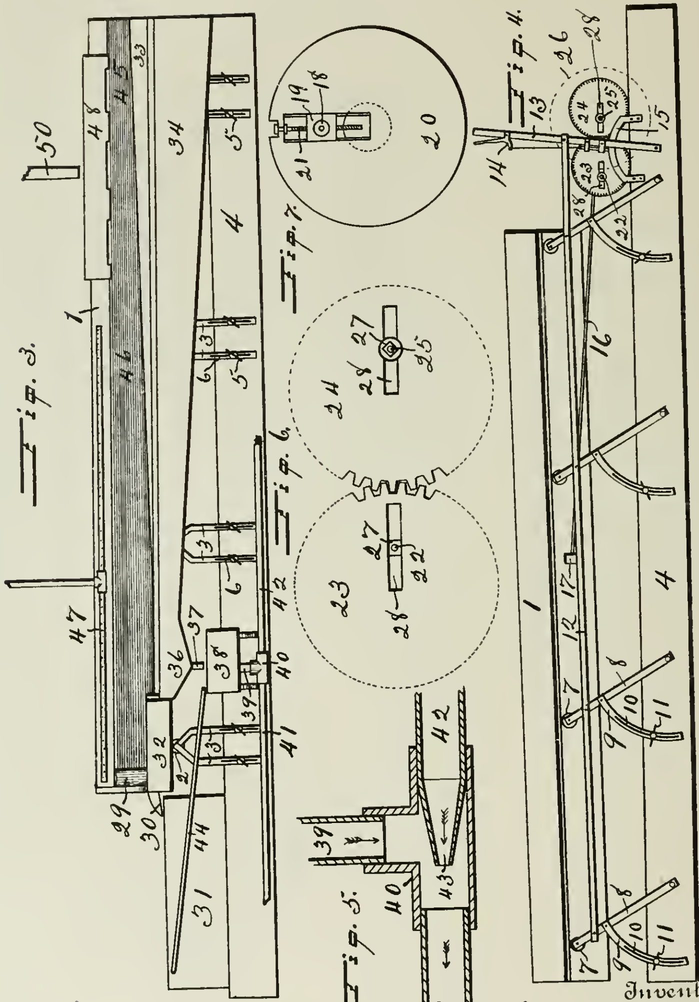
T. DYNAN.

ORE CONCENTRATOR.

(Application filed Dec. 24, 1900.)

(No Model.)

2 Sheets—Sheet 2.



Witnesses

M. Haynes.

L. B. Hodge.

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UNITED STATES PATENT OFFICE.

THOMAS DYNAN, OF AMADOR CITY, CALIFORNIA.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 676,534, dated June 18, 1901.

Application filed December 24, 1900. Serial No. 40,865. (No model.)

To all whom it may concern:

Be it known that I, THOMAS DYNAN, a citizen of the United States, residing at Amador City, in the county of Amador and State of California, have invented certain new and useful Improvements in Ore-Concentrators; and I do 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, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

My invention relates to ore-concentrators, and more particularly to that class known as "table-concentrators," over which crushed ore is introduced and the precious metal separated therefrom.

My object is to furnish an ore-concentrator with which the fine sulfurets may be thoroughly and effectively separated from the residue and saved, together with the coarser sulfurets. This I accomplish by the use of the peculiar construction, novel combination, and adaptation of parts hereinafter set forth, and particularly pointed out in the claims hereunto annexed, reference being had to the accompanying drawings for a better comprehension hereof, in which—

Figure 1 is a top view of my improved ore-concentrator. Fig. 2 is a detached sectional view through line X X, Fig. 1. Fig. 3 is a front side elevation of the concentrator. Fig. 4 is a rear elevation of the same, showing the adjustable roller-bearings. Fig. 5 is a detail sectional view of the injector-elevator. Fig. 6 is a detail view of the cam-gears, showing the adjusting-slot therein. Fig. 7 is a detail view of the crank, showing the adjustable crank-pin.

Similar figures of reference indicate corresponding parts in the several views.

I employ a table 1, which has its front side mounted on rollers 2, journaled in trusses 3, which are adjustably secured to the side of the bed-timbers 4 by thumb-nuts 5, said trusses 3 being adjustable by reason of slots 6, arranged therein.

The rear side of the table 1 is supported on rollers 7, which are journaled in arms 8, pivotally secured to the bed-timbers 4, said arms 8 each having a curved arm 9, provided with a slot 10 therein, secured thereto and adapted to be each engaged by a thumb-nut 11. The table 1 may be given the proper slant forward by the last-named arms 8 and 9, which said arms 8 are connected near the rollers 7 by a bar 12, which is pivotally secured to each and has one end attached to a lever 13, which has its lower end pivoted to the side of the bed-timbers 4 and is provided with the usual spring-fastener 14 and segment-rack 15, which is also attached to the bed-timbers 4.

The table 1 is oscillated by means of a rod 16, suitably attached at one end to a lug 17, which is rigidly attached at a suitable location beneath the table, preferably near the center thereof, and the other end of said rod 16 is journaled to a wrist-pin 18, which is rigidly attached to a base 19, adapted to be adjusted in a slot arranged radially in the crank-wheel 20. The base 19 and pin 18 are adjusted by means of a screw 21, operated from the periphery of the crank-wheel, with which screw the base 19 engages. The crank-wheel 20 is rigidly attached to one end of a shaft 22, which is suitably journaled on the bed-timbers and has a gear-wheel 23 attached eccentrically to its other end. A similar gear-wheel 24 is similarly attached to a shaft 25, which is journaled on the bed-timbers, said wheel 24 being adapted to engage the wheel 23 for the purpose as will be presently shown. The shaft 25 is provided with a suitable balance-wheel 26 and the usual power-pulleys 35.

As shown in Fig. 6, the eccentric gear-wheels 23 and 24 are each provided with a slot 28, arranged radially therein for the reception of the shafts 22 and 25, respectively, which are inserted therein and maintained rigidly in position by means of nuts 27. The slots 28 are provided for the purpose of giving the uneven oscillatory end motion to the table so much desired in machines of this class.

The top surface of the table is arranged in steps or terraces, as shown in Fig. 2, which extend from end to end of said table, said steps being preferably four inches wide and one-sixteenth of an inch drop from one step to the next step below. The table is given a slant, as shown in Fig. 2.

The table 1 has a groove 29 in its left-hand end, which terminates in a spout 30, which empties into a tank 31, which rests on the bed-timbers. On the lower edge of the table, near the left-hand end, a strip 32 is secured in position to confine the sulfurets and water and conduct the same into the tank 31. On the remainder of the lower edge of the table a tapering strip 33 is secured, as shown in Fig. 3, which extends from the lower right-hand corner to within a short distance of the end of the strip 32.

A sluice-box 34 is attached to the lower side of the table 1, so as to catch and carry away the residue that is separated from the sulfurets and carried over the strip 33. The strip 33 is preferably about one and one-half inches high at the extreme right-hand end and tapers to a point within about a foot of the strip 32, thus leaving a small space for unseparated quartz to pass from the table into the upper end of the sluice-box 34, which has a depression in the bottom thereof to prevent any sulfurets that may not be separated from passing away with the tailings, thereby forming a receptacle 36, which has an opening in the bottom thereof provided with a pipe 37 to conduct the contents into a box or vat 38, which is rigidly secured to the side of the bed-timbers 4. The overflow from the sulfurets-tank 31 is also conducted into this box or vat 38 by means of a pipe 44. As fast as the material enters the box 38 the same is carried back to the battery (not shown) by an injector-elevator (shown in Fig. 5) composed of the pipe 39, which is connected to the bottom of the box 38 and conducts its contents into a T-pipe connection 40, from which a pipe 41 extends to the battery, (not shown,) whither the contents of said pipes are impelled by water under proper pressure passing through a pipe 42, connected to the opposite end of the T 40 in line with the pipe 41, which pipe 42 is provided with a nozzle 43. As will be seen, a great saving of water is effected by reason of the double use of a greater part thereof.

I arrange a series of strips 45 across the right-hand end of the table, each being located, preferably, near the center of each step or terrace, said strip being preferably three-eighths of an inch thick and one-half inch high at the extreme end of the table, tapering to one-fourth inch at the other end. I also arrange another series of strips 46 diagonally on said table, said strips being placed parallel with the table and alternately between the strips 45, as shown in Fig. 1. These strips are three-eighths of an inch wide by one-fourth of an inch high to within a short distance (preferably one foot) of one end, whereupon said strips taper to a feather-edge, said ends being placed toward the groove 29.

A pipe 47 is arranged as shown in Figs. 1 and 3 for the purpose of supplying and distributing clear water on the forward end of the table.

A pulp distributer or spreader 48 is arranged rigidly on the upper side of the table near the right-hand end for the purpose of delivering the crushed ore evenly on the table. Said spreader 48 has a slot 49 arranged longitudinally in the top side for the reception and to allow the free action of a pipe 50, which conducts the pulp or crushed ore from the stamps or battery to the table.

The mode of operating my improved ore-concentrator is as follows: The bed-timbers 4 having been placed in position, the table 1, supported on the rollers 2 and 7, and the machinery for imparting motion to the table having been properly adjusted on the frame, the table 1 is given the desired slant forward to suit the quality of ore being worked by means of the rollers 7 and arms 8 and 9, which are operated by the lever 13, after which the thumb-nuts 11 are tightened to maintain the said arms more securely in position. The gear-wheels 23 and 24 are adjusted on the shafts 22 and 25 to give the proper uneven or jerky motion. By adjusting the shafts nearer the center of the wheels 23 and 24 the motion is lessened, and vice versa. The crank-pin 18 19 is adjusted in the crank-wheel 20, so as to give the desired length of end motion for the table. The pulp or crushed ore is introduced through the pipe 50 into the spreader 48, from whence it passes over the table. The sulfurets are caught by the strips 45 and 46 and carried forward by the uneven oscillatory end motion of the table, which has the right-hand end preferably about one inch lower than the other end for the purpose of preventing the refuse from running forward into the groove 29, and thence into the sulfurets-tank 31. As the sulfurets are carried forward on the table the water from the pipe 47 carries away all mud from the same, rendering said sulfurets free from mud or other impurities when they are deposited into the groove 29 and conducted into the tank 31. Any extremely fine sulfurets that are carried over the strips 45 are given a chance to settle in the lower right-hand corner by reason of an eddy formed by the strip 33, which prevents the water from flowing over the same at the extreme outer end, whereupon after said sulfurets have settled the same are carried forward by the oscillatory motion, as before described, until the end of the strip 33 is reached, at which point the said sulfurets, together with other unseparated quartz, are deposited into the receptacle 36 and from there into the box 38. From the box 38 said unseparated quartz is forced back to the battery by the injector-elevator (shown in Figs. 3 and 5) to be worked over and returned to the table.

I am well aware that ore-concentrators have been made which have corrugated surfaces; but these are defective

What I claim as new, and desire to secure by Letters Patent, is—

1. In an ore-concentrator of the class described the combination with a suitable table and its connections of the adjustable rollers 2 arranged under the front side of said table and journaled in trusses 3, said trusses 3 adjustably attached to suitable bed-timbers, by thumb-nuts, the rollers 7 arranged beneath the rear side of said table and journaled in arms 8, said arms 8 pivoted to bed-timbers and having the supporting-arms 9 attached thereto, said arms 9 each provided with a slot 10 and thumb-nut 11, the rod 12 attached to the arms 8 and to the lever 13, and said lever 13 provided with its spring-stop 14, all arranged and operating substantially as shown and described and for the purposes set forth herein.

2. In an ore-concentrator, the combination with a suitable foundation 4 of the table 1 with its surface composed of steps and provided with the strips 45 and 46 arranged as described, said table being mounted on suitable rollers which are mounted on and journaled in the said foundation, the spreader 48 suitably arranged on said table, the strips 33 and 32 arranged on the lower edge of the table, the groove 29 in the front end of the table, the tank 31 resting on the bed-timbers, the sluice-box 34 attached to the lower edge of the table and having the receptacle 36 at its upper end, the box 38, the injector-elevator connected to said box 38, the rod 16 suitably attached at one end to the table and its other end journaled to the wrist-pin 18, said wrist-pin adjustably attached to the crank-wheel 20, said crank-wheel 20 rigidly attached to a suitable shaft 22, the shafts 25 and 22 journaled on the bed-timbers, said shaft 25 having suitable balance-wheels and pulleys attached thereto, the eccentric gear-wheels 23 and 24 adjustably attached to one end of the shafts 22 and 25 respectively, and the water-pipe 47, all arranged and operating substantially as shown and described and for the purposes set forth herein.

3. In an ore-concentrator the combination with a table suitably mounted on roller-bearings, of the terraced surface of said table provided with the strips 45 and 46 arranged as described, the ore-spreader 48, the water-pipe 47, the strips 32 and 33 arranged on the lower side of said table, the sluice-box 34 having the receptacle 36 arranged at its top end, the box 38 arranged below the receptacle 36, the injector-elevator arranged below the said box 38, the force-pipe 42 and the discharge-pipe 41 suitably attached thereto and suitable machinery arranged to impart motion to the table, all arranged and operating substantially as shown and described and for the purposes set forth herein.

4. In an ore-concentrator, the combination of an inclined table having a trough at one end, means for supplying pulp to the table, means for actuating the table, a sluice-box arranged at the lower edge of the table and having a depression at its receiving end, a tank arranged to receive from the ough of the table, a receptacle arranged to receive from the depression of the sluice-box, means for conveying sulfurets from the tank to said receptacle, a water-supply pipe, and an injector-elevator interposed between and connected to the said receptacle and the water-supply pipe.

In testimony whereof I affix my signature in presence of two witnesses.

THOMAS DYNAN.

Witnesses:
RICHARD VANCE,
HENRY ALLAN.

COMPLAINANTS' EXIHBIT No. 56

Klein Patent No. 686,088

ALMON E. HART, Special Examiner

No. 686,088.

Patented Nov. 5, 1901.

J. KLEIN.

ORE CONCENTRATOR.

(Application filed Feb. 25, 1901.)

(No Model.)

2 Sheets—Sheet I.

Fig. 1.

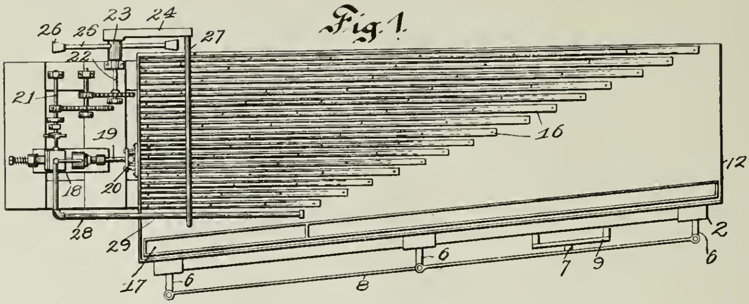


Fig. 2.

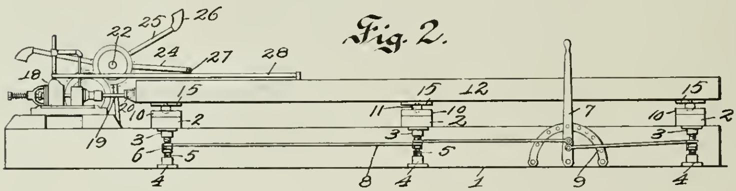


Fig. 3.

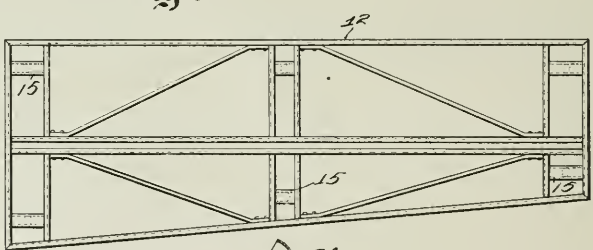
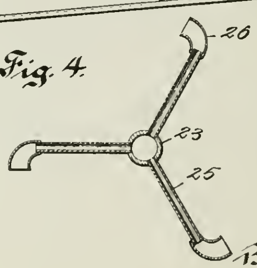


Fig. 4.



Witnesses

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J. D. Rippey.

Inventor.

John Klein

By Higdon & Longan Attys.

No. 686,088. Patented Nov. 5, 1901.

J. KLEIN.
ORE CONCENTRATOR.

(Application filed Feb. 25, 1901.)

(No Model.) 2 Sheets—Sheet 2.

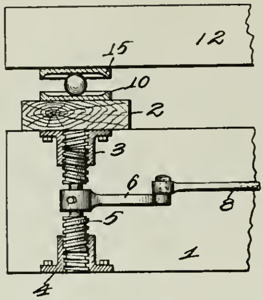


Fig. 5

Fig. 6

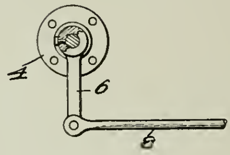


Fig. 7.

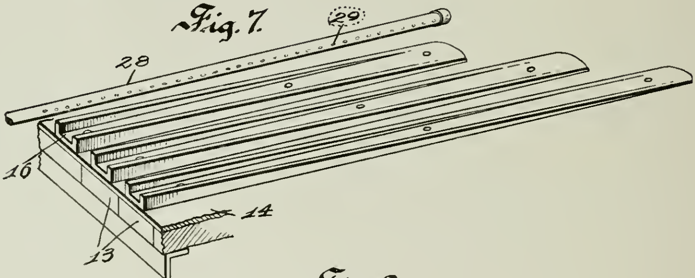
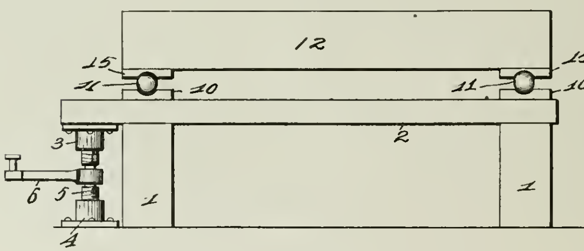


Fig. 8



Witnesses
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Inventor
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ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 686,088, dated November 5, 1901.

Application filed February 26, 1901. Serial No. 48,868. (No model.)

To all whom it may concern:

Be it known that I, JOHN KLEIN, of the city of Desloge, St. Francois county, State of Missouri, have invented certain new and useful Improvements in Ore-Concentrators, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

This invention relates to ore-concentrators; and it consists of the novel construction, combination, and arrangement of parts hereinafter shown, described, and claimed.

My improved concentrator consists of a table located upon a suitable support and provided with ball-bearings which reduce to a minimum the resistance encountered in operating the table and avoid the wear which would otherwise result were the bearing-blocks constructed to slide upon each other. The table is provided with the usual feed-trough near one side, from which the pulp can be fed in a steady stream upon the table. A series of channels is arranged upon the table, gradually lengthening toward the side opposite from the feed-trough, and these channels are arranged so that the table-surface is almost doubled and the elevated flat surfaces caused by the usual riffles are avoided. The table is provided with an adjusting device whereby it can be tilted, giving the proper inclination. A suitable motor is located at the front end of the table and operates the same, and also operates a secondary feeding mechanism which conveys back to the table any of the material which needs additional concentration or separation. I also provide an air-pipe for subjecting the pulp to the action of the air immediately after it leaves the feed-trough and before it reaches the channels.

In the drawings, Figure 1 is a plan view showing my invention. Fig. 2 is a side elevation thereof. Fig. 3 is a view showing the frame of the table. Fig. 4 is a sectional view showing a feed-wheel forming a part of my invention. Fig. 5 is a detail view showing one of the ball-bearings and the screw by which the table is raised or lowered. Fig. 6 is a detail view showing a part of the invention. Fig. 7 is a perspective view illustrating the arrangement of the channels on the table. Fig. 8 is a view showing the end of the table.

In the construction of this invention I provide a base or support 1, upon which the table and motor operating the same are mounted. At intervals along the base 1 are transverse members 2, which support the table and one end of which may be raised or lowered to give the table the proper inclination. As shown in Fig. 8, the members 2 project at one side beyond the base 1, and secured to the under sides of said members 2 are sleeves 3, provided with internal threads, and a similar sleeve 4 is supported in vertical alinement with each of the sleeves 3. A rod 5 operates in each adjacent pair of the sleeves, and the said rods are provided with opposite threads on their different ends, so that when they are turned they may be operated into or out of the sleeves 3 and 4, and thereby lower or raise the table. Connected to each of the rods 5 is an arm 6, and the said arms are connected to an operating-lever 7 by means of connecting-rods 8. The lever 7 is pivoted to the base 1, and a segment 9 is located adjacent to the said lever, so that it may be retained in the different adjustments in which it is placed. Upon the transverse members 2, adjacent the ends thereof, are the grooved blocks 10, within which are located balls 11, which form ball-bearings for the support of the table.

The table is constructed with a frame of angle-iron and is given additional strength by means of transverse and longitudinal braces which prohibit any of the parts from becoming loosened during the movement of the table. Upon the frame 12 is secured the top of the table, which consists of a series of longitudinal strips 13, bolted or otherwise fastened to the said frame 12. A covering 14, of linoleum or other suitable material, is secured over the top of the table, and upon this covering the pulp is delivered during the operation of the machine. Blocks 15, corresponding to the blocks 10, are secured to the under side of the table and are provided with grooves similar to the grooves in the blocks 10 for the reception of balls 11. These grooves, as shown in Fig. 5, are arranged parallel with the length of the table, so that the table may have a certain backward and forward movement, the scope of which is only limited by the length of the bearing-blocks. By this construction of bearing the resistance encountered in the operation of the table is greatly reduced and the blocks do not become worn, as would occur were they permitted to operate directly against each other. The advantage of this construction will be readily apparent to those familiar with machines of this character.

Upon the top of the table above the covering 14 is secured a series of metallic channels 16, which are spaced a suitable distance apart, as shown in Fig. 1 of the drawings. The vertical sides of these channels become gradually lower toward the rear end of the table, until at the extreme rear ends of the channels they disappear entirely and are even with the upper sides of the bottom of the channels. (See Fig. 7.) As shown in Fig. 1, the channels become gradually longer toward the discharge side of the table, the channel at that side being almost of equal length with the table. The channels constructed as described provide greater table-surface than results when strips are used as riffles, for the reason that no flat elevated surfaces are presented, except a small area of the vertical sides of the channels. The material may pass toward the rear end of the table, either between the channels or within them, thus economizing space and very nearly doubling the capacity of the table.

Upon the feed side of the table is located a trough 17, having divisions, one of which is at the rear of the table and the other at the forward end. The division at the front is to receive and deliver the pulp, and that part of the trough at the rear of the table receives the pure water and permits it to pass onto the table in a steady stream.

Located on the base 1, in front of the table, is a motor 18, which operates a rod 19, connected by a sort of universal joint 20 to the end of the table. The rod 19 is reciprocated by the motor 18, and as it does so it operates the table on the bearings above described. The connection 20, as stated, permits the table to assume different positions without interfering with the operation of the rod 19.

Located in any desired manner above the base is a shaft 21, adapted to rotate and which is connected by suitable intermediate gears to a shaft 22, carrying on its outer end a short pipe 23, the inner end of which is closed and the outer end of which opens into a trough or pipe 24. That part of the pulp or material which it is desired to pass over the table a second time is conveyed to a receptacle located beneath the outer end of the pipe 23 and from which it is taken and delivered onto the table to be again operated upon. A series of pipes or tubes 25 project radially from the pipe 23 and are carried around as the said pipe 23 and its shaft 22 are rotated. On the outer ends of the pipes 25 are carried elbows 26, which operate into the receptacle containing the mixture below the pipe 23 and receive a portion and retain it therein until the pipe assumes a vertical or inclined position, at which time it falls out of said pipe 25, in which it is contained, and into the pipe 23 and then into the pipe or trough 24, from which it is conveyed to the feed side of the table by means of an inclined pipe 27. The pipe or trough 24 and the pipe 27 are preferably inclined, so that the material will gravitate toward the end of the pipe 27, from which it is permitted to fall to the top of the table and pass through the concentrating process as the table is reciprocated by the motor 18. A pipe 28 leads from any suitable source of air-supply and projects over the front end of the table at the feed side thereof, and the said pipe is provided with a series of perforations 29, through which the air is forced to act upon the material immediately after it leaves the trough 17 and before it reaches the channels. By this action of the air the mineral is forced down toward the rear of the table and is passed along the ends of the channels to the point at which it is delivered from the top of the table.

A table constructed as above described is comparatively simple. The adjusting device whereby the table may be inclined permits of a very delicate and exact adjustment, and the table may be retained in the different positions by locking the lever 7 to the segment 9 in any known manner. The ball-bearings supporting the table reduce the resistance to a minimum and prevent any wear of the bearing-blocks. The material can be conveyed upon the table in a steady stream and is acted upon by the air from the pipe 28 before reaching the channels, and the ore is forced by the air toward the rear end of the table and permits the lighter particles to pass over the channels and to be conducted thereby toward the rear end of the table. Any material which it is desired to pass a second time over the table can be done so by conducting it to the receptacle located beneath the pipe 23, from which it will be raised by the rotary arms 25 and delivered into the trough or pipe 24, from which it flows by gravity to the opposite or feed side of the table.

The motor 18 is an air-motor, and air is supplied thereto through any suitable source and also to the table through the pipe 28. The table is reciprocated with a sudden and impulsive action, such as only motors of this class can give, and the frame 12 of the table is purposely constructed of strong angle-iron in order to withstand the strain. The rod or shaft 19, having the connection 20, does not in any manner interfere with the adjustment of the table; but the machine will be operated with equal effectiveness in whatever position it is placed.

I claim—

1. An ore-concentrating table, consisting of a rigid metallic frame, longitudinal strips

secured thereto, a linoleum covering upon said strips, a series of metallic troughs or channels having tapering sides, fixed upon said covering, screws for tilting the table, a lever for rotating said screws, and a lock for locking the lever to hold the screws, substantially as specified.

2. In a concentrating-table, a frame formed of angle-iron and having longitudinal and transverse braces, strips 13 rigidly secured to said frame, a covering of linoleum upon the said strips, a series of metallic channels 16 having vertical sides which taper from the front end to the rear of the table, secured upon the linoleum covering, the said channels becoming gradually lengthened toward the discharge side of the table, and means for reciprocating the table, substantially as specified.

3. In an ore-concentrator, a table, means for conveying the ore thereon in a steady stream, a series of metallic channels having vertical sides, removably secured to the top of the table and extending longitudinally thereon, transversely to the feed of the ore, the said channels tapering from the front to the rear of the table and being spaced apart to provide other channels, and means for reciprocating the table, substantially as specified.

4. In an ore-concentrator, a table having a series of metallic channels or troughs with vertical sides removably secured to its top and extending longitudinally thereon, the said channels or troughs tapering from the front to the rear of the table transversely of the feed of the ore and being spaced apart to form other channels, and means for reciprocating the table, substantially as specified.

5. An ore-concentrating table, consisting of a rigid metallic frame, a number of strips secured thereon and forming the top of the table, means for feeding the ore onto the table in a steady stream, a series of parallel metallic troughs or channels removably secured upon the top of the table and extending longitudinally thereon transversely of the feed of the ore and tapering from the front to the rear of the table, means for tilting the table, means for retaining the table in different positions, and means for reciprocating the table, substantially as specified.

6. An ore-concentrator, consisting of a table having a series of metallic channels or troughs secured to its top and spaced apart to provide other channels or troughs, means for delivering the pulp onto the table, an air-motor for reciprocating the table, an air-spraying pipe leading from the motor and extending over the table, a pipe adjacent to the table, means for rotating the pipe, a series of hollow radial arms carried by said pipe and rotated therewith, and means for delivering pulp onto the table when the said parts are rotated, substantially as specified.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN KLEIN.

Witnesses:

W. T. HAMMOCK,

S. E. JACKSON.

COMPLAINANTS' EXHIBIT No. 57

Ten Winkel Patent No. 770,877

ALMON E. HART, Special Examiner

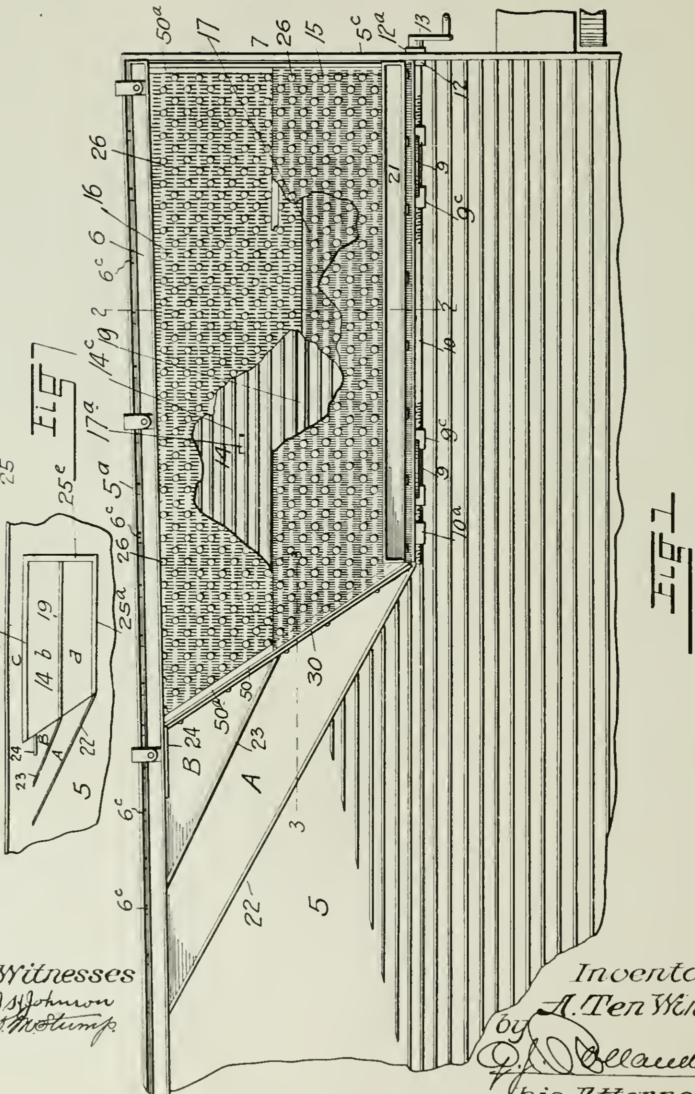
No. 770,877. PATENTED SEPT. 27, 1904.

A. TEN WINKEL.

CLASSIFYING OR SIZING APPARATUS.

APPLICATION FILED NOV. 9, 1903.

NO MODEL. 2 SHEETS—SHEET 1.



Witnesses

J. H. Johnson

F. M. Stump.

Inventor

A. Ten Winkel

by G. J. Ollaudit.

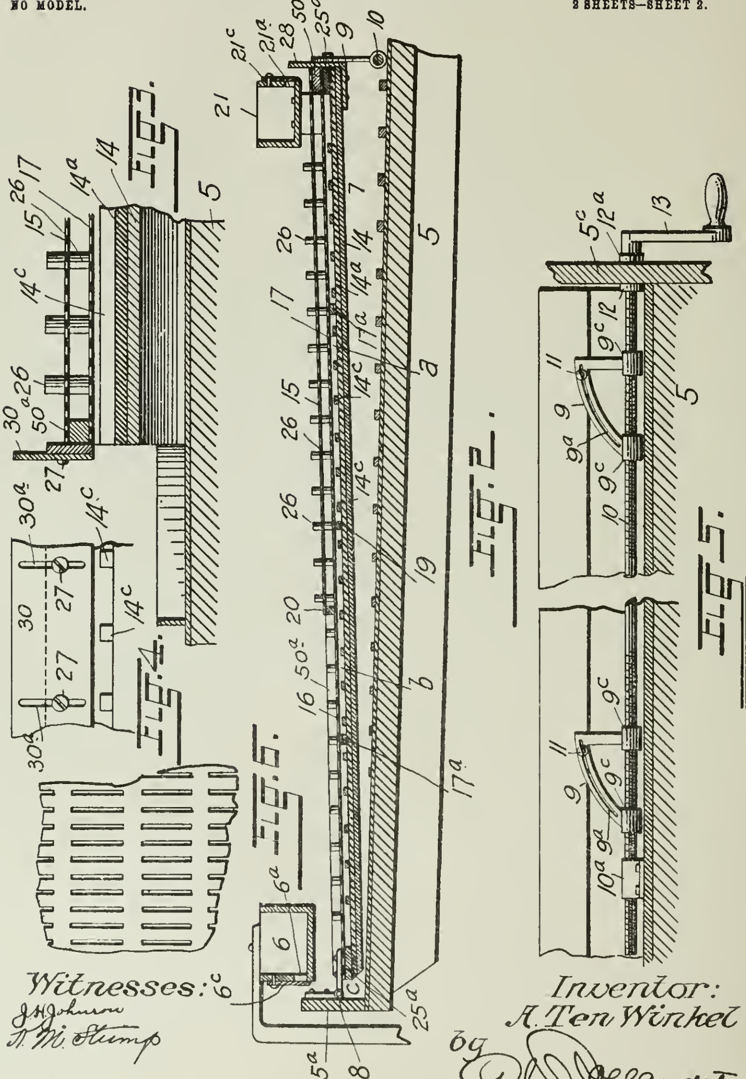
his Attorney

A. TEN WINKEL.

CLASSIFYING OR SIZING APPARATUS.

APPLICATION FILED NOV. 9, 1903.

NO MODEL. 2 SHEETS—SHEET 2.



Witnesses:
J. H. Johnson
N. M. Stump

Inventor:
A. Ten Winkel
by G. J. Gallaudet
his Attorney

UNITED STATES PATENT OFFICE.

AUGUST TEN WINKEL, OF DENVER, COLORADO.

CLASSIFYING OR SIZING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 770,877, dated September 27, 1904.

Application filed November 9, 1903. Serial No. 180,496. (No model.)

To all whom it may concern:

Be it known that I, AUGUST TEN WINKEL, a citizen of the United States of America, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Classifying or Sizing Apparatus, of which the following is a specification.

My invention relates to devices employed for sorting the crushed ore into grains of various sizes preparatory to being fed on the concentrating-tables; and the object of my invention is to produce a classifying device which, operating in conjunction with the concentrating-table to which it is attached, will classify the pulp fed onto it and deposit the various sizes upon the concentrating-table along its upper edge, where water may be supplied in varying quantities, according to the size and condition of the material.

I attain my object by the mechanism illustrated in the accompanying drawings, in which the device is shown mounted upon a concentrating-table of the Wilfley type, although it must be understood that my sizer may be attached to and used in conjunction with any table either of the jogging or bumping variety.

In the drawings, Figure 1 is a plan view of my sizer mounted at the feed-corner of a Wilfley table. Portions of the screens have been broken away in order to show screens and riffled table located underneath the upper screens. Fig. 2 is an enlarged cross-section taken along line 2 2 of Fig. 1. Fig. 3 is an enlarged longitudinal section of a portion of the device, taken along line 3 3 of Fig. 1. Fig. 4 is a front view of Fig. 3. Fig. 5 is a section of the table, taken in front of the high side of the sizer, showing the mechanism employed for adjusting its inclination. Fig. 6 illustrates the particular screen or perforated plate which is most suitable for use on my device; and Fig. 7, a plan view of the table 14 of the sizer, drawn to a reduced scale, showing connection of compartments *a* and *b* of the sizer with compartments A and B on the table. Riffles are omitted for sake of clearness.

Similar reference characters refer to similar parts throughout the various views.

5 represents the transversely-inclined concentrating-table with a feed and water trough 6. This trough as it is used at present is divided into two compartments by a transversely-located partition, the compartment above the feed-corner of the table being used for feeding the pulp onto the table, while the other compartment supplies the water necessary for the proper treatment of the ores. When my device is attached to the table, I remove the partition and employ the entire trough for the distribution of water along the table.

The sizer 7, located at the feed-corner of the concentrating-table, is inclined toward the upper edge of said table and hinged at its lowest side to the upwardly-extending flange 5^a of table 5 by means of suitably-located hinges 8. The opposite or high side of the sizer is supported by slotted segments 9, mounted on a threaded rod 10, the side of the sizer having been provided with bolts 11, which pass through the slots 9^a of segments 9. Rod 10 is supported at one end in a stationary box 10^a, located on the upper surface of the table, while its opposite extremity extends through and beyond the flange 5^c of table 5. Collars 12 and 12^a, located, respectively, at the inside and outside of flange 5^c and secured to rod 10, prevent longitudinal movement of the rod. A crank 13, mounted on the extremity of the rod extending beyond flange 5^c, affords means for turning same. Segments 9 are provided with sleeves 9^c, having female screw-threads for the reception of rod 10, which passes through them.

When it is desired to change the inclination of sizer 7 in relation to the surface of table 5, crank 13 is turned in the required direction, causing sleeves 9^c and with them segments 9 to travel along rod 10, and bolts 11 in following slots 11^a will cause the side of the sizer to be raised or lowered, according to the direction in which rod 10 is being turned. Sizer 7 is composed of a table 14, provided on its upper surface with a linoleum covering 14^a and longitudinal riffles 14^c, placed upon and engaging the linoleum. Secured to and supported by table 14 is a rectangular three-sided frame 25, composed of two parallel side strips 25^a, connected by a cross-piece 25^e, the fourth side being omitted to allow the discharge of the ore from plate 14. Secured to frame 25 are two screens 16 and 17, which lying in one plane and adjoining each other extend along the entire length of the table 14. They may be fastened together by soldering or other suitable means and are provided on their upper surface with a number of projections, whose function is the breaking of the pulp which passes over the screens.

Screens 16 and 17 may be supported and kept from sagging by suitably-located supports 17^a. Along the division-line of the two screens is located a longitudinal cleat 19, which resting upon the linoleum covering of table 14 extends along its entire length and engaging the under surface of screens 16 and 17 divides the space between the screens and plate 14 into two compartments *a* and *b*. Placed on top of screens 16 and 17 is a second three-sided frame 50, composed of two end pieces 50^a, connected by a side piece 50^c, the open side in this case facing the lower side of the sizer. Secured to frame 50 and resting upon projections 26 of screens 16 and 17 is a third screen 15, the upper surface of which is, like the other screens, provided with a number of projections 26.

Screen 15, extending along the entire length of the table, is of a width sufficient to cover screen 17 and a portion of the adjoining screen 16. Its inner edge rests upon a cleat 20, which engages the upper surface of screen 16 and, like cleat 19, extends along the entire length of the sizer. Cleat 20 in conjunction with the upper part of frame 50 forms a rectangular frame which incloses the entire space between screen 15 and the screens located beneath it. Screens 15, 16, and 17 vary in mesh, screen 16 being the coarsest (say forty) and 17 the finest, (sixty,) while the upper screen 15 is of a medium mesh, (fifty.)

The feed-box 21 is located at the upper side of the sizer, being secured thereto in any suitable way. It is provided with a number of apertures 21^a, which may be closed or opened by means of gates 21^c. The pulp on leaving the feed-box through apertures 21^a falls upon the fifty-mesh screen 15. The material finer than fifty mesh will fall through screen 15 onto the sixty-mesh screen 17, through which the material finer than sixty mesh will fall into compartment *a* of the riffled table 14, along which on account of the shaking motion of the concentrating-table to which the sizer is attached it will travel along the riffles and into a compartment A on the surface of the concentrating-table, said compartment being separated from the rest of the table by means of an upwardly-extending flange 22. The material which did not fall through screen 15 will travel over said screen and fall onto the forty-mesh screen 16, through which the material finer than forty mesh will fall into compartment 6 of table 14, while the coarser material will on account of the shaking motion and inclined position of the sizer travel over the edge of the sizer onto the concentrating-table at C. The material which did not pass through screen 17 will travel transversely along said screen onto the portion of screen 16 extending from the line on which it joins screen 17 to cleat 20 and will fall into compartment *b* of table 14, from where it, together with the material which fell through screen 16, will move transversely into a compartment B of the concentrating-table, which is separated from the before-mentioned compartment A by an upwardly-extending flange 23. A third flange 24 prevents the ore coming from B from mixing with the ore which fell from screen 16 onto the table at C.

Partitions 22 and 23 extend, respectively, from points directly underneath the upper corner of the sizer at the discharge end and the point of termination of dividing-cleat 20 at the same end of the sizer toward the edge of table 5, terminating at points underneath water-trough 6 and a certain distance away from flange 5^a of the table, the function of the partitions being to compel the ore discharged from the sizer to move to the upper edge of the concentrating-table, from where it is made to run along the entire width of said table for concentrating purposes. Water-trough 6 has a number of apertures 6^a with corresponding gates 6^c, through which clean water may be applied to the classified material on the table, thereby facilitating its running over the concentrating-table, which is especially of value when the pulp is thick and heavy. By proper manipulation of gates 6^c, located above the different ore-compartments on the table, the flow of water may be regulated to suit the various sizes contained in the compartments A, B, and C.

At the discharge end of my sizer I have located a gate 30, which is guided during up and downward movement and held in place at any desired height by bolts 24, screwed into the edge of the sizer and passing through slots 30^a in the gate. By raising or lowering gate 30, which operates on the principle of a head-gate in an irrigating-ditch, I am enabled to regulate the amount of water which flows with the ore from the compartments *a* and *b* of the table 14 onto the concentrating-table. Together with the pulp water is constantly fed onto the sizer out of feed-box 19, the quantity of water to be sufficient to cover the sizer at all times. To prevent the water and pulp running off screen 15 at the high or feed side of the sizer, that side is provided with an upwardly-extending flange 28, which extends along its entire length. Projections 26, although shown in the drawings as being cylindrical, may be of any desired shape, depending largely on the kind of ore it is desired to treat.

In Fig. 4 is illustrated a section of screen or perforated plate which I preferably use on my sizer, as it obviates the necessity of stretching, is stronger and more durable than the wire screens, and does not clog.

Having thus described my invention, what I claim is—

1. A classifier or sizer comprising a transversely-inclined riffled table, adjoining screens running lengthwise above said table, a third screen located above said screens, a partition located on said table underneath the division-line of said adjoining screens, cleats on said table supporting said screens, the distance between said screens and the table exceeding the height of the riffles, substantially as described.

2. In a classifier or sizer, a transversely-inclined table, adjoining screens running lengthwise above said table, a third screen located above said adjoining screens, suitable means for dividing the space between the adjoining screens and said table into two compartments open at one end and suitable means for varying the area of the openings at said end, substantially as described.

3. In a classifier or sizer, a transversely-inclined riffled table, adjoining screens located above said table, the space between the screens and the table being divided into two compartments open at one of their ends, a gate, adapted to close said open ends, a third screen located above and covering one of the before-mentioned screens and part of the adjoining one, the space between the uppermost and lower screens being inclosed and a feed-box located above said upper screen, substantially as described.

4. The combination with a transversely-inclined concentrating-table of a riffled bed, transversely inclined toward and hinged at the upper edge of said table, adjoining and superimposed screens secured to and above said bed, suitable means for feeding pulp onto said screens, means for discharging the various grades of ore onto said table at different points and suitable means for varying the angle between said bed and the concentrating-table, substantially as described.

5. The combination with a transversely-inclined concentrating-table of a riffled bed transversely inclined toward and hinged at the upper edge of said table, adjoining and superimposed screens secured to and above said bed, suitable means for feeding pulp onto said screens, means for discharging the various grades of ore onto said table at different points, a rotatable, longitudinally-stationary, threaded rod mounted on said table, threaded plate-bearing sleeves mounted on said rod, segmental slots in said plates and bolts secured to the upper side of said bed and passing through said slots, substantially as described.

6. In a sizer or classifier, the combination with a riffled bed provided with a plurality of superimposed screen-sections and transversely inclined toward the upper edge of a concentrating-table, of partitions extending from the discharge end of said bed toward the upper edge of said table, substantially as described.

7. The combination with a transversely-inclined concentrating-table of a riffled bed, transversely inclined toward the upper edge of said table, adjoining screens of varying mesh located above and running lengthwise of said bed, a screen located above the adjoining screens, suitable means for feeding pulp onto the uppermost screen, and partitions on said table adapted to direct the material, discharged at different points from the screens and the riffled bed, toward the upper edge of the concentrating-table, and means for feeding water in varying quantities into the compartments formed by said partitions, substantially as described.

8. The combination with a transversely-inclined concentrating-table of a linoleum-covered, riffled plate, transversely inclined toward and hinged at the upper edge of said table, adjoining longitudinal screens secured to a frame on said plate, the space between them and the plate being divided into two compartments open at one end, suitable means for regulating the discharge from the compartments, a screen located above and covering one of said screens and part of the adjoining one, projections extending above surface of said screens, a feed-trough located above the uppermost screen, means on the concentrating-table for directing the various grades of ore, discharged onto it, toward the upper edge of the table, a water-trough located at the upper edge of the table and provided with discharge-apertures and corresponding gates, and suitable means for varying the inclination of the riffled plate in relation to the table, substantially as described.

In testimony whereof I have signed my name, before two subscribing witnesses, this 3d day of November, 1903.

AUGUST TEN WINKEL.

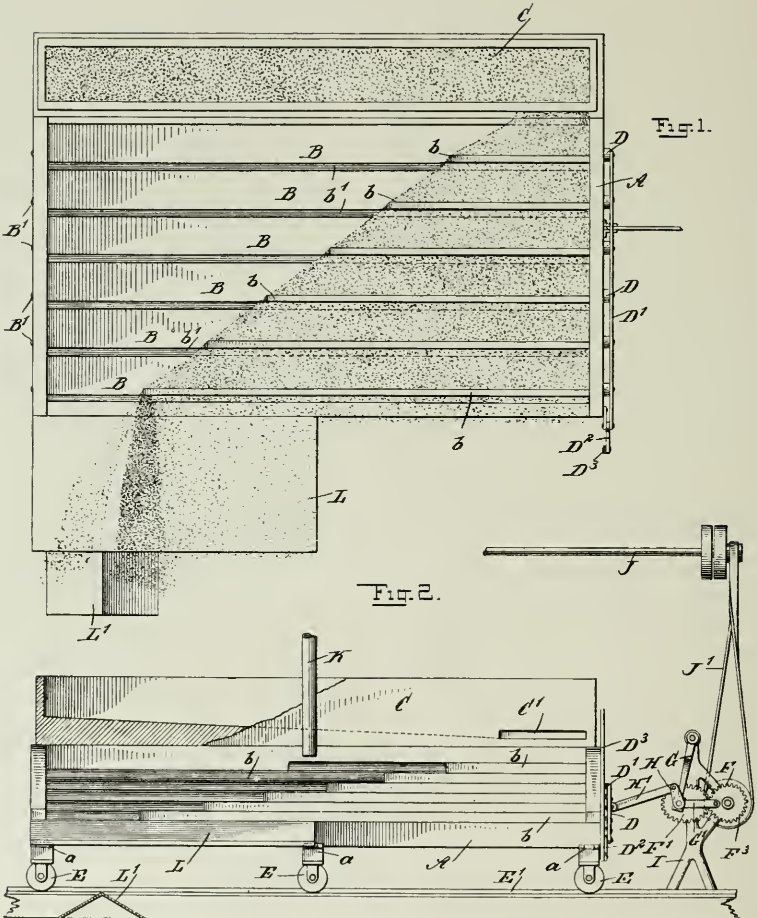
Witnesses:
G. J. ROLLANDET,
K. M. STUMP.

COMPLAINANTS' EXHIBIT No. 58
Grannatt Patent No. 632,109
ALMON E. HART, Special Examiner

No. 632,109. Patented Aug. 29, 1899.

H. C. GRANNATT.
ORE CONCENTRATOR.
(Application filed May 6, 1898.)

(No Model.) 2 Sheets—Sheet 1.



WITNESSES:
Geo. W. Naylor
H. L. Reynolds.

INVENTOR
H. C. Grannatt
BY Munn & Co
ATTORNEYS.

No. 632,109.

Patented Aug. 29, 1899.

H. C. GRANNATT.

ORE CONCENTRATOR.

(Application filed May 6, 1898.)

(No Model.)

2 Sheets—Sheet 2.

Fig. 3.

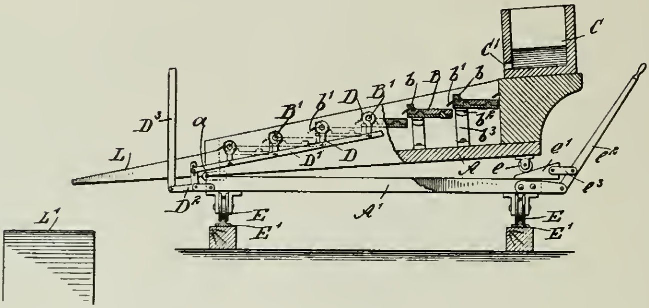


Fig. 6.

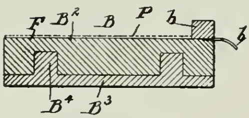


Fig. 7.

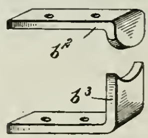


Fig. 4.

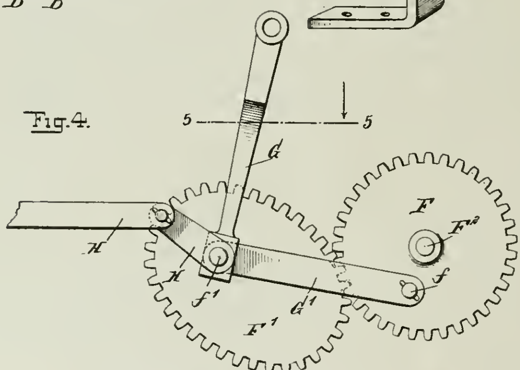
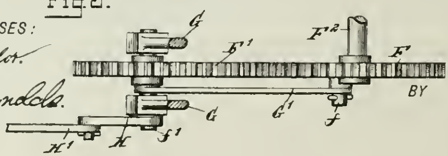


Fig. 5.



WITNESSES:

Geo. W. Naylor.

H. L. Reynolds.

INVENTOR

H. C. Grannatt.

BY

Munn & Co.

ATTORNEYS.

United States Patent Office.

HENRY C. GRANNATT, OF COLORADO SPRINGS, COLORADO.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 632,109, dated August 29, 1899.

Application filed May 6, 1898. Serial No. 679,941. (No model.)

To all whom it may concern:

Be it known that I, HENRY C. GRANNATT, of Colorado Springs, in the county of El Paso and State of Colorado, have invented a new and Improved Ore-Concentrator, of which the following is a full, clear, and exact description.

My invention relates to an ore concentrating or amalgamating device to be used in connection with water and which treats the material by flowing it over plates or tables which are inclined and which are given longitudinally-reciprocating and laterally-oscillating motions.

The invention comprises the features which will be hereinafter described, and particularly pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a top plan view of my device. Fig. 2 is a side elevation. Fig. 3 is an end elevation, partially in section. Fig. 4 is a side elevation of the elliptical gears by which the differential reciprocation is obtained. Fig. 5 is a top plan view of said gears. Fig. 6 is a cross-section through the slats upon which the ore is treated, and Fig. 7 is a perspective view of the pivot used for supporting the central portions of the pivoted slats.

The object of my invention is to provide a machine for the treatment of ores by the wet process which shall require less water than the mechanisms usually employed and at the same time to secure a greater efficiency.

The framework of my device comprises two frames A and A′, which are pivoted by hinges a upon one side edge, so that the angle of the upper frame A may be readily adjusted to comply with the requirements in treating different ores. The upper frame A is preferably of a rectangular shape and has mounted therein a series of slats B, extending longitudinally of the frame. These slats are provided with riffles b, extending along the lower side edge thereof and retaining the water and ore upon the slat. The length of the riffles b upon the successive slats varies, being shortest on the upper slat and increasing in length on the successive slats.

The pulp or ground ore mixed with water is introduced into the box C, which is placed at the upper edge of the concentrator, and escapes upon the slats through an opening C′ at one end of the concentrator. It is intended that the pulp should have a comparatively small amount of water mixed therewith, as the device is intended for use in places where the supply of water is scarce. It is not to be understood, however, that my device will work successfully only with a small supply of water, but that it is especially adapted for use in places where the water-supply is short.

The slats B are preferably constructed as indicated in the cross-section shown in Fig. 6. Each slat consists of two parts B^2 and B^3, which are connected to each other by grooves and tongues B^4. The object of this construction is to prevent warping of the slats. The slats are provided at each end with pivots B′, which are located at one side of the slats and preferably on the same line as the riffles b. While it is preferred that the upper edge of the riffles b should be directly over or in line with the center of pivots, the device will work with large measure of success when the riffles are placed at either side of this point, the best result, however, being obtained when the riffles correspond in line with the pivots. This last construction produces a line of comparatively unagitated or quiet material next to the riffles and gives the heavier particles a better chance to collect there. If the pivot were otherwise placed relative to the riffle, the material being concentrated would be kept in greater agitation, so that no quiet zone or line could form, and the heavier particles would be carried along more rapidly.

To give an oscillating motion to the slats, the pivot at one end of each slat is extended and is provided with a crank D, the cranks upon the different slats being connected by a common connecting-rod D′. To more thoroughly support the central portions of the slats, which otherwise might sag, a pivot, such as that shown in Fig. 7, is provided. This pivot consists of two bent plates b^2 and b^3, the plate b^2 being fastened to the under surface of the slat and the plate b^3 being attached to the frame A. The plate b^2 has one end bent downward and provided with a convexly-rounded extremity, while the plate b^3 has one end bent up and provided with a concavelyrounded extremity adapted to engage the end of the plate b^2.

Each of the slats E is preferably provided on the edge having the riffle with a flap b' of leather, tin, or other suitable material and which projects a sufficient distance to insure the overflow from one slat being deposited within the edge of the slat below it.

The frame A is made adjustable in elevation upon the frame A' and is provided with rollers e upon the edge opposite the hinges. Mounted upon the frame A' is a lever e^2, connected by means of a link e^3 with an inclined block or wedge e', which supports the roller e. By moving this wedge in or drawing it out the elevation of this edge of the frame A is varied. The frame A' is provided with rollers or wheels E beneath the same and running upon a track E', extending longitudinally of the frame. The whole device is thus capable of longitudinal motion upon the track. This motion is secured by means of the circular and elliptical gears. (Shown in Figs. 4 and 5, also in Fig. 2.)

Upon a suitable supporting-frame I is journaled a circular gear F, which is fixed upon a shaft F^2, which carries a pulley F^3. This pulley is connected by a belt J' with a pulley mounted upon any suitable shaft J, said shaft being rotated by connection with some source of power. The gear F is thus given a continuous and uniform rotation. The gear F is provided with a crank-pin f, upon which is pivoted one end of link G'. The opposite end of the link is loosely held upon a pin f', that is secured upon an elliptical gear F'. This gear is supported by means of an arm G, which at its upper end is pivoted upon the framework I and at its lower end engages the pin f'. This permits the gear F' to swing in an arc of a circle of which the arm G is a radius. The outline of the gear F' is so constructed with reference to the pivot-points f and f' and their distances from their respective centers that the gears F and F' are constantly in mesh. The link G' serves to hold the gear F' against the gear F, while the arm G gives it a swinging support.

Upon the pin f' is fixed a crank-arm H, to the outer end of which is secured a link or connecting-rod H', which at its opposite end is attached to the frame A. By this means the frame A is given a reciprocation which varies in speed, being more rapid in one direction than in the other. The more rapid motion of the frame is given to it while traveling away from the gear-wheels, while the slow motion is on the return. The result of this is to work the heavier particles of the ore, which carry the values, toward the left, as shown in Figs. 1 and 2—that is, along the slats toward the ends of the riffles b. One or more pipes K or other suitable means are provided by which clear water may be introduced upon the slats, so as to insure a more thorough washing and separation of the parts.

The operation of the device is as follows: The pulp or ground ore is introduced through the box C upon the upper slat and at one end thereof. These slats are given a constant slight oscillating motion upon their pivots and at the same time are given a reciprocating motion as a body. As a consequence of this the pulp is not given an opportunity to settle, but is kept thoroughly agitated in the water, and a smaller amount of water is also sufficient for this purpose The oscillating movement of the slats will tend to work the concentrates down into the angle above the riffles. The lighter particles, which will come to the surface, will work over the edges of the riffles with a portion of the water and be deposited upon the slat next below. The concentrates and heavier particles will, by the longitudinal reciprocation of the frame and slats, be gradually worked lengthwise of the slats until they reach the ends of the riffles. They will then be discharged from the ends of the riffle upon the slat next below. As the riffle upon each succeeding slat is longer than the preceding one, the result by the time the concentrates reach the first slat is a very thorough separation of the worthless particles from the valuable ones.

To the lower end of the frame, as described, may be attached a finishing-table L. This table is flat and has an incline in about the same direction as that of the slats, being made to tip more or less to suit different kinds of ore. This table is given a longitudinal reciprocation with the main frame. Beneath the lower edge of the table may be placed two V-shaped plates, which serve to secure a final separation of the concentrates from the worthless particles of the ore.

This device may be used for concentrating ores in places where the water-supply is very limited. It will secure a thorough separation with great economy in the use of water. In ordinary use it is preferable that the slats B be covered with a layer of some material such as linoleum. Such a layer is indicated by the dotted lines at P in Fig. 6. In case the device is desired to be used as an amalgamator, as well as a concentrator, an amalgamated metal plate may be substituted for the sheet of linoleum. The riffles may also be extended the entire length of the slat and the longitudinal reciprocating motion disconnected.

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

1. An ore-concentrator, comprising a frame having a series of inclined slats therein, pivoted at their lower edges and each having a riffle extending along its pivot edge, and with its upper edge substantially in line with the pivots, said slats being placed in successively lower planes, so that the overflow from one is received by the next, and the riffles extending from the feeding end of the slats a part only of their length and being of successively greater length, and means for giving the

frame reciprocations longitudinally of the slats, and for simultaneously giving the slats a slight oscillation on their pivots, substantially as described.

2. An ore-concentrator, comprising a frame having a series of inclined slats therein, pivoted at their lower edges, each having a riffle extending along its pivoted edge, the upper edges of the riffles being substantially in line with the pivots, said slats being placed in successively lower planes so that the overflow from one is received by the next, and the riffles extending from the feeding end of the slats a part only of their length and being of successively greater length, wheels under the frame, a track extending longitudinally of the slats, mechanism attached to the frame to reciprocate it, and means for simultaneously giving the slats a slight oscillating motion on their pivots, substantially as described.

3. An ore-concentrator, comprising a frame having a series of inclined slats therein, pivoted at their lower edges, each having a riffle extending along its pivot edge with its upper edge substantially in line with the pivots said slats being placed in successively lower planes, so that the overflow from one is received by the next, and the riffles extending from the feeding end of the slats a part only of their length and being of successively greater length, wheels under the frame, a track for said wheels extending longitudinally of the slats, mechanism attached to the frame to reciprocate it, cranks upon the slat-pivots, a common connecting-rod for said cranks, and a power connection to said rod, for simultaneously giving the slats a slight oscillating motion, substantially as described.

4. An ore-concentrator, comprising a frame having a series of inclined slats therein, pivoted at their lower edges, each having a riffle extending along its pivot edge, and with its upper edge substantially in line with the pivots, said slats being placed in successively lower planes so that the overflow from one is received by the next, and the riffles extending from the feeding end of the slats a part only of their length and being of successively greater length, means for giving the frame reciprocations longitudinally of the slats and for simultaneously giving the slats a slight oscillation on their pivots, and an inclined finishing-table attached to the opposite side of the device and receiving the concentrates thereon, substantially as described.

5. An ore-concentrator, comprising a frame formed in two parts, hinged to each other at one edge and provided at their other edges with adjustable separating means, said frame having a series of inclined slats therein, pivoted at their lower edges and each having a riffle extending along its pivot edge with its upper edge substantially in line with the pivots, said slats being placed in successively lower planes so that the overflow from one is received by the next, and the riffles extending from the feeding end of the slats a part only of their length and being of successively greater length, and means for giving the frame reciprocations longitudinally of the slats and for simultaneously giving the slats a slight oscillation on their pivots, substantially as described.

6. An ore-concentrator, comprising a frame formed in two parts hinged to each other at one edge, a roller on one part at its opposite edge, a wedge-block engaging said roller, a lever controlling the wedge-block, said frame having a series of inclined slats therein, pivoted at their lower edges and each having a riffle extending along its pivot edge, and with its upper edge substantially in line with the pivots, said slats being placed in successively lower planes so that the overflow from one is received by the next, and the riffles extending from the feeding end of the slats a part only of their length and being of successively greater length, and means for giving the frame reciprocations longitudinally of the slats, and for simultaneously giving the slats a slight oscillation on their pivots, substantially as described.

7. An ore-concentrator, comprising a frame having a series of inclined slats therein, pivoted at their lower edge, and having intermediate pivotal supports, comprising bars having respectively a convex and concave arc formed upon their ends and fixed to the slats and their supports, the slats also having riffles extending along their pivot edge, with their upper edges substantially in line with the pivots, said slats being placed in successively lower planes so that the overflow from one is received by the next, and the riffles extending from the feeding end of the slats a part only of their length and being of successively greater length, and means for giving the frame reciprocations longitudinally of the slats, and for simultaneously giving the slats a slight oscillation on their pivots, substantially as described.

8. An ore-concentrator, comprising a frame having a series of inclined slats therein, pivoted at their lower edges and each having a riffle extending along its pivot edge, the upper side of the riffle being substantially in line with the pivots, said slats being placed in successively lower planes so that the overflow from one is received by the next, and the riffles extending from the feeding end of the slats a part only of their length and being of successively greater length, the slats also having flaps extending from their lower edge over the upper edge of the next slat, and means for giving the frame reciprocations longitudinally of the slats and for simultaneously giving the slats a slight oscillation on their pivots, substantially as described.

9. An ore-concentrator, comprising a frame having a series of inclined slats therein, pivoted at their lower edge and each having a riffle extending along one edge and substantially in line with its pivot, said slats being

placed in successively lower planes, so that the overflow from one is received by the next, and the riffles extending from the feeding end of the slats a part only of their length and being of successively greater length, flaps attached to the lower sides of the slats and extending over the upper edge of the next slat, wheels under the frame, a track extending longitudinally of the slats, mechanism attached to the frame for reciprocating the frame, cranks upon the pivots of the slats, and means connected to said cranks, for simultaneously giving the slats a slight oscillating motion, substantially as described.

10. An ore-concentrator, comprising a frame having a series of inclined slats therein, pivoted at their lower edges and each having a riffle extending along its pivot edge, the upper edge of the riffle being substantially in line with the pivots, said slats being placed in successively lower planes, so that the overflow from one is received by the next, and the riffles extending from the feeding end of the slats a part only of their length and being of successively greater length, a differential reciprocating mechanism connected to the frame for giving it motion longitudinally of the slats, and means for simultaneously giving the slats a slight oscillating motion on their pivots, substantially as described.

11. An ore-concentrator, comprising a frame having a series of inclined slats therein, pivoted at their lower edges and each having a riffle extending along one edge substantially in line with its pivots, said slats being placed in successively lower planes, so that the overflow from one is received by the next, and the riffles extending from the feeding end of the slats a part only of their length and being of successively greater length, a circular spur-gear having a power connection, an elliptical spur-gear, means for moving the gear-centers to hold said gears in mesh, a crank-pin carried by the elliptical gear, a link connecting said crank-pin with the concentrating-frame, and means for simultaneously giving the slats a slight oscillating motion on their pivots, substantially as described.

12. An ore-concentrator, comprising a frame having a series of inclined slats therein, pivoted at their lower edges and each having a riffle extending along its pivot edge, the upper edge of the riffle being substantially in line with the pivots, said slats being placed in successively lower planes so that the overflow from one is received by the next, a circular gear having a power connection, an elliptical gear, a link connecting the gears and holding them in mesh, a link having a fixed pivot at one end and pivoted at the other end to the elliptical gear, a crank-pin upon said elliptical gear, a link connecting said crank-pin with the concentrating-frame, and means for simultaneously giving the slats a slight oscillating motion on their pivots, substantially as described.

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COMPLAINANTS' EXHIBIT No. 59

Cammett Patent No. 713,747

ALMON E. HART, Special Examiner

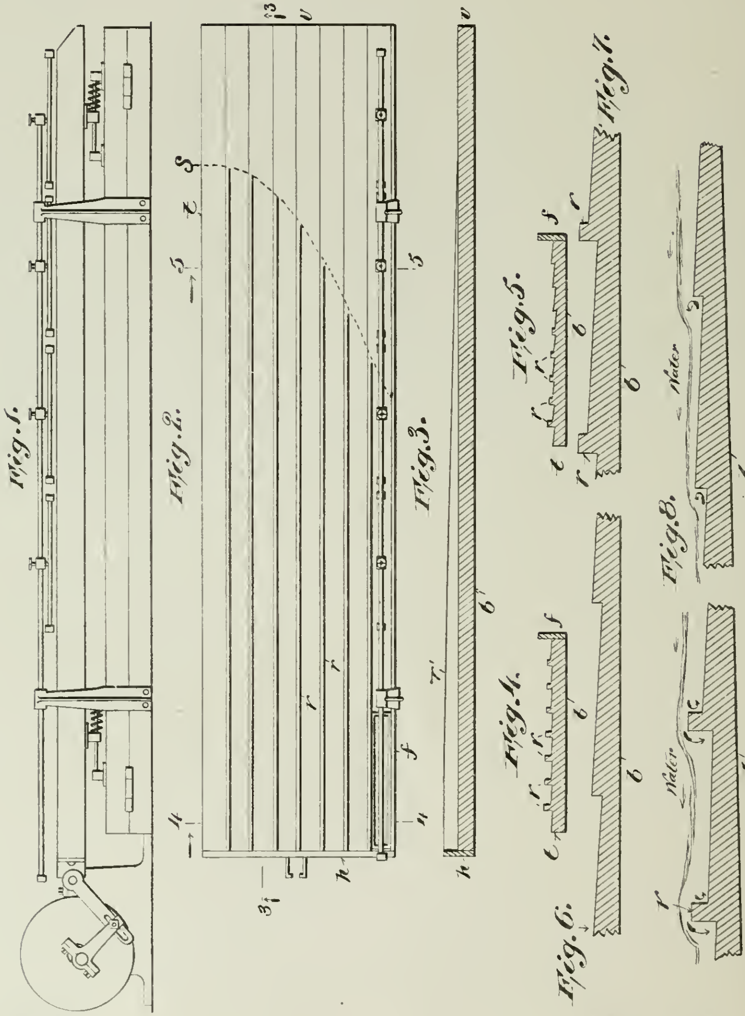
No. 713,747 Patented Nov. 18, 1902.

I. A. CAMMETT.

ORE CONCENTRATING TABLE.

Application filed Mar. 19, 1901.

(No Model.)



Witnesses;
C.W. Benjamin
Henry S. Morton.

Inventor;
Ira A. Cammett.
by [signature] atty

UNITED STATES PATENT OFFICE.

IRA AUSTIN CAMMETT, OF DENVER, COLORADO, ASSIGNOR TO THE DENVER ENGINEERING WORKS COMPANY, OF DENVER, COLORADO, A CORPORATION.

ORE-CONCENTRATING TABLE.

SPECIFICATION forming part of Letters Patent No. 713,747, dated November 18, 1902.

Application filed March 19, 1901. Serial No. [illegible],877. (No model.)

To all whom it may concern:

Be it known that I, IRA AUSTIN CAMMETT, of Denver, in the county of Arapahoe, in the State of Colorado, have invented certain new and useful Improvements in Ore-Concentrating Tables, of which the following is a description accompanied by drawings.

There are several types of concentrators which may be regarded as tables, whether similar to buddles or traveling belts or true tables of the Rittinger type that do not travel, but have vibratory or percussive movements. The present invention, while applicable in a greater or less degree to certain forms of these divers constructions, is especially valuable for tables of the Rittinger type, and therefore specially applicable to them. It has been customary to give to such tables an inclination in one direction and a percussive motion or peculiar vibrating motion at right angles or at nearly right angles to the inclination. The inclination determines the natural direction or flow of the water, and the percussive motion determines the direction in which the values will be mechanically carried by the table. Of course the values are also acted upon by the flow of the water, so that they follow diagonal paths which correspond neither with the flow of the water nor with the line of mechanical vibration. It must, however, be understood that although I am describing the invention in connection with a flow of water this does not prevent the principles of operation of the invention from being utilized in a dry separator.

For the purposes of definition the term "longitudinal" will be used in this specification to mean where the sense so permits a direction transverse to the inclination of the table and preferably parallel or nearly parallel with the percussive or vibratory movement. The inclination of these tables is usually adjustable to at least a slight extent in the direction of the mechanical movement, as well as at right angles thereto.

The present invention relates, primarily, to the riffled or partly-riffled surfaces of such concentrating-tables.

The object of the invention is to improve and perfect the table-surface so as to produce better and, indeed, substantially perfect concentration and separation of certain grades of ore than has heretofore been possible.

The advantages of tapered riffles, whether in the form of raised ribs or depressed grooves, are now well known. Such tapered riffles are illustrated, for example, in the Cammett & Shepard patent, No. 632,892, of September 12, 1889, and in others. In the Cammett & Shepard patent a series of riffles are described and claimed which are reduced in height and continue at a lower level before their termination toward the values end of the table. The present improvement is a particular form of riffling which is in some respects closely related to that patent.

The nature of the present invention will now be readily understood by a description of the accompanying drawings.

In the drawings, Figure 1 is a general view without much regard to detail, showing an ore-concentrator of one type to which the present improvements are applicable. Fig. 2 is a plan view of the table-top embodying the present improvements. Fig. 3 is a vertical section of the same on the plane 3 3. Figs. 4 and 5 are cross-sections on the planes 4 4 and 5 5. Figs. 6 and 7 are enlarged sectional views of parts of Fig. 5 toward the right-hand end and left-hand end, respectively, of the said figure. Fig. 8 is a sectional view showing the probable action of water in effecting the riffling.

The bed b of the table-top is provided with a series of longitudinal ribs r, forming riffles. These ribs when considered separately are of considerable height at the head end h of the table and diminish in height toward the values end v of the active surface of the table. One side of each rib becomes flush with the bottom of the channel or adjacent table-surface, while the other side of the same rib is still considerably raised above the adjacent table-surface to a height which may vary from a sixty-fourth of an inch, or thereabout, up to an eighth of an inch or more, the upper limit not having been definitely determined by me.

The effect of such obliteration of one side of the table is plainly seen in Fig. 6, and this condition may continue throughout the remaining active surface of the table toward the values end v. Whether or not there is a plain, smooth, or unriffled portion at the extreme values end of the table, I do not mean to make a characteristic of the present invention. In addition to the characteristics of the individual ribs or riffles just described the riffles as considered collectively differ one from another in that the higher ribs—that is, those toward the feed side f of the table—diminish in height in advance of those farther down in the table nearer the waste or tailings side t. The dotted line s s, Fig. 2, shows a point where the upper side or each rib sinks into and is obliterated in the adjacent surface of the table. The curvature of this line s s results from the longitudinal distance between the points where adjacent ribs are so obliterated on one side in the table-surface, it being greater toward the upper or feed side of the table than toward the lower or tailings side t of the table.

From the foregoing it will be seen that one side of each rib sinks into the general table-surface in advance of the other side of the same rib; secondly, that such sinking takes place on the upper ribs considerably in advance of where it takes place on the lower rib; thirdly, that this difference between neighboring ribs is greater toward the upper side of the table than toward the lower or tailings side. While I prefer to have all these three characteristics combined, it is obvious that they need not necessarily be so combined, and I point out in the following claims the features and combinations of features that I desire to protect. The operation of the table constructed as described is peculiarly advantageous for treating some grades of ores where it is considered an advantage not to have well-defined grooves along the portion of the table where the novel separation between fine values and fine gangue or waste takes place. The curve s s, convex toward the feed side and values end of the table, represents an approximation to the natural edge of the mass of mineral which covers the table when in operation, though I do not mean that such a curve corresponds in location with the boundary of the bed of mineral upon the table, because it is obvious that the boundary of the unbroken bed of mineral upon the table will vary its position according to whether the amount of mineral fed onto the table is greater or less. The riffled surface of the table lying on the convex side of the curve s s presents a step-like or clapboard-like surface, as shown by Figs. 6 and 7, and when the inclination of the table is very slight, as it frequently is in practice, the surfaces between neighboring riffles will be approximately level, so that values in falling from one level to another will tend to be held by the small eddy or quiet spot which forms beneath the protecting-wall of the riffle, as indicated in Fig. 8.

What I claim, and desire to secure by these Letters Patent, is the following:

1. An improved concentrating-table having a table-surface embodying a series of raised ribs or riffles which diminish in height as they extend toward the tail end of the table and which sink into the adjacent surface of the table on one side of each while continuing farther upon the other side, for substantially the purposes set forth.

2. An improved concentrating-table having a table-surface embodying a series of raised ribs or riffles which diminish in height as they extend toward the tail end of the table and which sink into the adjacent surface of the table on one side of each while continuing farther upon the other side, a portion of the table-surface constituting a series of shallow step-like riffles in a continuous integral surface, for substantially the purposes set forth.

3. An improved concentrating-table having a table-surface embodying a series of raised ribs or riffles which in part are raised on both sides, and in part are raised only on one side, forming a step-like formation, the line or zone of demarkation between such part being less oblique to the ribs on the upper or higher side of the table and more oblique or transverse to the ribs on the lower or tailings side of the table, for substantially the purposes set forth.

Signed this 14th day of March, 1901, at Anaconda, Montana.

IRA AUSTIN CAMMETT.

Witnesses:
R. DE B. SMITH,
J. W. MEHARGEY.

COMPLAINANTS' EXHIBIT No. 60

Cammett & Shepard Patent No. 769,431

ALMON E. HART, Special Examiner

No. 769,431. PATENTED SEPT. 6, 1904

I. A. CAMMETT & F. E. SHEPARD.

ORE CONCENTRATOR.

APPLICATION FILED MAR. 29, 1898.

NO MODEL. 5 SHEETS—SHEET 1.

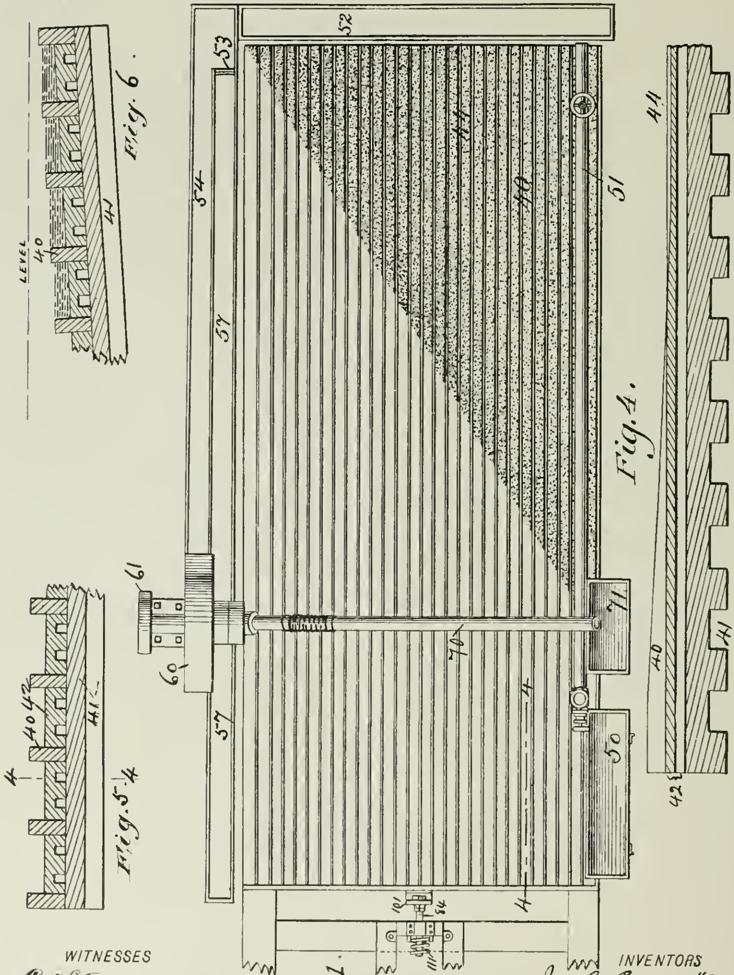


Fig. 1.

WITNESSES

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No. 769,431. PATENTED SEPT. 6, 1904.

I. A. CAMMETT & F. E. SHEPARD.

ORE CONCENTRATOR.

APPLICATION FILED MAR. 29, 1898.

NO MODEL 5 SHEETS—SHEET 2.

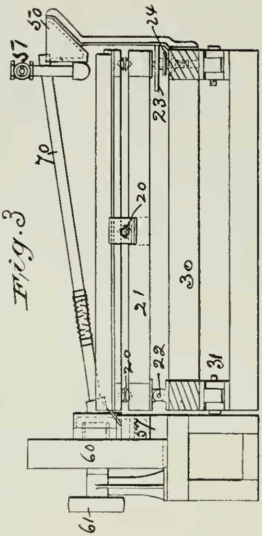

Fig. 3

Fig. 7.

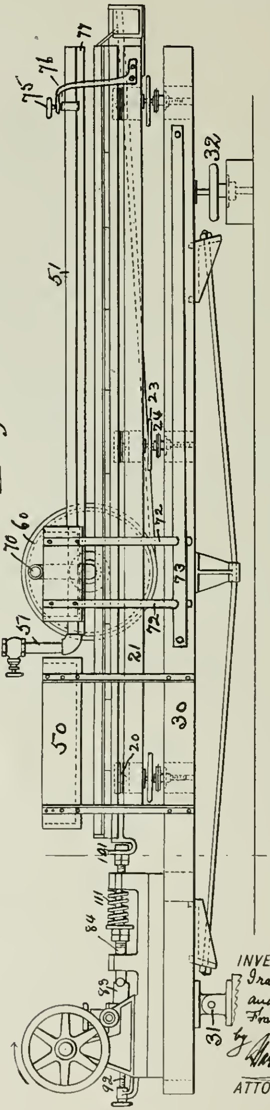

Fig. 2

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No. 769,431. PATENTED SEPT. 6, 1904.

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ORE CONCENTRATOR.

APPLICATION FILED MAR. 29, 1898.

NO MODEL. 5 SHEETS—SHEET 3.

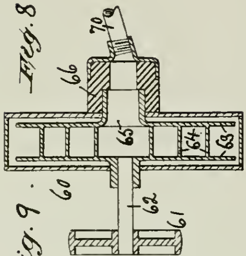

Fig. 8.

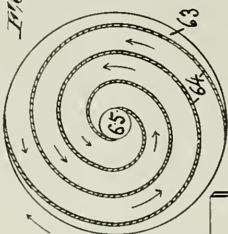

Fig. 9.

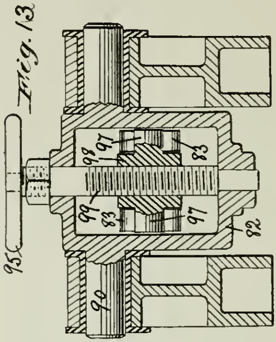

Fig. 13.

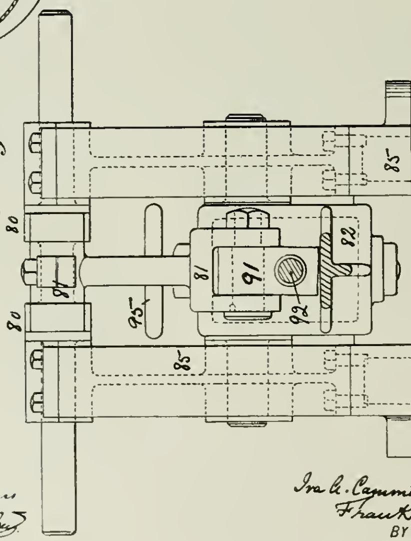

Fig. 12.

WITNESSES

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No. 769,431. PATENTED SEPT. 6, 1904.

I. A. CAMMETT & F. E. SHEPARD.

ORE CONCENTRATOR.

APPLICATION FILED MAR. 29, 1898.

NO MODEL. 5 SHEETS—SHEET 4.

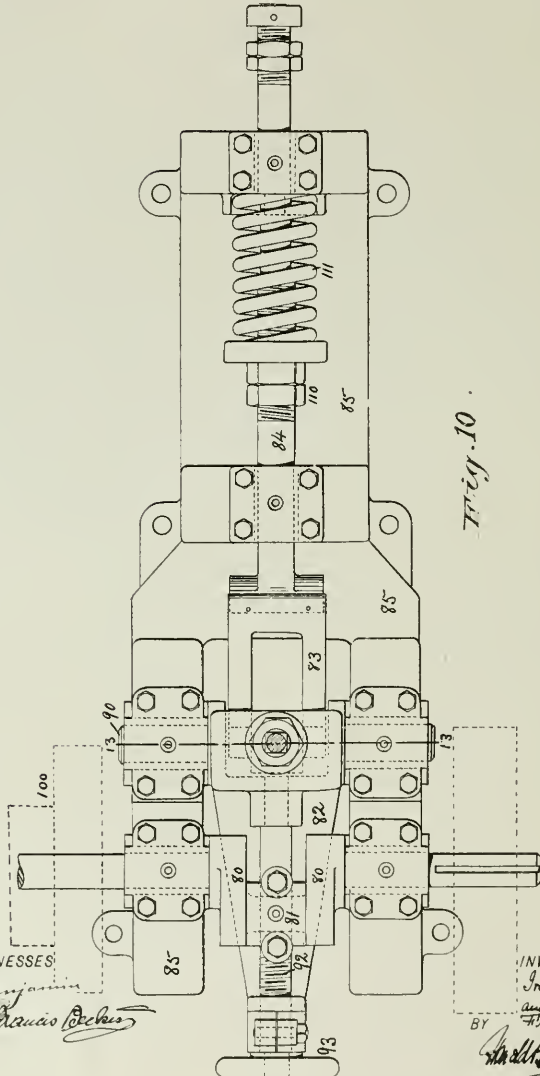

Fig. 10.

WITNESSES

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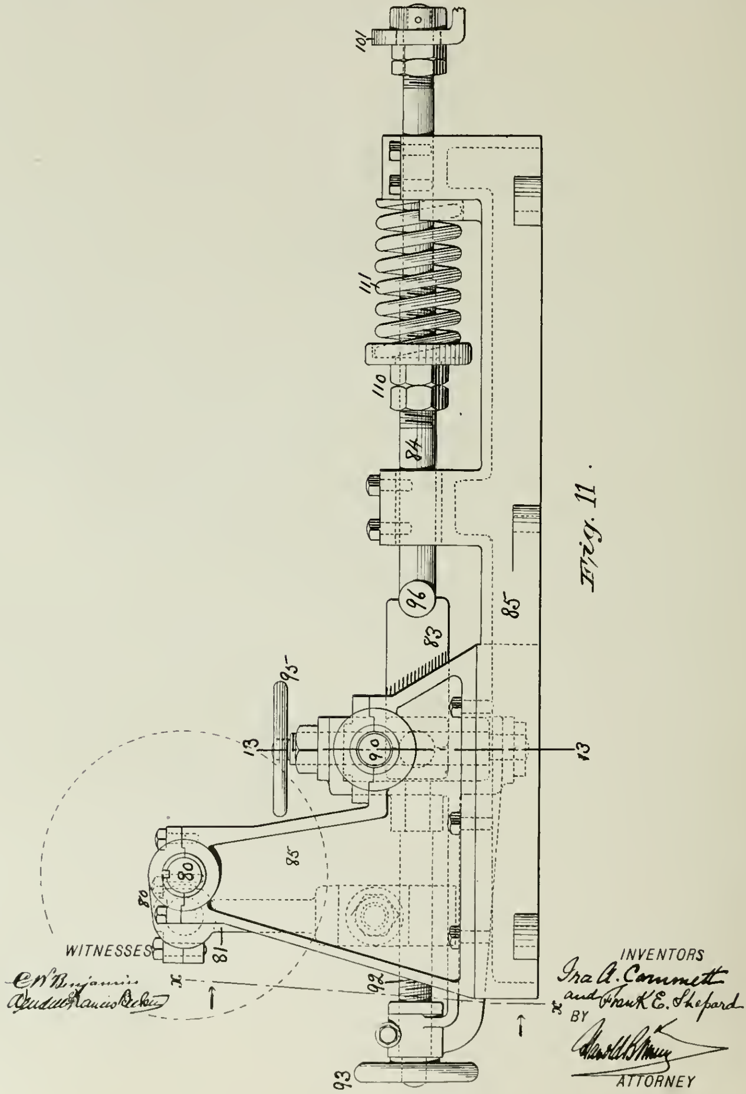
ORE CONCENTRATOR.

APPLICATION FILED MAR. 29, 1898.

NO MODEL. 5 SHEETS—SHEET 5.



UNITED STATES PATENT OFFICE.

IRA A. CAMMETT AND FRANK E. SHEPARD, OF DENVER, COLORADO, ASSIGNOR TO ARTHUR R. WILFLEY, OF DENVER, COLORADO.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 769,431, dated September 6, 1904.

Application filed March 29, 1898. Serial No. 675,637. (No model.)

To all whom it may concern:

Be it known that we, IRA A. CAMMETT and FRANK E. SHEPARD, of Denver, Colorado, have invented certain new and useful Improvements Relating to Ore-Concentrators, of which the following is a description, referring to the accompanying drawings, which form a part of this specification.

The object of the invention is to improve the construction and perfect the operation of ore-concentrators.

The nature of the invention is such that it will be best understood by an inspection of the accompanying drawings, which show one embodiment of it, though it must not be understood that it is limited to the minor details of construction there shown.

Figure 1 is a plan view of the table and some of its attachments. Fig. 2 is a side elevation of the concentrator. Fig. 3 is an end view of the table and some of its attachments, the frame being shown partly in cross-section. Fig. 4 is a sectional detail on the plane 4 4 of Figs. 1 and 5. Fig. 5 is a cross-section at right angles to Fig. 4. Fig. 6 is a cross-section showing a portion of the table transversely inclined. Fig. 7 is a cross-section of a water-supply pipe. Fig. 8 is a central axial section of the conveying apparatus or pump used for the middlings. Fig. 9 is a central section transverse to the axis, showing the rotating portion of the same. Fig. 10 is a plan view, and Fig. 11 is a side elevation, of the end-shake mechanism. Fig. 12 is an end elevation, partly in cross-section, on the plane X X of Fig. 11; and Fig. 13 is a vertical section on the plane 13 13, Figs. 10 and 11.

Throughout the drawings like numerals of reference indicate like parts.

The table of the concentrator is mounted to reciprocate longitudinally under the action of the end-shake motion, which will be later described. Preferably ball-bearings 20 are provided to permit the endwise movement of the table upon its frame 21. The frame 21 is hinged or mounted so as to tilt upon a longitudinal axis 22 and is adjustable thereon by means of any one of the three hand-wheels 23, which are coöperatively connected by means of the sprocket-wheels 24, so that they may all three be simultaneously actuated. The lower frame or bed-frame 30, upon which the frame 21 is adjustable, as just described, is supported upon hinges or fulcrums 31, which form a transverse axis, upon which the apparatus may be inclined by means of the hand-wheel 32. By these means the table may be inclined transversely and longitudinally to the desired degree, and by a combination of both adjustments the table may be inclined obliquely, so as to raise one of its corners. The table itself is constructed of fluted wookwork, the flutings and the grains of the wood lying at right angles to each other in the two layers. (Clearly seen in Figs. 4, 5, and 6.) By this construction the table may be made very light and at the same time will retain its shape. The riffles 40 are in the form of strips set on edge upon the transverse members 41 of the table. Between these riffles 40 are set the longitudinally-grooved upper members of the table 42, which form the surface or bed of the table and separate the riffles. The left-hand end of the table, as seen in Fig. 1, will be referred to as the "head" end and the other as the "tail" end for distinction. The riffles run from the head end toward the tail end, gradually diminishing in height until they converge into or sink below the surface formed by the members 42, which separate the riffles from each other. The riffles at the feed side of the table are comparatively short and are successively of greater length as the gangue side or tailings side of the table is approached. This results in producing a triangular area toward the tail end and feed side of the table, in which the riffles do not project above the surface of the table, as clearly seen in Fig. 1. The surface of this portion 44 of the table is given a roughened finish similar to a piece of coarse sandpaper or grooved from the end of the riffles toward the end of the table. This result is preferably accomplished by coating it with a paint not susceptible to the action of water and either roughening the surface of the paint or introducing sand or other small particles into the paint before it is applied. The grooves are made by planing the riffle-strip below the level of the table. While the strips 43, which form the riffles, also form part of the flat portion 44 of the table, the separating-lines do not appear in the space 44. These lines are omitted for the purpose of distinguishing between the part of the table where the riffles are raised and the part in which they sink into or below the common level of the separating members 42. It must be understood that all the riffles taper down from the head end to the boundary of the space 44, the shorter riffles tapering more rapidly than those that are on the tailings side of the table, but all assuming the common level of the surface 44 or below same along the oblique line which bounds it. Were the riffles simply tapered down from the head end to where they disappear at this oblique line and nailed upon a flat surface they would tend to curl up at the thin ends under the action of water; but by being inserted on edge between the separating members 42 and resting upon the transverse members 41 the whole table is made firm and secure and the bending or curling of the riffles prevented.

The pulp or material to be treated is fed into the feed-box 50, placed above the riffle-surface at the feed side of the table near the head end. The end-shake movement, which is given to the table and which will be presently described, carries the material along the riffle-surface toward the tail end of the table and into the roughened or grooved surface 44, where it is acted upon by clean water delivered from the water-supply pipe 51. The gangue or tailings wash across the successive riffles from the vicinity of the feed-box 50 and finally pass at the tailings side of the table into the tailings-box 57. The concentrates or valuable mineral portions of the pulp are carried along between the riffles toward the tail end of the table until they reach the surface 44, and after being almost entirely freed from gangue and foreign materials by the wash-water upon the surface 44 they pass into the concentrates-box 52. As the pulp or wet material starts from the corner of the table beneath the feed-box 50 the water which it contains spreads out over the surface of the table as it flows toward the tailings side. As the result of this, particles of metal or valuable mineral which are washed over the first one or two riffles will be caught by the succeeding riffles and eventually carried toward the tail end of the table and into the roughened or grooved surface 44 to be acted upon by the wash-water from the pipe 51.

The middlings, which is that portion of the material which should be delivered near the corner of the table diagonally opposite to the feed-box, are re-treated for the recovery of any valuable mineral which may remain in them. For the purpose of dividing the tailings into middlings and tailings which are not to be re-treated the movable partition 53, separating the middlings-conveyer 54 from the tailings-box 57, is provided. By moving this toward or from the tail end of the table more or less of the tailings will pass as middlings into the inclined conveyer 54 and wash down toward the centripetal conveyer 60, (which will be presently described,) and thereby delivered through the pipe 70 to the middlings feed-box 71. This middlings feed-box delivers the middlings back onto the table at the feed side, but at a point considerably nearer the tail end than the feed-box 50. By adjusting the point at which the middlings feed-box 71 delivers the middlings back onto the table almost perfect separation of the middlings can be obtained. To permit this adjustment of the box 71, it may be mounted on adjustable supports 72, which may travel along the rail or stationary support 73, secured on the side of the bed-frame 30. The wash-water is delivered from the pipe 51 along the feed side of the surface 44. The tail end of the pipe 51 is supported by a hand-screw 75 and bracket 76. By turning the hand-screw 75 the end of the pipe may be raised or lowered to affect the flow of water from it. The pipe 51 is slotted or perforated at intervals, preferably for its whole length, as indicated at 76 in Fig. 7, preferably on the upper side of the pipe. Beneath is provided the drip-flange 77. The water flowing through the opening 76 runs around the pipe 51 and is spread by the drip-flange 77 into a continuous sheet as it flows onto the table. By turning the screw 75 the relative quantity of water delivered at the respective ends of the pipe 51 may be regulated at will.

The centripetal pump or conveyer 60 may be driven by a belt-wheel 61 and shaft 62, upon which is mounted the rotary parts of the conveyer. The rotary part consists of two side plates 63, with the two spiral coils 64, forming spiral channels between them, extending from the exterior to the central space 65. The central space 65 is provided with a projecting flange, as shown, which fits within the stationary hub 66 of the casing. To the hub 66 is connected the middlings tail-pipe 70, already described. The plate 63 and spirals 64 are partly submerged in the middlings conveyer-box 54, so that the rotation of the spirals causes it to gather up a portion of the pulp and water, depending in amount upon the depth to which the spirals are submerged. The spirals are turned in the direction shown by the outermost arrow in Fig. 8, and as the result the pulp and water taken up at each rotation, combined with the air which is taken in between the successive quantities of water and pulp, are forced by gravity in the direction indicated by the arrow, reaching the central space 65 and flowing out through the pipe 70 into the middlings feed-box 71.

By inspection of Fig. 8 it will be seen that there are two spirals, forming two spiral passages, so that two quantities of pulp or water are taken up at each rotation of the conveyer-tus. This tends to balance the action of the pump and increase its capacity for a given diameter and speed, while decreasing the number of pulsations for a given speed. If any leakage takes place between the hub 66 and the rotating part of the pump or conveyer, it will merely flow back into the casing and be taken up again by the spirals. By this simple arrangement complications of a stuffing-box are avoided. This centripetal conveyer or pump will lift pulp, sand, &c., without choking, and it requires a very small amount of power in its operation.

The end-shake apparatus remains to be described. Its principal parts are the crank-shaft 80, pitman 81, oscillating frame 82, connecting-link 83, and reciprocating rod 84, mounted in the framework or housing 85. The oscillating frame 82 turns upon the trunnions 90 in suitable bearings in the housing 85. It is oscillated upon these trunnions by means of the pitman 81, which is pivoted at one end to the box 91, adjustable along the screw 92 by the hand-wheel 93. The object of this adjustment is to produce any desired difference in the relative speeds of the direct and return movements of the reciprocating rod 84, so as to give an end-shake movement to the table that will tend to cause a progressive travel of the particles along the surface of the table in distinction to a mere evenly-balanced or harmonic movement, which would merely agitate without giving progressive movement to the particles—that is to say, when the box 91 is adjusted so as to be beneath the shaft 80 the direct and return movements of the table are of substantially similar character; but when the box 91 is screwed toward the hand-wheel 93 and displaced from directly beneath the shaft 80, then a quickening of the return movement and a delaying of the direct movement is produced. Incidentally the adjustment of the box 91 by means of the hand-wheel 93 causes a variation in the length of the stroke, as well as a difference in its quality; but this is not the object of the adjustment, and the length of stroke is changed to any desired extent by independent means operated by the hand-wheel 93. These means are as follows: The reciprocating rod is spring-pressed toward the link 83 and is, indeed, kept in contact with the link solely by the compression of the spring. The link 83 is a loose link having recesses at each end, one of which recesses receives the trunnion or bearing 96 of the rod 84, while the other end of the link, forked as shown in Fig. 10, bears against trunnions 97, carried by a vertically-adjustable box 98, which is screw-threaded on the screw 99. By turning the hand-wheel 95, and thereby the screw 99, the box 98 is adjusted so as to bring the trunnions 97 toward and from the axial line of the trunnions 90. It is clear that when the trunnions 97 are coaxial with the trunnions 90 no movement will be given to the link 83 or reciprocating rod 84 when the oscillating frame 82 is rocked. On the other hand, when the box 98 is screwed downward more and more motion is given to the link 83 and rod 84. It therefore follows that by adjusting the hand-wheel 93 the quality of the end-shake or quick-return movement is modified, while by adjusting the hand-wheel 95 the length or throw of the movement is controlled. Moreover, the crank-shaft 80 is provided with means for varying its speed—such, for instance, as the cone-pulleys 100, Fig. 10. By this means the number of reciprocations and also the speed of reciprocations is variable at will. The reciprocating rod 84 is connected with the table by means of a lug, plate, or loop 101 through a slot in which the rod 84 extends. This slot or some other adjustable connection is necessary to permit the inclination and adjustment of the table without affecting its connection with the rod 84. By means of the nuts 110 the compression of the spring 111 can be varied at will to press the rod 84, link 83, and trunnions 97 into firm engagement with each other. One advantage of having these connections spring-pressed together is that no lost motion will be produced by working of the parts, as the spring takes up the wear.

In describing so much in detail the form of the invention which has been selected for illustration it must not be understood that there is any implication that the invention is restricted to any such minor details. On the contrary,

We claim, and desire to secure by these Letters Patent, the following features, without meaning to imply in any claim features not mentioned or necessarily understood therein:

1. In combination in a concentrator-table, the riffles, and the separating-pieces 42 forming the table-surface and between which the riffles are placed, the said riffles lying between and projecting above the separating-pieces for a portion only of their length and merging into and continuing between the said separating-pieces toward the tail end, substantially as set forth.

2. In the end-shake mechanism for a concentrator, the pivotally-mounted oscillating frame or member thereof provided with two adjusting-screws, each having a screw-threaded box thereon, a crank and pitman actuating one of the said boxes, and a link actuated by the other of said boxes and connected to the parts to be shaken, the said screws acting to adjust the said boxes toward and from the center of motion of the said frame or member to vary the operation of the mechanism, substantially as set forth.

3. In a concentrating apparatus the combination of a lower frame hinged at one end and adjustable vertically at the other, an end-shake

below the level of the table. While the strips 40, which form the riffles, also form part of the flat portion 44 of the table, the separating-lines do not appear in the space 44. These lines are omitted for the purpose of distinguishing between the part of the table where the riffles are raised and the part in which they sink into or below the common level of the separating members 42. It must be understood that all the riffles taper down from the head end to the boundary of the space 44, the shorter riffles tapering more rapidly than those that are on the tailings side of the table, but all assuming the common level of the surface 44 or below same along the oblique line which bounds it. Were the riffles simply tapered down from the head end to where they disappear at this oblique line and nailed upon a flat surface they would tend to curl up at the thin ends under the action of water; but by being inserted on edge between the separating members 42 and resting upon the transverse timbers 41 the whole table is made firm and secure and the bending or curling of the riffles prevented.

The pulp or material to be treated is fed into the feed-box 50, placed above the riffle-surface at the feed side of the table near the head end. The end-shake movement, which is given to the table and which will be presently described, carries the material along the riffle-surface toward the tail end of the table and onto the roughened or grooved surface 44, where it is acted upon by clean water delivered from the water-supply pipe 51. The gangue or tailings wash across the successive riffles from the vicinity of the feed-box 50 and finally pass at the tailings side of the table into the tailings-box 57. The concentrates or valuable mineral portions of the pulp are carried along between the riffles toward the tail end of the table until they reach the surface 44, and after being almost entirely freed from gangue and foreign materials by the wash-water upon the surface 44 they pass into the concentrates-box 52. As the pulp or wet material starts from the corner of the table beneath the feed-box 50 the water which it contains spreads out over the surface of the table as it flows toward the tailings side. As the result of this, particles of metal or valuable mineral which are washed over the first one or two riffles will be caught by the succeeding riffles and eventually carried toward the tail end of the table and onto the roughened or grooved surface 44 to be acted upon by the wash-water from the pipe 51.

The middlings, which is that portion of the material which should be delivered near the corner of the table diagonally opposite to the feed-box, are re-treated for the recovery of any valuable mineral which may remain in them. For the purpose of dividing the tailings into middlings and tailings which are not to be re-treated the movable partition 53, separating the middlings-conveyer 54 from the tailings-box 57, is provided. By moving this toward or from the tail end of the table more or less of the tailings will pass as middlings into the inclined conveyer 54 and wash down toward the centripetal conveyer 60, (which will be presently described,) and thereby delivered through the pipe 70 to the middlings feed-box 71. This middlings feed-box delivers the middlings back onto the table at the feed side, but at a point considerably nearer the tail end than the feed-box 50. By adjusting the point at which the middlings feed-box 71 delivers the middlings back onto the table almost perfect separation of the middlings can be obtained. To permit this adjustment of the box 71, it may be mounted on adjustable supports 72, which may travel along the rail or stationary support 73, secured on the side of the bed-frame 30. The wash-water is delivered from the pipe 51 along the feed side of the surface 44. The tail end of the pipe 51 is supported by a hand-screw 75 and bracket 76. By turning the hand-screw 75 the end of the pipe may be raised or lowered to affect the flow of water from it. The pipe 51 is slotted or perforated at intervals, preferably for its whole length, as indicated at 78 in Fig. 7, preferably on the upper side of the pipe. Beneath is provided the drip-flange 77. The water flowing through the opening 78 runs around the pipe 51 and is spread by the drip-flange 77 into a continuous sheet as it flows onto the table. By turning the screw 75 the relative quantity of water delivered at the respective ends of the pipe 51 may be regulated at will.

The centripetal pump or conveyer 60 may be driven by a belt-wheel 61 and shaft 62, upon which is mounted the rotary parts of the conveyer. The rotary part consists of two side plates 63, with the two spiral coils 64, forming spiral channels between them, extending from the exterior to the central space 65. The central space 65 is provided with a projecting flange, as shown, which fits within the stationary hub 66 of the casing. To the hub 66 is connected the middlings tail-pipe 70 already described. The plate 63 and spirals 64 are partly submerged in the middlings conveyer-box 54, so that the rotation of the spirals causes it to gather up a portion of the pulp and water, depending in amount upon the depth to which the spirals are submerged. The spirals are turned in the direction shown by the outermost arrow in Fig. 9, and as the result the pulp and water taken up at each rotation, combined with the air which is taken in between the successive quantities of water and pulp, are forced by gravity in the direction indicated by the arrow, reaching the central space 65 and flowing out through the pipe 70 into the middlings feed-box 71.

By inspection of Fig. 9 it will be seen that there are two spirals, forming two spiral passages, so that two quantities of pulp or water are taken up at each rotation of the apparatus. This tends to balance the action of the pump and increase its capacity for a given diameter and speed, while decreasing the number of pulsations for a given speed. If any leakage takes place between the hub 66 and the rotating part of the pump or conveyer, it will merely flow back into the casing and be taken up again by the spirals. By this simple arrangement complications of a stuffing-box are avoided. This centripetal conveyer or pump will lift pulp, sand, &c., without choking, and it requires a very small amount of power in its operation.

The end-shake apparatus remains to be described. Its principal parts are the crank-shaft 80, pitman 81, oscillating frame 82, connecting-link 83, and reciprocating rod 84, mounted in the framework or housing 85. The oscillating frame 82 turns upon the trunnions 90 in suitable bearings in the housing 85. It is oscillated upon these trunnions by means of the pitman 81, which is pivoted at one end to the box 91, adjustable along the screw 92 by the hand-wheel 93. The object of this adjustment is to produce any desired difference in the relative speeds of the direct and return movements of the reciprocating rod 84, so as to give an end-shake movement to the table that will tend to cause a progressive travel of the particles along the surface of the table in distinction to a mere evenly-balanced or harmonic movement, which would merely agitate without giving progressive movement to the particles—that is to say, when the box 91 is adjusted so as to be beneath the shaft 80 the direct and return movements of the table are of substantially similar character; but when the box 91 is screwed toward the hand-wheel 93 and displaced from directly beneath the shaft 80, then a quickening of the return movement and a delaying of the direct movement is produced. Incidentally the adjustment of the box 91 by means of the hand-wheel 93 causes a variation in the length of the stroke, as well as a difference in its quality; but this is not the object of the adjustment, and the length of stroke is changed to any desired extent by independent means operated by the hand-wheel 93. These means are as follows: The reciprocating rod is spring-pressed toward the link 83 and is, indeed, kept in contact with the link solely by the compression of the spring. The link 83 is a loose link having recesses at each end, one of which recesses receives the trunnion or bearing 96 of the rod 84, while the other end of the link, forked as shown in Fig. 10, bears against trunnions 97, carried by a vertically-adjustable box 98, which is screw-threaded on the screw 99. By turning the hand-wheel 95, and thereby the screw 99, the box 98 is adjusted so as to bring the trunnions 97 toward and from the axial line of the trunnions 90. It is clear that when the trunnions 97 are coaxial with the trunnions 90 no movement will be given to the link 83 or reciprocating rod 84 when the oscillating frame 82 is rocked. On the other hand, when the box 98 is screwed downward more and more motion is given to the link 83 and rod 84. It therefore follows that by adjusting the hand-wheel 93 the quality of the end-shake or quick-return movement is modified, while by adjusting the hand-wheel 95 the length or throw of the movement is controlled. Moreover, the crank-shaft 80 is provided with means for varying its speed—such, for instance, as the cone-pulleys 100, Fig. 10. By this means the number of reciprocations and also the speed of reciprocations is variable at will. The reciprocating rod 84 is connected with the table by means of a lug, plate, or loop 101 through a slot in which the rod 84 extends. This slot or some other adjustable connection is necessary to permit the inclination and adjustment of the table without affecting its connection with the rod 84. By means of the nuts 110 the compression of the spring 111 can be varied at will to press the rod 84, link 83, and trunnions 97 into firm engagement with each other. One advantage of having these connections spring-pressed together is that no lost motion will be produced by working of the parts, as the spring takes up the wear.

In describing so much in detail the form of the invention which has been selected for illustration it must not be understood that there is any implication that the invention is restricted to any such minor details. On the contrary,

We claim, and desire to secure by these Letters Patent, the following features, without meaning to imply in any claim features not mentioned or necessarily understood therein:

1. In combination in a concentrator-table, the riffles, and the separating-pieces 42 forming the table-surface and between which the riffles are placed, the said riffles lying between and projecting above the separating-pieces for a portion only of their length and merging into and continuing between the said separating-pieces toward the tail end, substantially as set forth.

2. In the end-shake mechanism for a concentrator, the pivotally-mounted oscillating frame or member thereof provided with two adjusting-screws, each having a screw-threaded box thereon, a crank and pitman actuating one of the said boxes, and a link actuated by the other of said boxes and connected to the parts to be shaken, the said screws acting to adjust the said boxes toward and from the center of motion of the said frame or member to vary the operation of the mechanism, substantially as set forth.

3. In a concentrating apparatus the combination of a lower frame hinged at one end and adjustable vertically at the other, an end-shake

mechanism mounted on the said lower frame, an intermediate frame hinged at one side to the said lower frame and adjustable vertically at its other side, and a table-top mounted to reciprocate longitudinally on the said intermediate frame and connected to be actuated by the said end-shake mechanism upon the said lower frame, substantially as set forth.

4. The table-top for reciprocating concentrating-tables having a riffled upper portion and having an under portion of grooved or channeled timbers extending transversely to the riffles, whereby a light strong table is produced having a minimum of inertia in proportion to its strength, and stiffened longitudinally by the said riffles and transversely by the said grooved or channeled timbers, substantially for the purposes set forth.

5. In a concentrator, a table, the surface of which has in part raised ribs or riffles and in part a roughened and grooved formation, substantially as set forth

6. A concentrator-table, the surface of which toward the head end has raised ribs or riffles and toward the tail end has a grooved formation, the riffling throughout both the raised rib portion and the grooved portion being in continuous lines, whereby the lower strata of minerals may pass continuously without interruption or restratification from the ribbed portion to the grooved portion, for substantially the purposes set forth.

In testimony whereof we have hereunto set our hands this 22d day of March, 1898.

IRA A. CAMMETT.
FRANK E. SHEPARD.

Witnesses:
E. RANSOME,
M. C. RUSSELL.

COMPLAINANTS' EXHIBIT No. 61

Kemp, Loomis & Fitzwater Patent No. 963,582

ALMON E. HART, Special Examiner

A. M. KEMP, M. W. LOOMIS & J. E. FITZWATER.

BIFFLE FOR CONCENTRATING TABLES.

APPLICATION FILED FEB. 13, 1909.

963,582. Patented July 5, 1910.

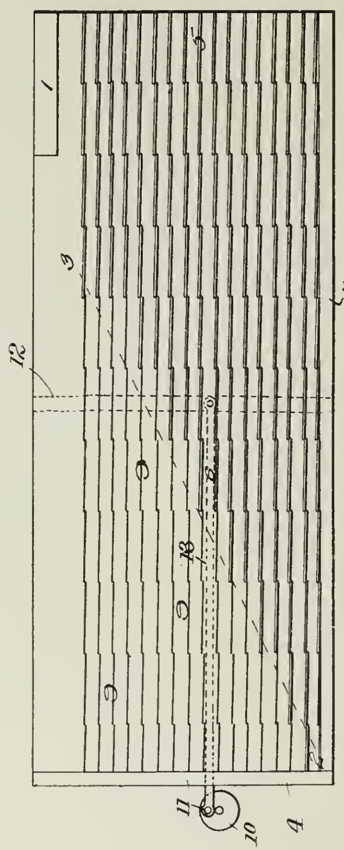


Fig. 1.

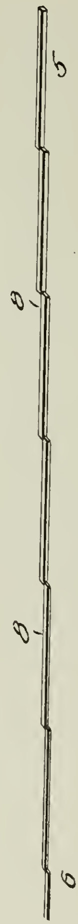


Fig. 2.

Witnesses
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Inventors
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and J. E. Fitzwater
By Howard A. Coombs
Attorney

UNITED STATES PATENT OFFICE.

ALBERT M. KEMP AND MERTON W. LOOMIS, OF DENVER, COLORADO, AND JOSEPH E. FITZWATER, OF ROSSVILLE, ILLINOIS.

RIFFLE FOR CONCENTRATING-TABLES.

963,582. Specification of Letters Patent. **Patented July 5, 1910.**

Application filed February 13, 1909. Serial No. 477,733.

To all whom it may concern:

Be it known that we, (1) ALBERT M. KEMP, (2) MERTON W. LOOMIS, and (3) JOSEPH E. FITZWATER, citizens of the United States, residing at (1 2) Denver, in the county of Denver and State of Colorado, and (3) Rossville, Vermilion county, Illinois, have invented certain new and useful Improvements in Riffles for Concentrating-Tables, of which the following is a specification.

Our invention relates to tables for ore-concentrators, and more particularly to the form and arrangement of the riffles of such tables, and has for its object to provide a more efficient surface for separating the gangue and concentrates. We attain this object by the construction shown in the accompanying drawing, in which:—

Figure 1 is a plan view of the top of a concentrator table built in accordance with our invention and Fig. 2 is a perspective of one of the riffle-bars, shown detached from the table.

1 is the pulp-box, located at the head of the table, 4 the discharge end for the concentrates and 7 the side at which the gangue is discharged.

The riffles 5—6, are arranged substantially parallel to each other and to the sides of the table; each riffle comprising a series of sections 8, 8, gradually decreasing in depth from the head of the table to a diagonal line 2, 3, and having their ends slightly overlapping laterally, as shown in the drawings. By this construction, shoulders, having their faces normal to the longitudinal riffles, are formed by the overlapping ends of the sections, which shoulders assist materially in propelling the material toward the concentrates discharge end of the table. From the head of the table to the diagonal line 2, 3, these sections are preferably composed of wood. Between this line and the foot of the table, the sections are preferably of metal of slight and uniform thickness, such as strips of hoop-iron; but are still secured to the table in substantially parallel rows, and with laterally-overlapping ends, as shown at 9, 9.

Our table may be used with any desired form of driving mechanism; such, for example, as that shown in our Patent No. 900,285, dated Oct. 6, 1908; or the riffles may be attached to existing forms of tables. In Fig. 1, we have illustrated the means for reciprocating the table as consisting of a driving pulley 10, carrying eccentrically a crank pin 11, which is connected to a cross bar 12 of the table, by a connecting rod 13.

We are aware that continuous riffles of gradually decreasing thickness have been used; as have also riffle-bars arranged in zigzag lines, and bars capped with a metallic strip. Our arrangement is, however, exceedingly rapid and efficient in operation and effects a better separation of the different grades of concentrates than other constructions with which we are familiar.

What we claim is:—

1. A concentrator-table having riffles comprising contacting, laterally-overlapping sections the forward ends of which form shoulders having their faces normal to the longitudinal direction of the riffles; and means to reciprocate said table substantially as described.

2. A concentrator-table having riffles comprising contacting, laterally-overlapping sections decreasing in thickness from the head of the table toward the foot thereof the forward ends of said sections forming shoulders having their faces normal to the longitudinal direction of the riffles, and means to reciprocate said table substantially as described.

3. A concentrator-table having a plurality of riffles extending throughout its length, said riffles comprising contacting, laterally-overlapping sections the forward ends of which form shoulders having their faces normal to the longitudinal direction of the riffles; and means to reciprocate said table substantially as described.

4. A concentrator-table having a plurality of riffles extending throughout its length, said riffles comprising a series of contacting, laterally-overlapping sections decreasing in thickness from the head of the table toward the foot thereof the forward ends of said sections forming shoulders having their faces normal to the longitudinal direction of the riffles; and means to reciprocate said table substantially as described.

5. A riffle for concentrator-tables comprising laterally-overlapping sections; some of said sections decreasing uniformly in thickness and others thereof being of substantially uniform thickness the forward ends of said sections forming shoulders having

their faces normal to the longitudinal direction of the riffles; and means to reciprocate said table substantially as described.

6. A riffle for concentrator-tables comprising a series of laterally-overlapping, vertically-tapering sections and a series of laterally-overlapping metallic sections of uniform thickness the forward ends of said sections forming shoulders having their faces normal to the longitudinal direction of the riffles; and means to reciprocate said table substantially as described.

7. A concentrator-table provided with a parallel series of riffles extending throughout its length, each of said riffles comprising laterally-overlapping sections decreasing in thickness from the head of the table toward the foot thereof and laterally-overlapping sections of substantially uniform thickness; the number of said last named sections decreasing from one side of the table toward the other side thereof; and means to reciprocate said table substantially as described.

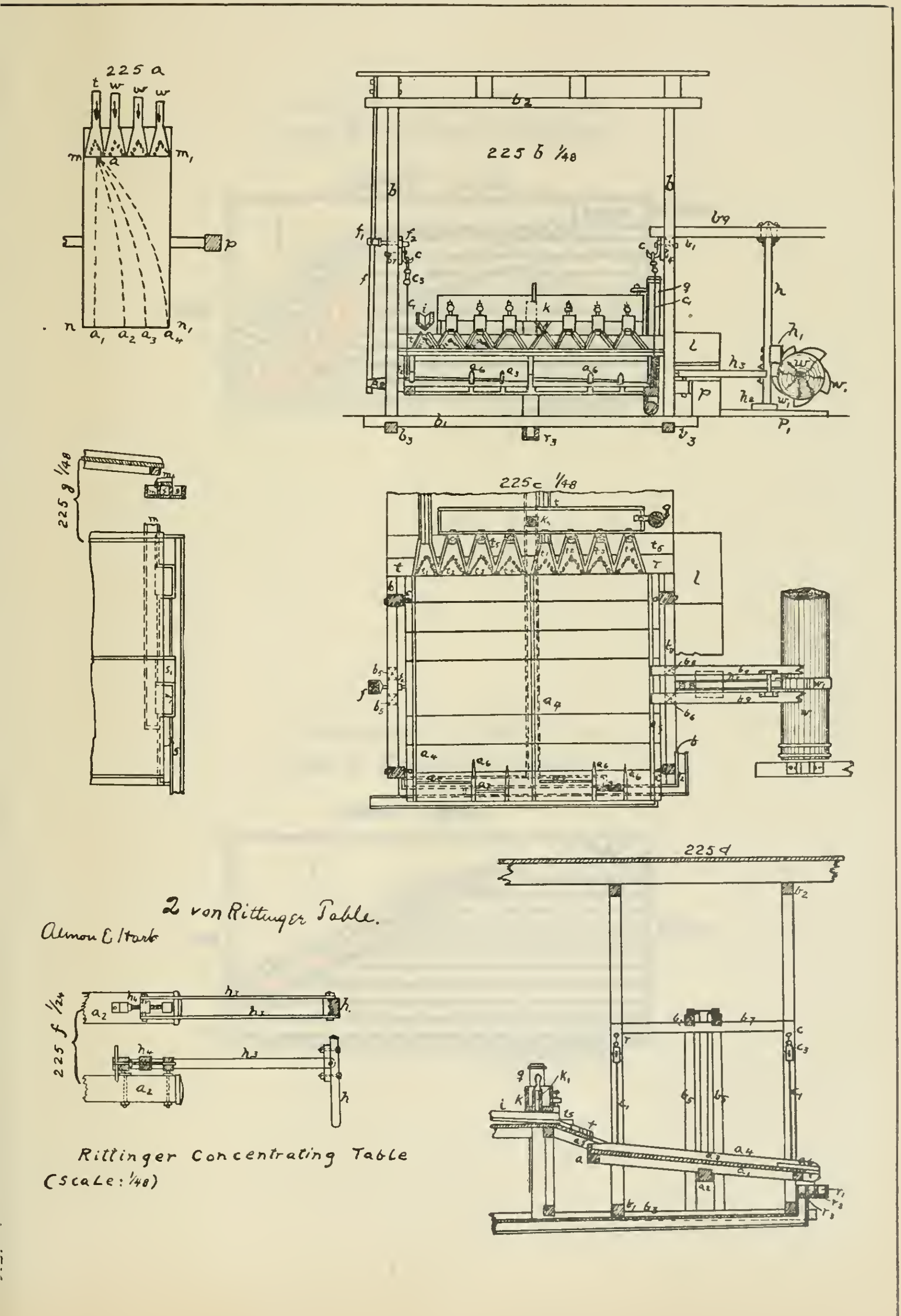
In testimony whereof we have affixed our signatures, in presence of witnesses.

ALBERT M. KEMP.
MERTON W. LOOMIS.
JOSEPH E. FITZWATER.

Witnesses:
JOHN H. GABRIEL,
LENA E. HANNEN,
J. E. SWIFT,
G. A. RAY.

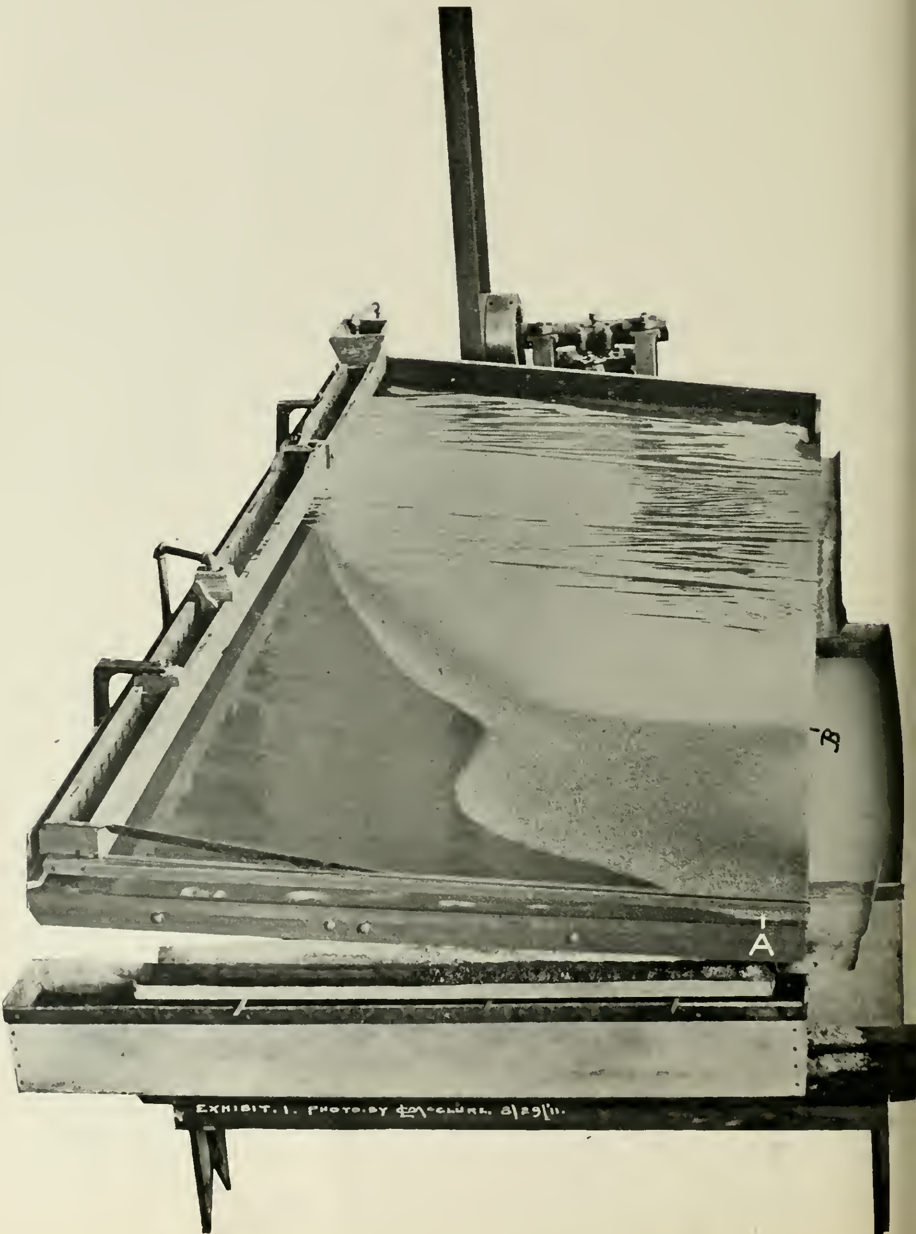
Complainant's Exhibit No. 62. Blue-Print of Drawings von Rittinger Table.

Almon E. Hart, Special Examiner.



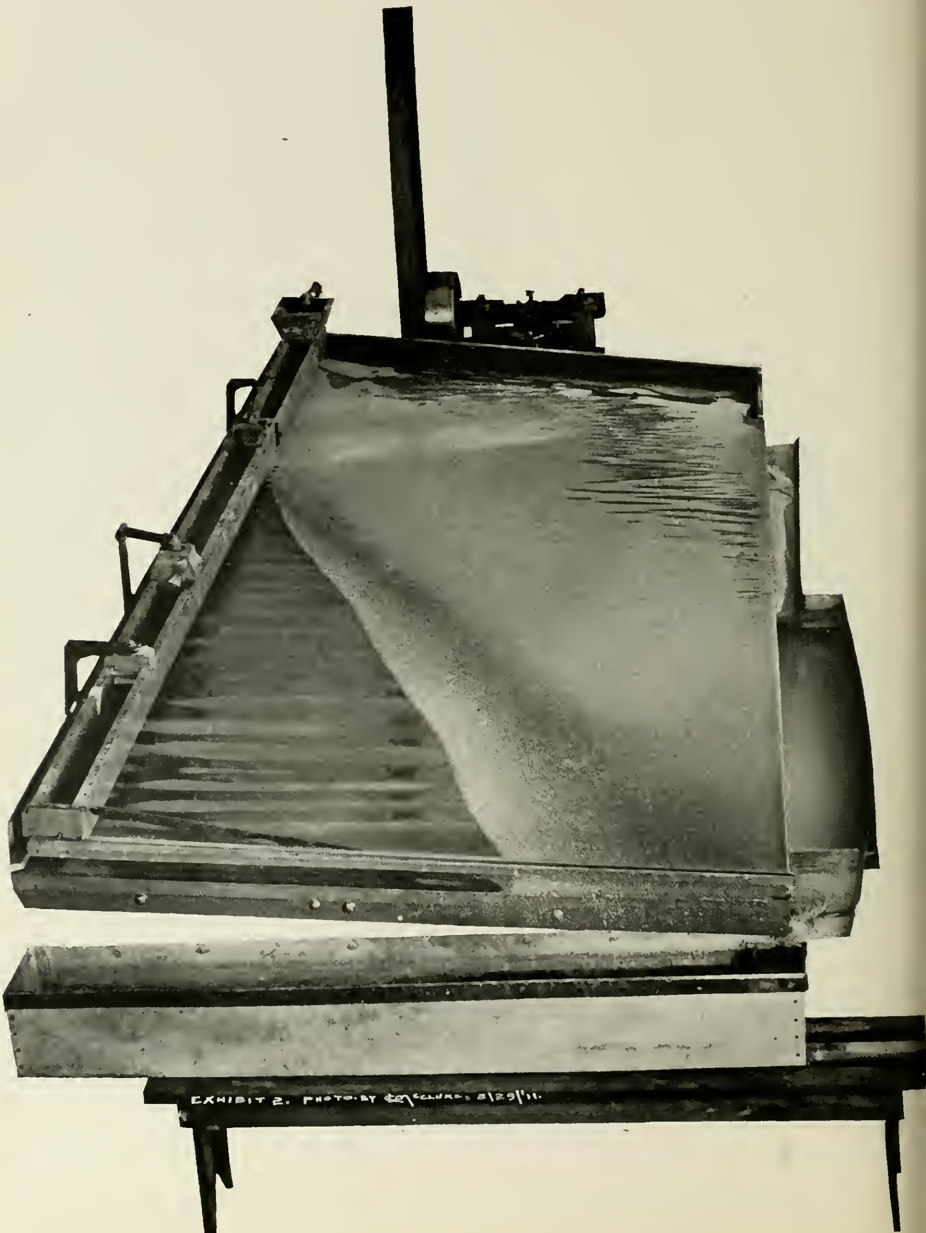
Complainant's Exhibit No. 69. Photograph No. 1 Wilfley Table Without Riffles, Irregular Feed.

Almon E. Hart, Special Examiner.



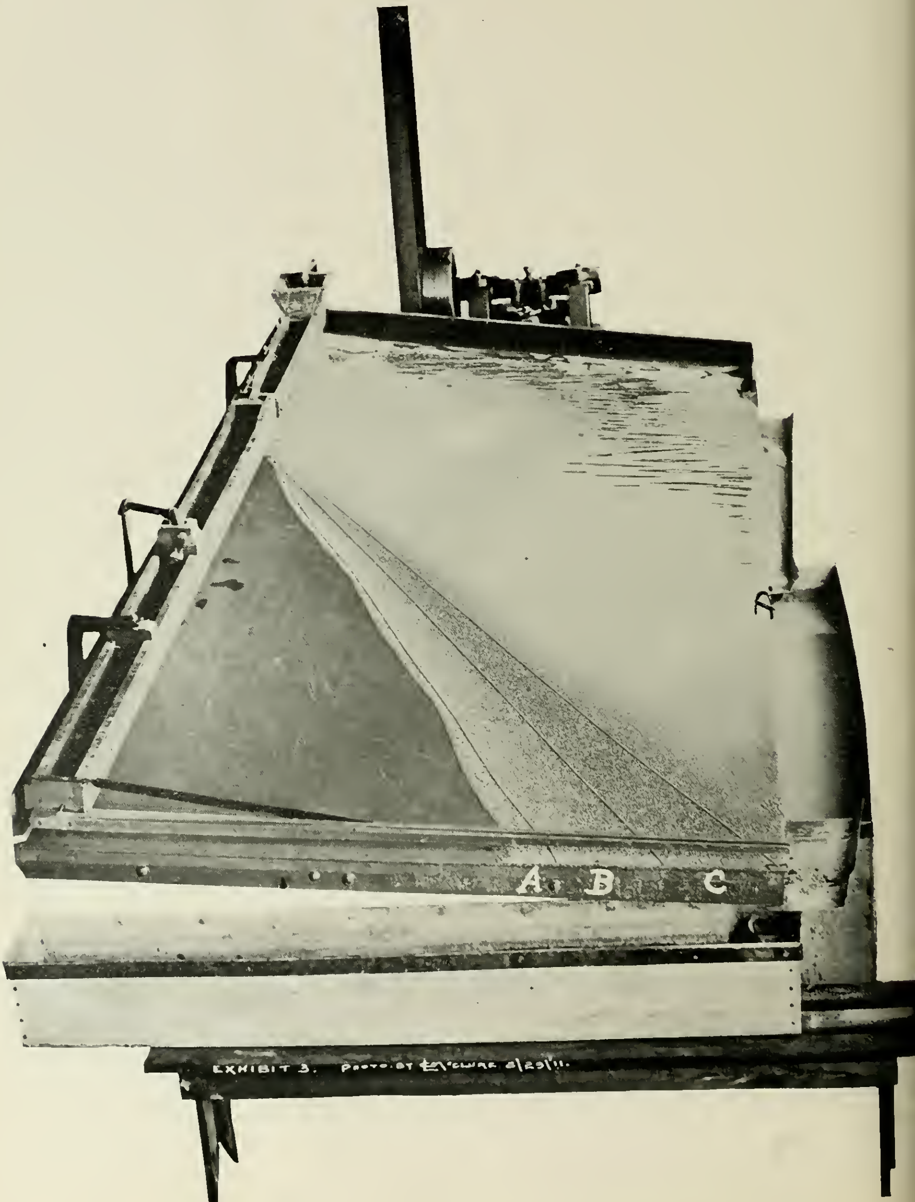
Complainant's Exhibit No. 70. Photograph No. 2, Wilfley Table Without Riffles, Regular Feed (One Ton Per Hour).

Almon E. Hart, Special Examiner.



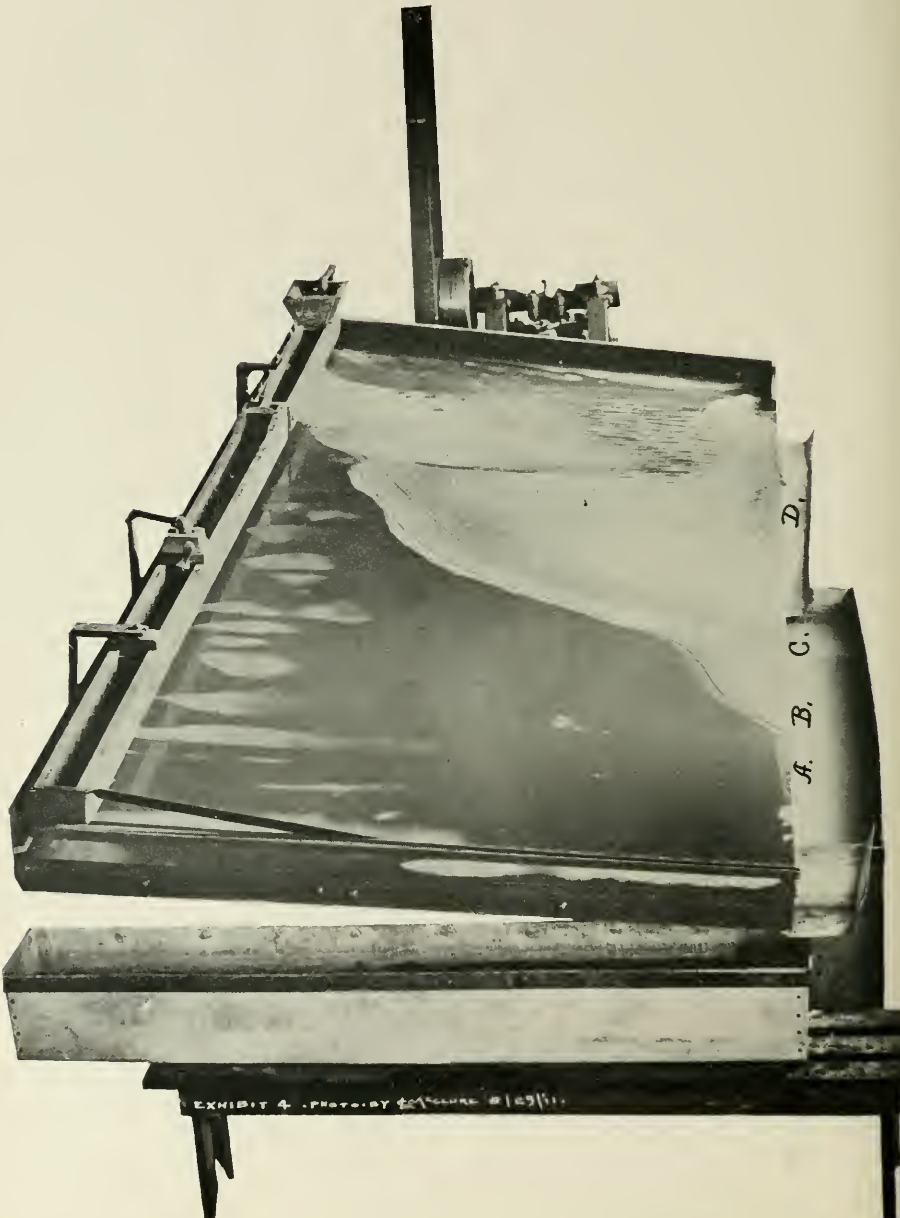
Complainant's Exhibit No. 71. Photograph No. 3, Wilfley Table Without Riffles, Regular Feed (One Ton Per Hour).

Almon E. Hart, Special Examiner.



Complainant's Exhibit No. 72. Photograph No. 4, Wilfley Table, Without Riffles, Feed Half Ton Per Hour.

Almon E. Hart, Special Examiner.

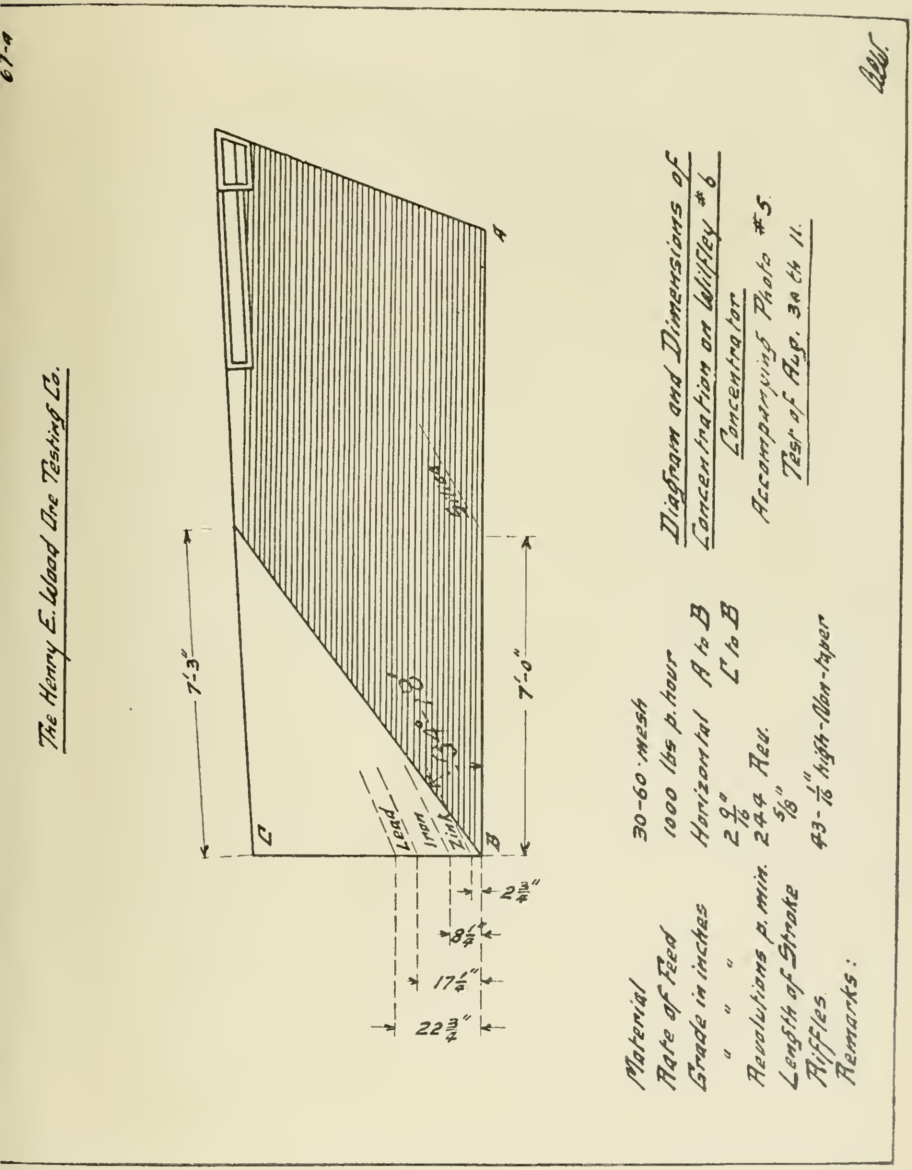


Complainant's Exhibit No. 73. Photograph No. 5, Wilfley Table With Rectangular Riffles of Uniform and Equal Height, Terminating Diagonally, Upper End of Diagonal Line of Termination Advanced, Feed Half Ton Per Hour.

Almon E. Hart, Special Examiner.

Complainant's Exhibit No. 73-A. Blue-Print Diagram of Photograph Exhibit No. 73.

Almon E. Hart, Special Examiner.

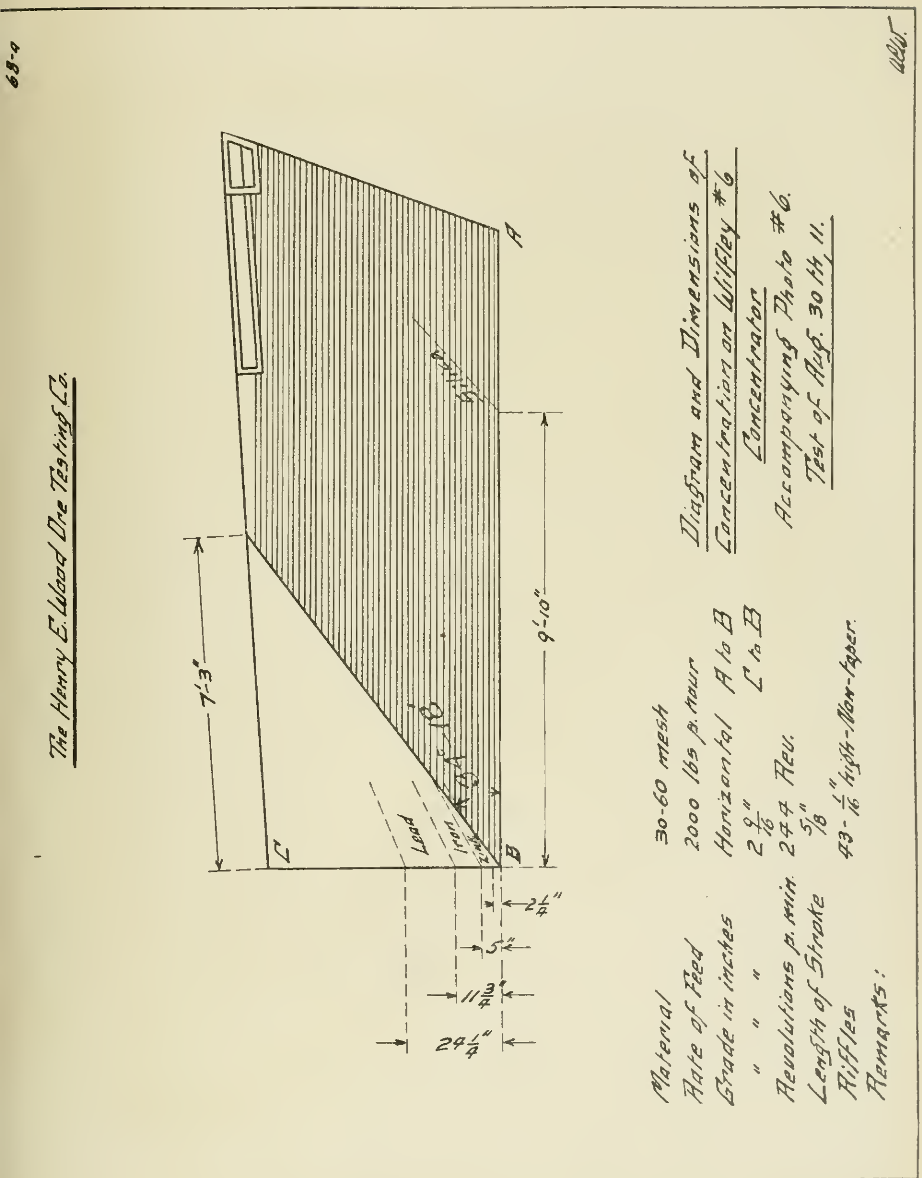


Complainant's Exhibit No. 74. Photograph No. 6, Wilfley Table With Rectangular Riffles of Uniform and Equal Height, Terminating Diagonally, Upper End of Diagonal Line of Termination Advanced, Feed One Ton Per Hour.

Almon E. Hart, Special Examiner.

Complainant's Exhibit No. 74-A. Blue-Print Diagram of Photograph Exhibit No. 74.

Almon E. Hart, Special Examiner.

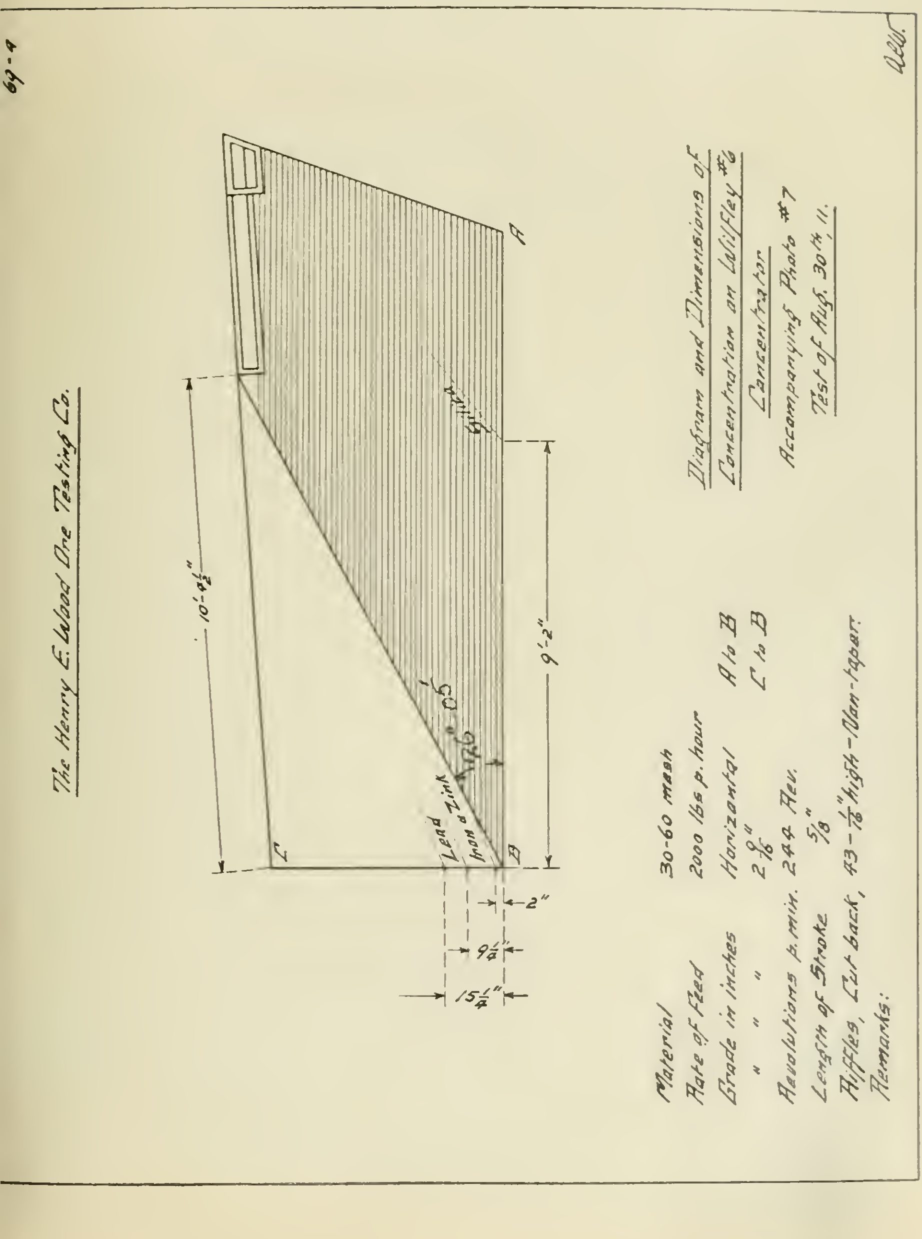


Complainant's Exhibit No. 75. Photograph No. 7, Wilfley Table with Rectangular Riffles of Uniform and Equal Height, Terminating Diagonally, Upper End of Diagonal Line of Termination Receding Towards Mechanism End, Feed One Ton Per Hour.

Almon E. Hart, Special Examiner.

Complainant's Exhibit No. 75-A. Blue-Print Diagram of Photograph Exhibit No. 75.

Almon E. Hart, Special Examiner.

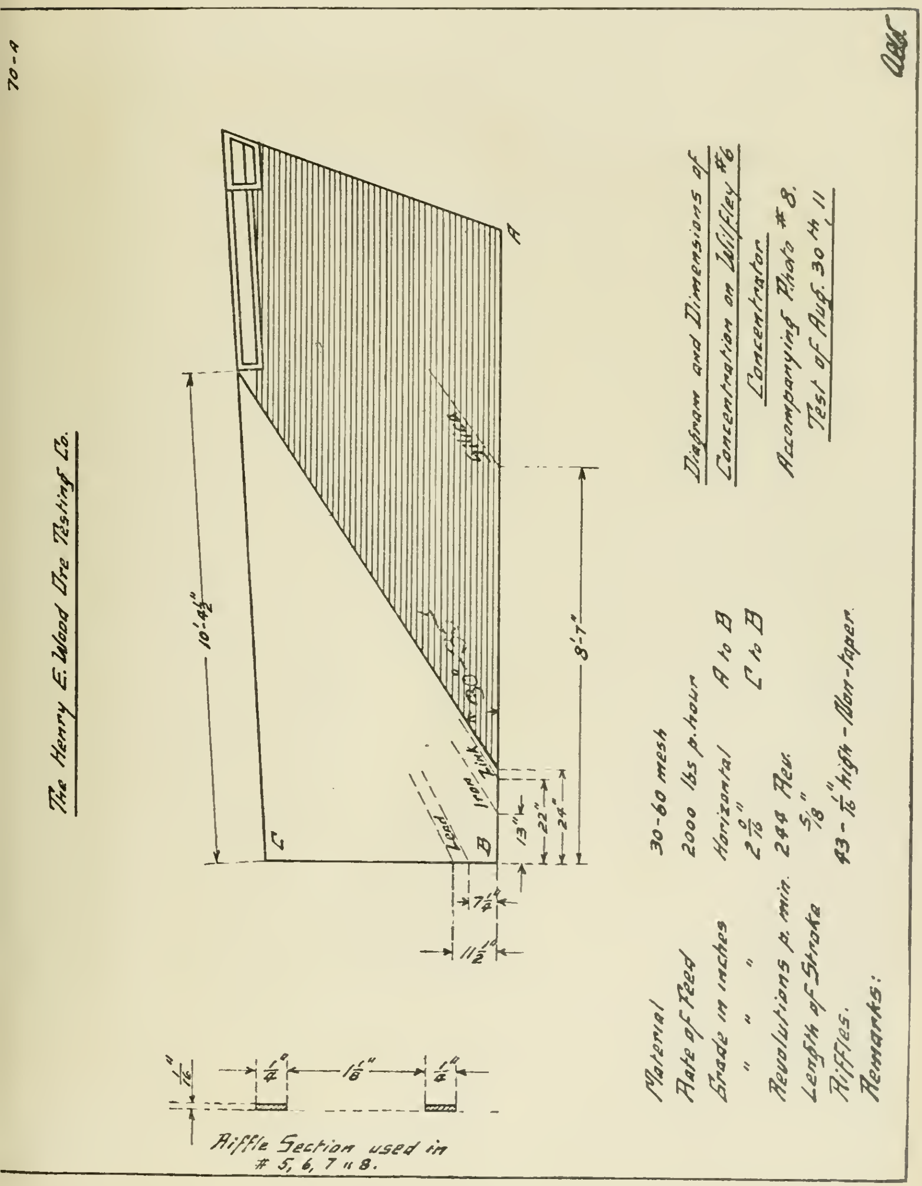


Complainant's Exhibit No. 76. Photograph No. 8, Wilfley Table With Rectangular Riffles of Uniform and Equal Height, Terminating Diagonally, Lower End of Diagonal Line of Termination Receding Towards Mechanism End, Feed One Ton Per Hour.

Almon E. Hart, Special Examiner.

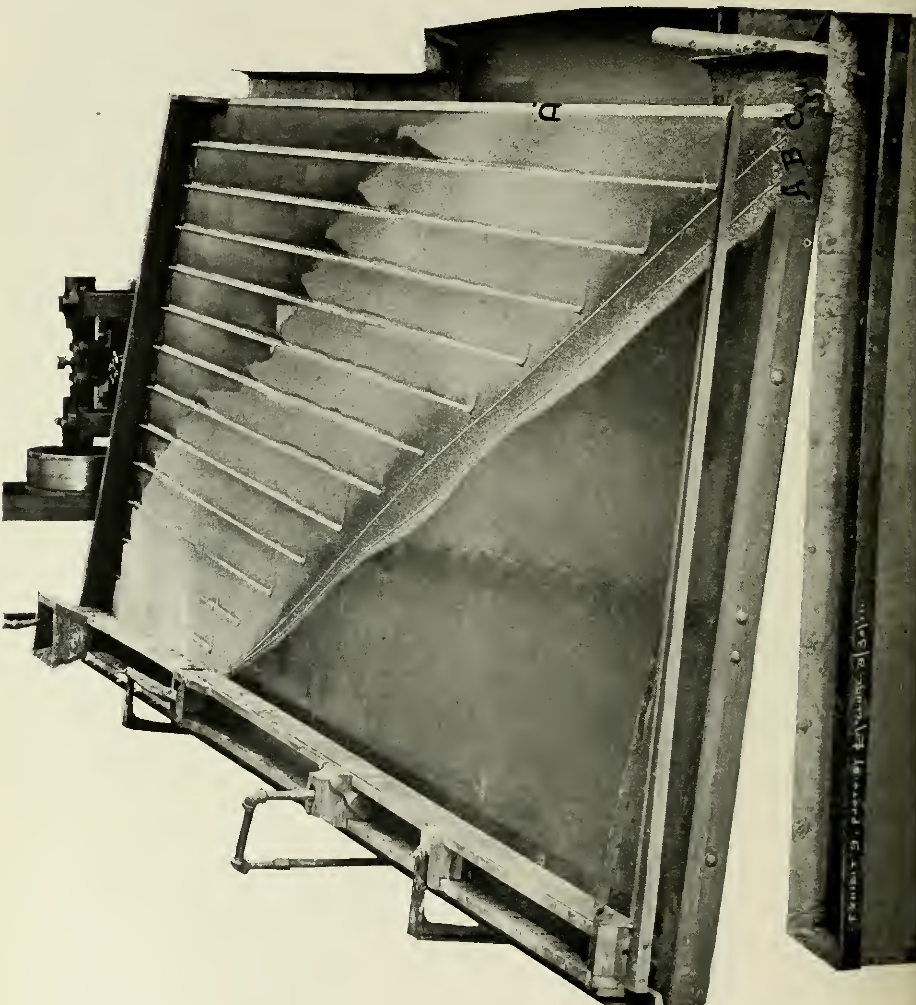
Complainant's Exhibit No. 76-A. Blue-Print Diagram of Photograph Exhibit No. 76.

Almon E. Hart, Special Examiner.



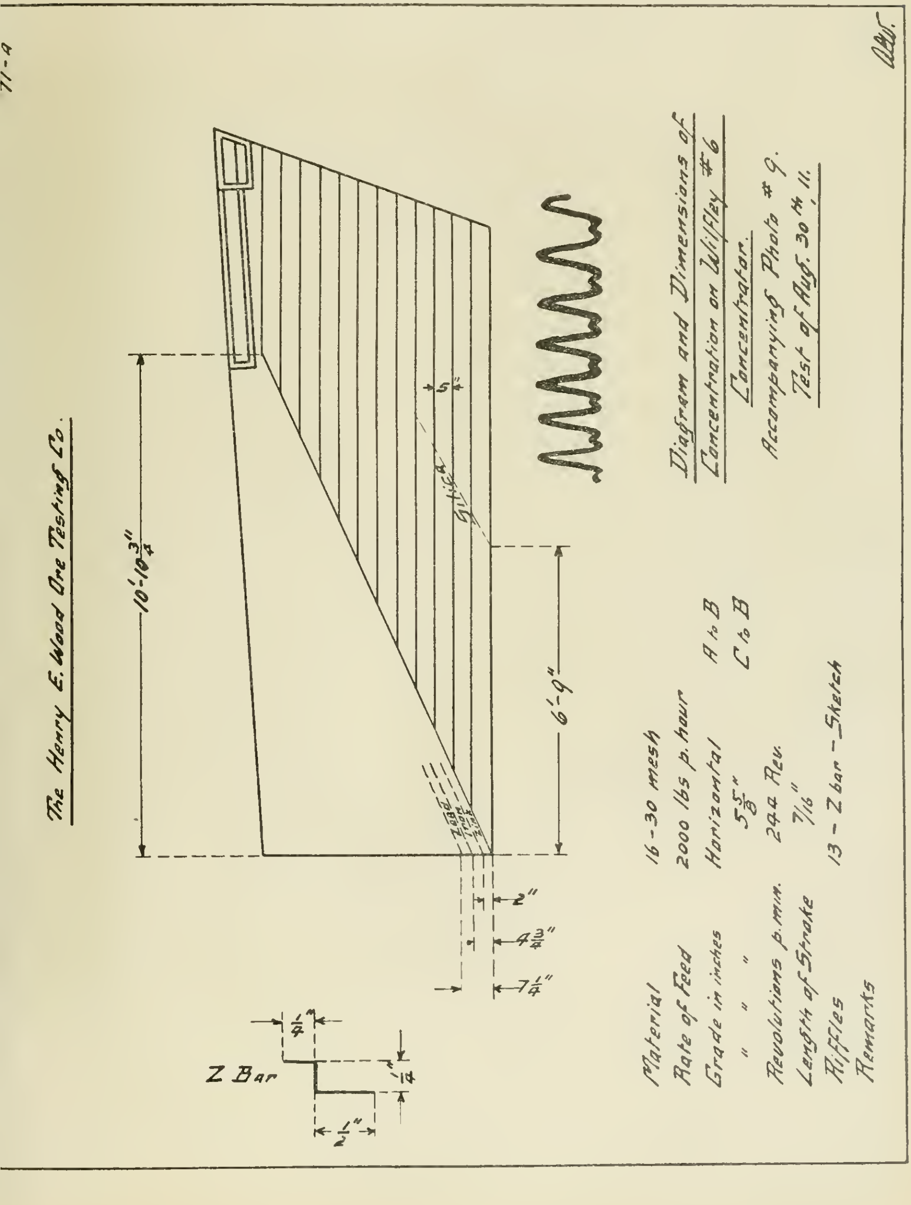
Complainant's Exhibit No. 77. Photograph No. 9, Wilfley Table With Z-Bar Riffles of Uniform Height, ¼ Inch High, Terminating on a Diagonal Line.

Almon E. Hart, Special Examiner.



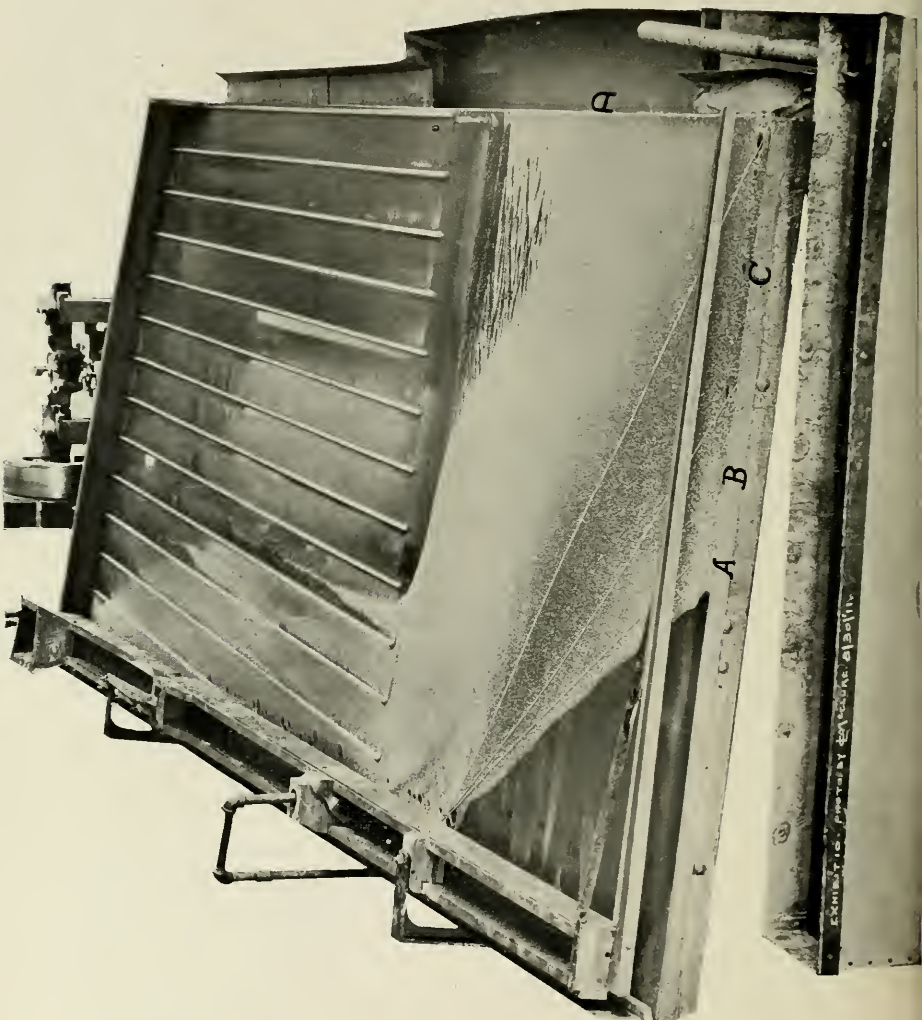
Complainant's Exhibit No. 77-A. Blue-Print Diagram of Photograph Exhibit No. 77.

Almon E. Hart, Special Examiner.



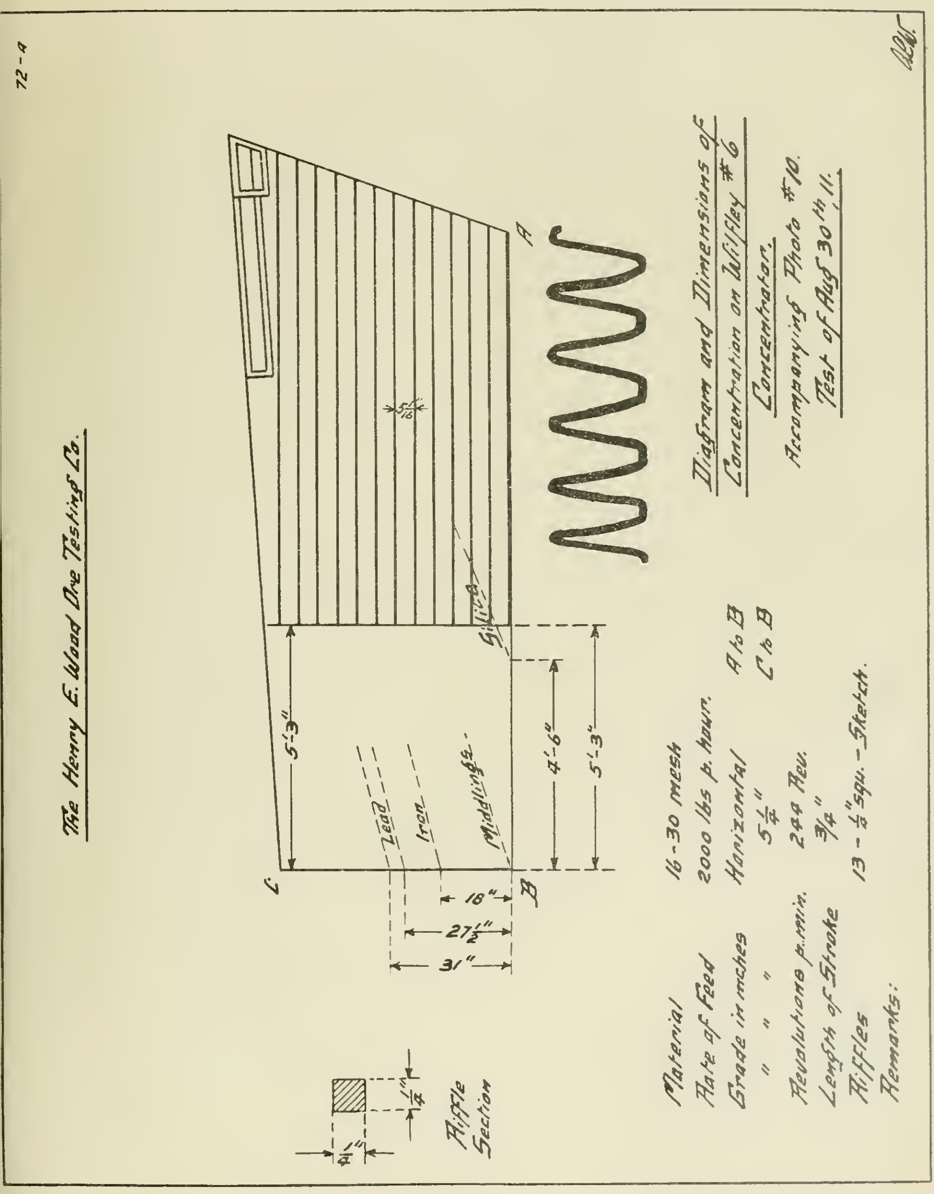
Complainant's Exhibit No. 78. Photograph No. 10, Wilfley Table With Rectangular Wood Riffles, ¼ Inch High, of Equal Length, Feed One Ton Per Hour.

Almon E. Hart, Special Examiner.



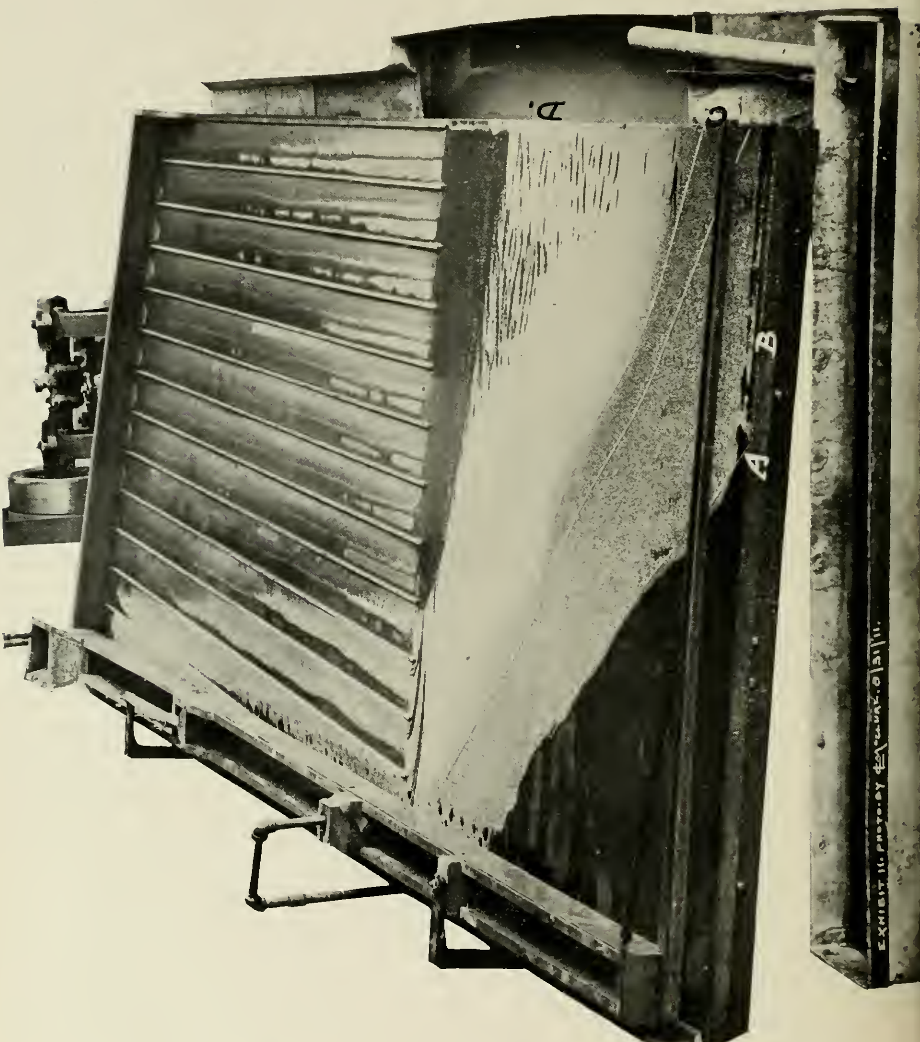
Complainant's Exhibit No. 78-A. Blue-Print Diagram of Photograph Exhibit No. 78.

Almon E. Hart, Special Examiner.



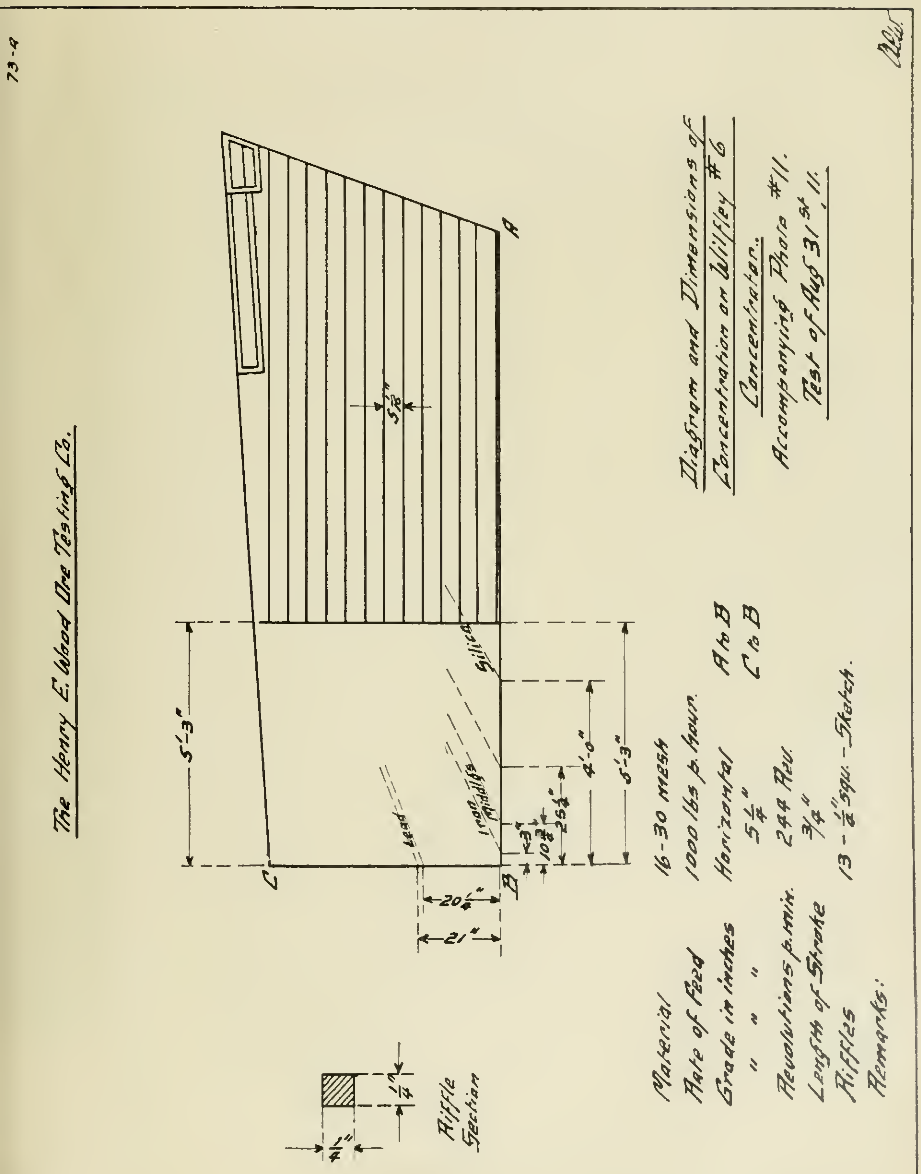
Complainant's Exhibit No. 79. Photograph No. 11, Wilfley Table With Rectangular Wood Rifles, 1/4 Inch High, of Equal Length, Feed Half Ton Per Hour.

Almon E. Hart, Special Examiner.



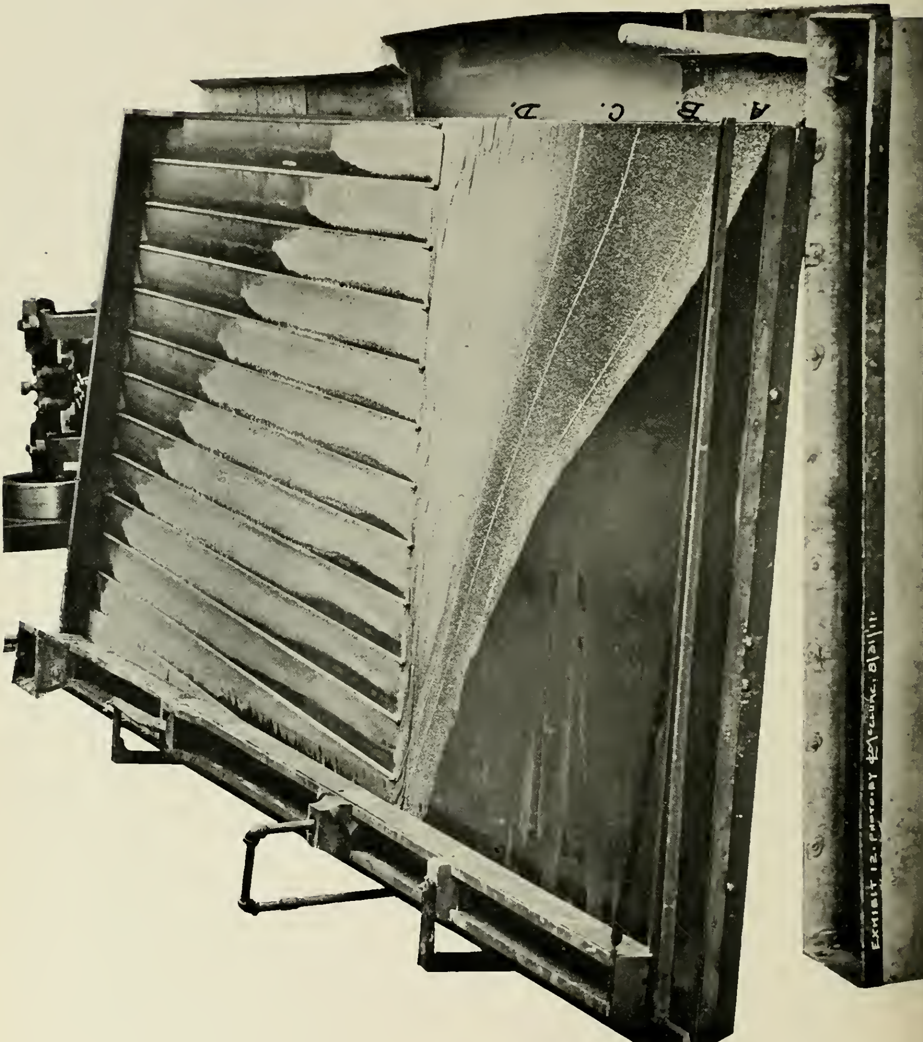
Complainant's Exhibit No. 79-A. Blue-Print Diagram of Photograph Exhibit No. 79.

Almon E. Hart, Special Examiner.



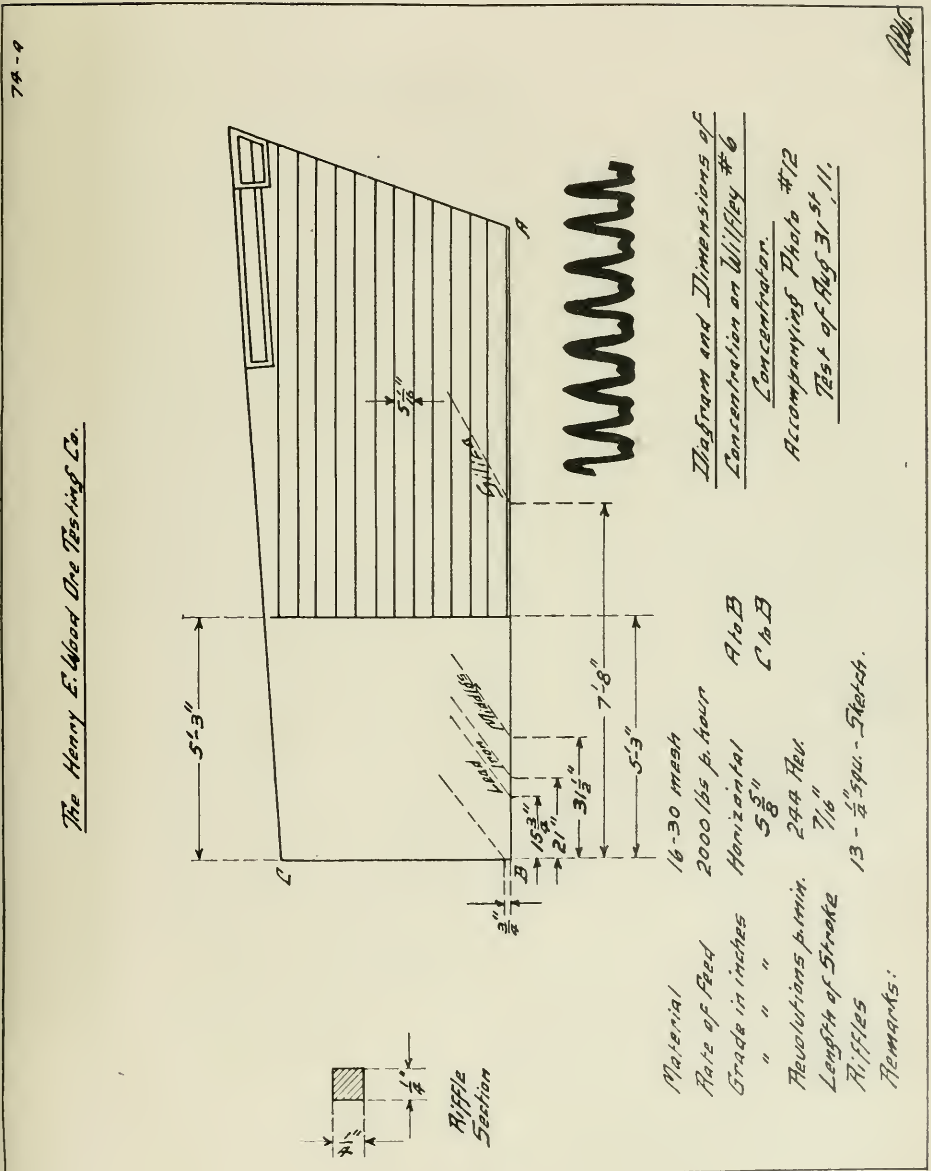
Complainant's Exhibit No. 80. Photograph No. 12, Wilfley Table With Rectangular Wood Riffles, ¼ Inch High, of Equal Length, Change of Transverse Inclination and Length of Stroke.

Almon E. Hart, Special Examiner.



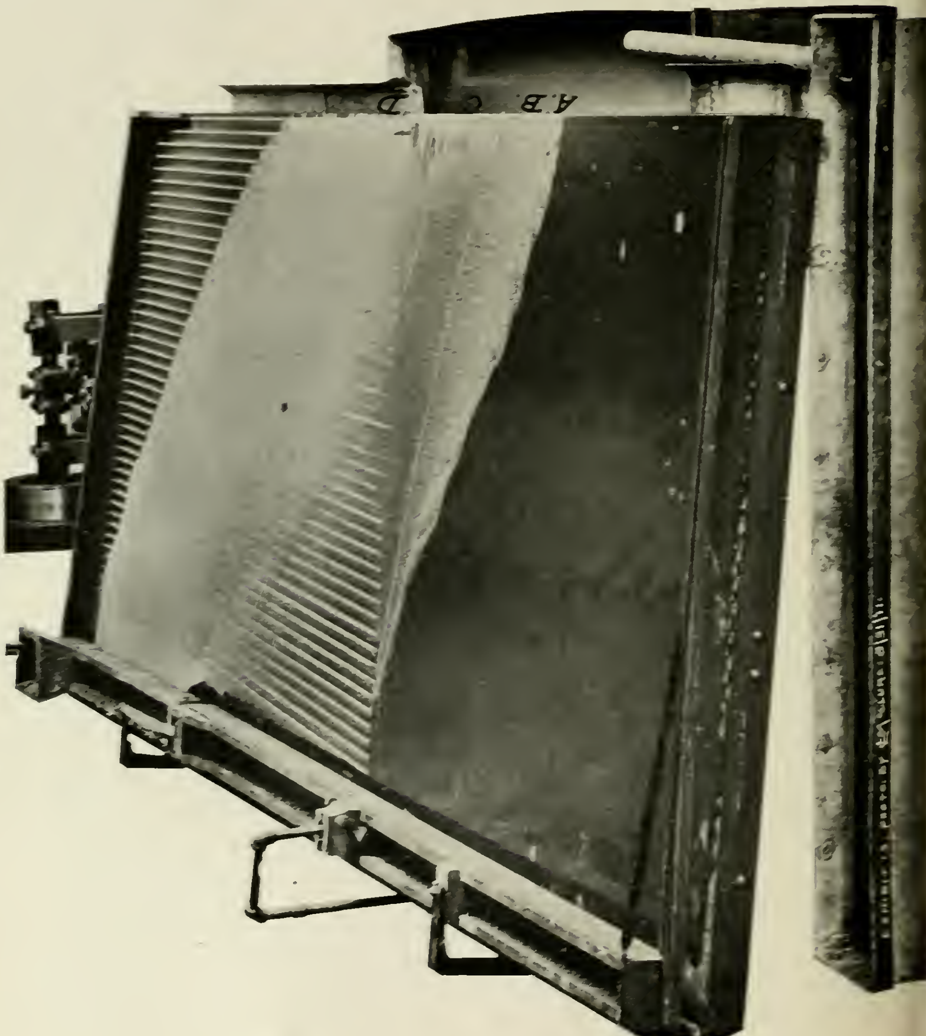
Complainant's Exhibit No. 80-A. Blue-Print Diagram of Photograph Exhibit No. 80.

Almon E. Hart, Special Examiner.



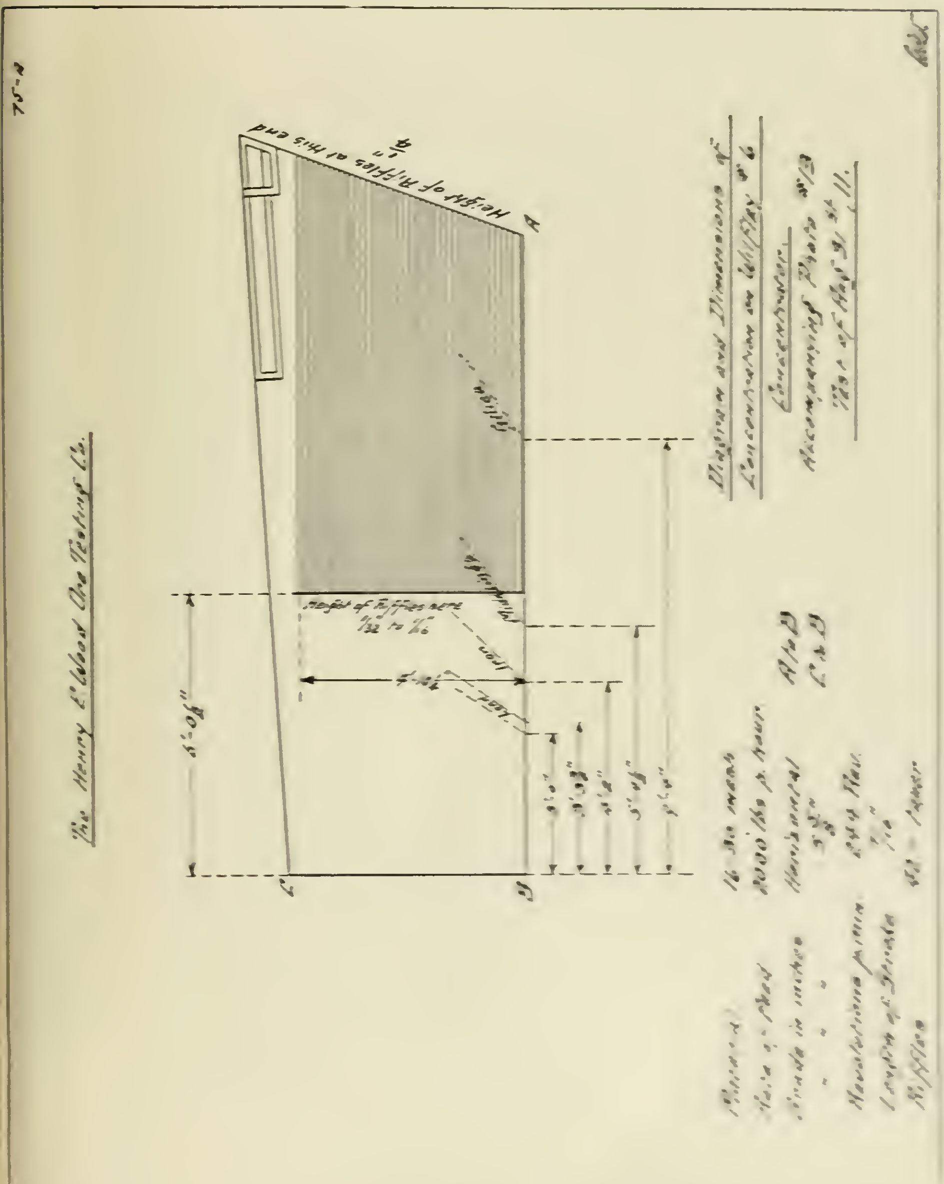
Complainant's Exhibit No. 51. Photograph No. 13. Wilfley Table With Riffles of Equal Length, Terminating Uniformly. Feed One Ton Per Hour.

Almon E. Hart, Special Examiner.



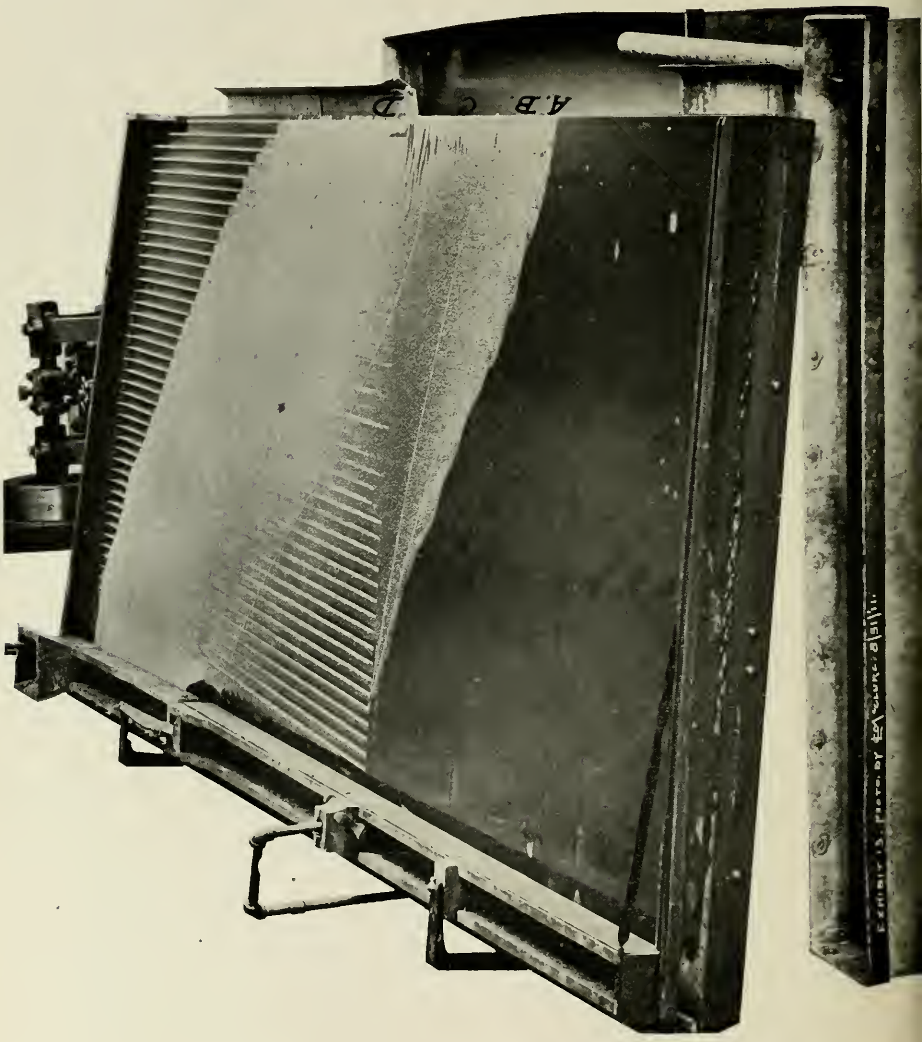
Complainant's Exhibit No. 81-A. Blue-Print Diagram of Photograph Exhibit No. 81.

Almon E. Hart, Special Examiner.



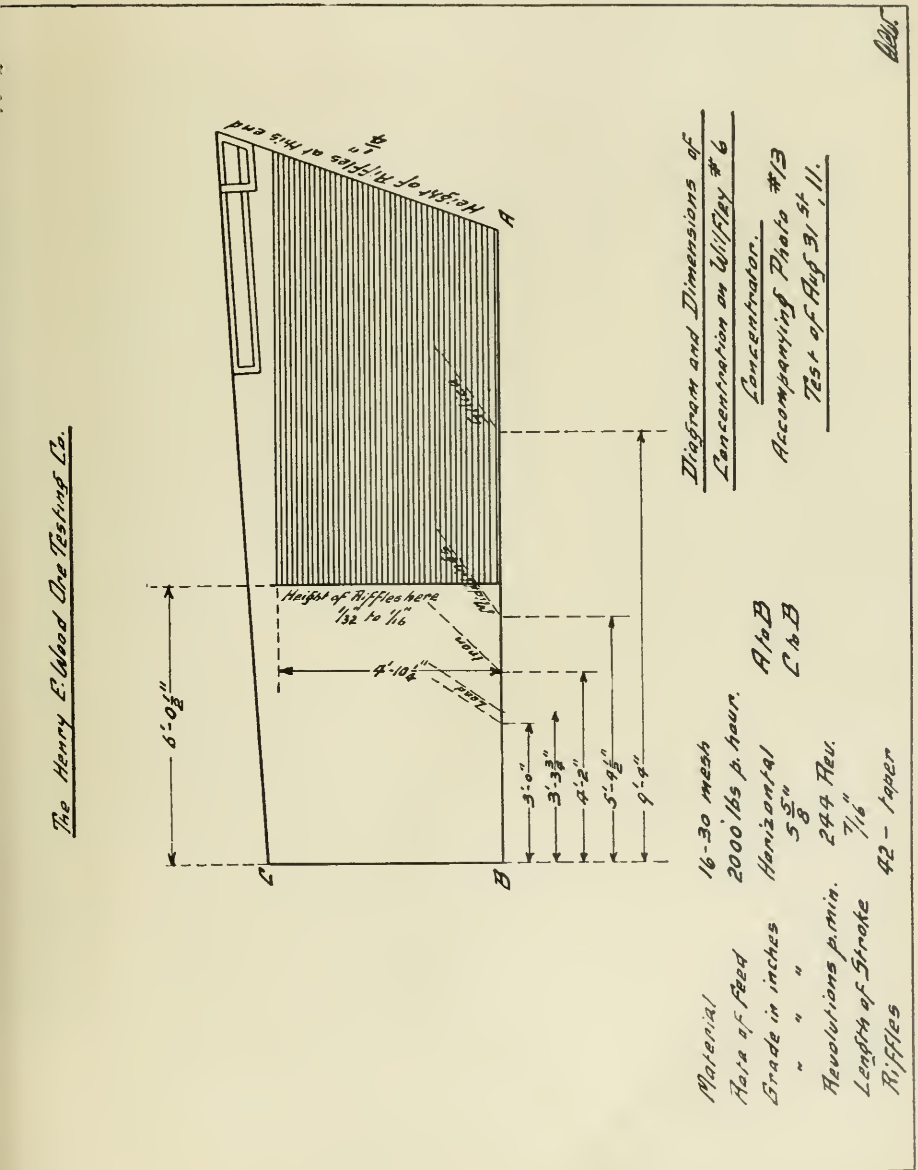
Complainant's Exhibit No. 81. Photograph No. 13, Wilfley Table With Riffles of Equal Length, Terminating Uniformly, Feed One Ton Per Hour.

Almon E. Hart, Special Examiner.



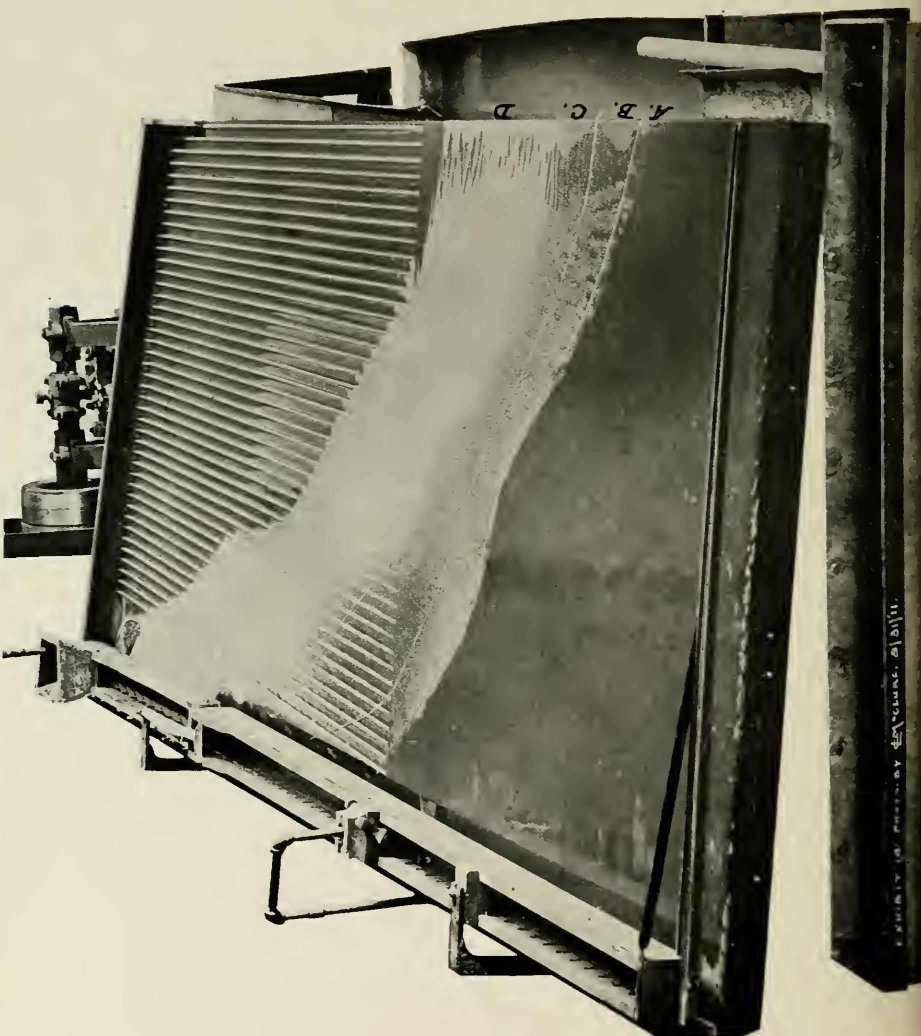
Complainant's Exhibit No. 81-A. Blue-Print Diagram of Photograph Exhibit No. 81.

Almon E. Hart, Special Examiner.



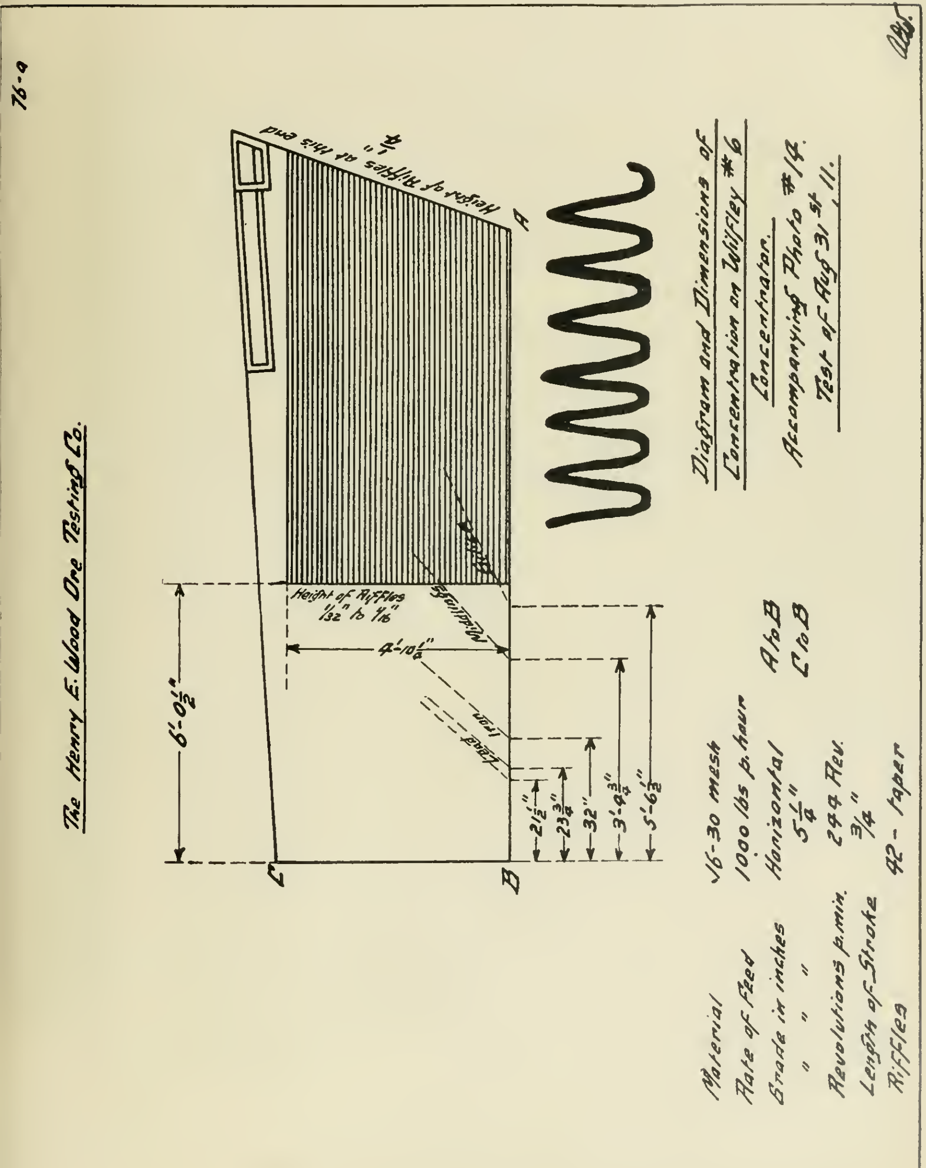
Complainant's Exhibit No. 82. Photograph No. 14, Wilfley Table, 5¼ Inches Transverse Inclination, ¾-Inch Stroke, Feed One-Half Ton Per Hour.

Almon E. Hart, Special Examiner.



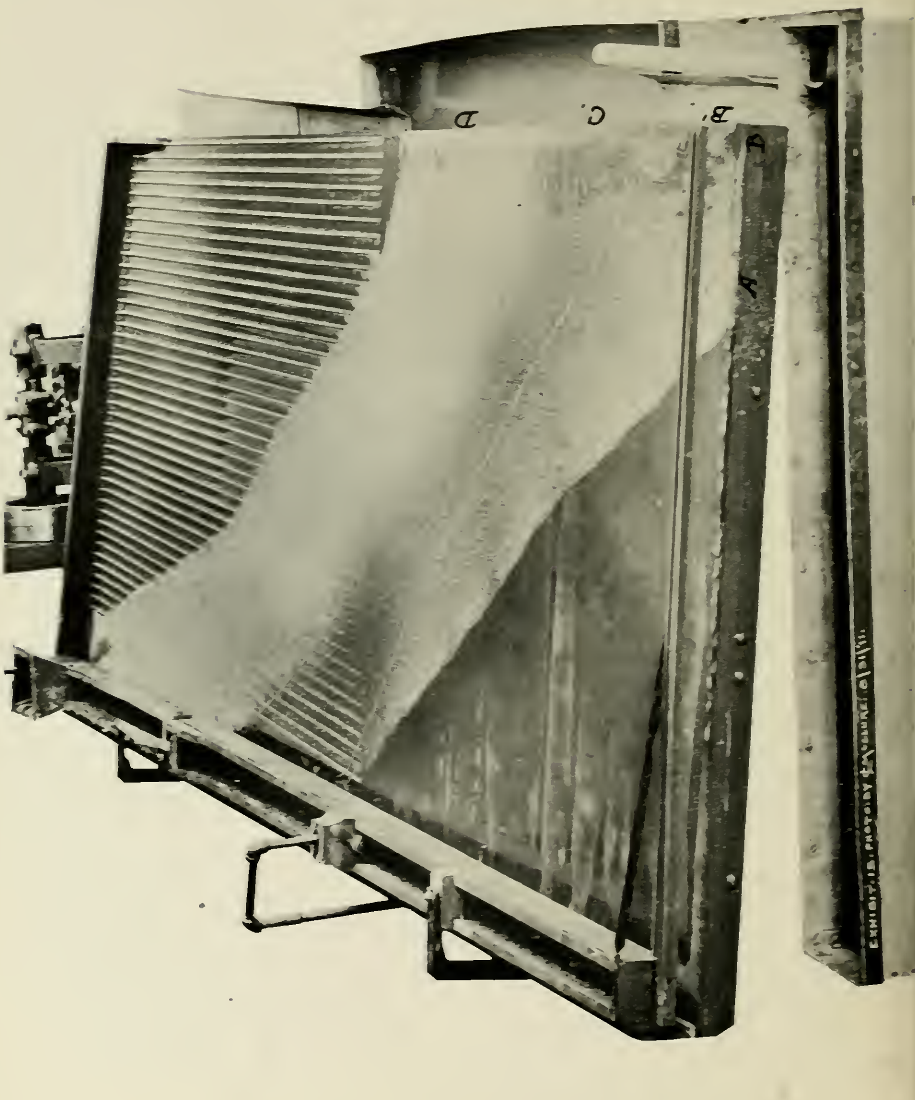
Complainant's Exhibit No. 82-A. Blue-Print Diagram of Photograph Exhibit No. 82.

Almon E. Hart, Special Examiner.



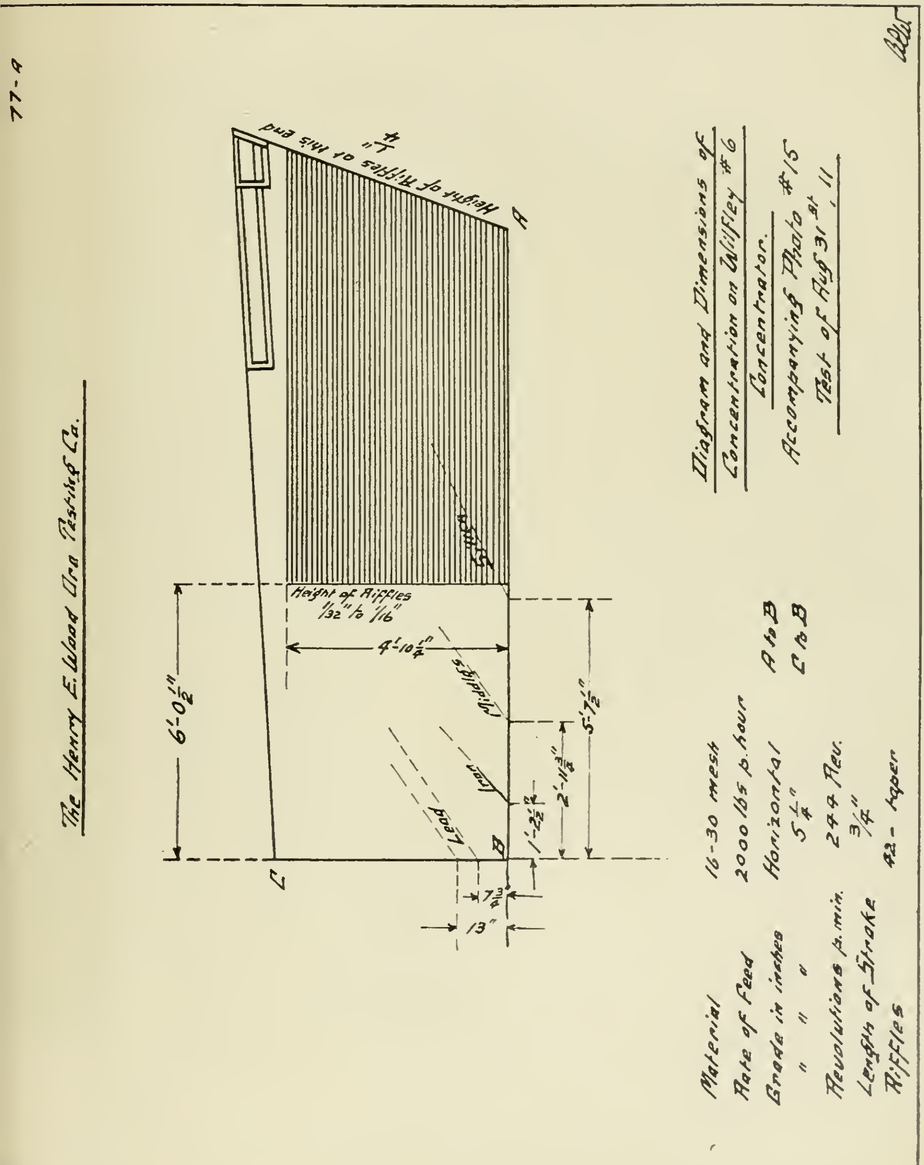
Complainant's Exhibit No. 83. Photograph No. 15. Wilfley Table With Uniformly Tapering Riffles of Equal Length, Level Longitudinally, $5\frac{1}{4}$ Inches Transverse Inclination, $\frac{3}{4}$-Inch Stroke.

Almon E. Hart, Special Examiner.



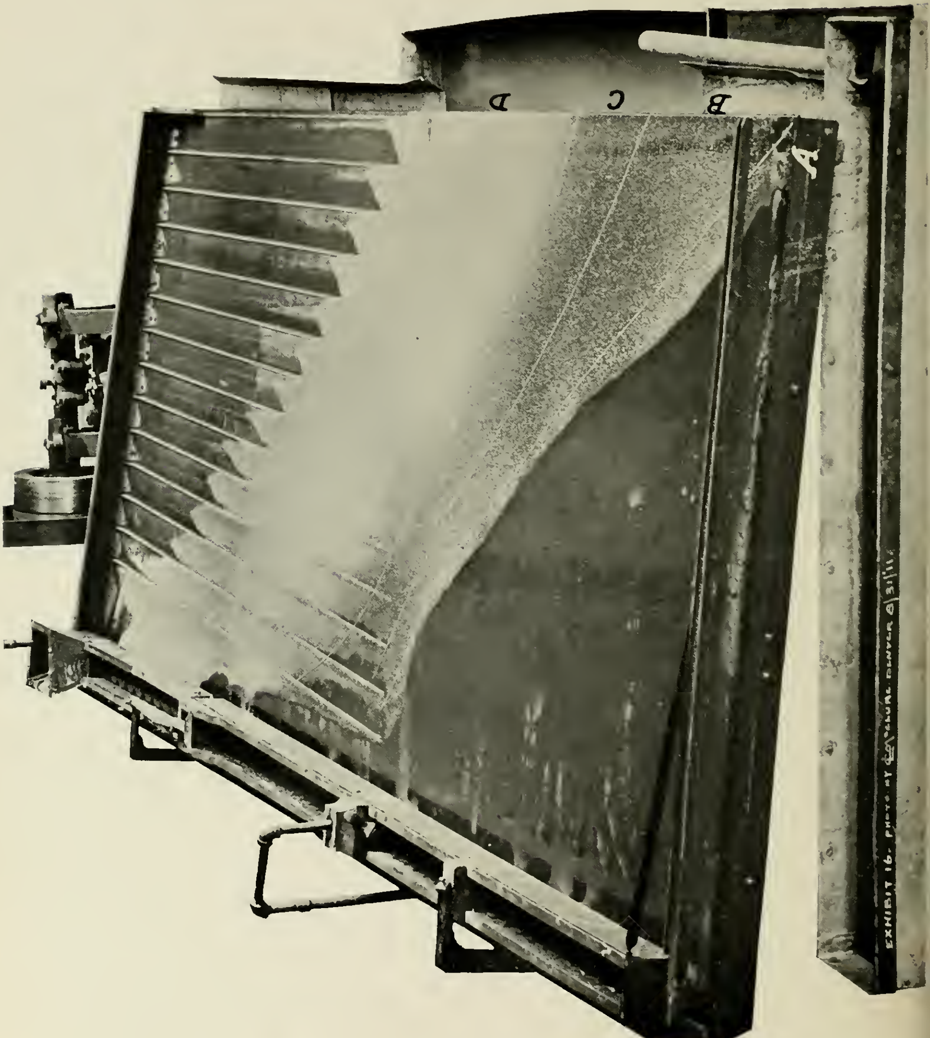
Complainant's Exhibit No. 83-A. Blue-Print Diagram of Photograph Exhibit No. 83.

Almon E. Hart, Special Examiner.



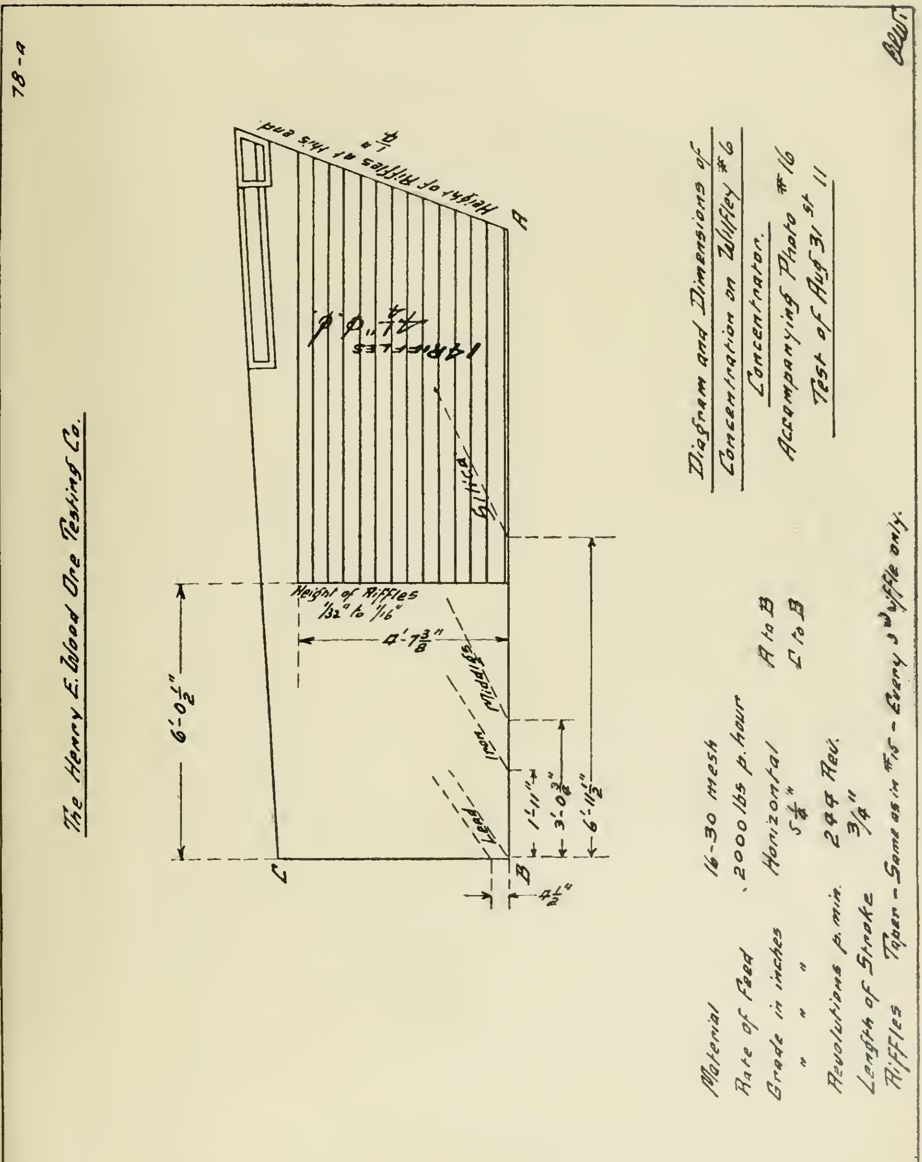
Complainant's Exhibit No. 84. Photograph No. 16, Wilfley Table With
14 Uniformly Tapering Riffles of Equal Length,
Spaced 4¼ Inches.

Almon E. Hart, Special Examiner.



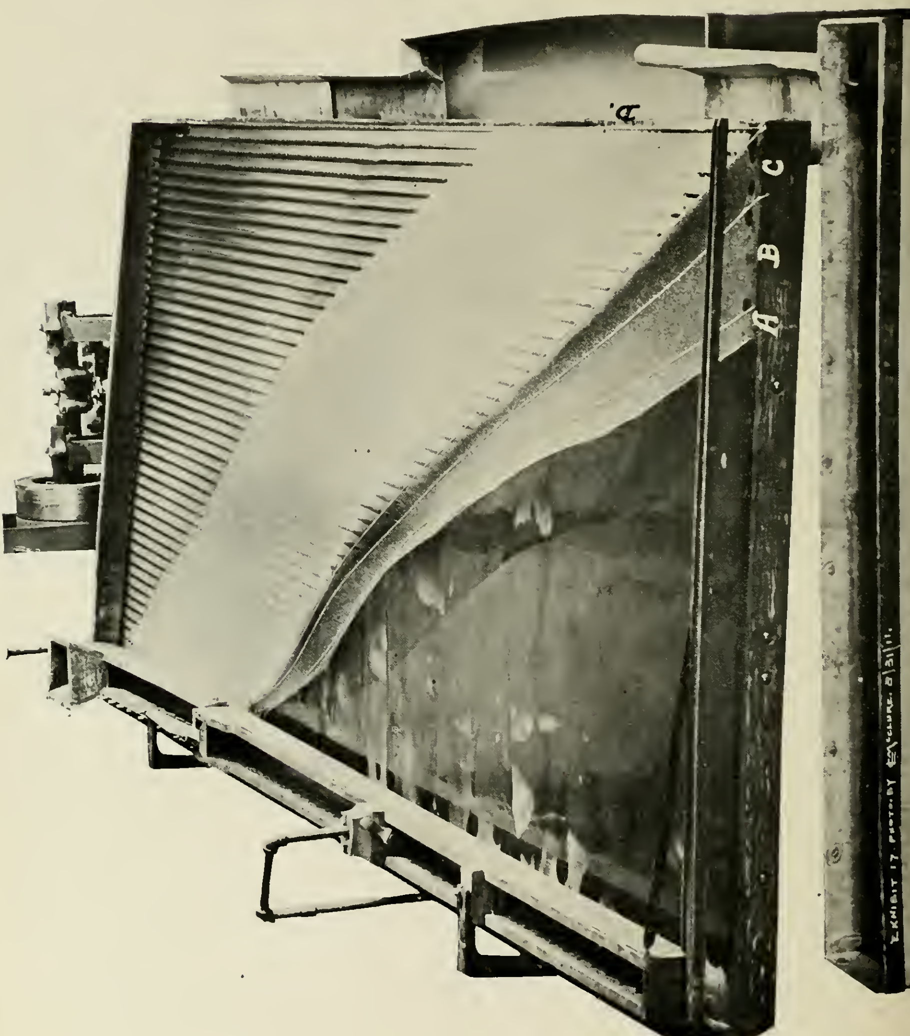
Complainant's Exhibit No. 84-A. Blue-Print Diagram of Photograph Exhibit No. 84.

Almon E. Hart, Special Examiner.



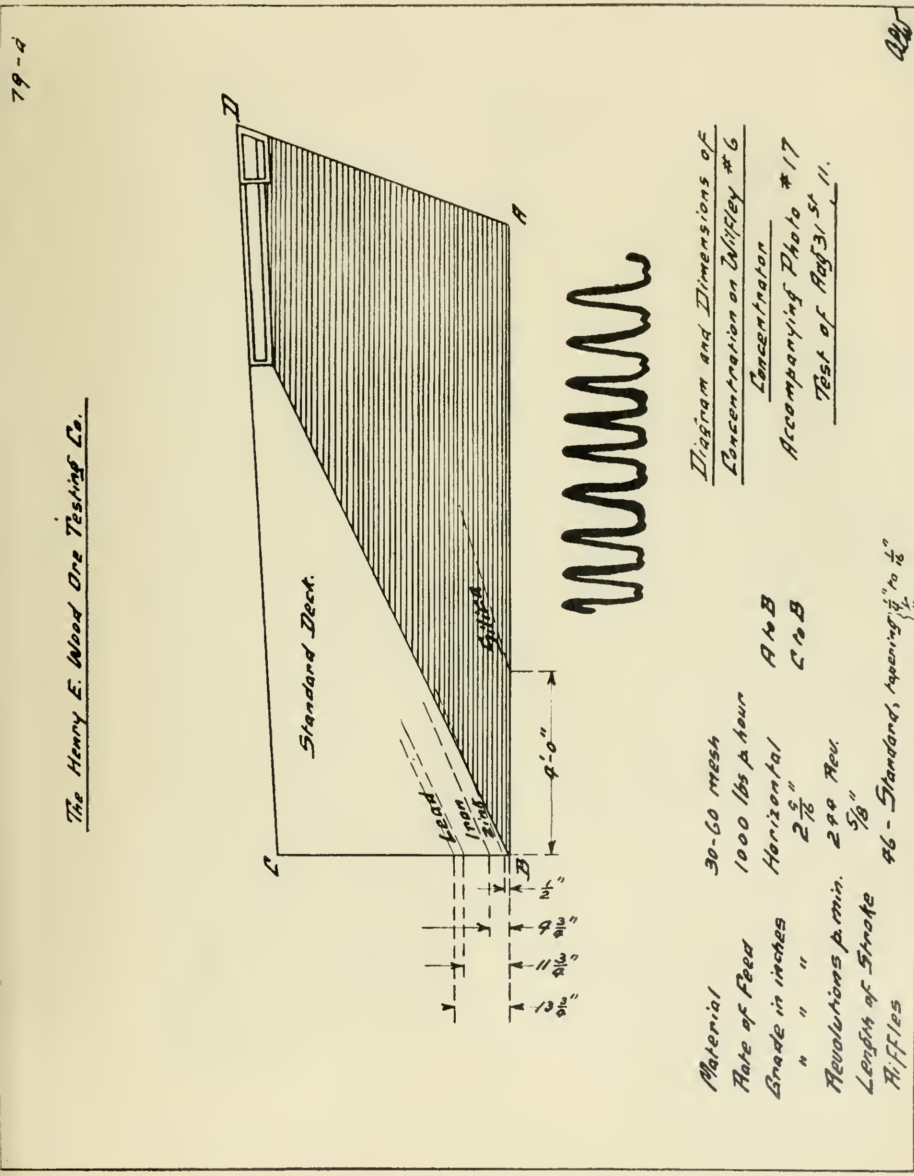
Complainant's Exhibit No. 85. Photograph No. 17, Wilfley Standard Commercial Table With Tapering Riffles, Feed One-Half Ton Per Hour.

Almon E. Hart, Special Examiner.



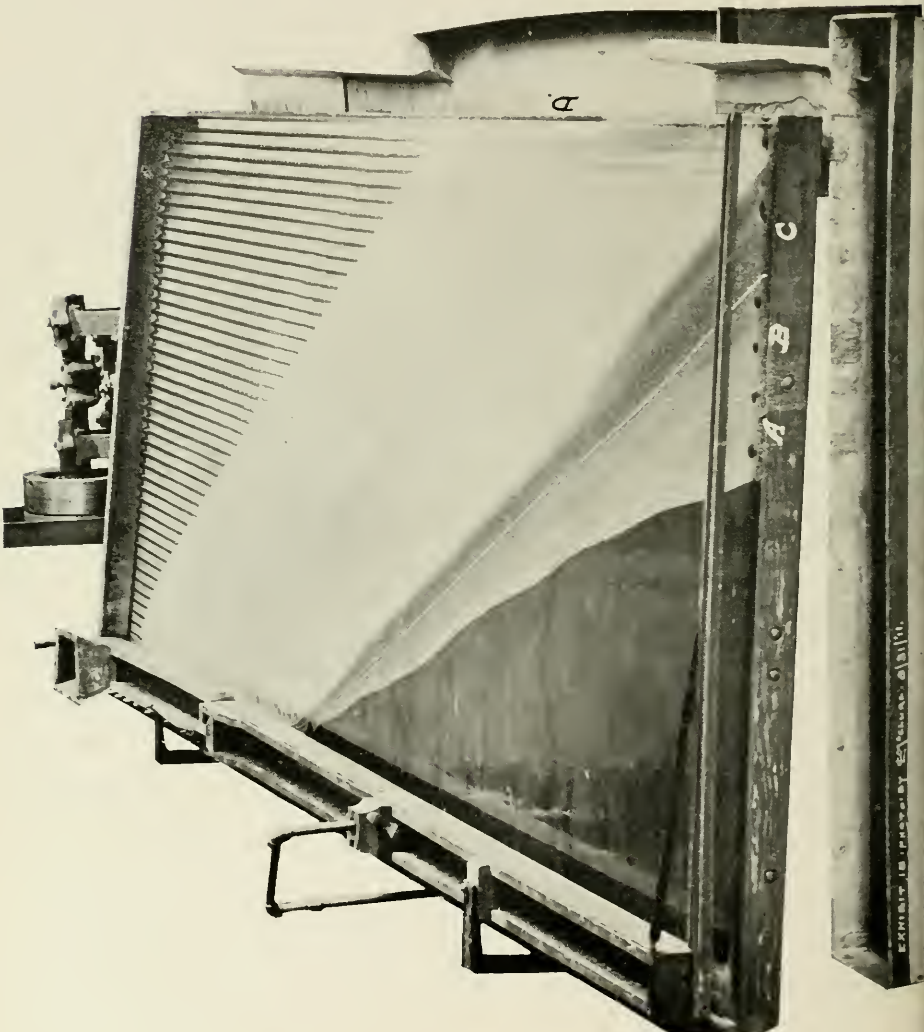
Complainant's Exhibit No. 85-A. Blue-Print Diagram of Photograph Exhibit No. 85.

Almon E. Hart, Special Examiner.



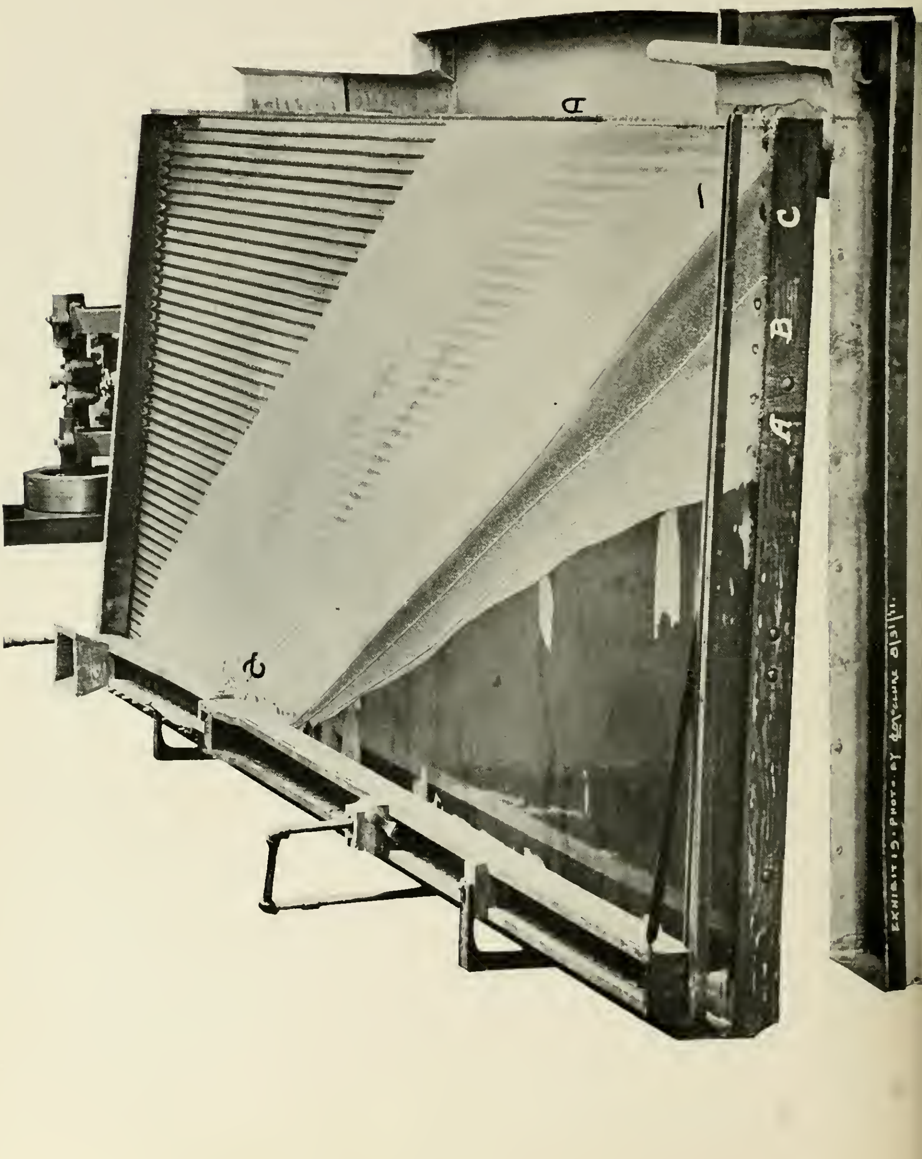
Complainant's Exhibit No. 86. Photograph No. 18, Wilfley Standard Table With Tapering Riffles, Feed One Ton Per Hour.

Almon E. Hart, Special Examiner.



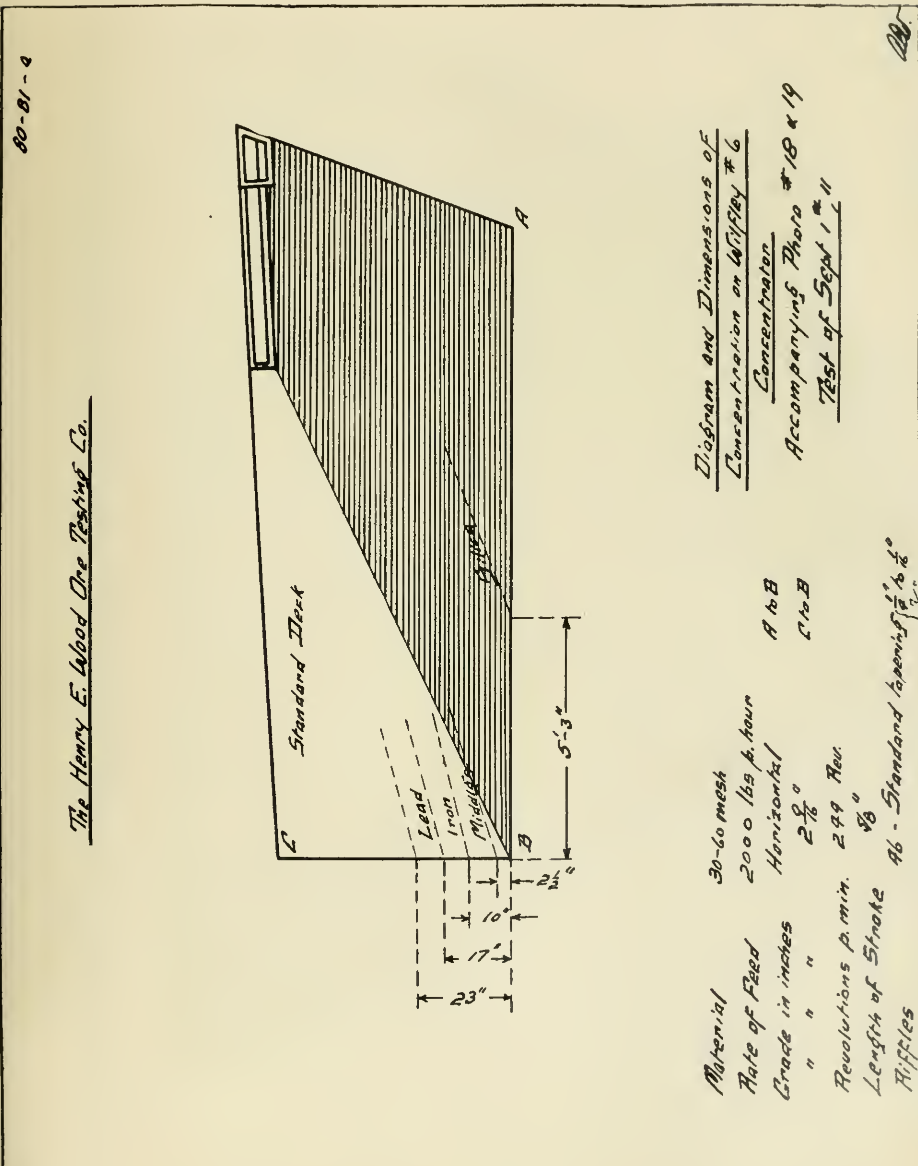
Complainant's Exhibit No. 87. Photograph No. 19, Wilfley Standard Table With Tapering Riffles, Feed One Ton Per Hour.

Almon E. Hart, Special Examiner.



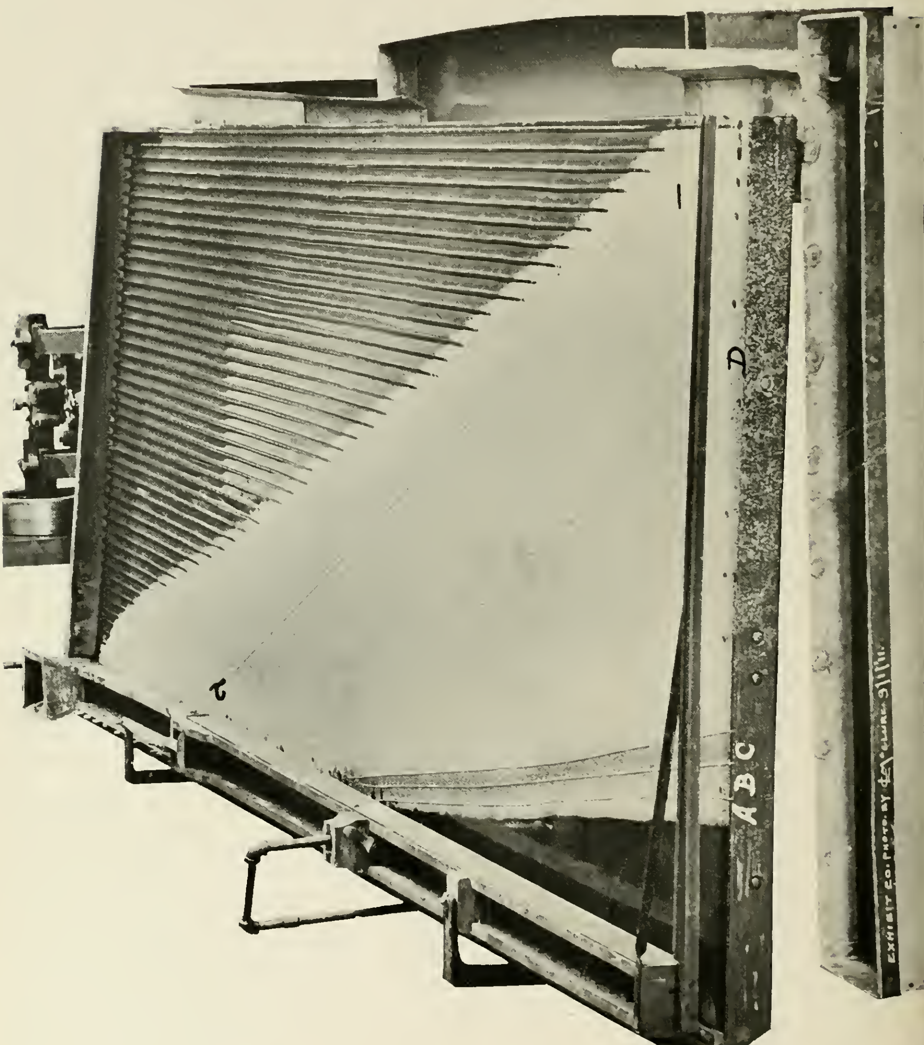
Complainant's Exhibit No. 86-87-A. Blue-Print Diagram of Photographs Exhibits Nos. 86 and 87.

Almon E. Hart, Special Examiner.



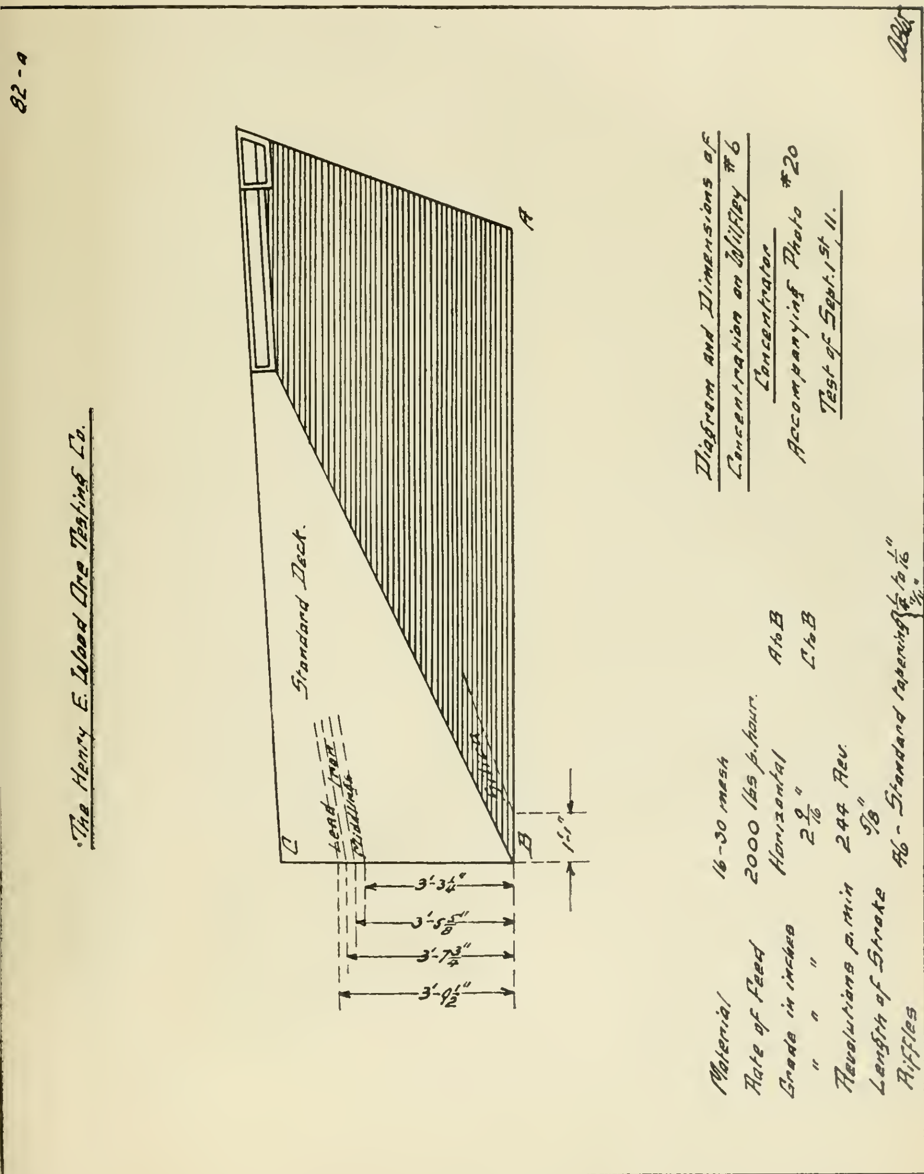
Complainant's Exhibit No. 88. Photograph No. 20, Wilfley Commercial Construction, Feed 1 Millimeter Pulp, One Ton Per Hour.

Almon E. Hart, Special Examiner.



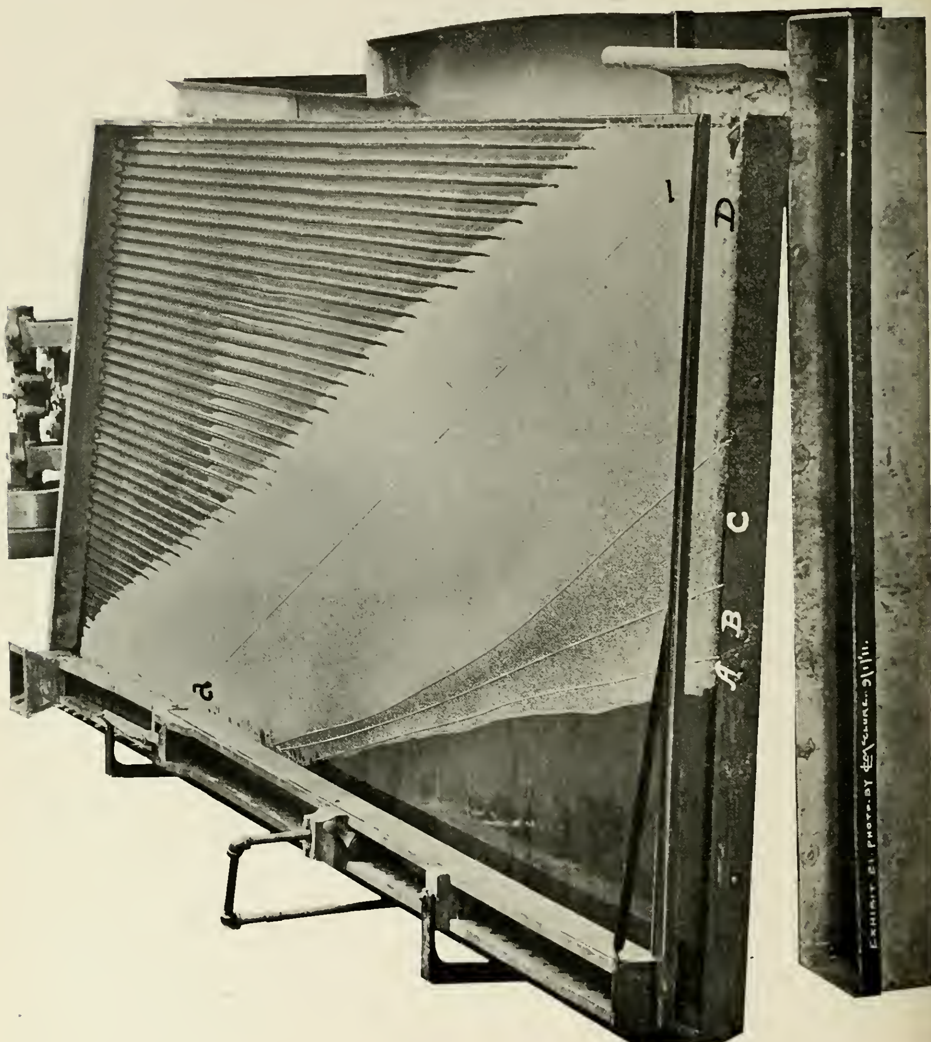
Complainant's Exhibit No. 88-A. Blue-Print Diagram of Photograph Exhibit No. 88.

Almon E. Hart, Special Examiner.



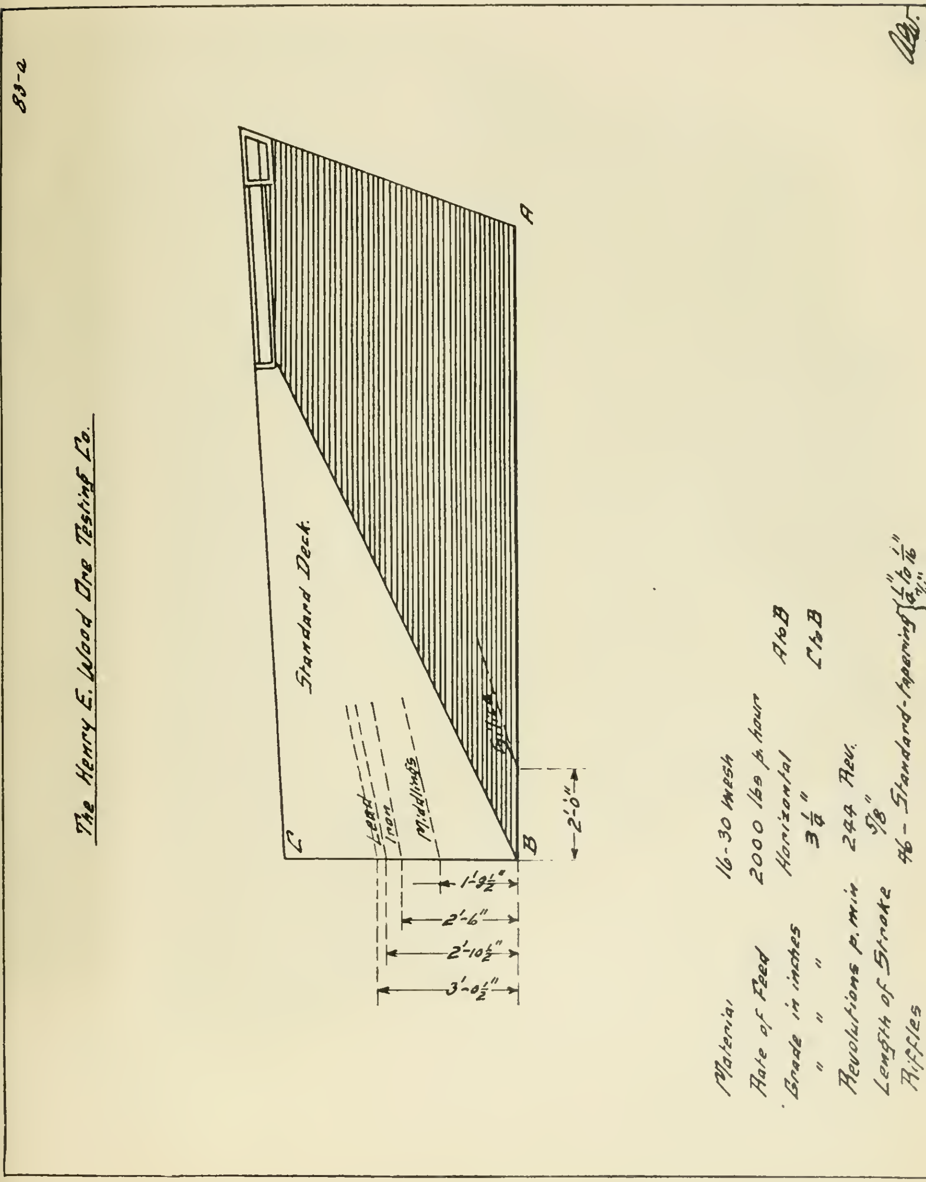
Complainant's Exhibit No. 89. Photograph No. 21, Wilfley Standard Table, Increased Transverse Inclination, Feed One Ton Per Hour.

Almon E. Hart, Special Examiner.



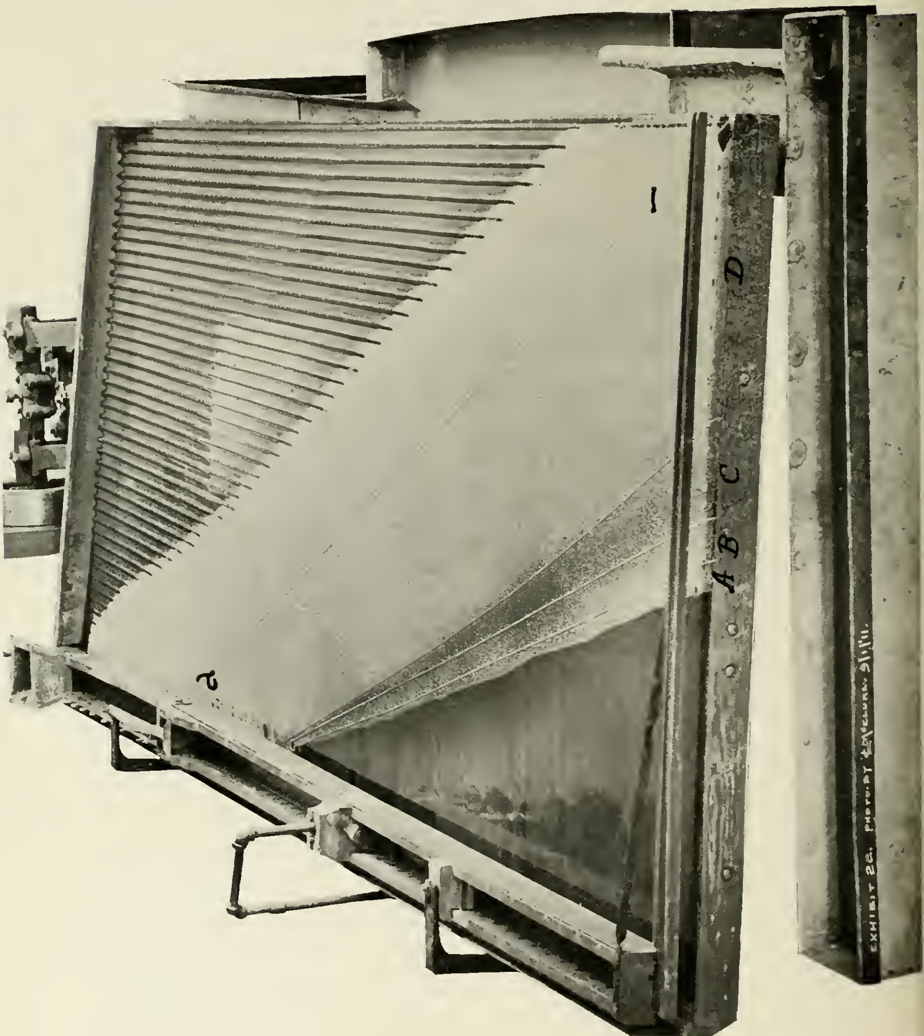
Complainant's Exhibit No. 89-A. Blue-Print Diagram of Photograph Exhibit No. 89.

Almon E. Hart, Special Examiner.



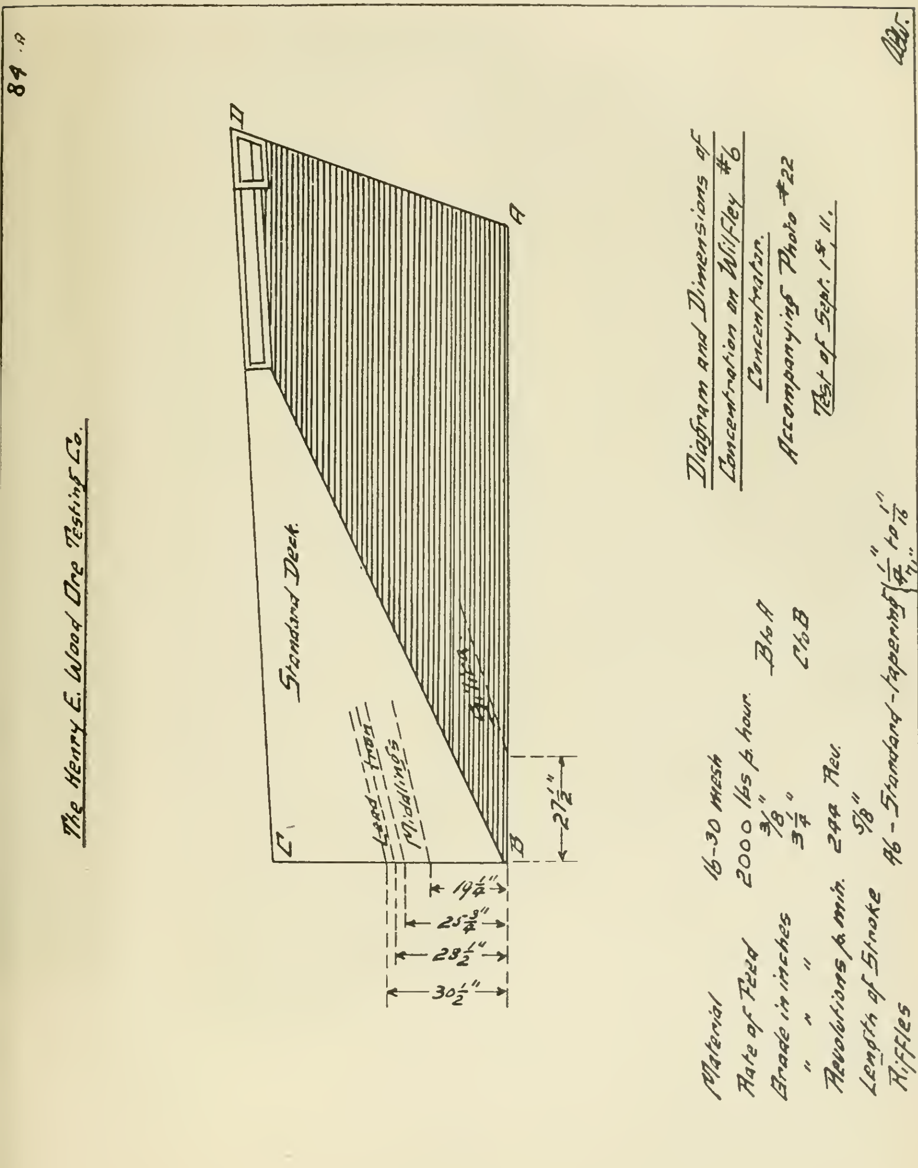
Complainant's Exhibit No. 90. Photograph No. 22, Wilfley Standard Table, Longitudinally Inclined.

Almon E. Hart, Special Examiner.



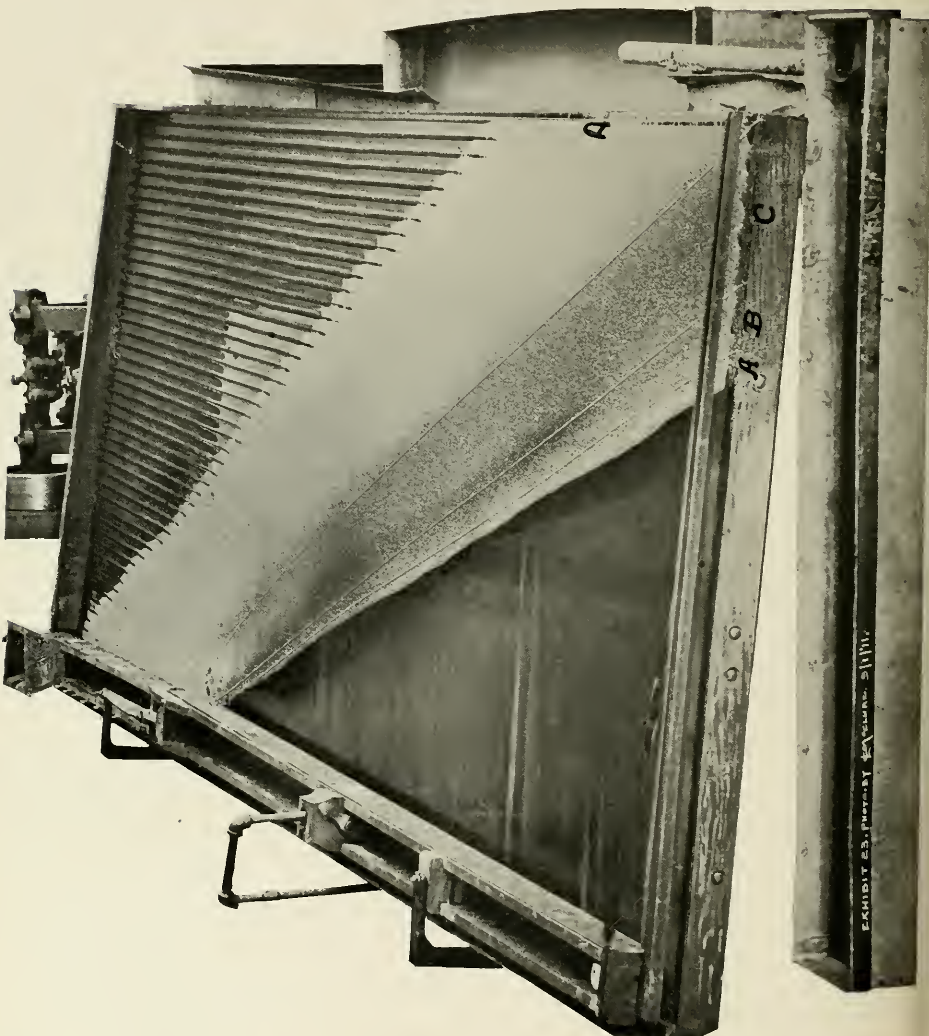
Complainant's Exhibit No. 90-A. Blue-Print Diagram of Photograph Exhibit No. 90.

Almon E. Hart, Special Examiner.



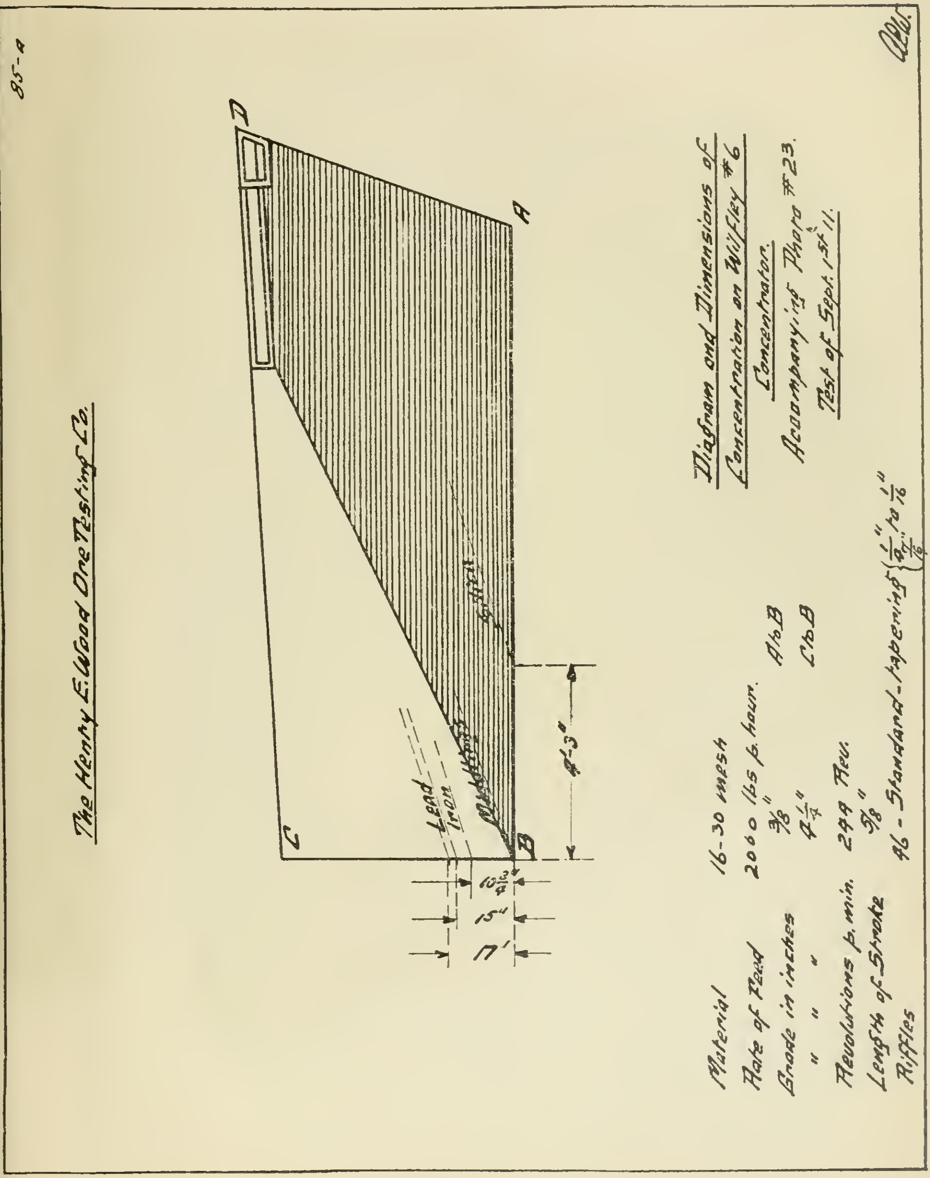
Complainant's Exhibit No. 91. Photograph No. 23, Wilfley Standard Table, Transverse Inclination Increased.

Almon E. Hart, Special Examiner.



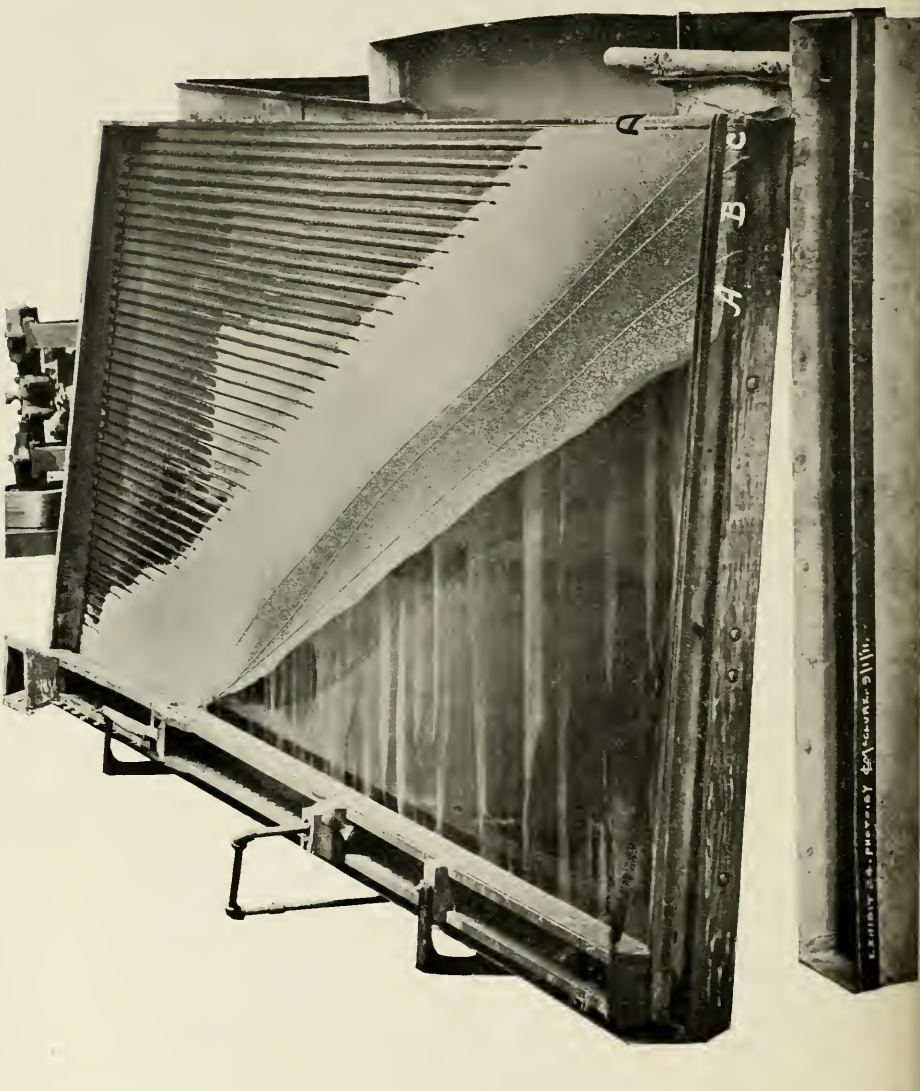
Complainant's Exhibit No. 91-A. Blue-Print Diagram of Photograph Exhibit No. 91.

Almon E. Hart, Special Examiner.



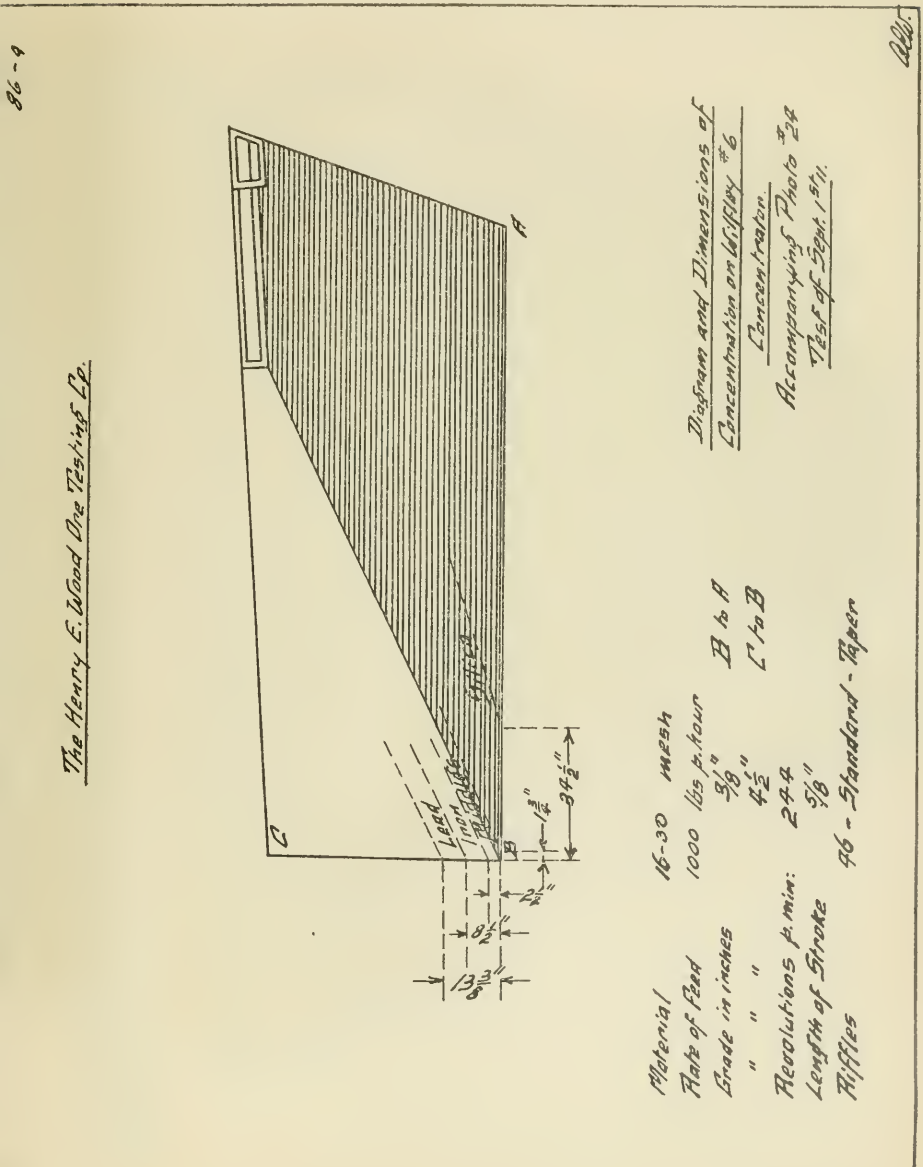
Complainant's Exhibit No. 92. Photograph No. 24, Wilfley Standard Table, Longitudinally Inclined, Feed One-Half Ton Per Hour.

Almon E. Hart, Special Examiner.



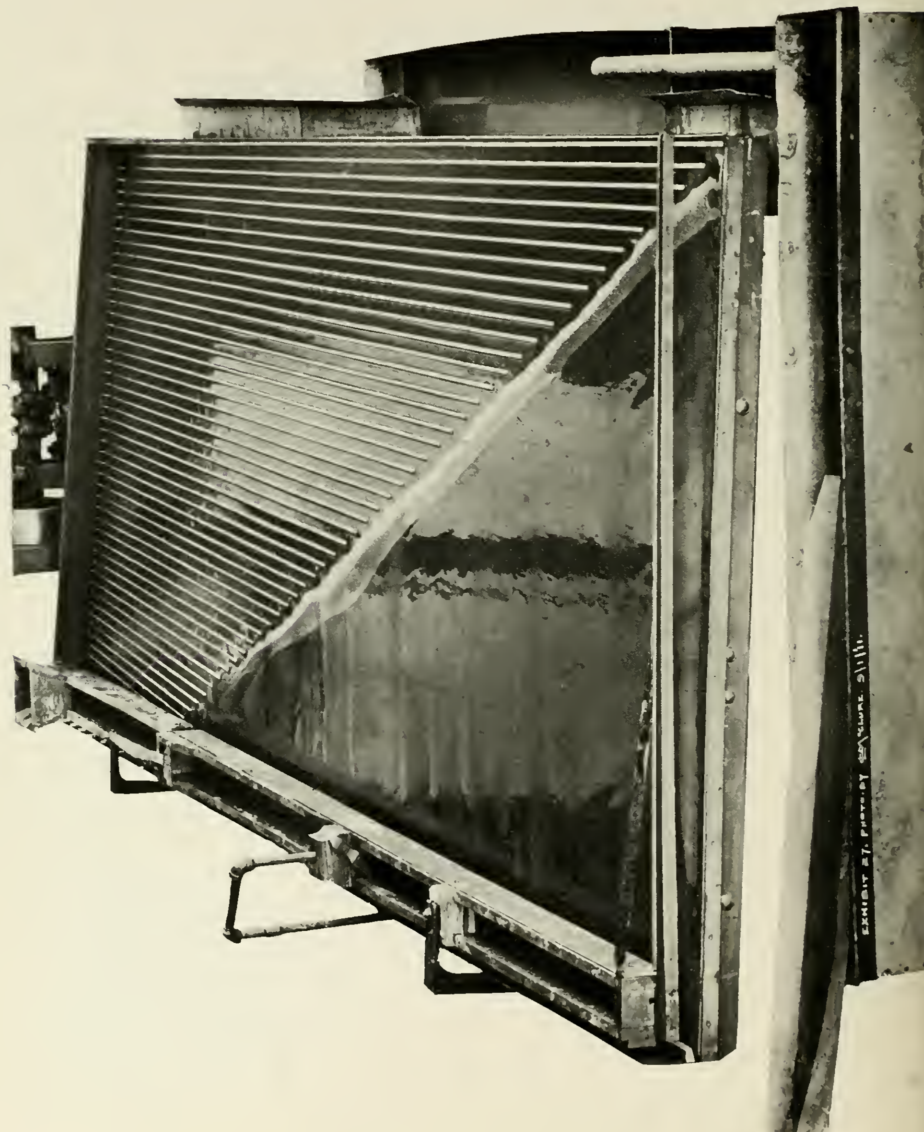
Complainant's Exhibit No. 92-A. Blue-Print Diagram of Photograph Exhibit No. 92.

Almon E. Hart, Special Examiner.



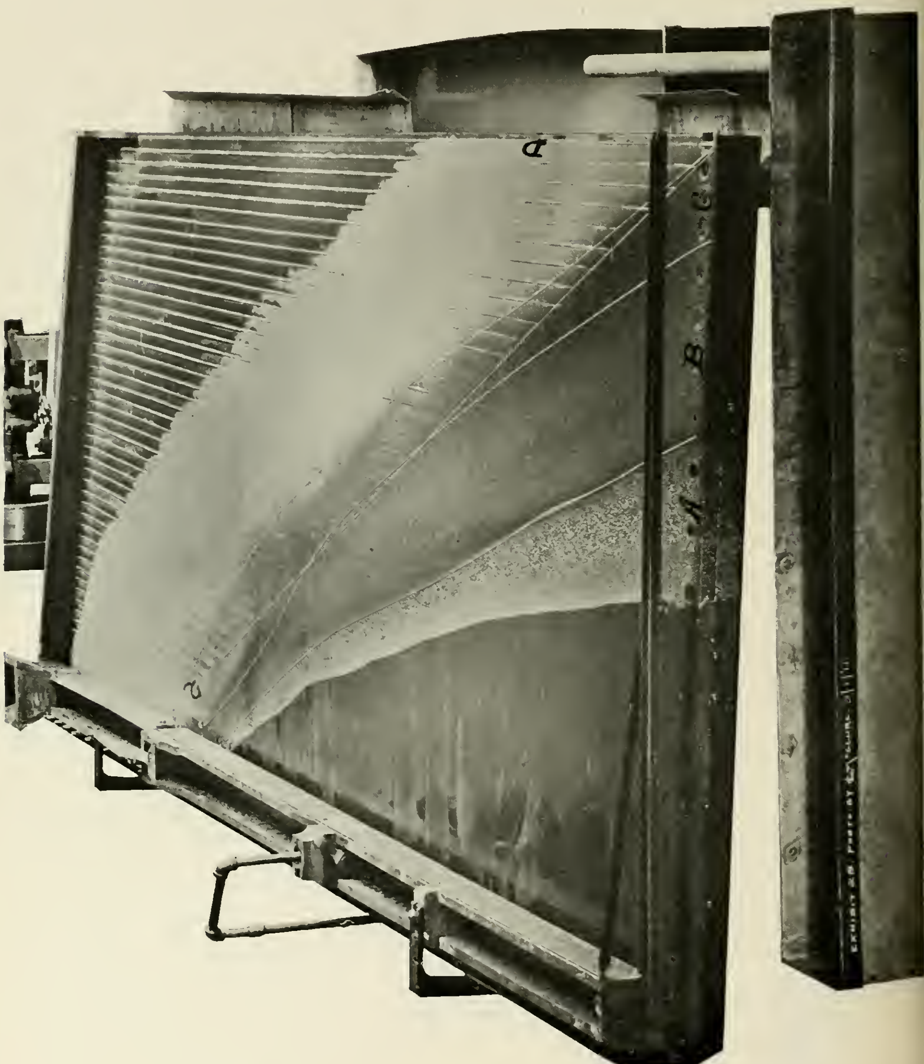
Complainant's Exhibit No. 93. Photograph No. 27, Wilfley Table With Z-Bar Riffles Terminating on a Diagonal Line, Illustrating Influence of Riffle Tips in Advance of Physical Termination.

Almon E. Hart, Special Examiner.



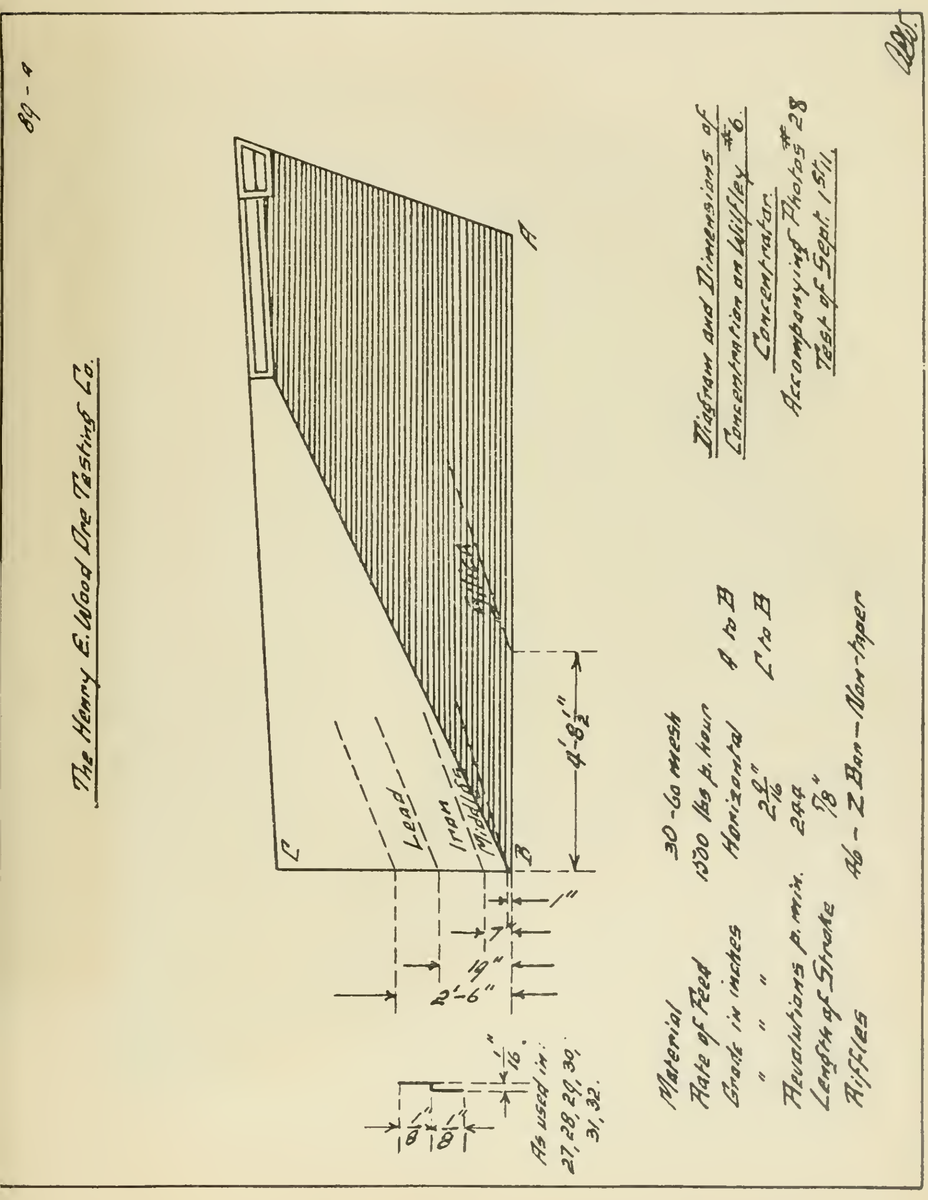
Complainant's Exhibit No. 94. Photograph No. 28, Wilfley Table With Z-Bar Riffles, Uniform Height, Feed 3/4 Ton Per Hour.

Almon E. Hart, Special Examiner.



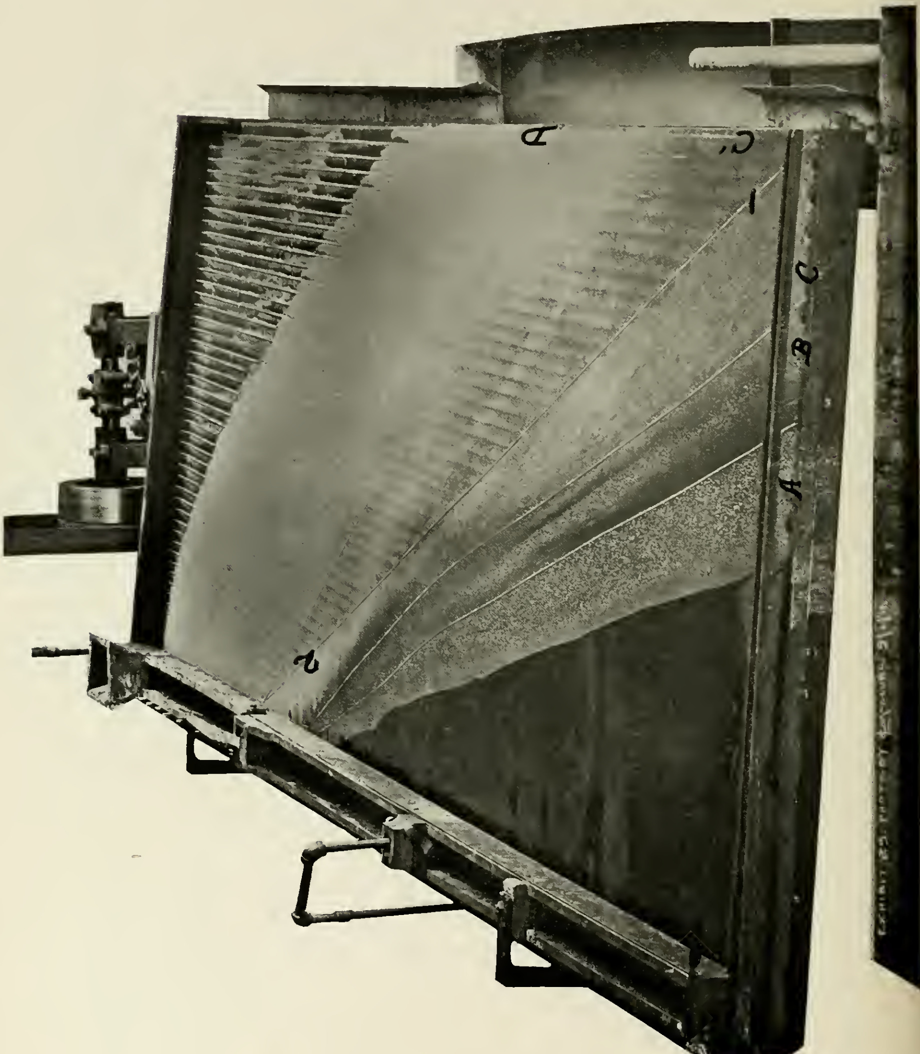
Complainant's Exhibit No. 94-A. Blue-Print Diagram of Photograph Exhibit No. 94.

Almon E. Hart, Special Examiner.



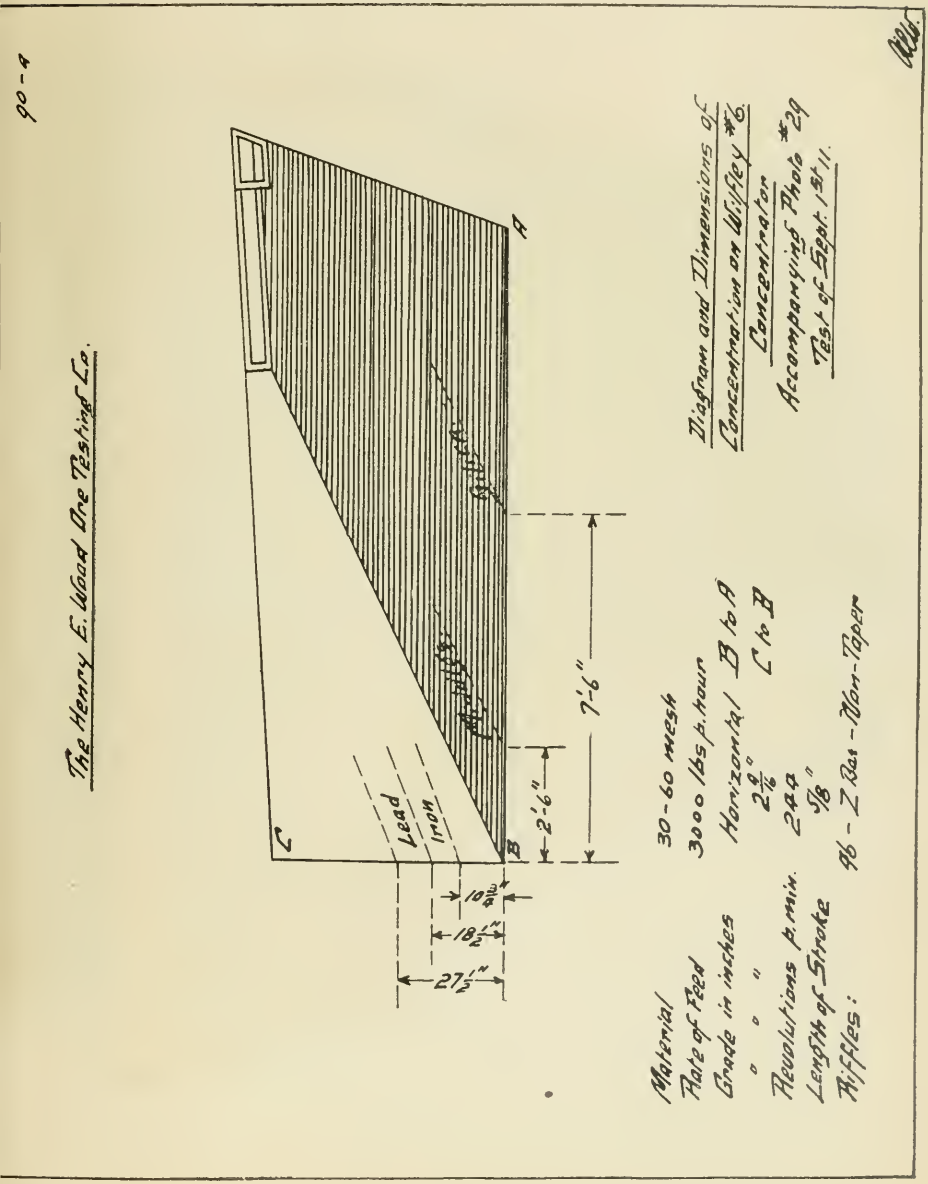
Complainant's Exhibit No. 95. Photograph No. 29, Wilfley Table With Z-Bar Riffles of Uniform Height, Feed One and One-Half Tons Per Hour.

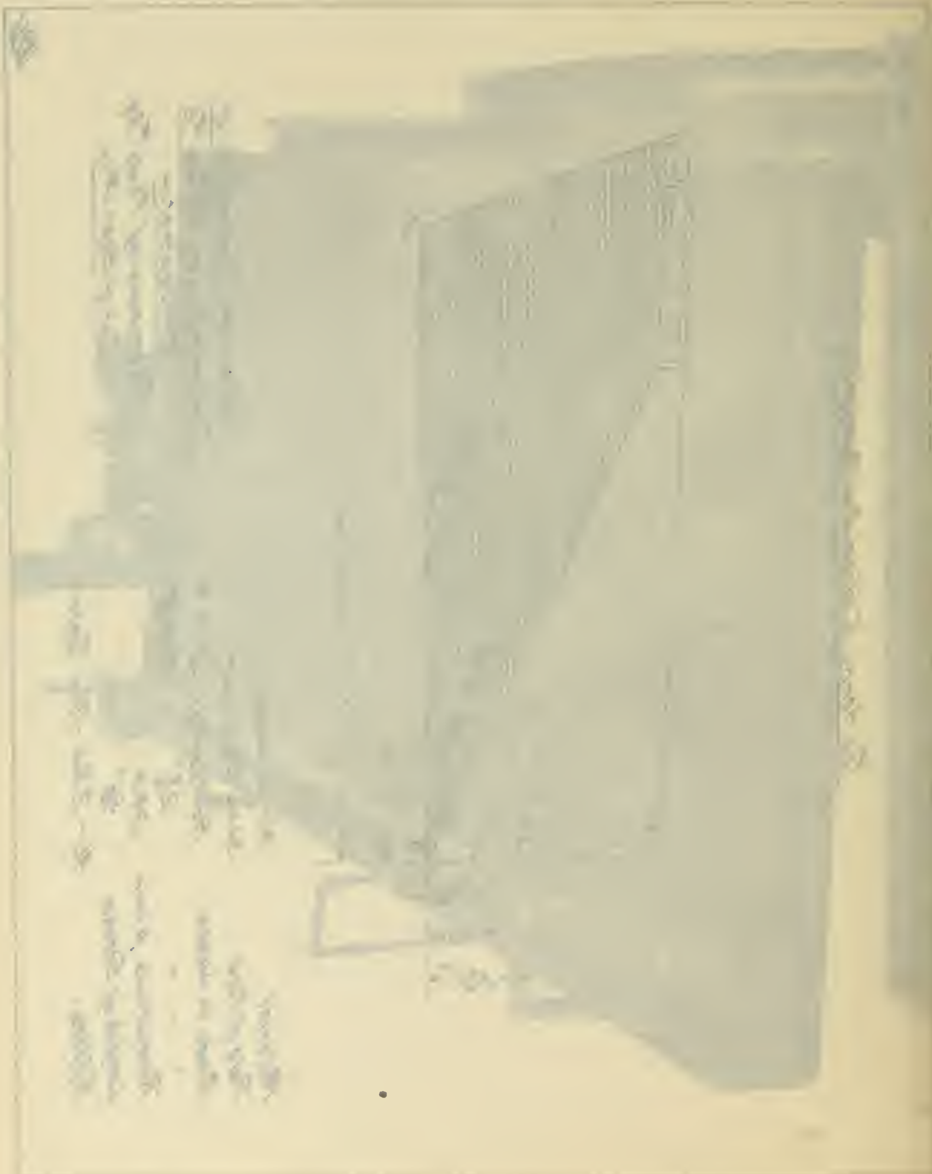
Almon E. Hart, Special Examiner.



Complainant's Exhibit No. 95-A. Blue-Print Diagram of Photograph Exhibit No. 95.

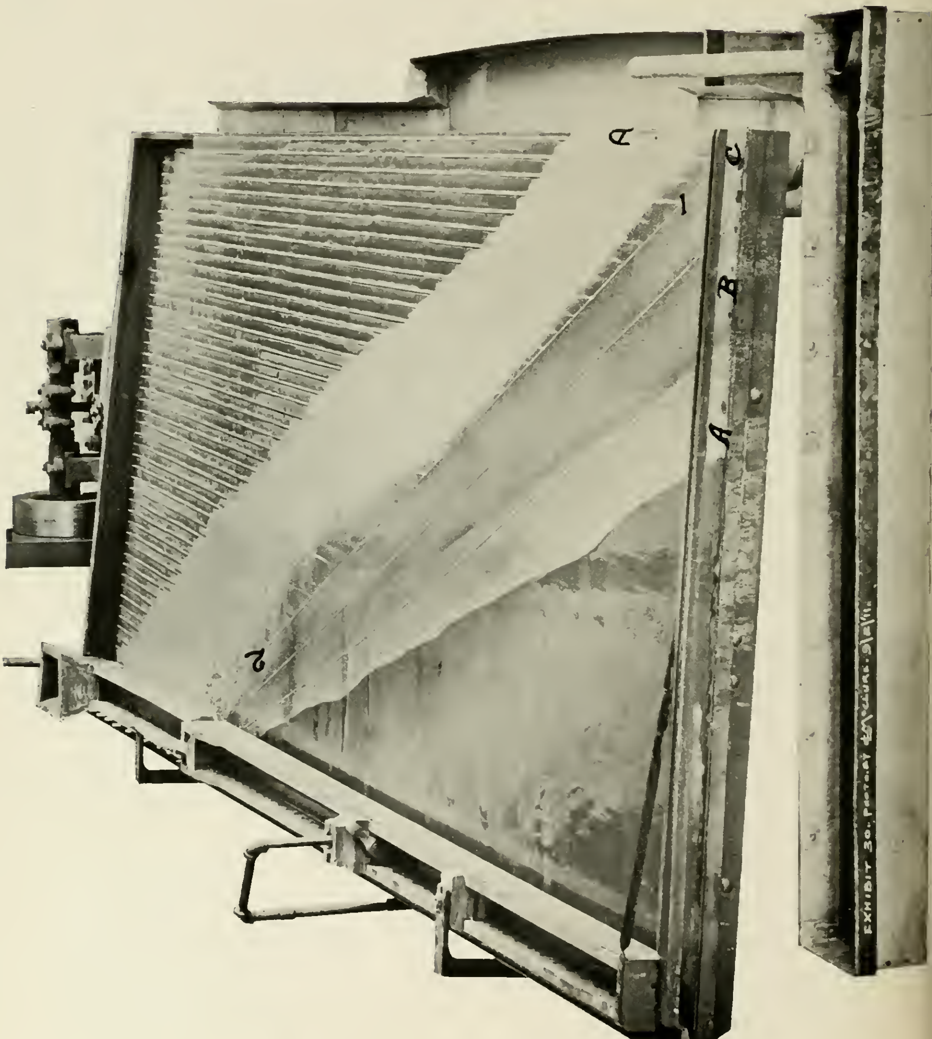
Almon E. Hart, Special Examiner.





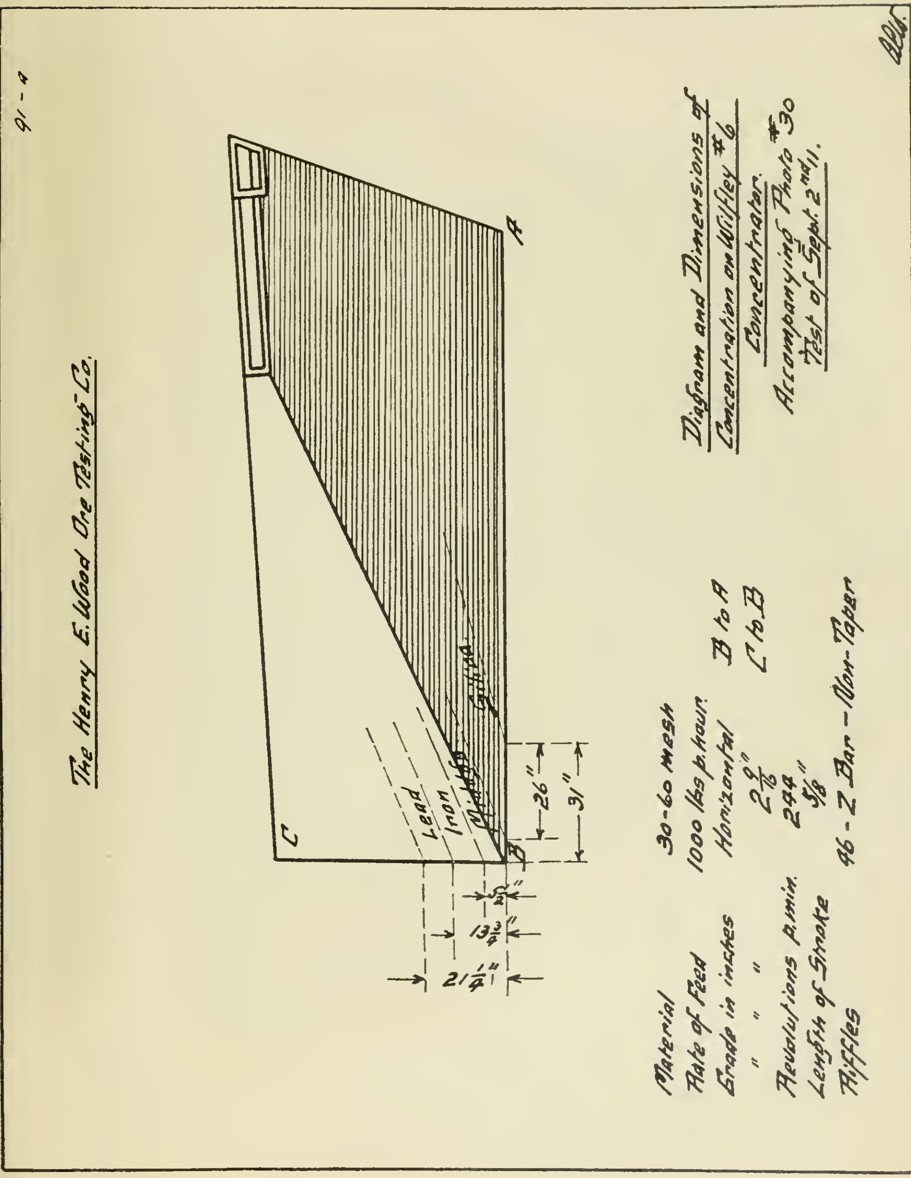
Complainant's Exhibit No. 96. Photograph No. 30, Wilfley Table With Z-Bar Riffles, Uniform Height, Feed One-Half Ton Per Hour.

Almon E. Hart, Special Examiner.



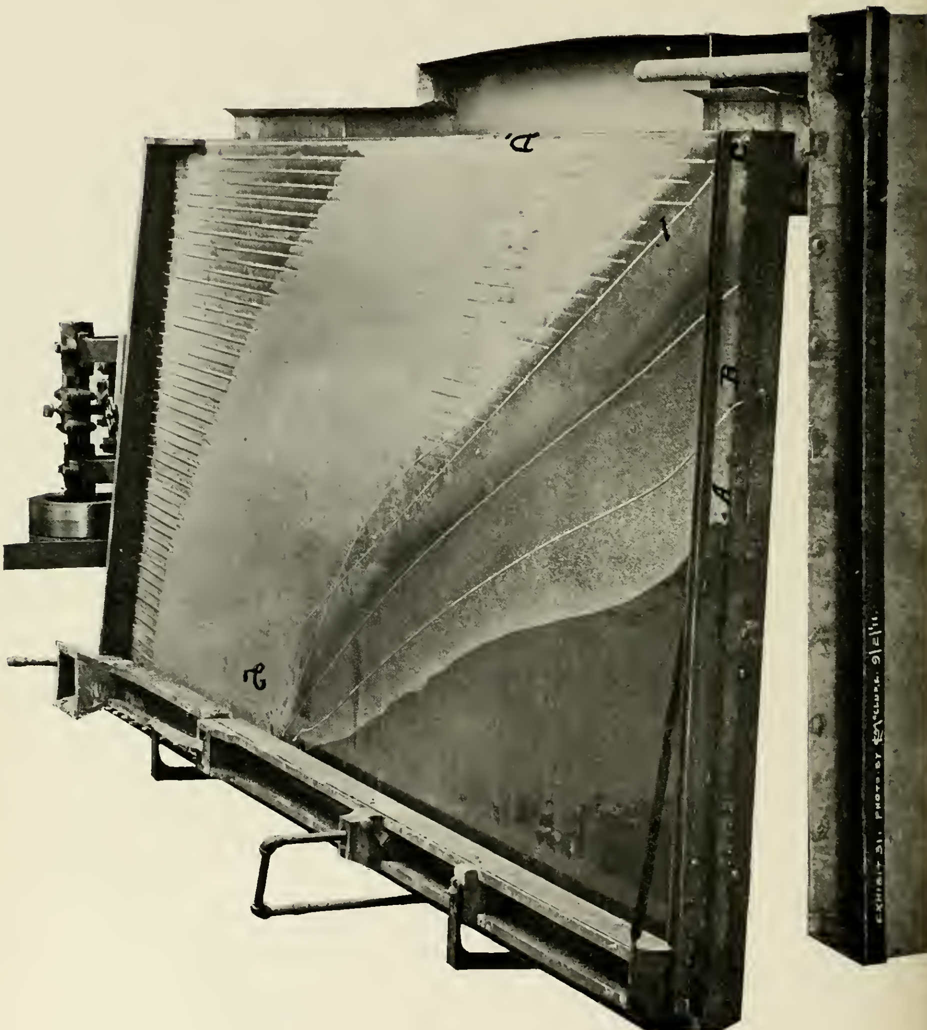
Complainant's Exhibit No. 96-A. Blue-Print Diagram of Photograph Exhibit No. 96.

Almon E. Hart, Special Examiner.



Complainant's Exhibit No. 97. Photograph No. 31, Wilfley Table With Z-Bar Riffles, Uniform Height, Feed One Ton Per Hour.

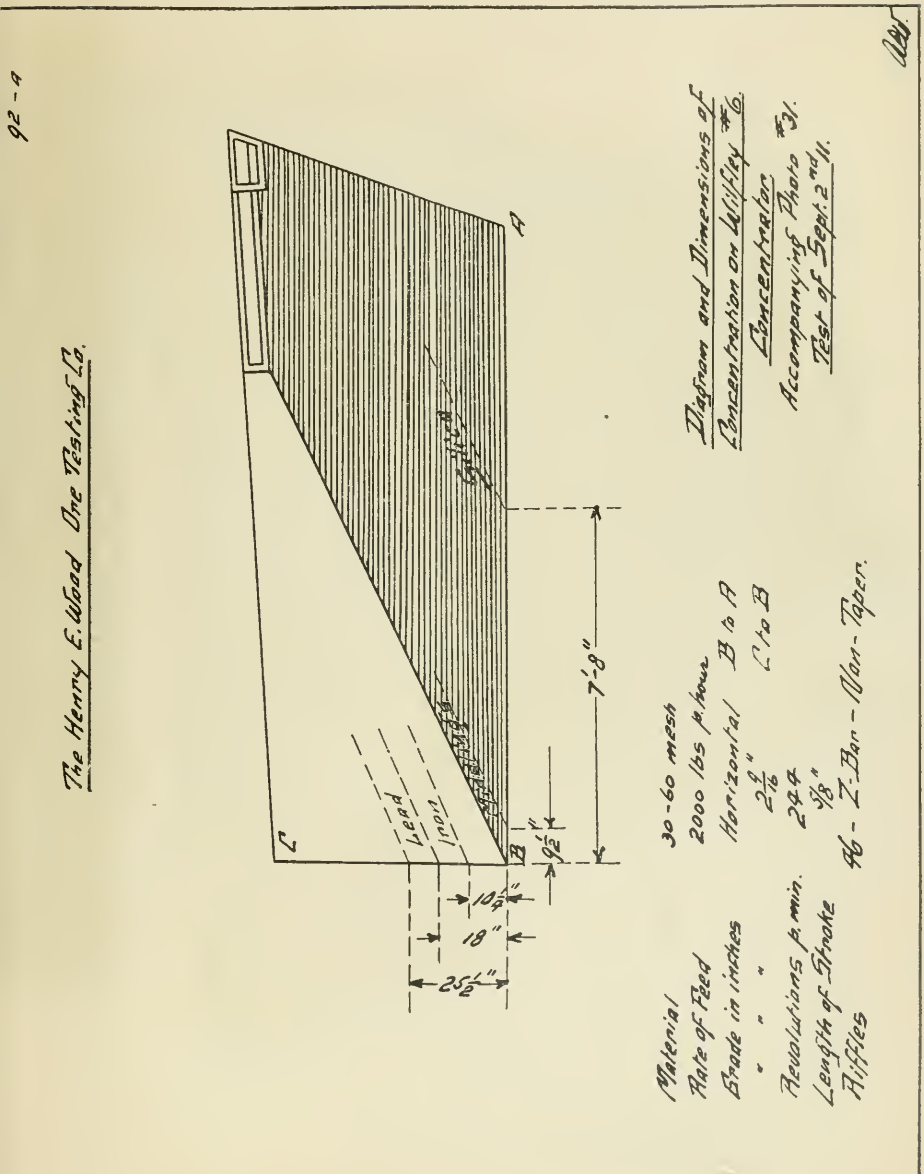
Almon E. Hart, Special Examiner.



Complainant's Exhibit No. 97-A. Blue-Print Diagram of Photograph Exhibit No. 97.

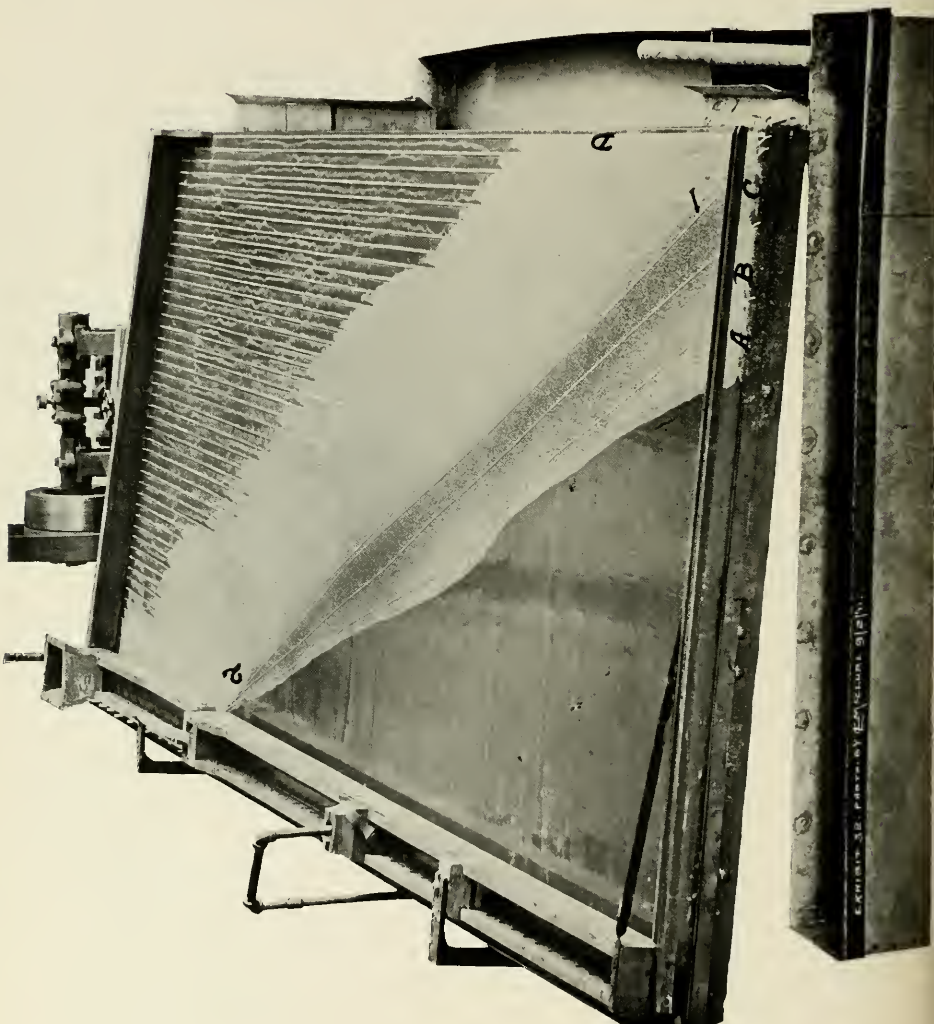
Almon E. Hart, Special Examiner.

92-A



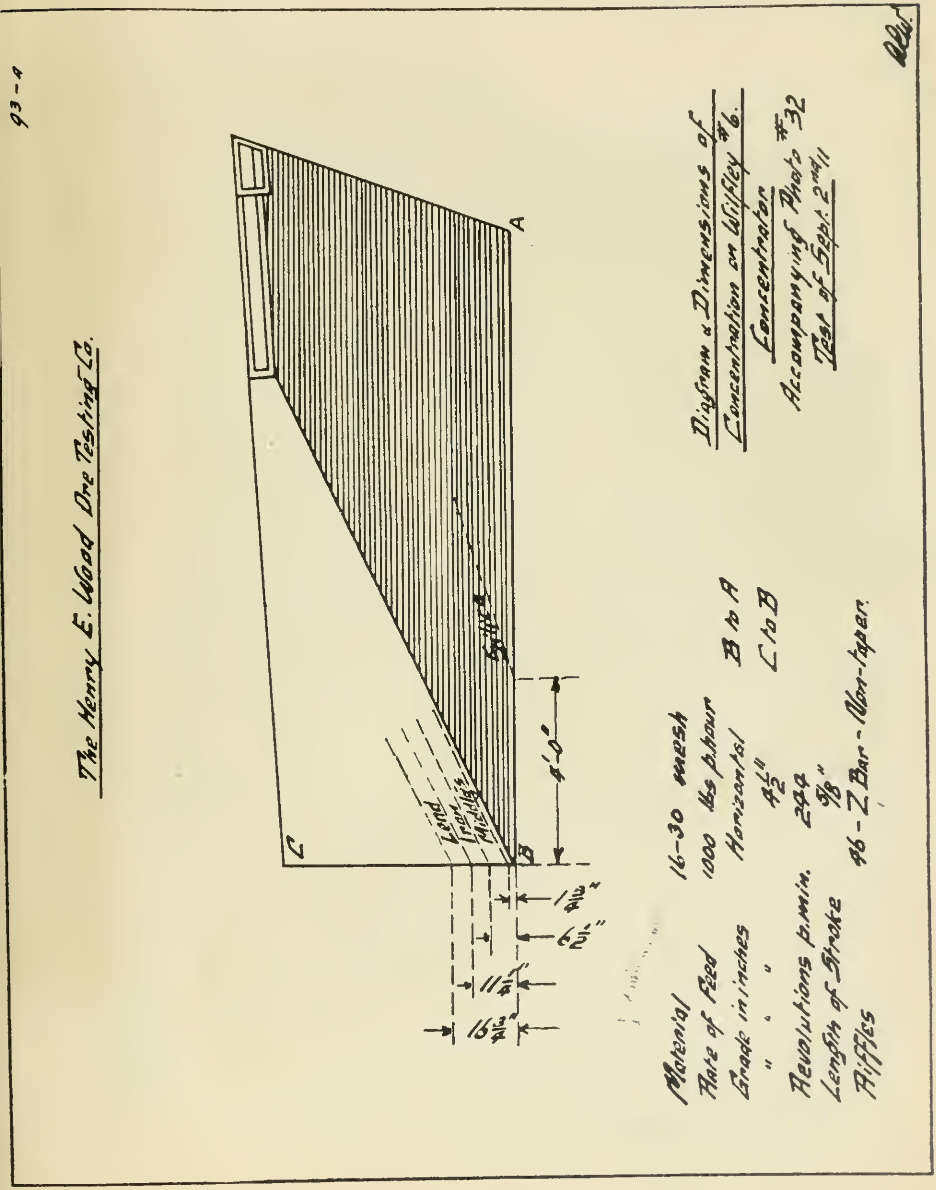
Complainant's Exhibit No. 98. Photograph No. 32, Wilfley Table With Z-Bar Riffles of Uniform Height, Increased Transverse Inclination, Feed One-Half Ton Per Hour.

Almon E. Hart, Special Examiner.



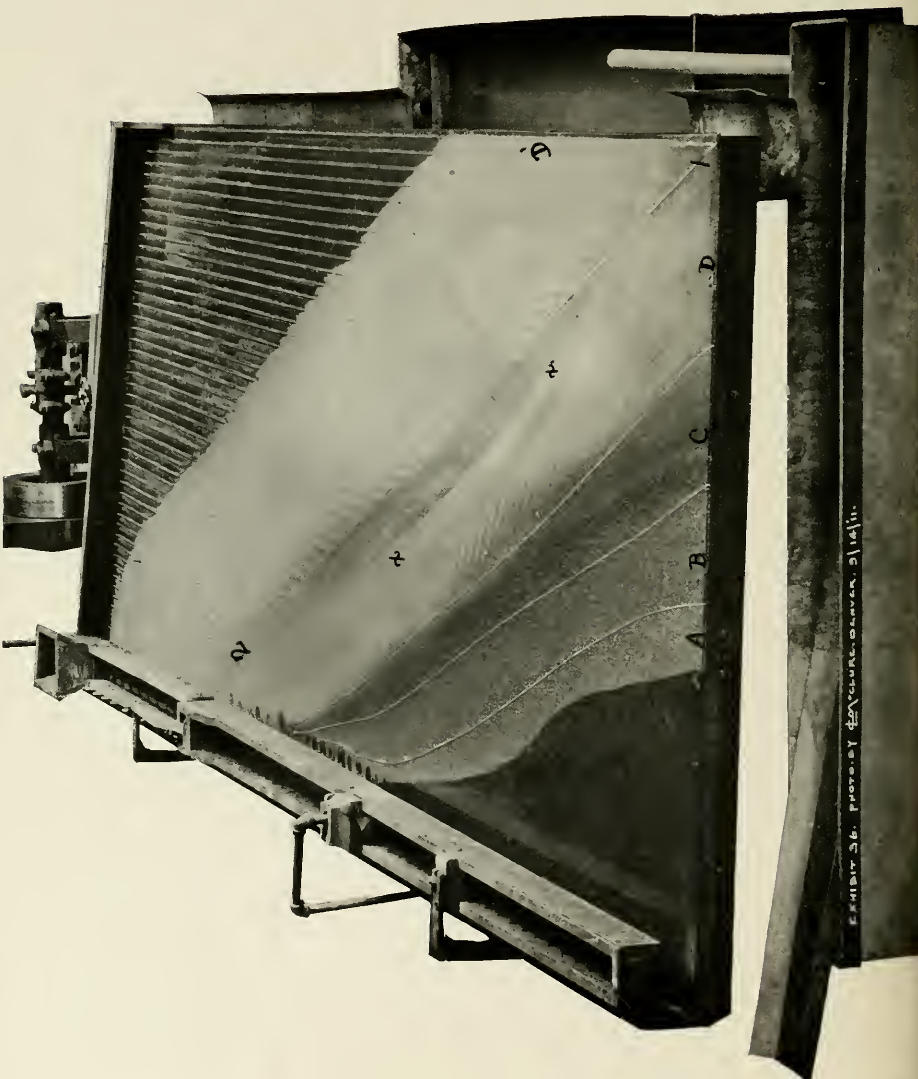
Complainant's Exhibit No. 98-A. Blue-Print Diagram of Photograph Exhibit No. 98.

Almon E. Hart, Special Examiner.



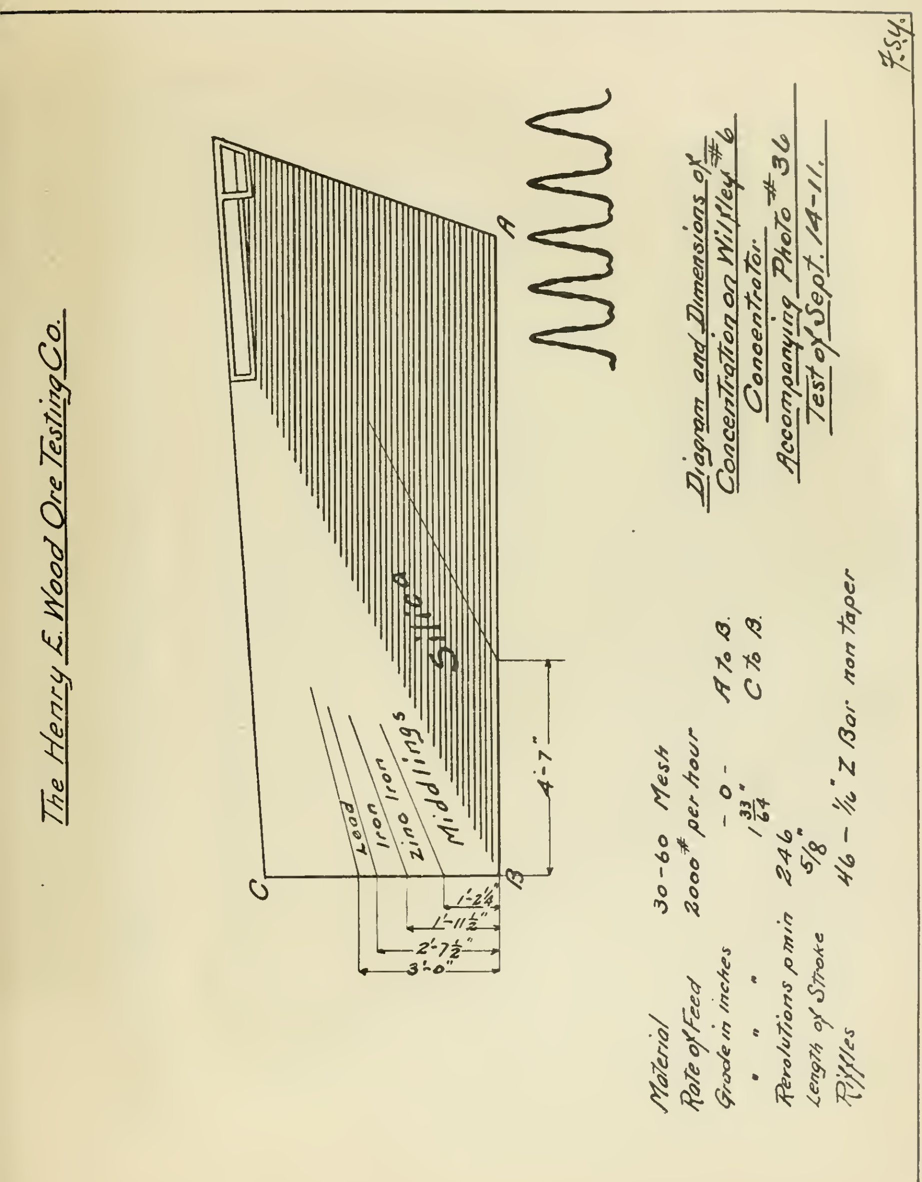
Complainant's Exhibit No. 99. Photograph No. 36, Wilfley Table With Z-Bar Riffles of Uniform Height, 1/16 Inch High, Terminating on a Diagonal Line.

Almon E. Hart, Special Examiner.



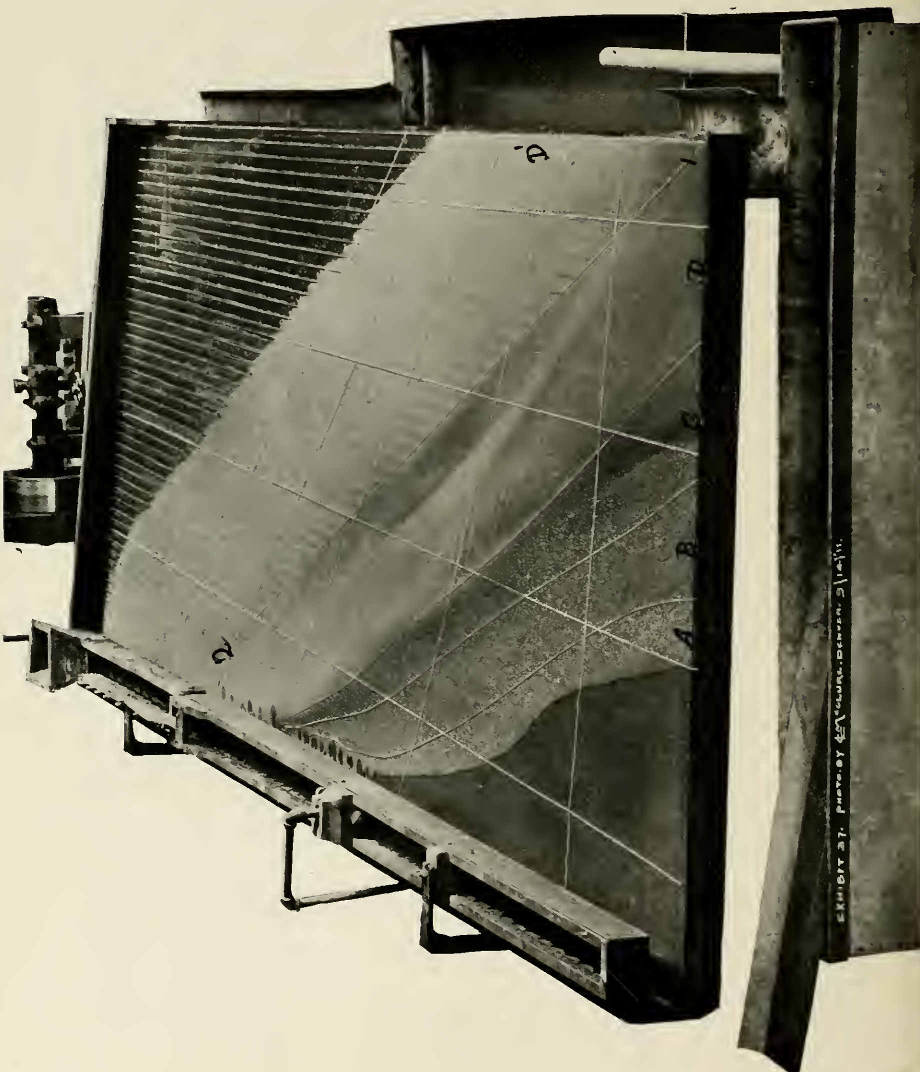
Complainant's Exhibit No. 99-A. Blue-Print Diagram of Photograph Exhibit No. 99.

Almon E. Hart, Special Examiner.



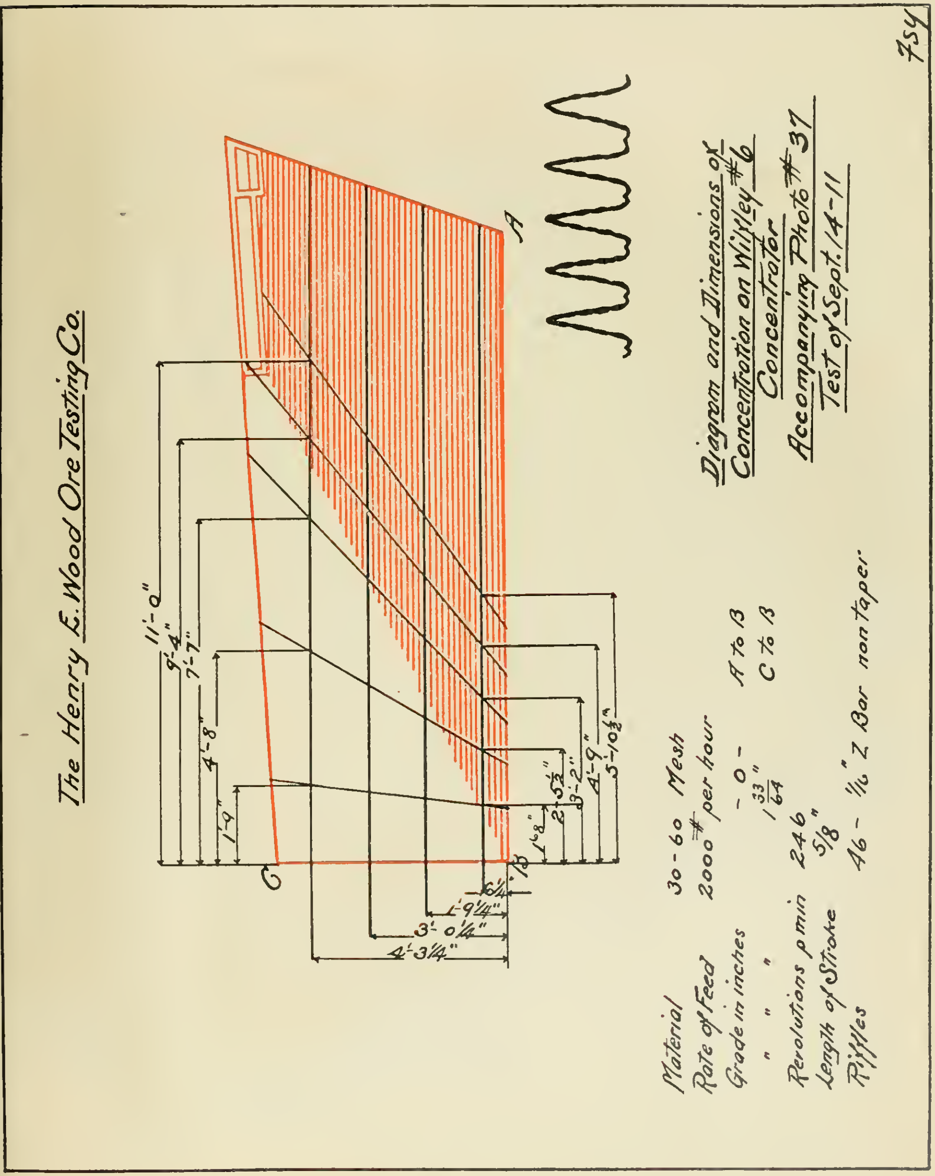
Complainant's Exhibit No. 100. Photograph No. 37, Wilfley Table with Z-Bar Riffles of Uniform Height, 1/16 Inch High, Terminating on a Diagonal Line, with Certain Lines Placed Upon the Surface.

Almon E. Hart, Special Examiner.



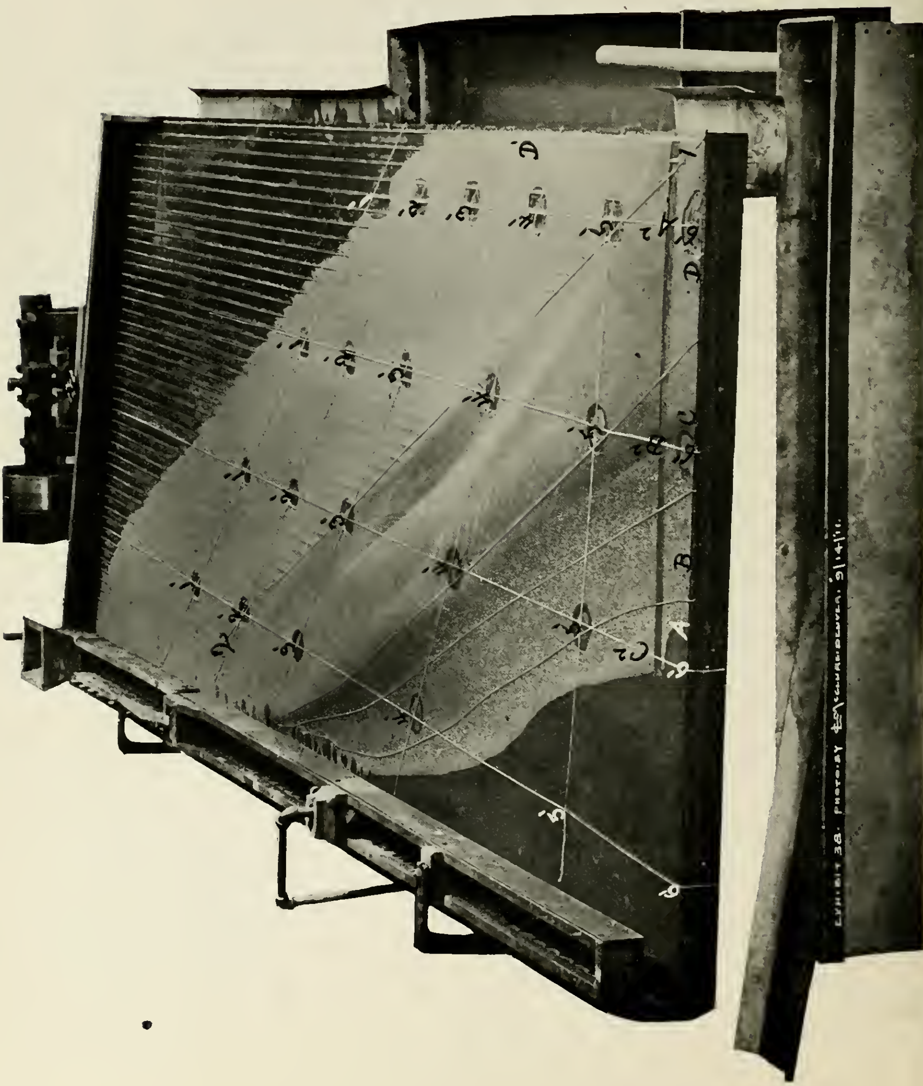
Complainant's Exhibit No. 100-A. Blue-Print Diagram of Photograph Exhibit No. 100.

Almon E. Hart, Special Examiner.



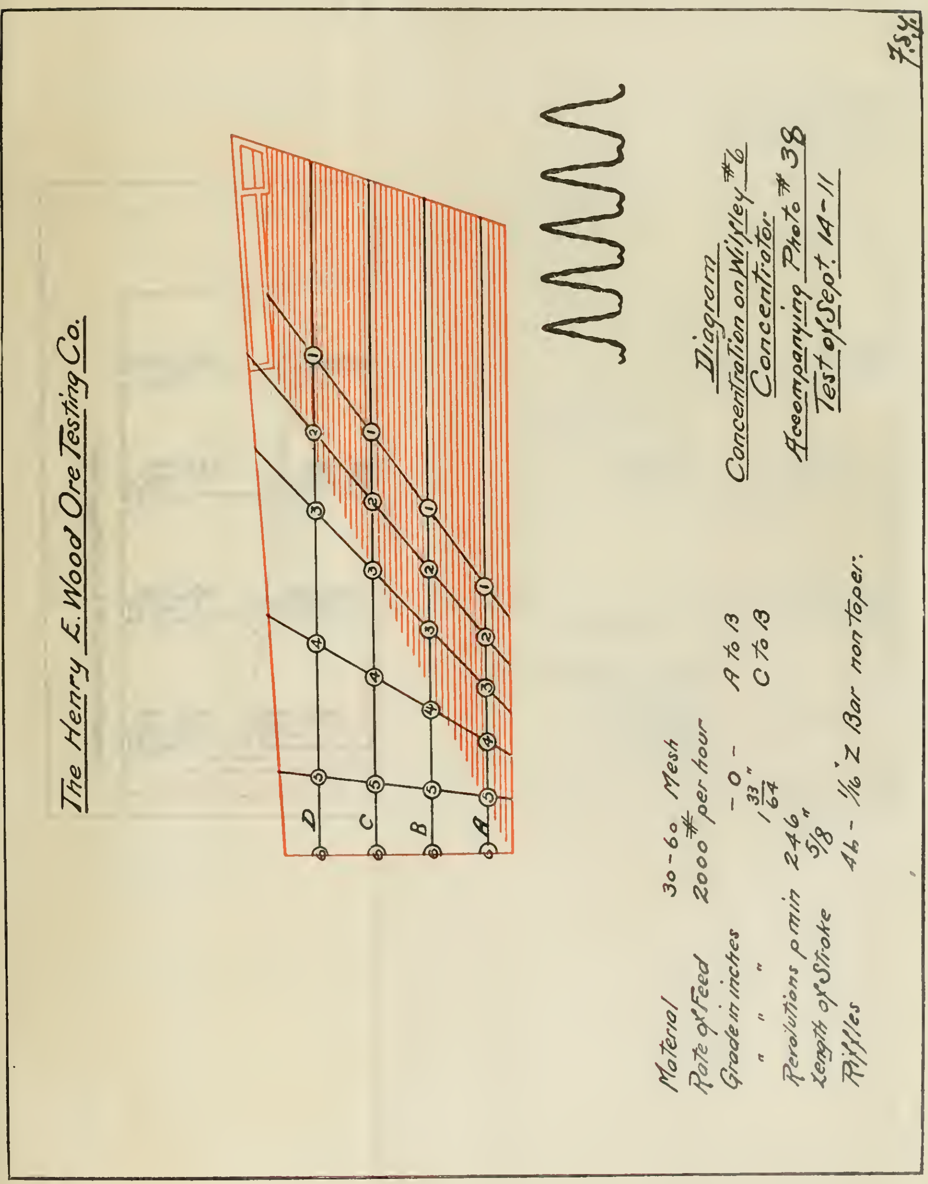
Complainant's Exhibit No. 101. Photograph No. 38, Wilfley Table with Z-Bar Riffles of Uniform Height, 1/16 Inch High, Terminating on a Diagonal Line with Certain Lines Placed Upon the Surface Showing Location from Which Materials Were Taken from the Table Surface.

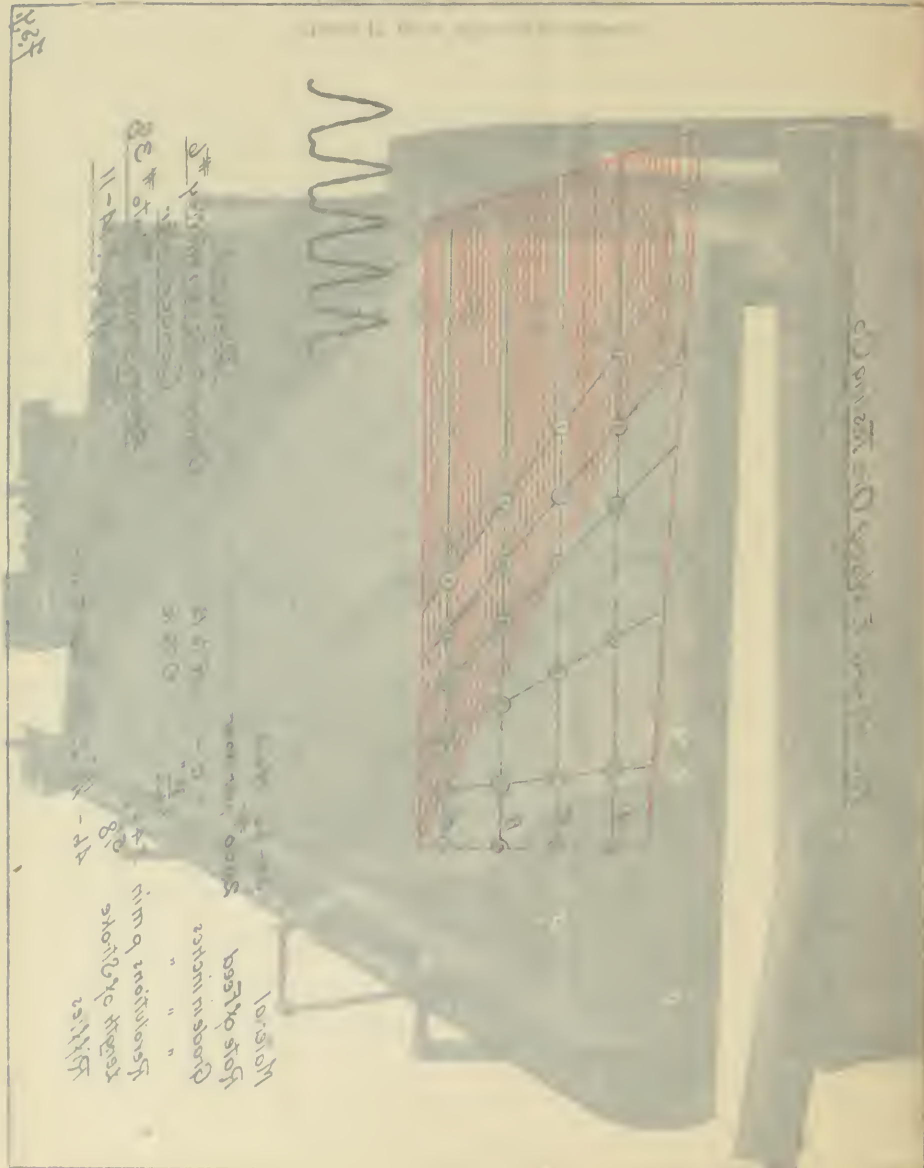
Almon E. Hart, Special Examiner.



Complainant's Exhibit No. 101-A. Blue-Print Diagram of Photograph Exhibit No. 101.

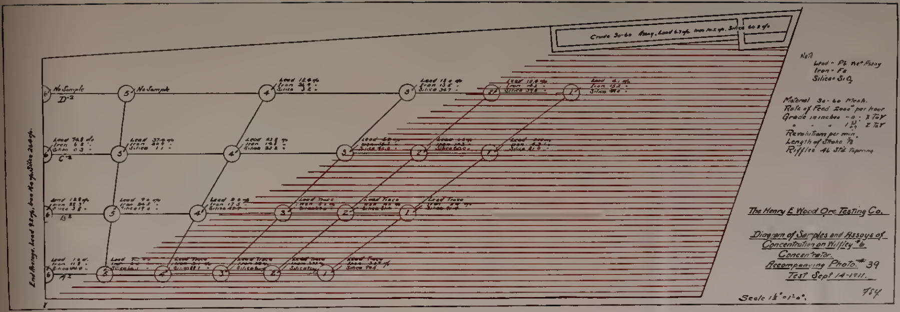
Almon E. Hart, Special Examiner.





Complainant's Exhibit No. 102. Scobey Chart.

Almon E. Hart, Special Examiner.



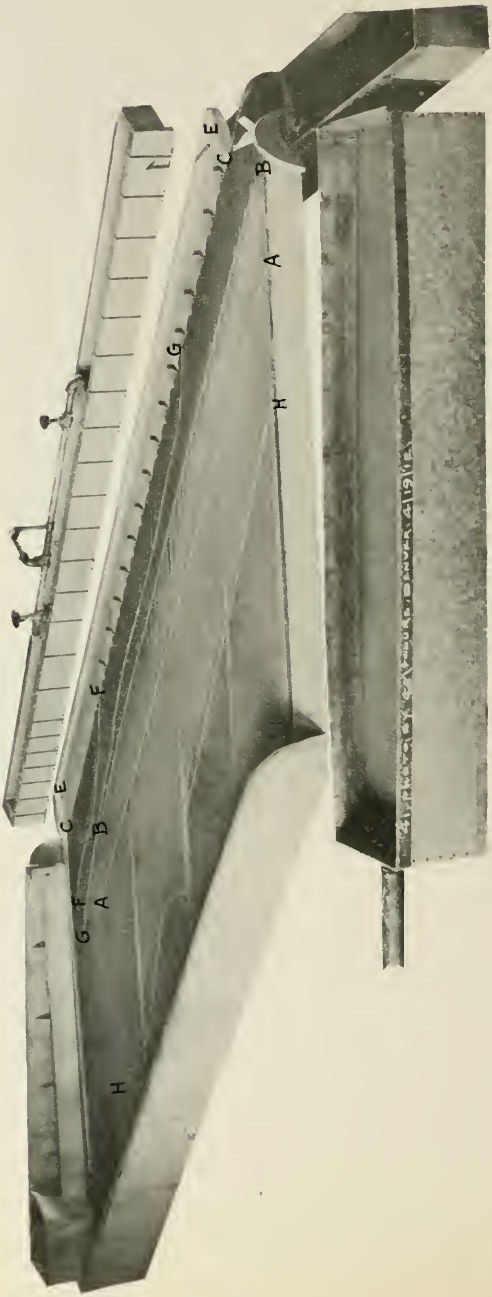
Complainant's Exhibit No. 103. Assays of Samples Taken as Shown in Photograph Complainant's Exhibit No. 101 and Complainant's Exhibit No. 102, Scobey Chart.

Almon E. Hart, Special Examiner.

No.	MARKED	GOLD, Ozs.	SILVER, Ozs.	LEAD, Per Cent. Wet	(Wet) Copper, Per Cent.	ZINC, Per Cent.	IRON, Per Cent.	SILICA, Per Cent.	Per Cent.	VALUE
Crude - 30-60 mesh--				6.30			10.20	80.20		
	A^2 - 1..........			Trace			3.05	90.80		
	A^2 - 2........ .			Trace			2.55	92.00		
	A^2 - 3........			Trace			2.90	90.00		
	A^2 - 4..... ...			Trace			3.10	88.10		
	A^2 - 5........			1.00			5.80	66.10		
	A^2 - 8...... ...			1.60			11.80	44.40		
	B^2 - 1..			Trace			2.90	91.40		
	B^2 - 2...			Trace			4.00	81.20		
	B^2 - 3..........			Trace			8.00	67.80		
	B^2 - 4...			2.00			17.50	42.70		
	B^2 - 5....			9.00			24.50	19.00		
	B^2 - 6... ..			16.80			22.30	3.80		
	C^2 - 1.... ...			0.10			4.30	81.00		
	C^2 - 2.. . ..			0.30			10.20	60.00		
	C^2 - 3.. ...			5.20			18.20	40.00		
	C^2 - 4... ..			23.80			14.80	23.20		
	C^2 - 5...			37.40			20.90	1.10		
	C^2 - 6...			74.80			6.20	0.30		
	D^2 - 1..........			4.10			15.20	49.00		
	D^2 - 2..........			10.40			14.20	39.60		
	D^2 - 3..........			18.00			13.50	34.70		
	D^2 - 4..........			18.40			26.90	3.20		
End Average..........				9.20			18.00	26.40		

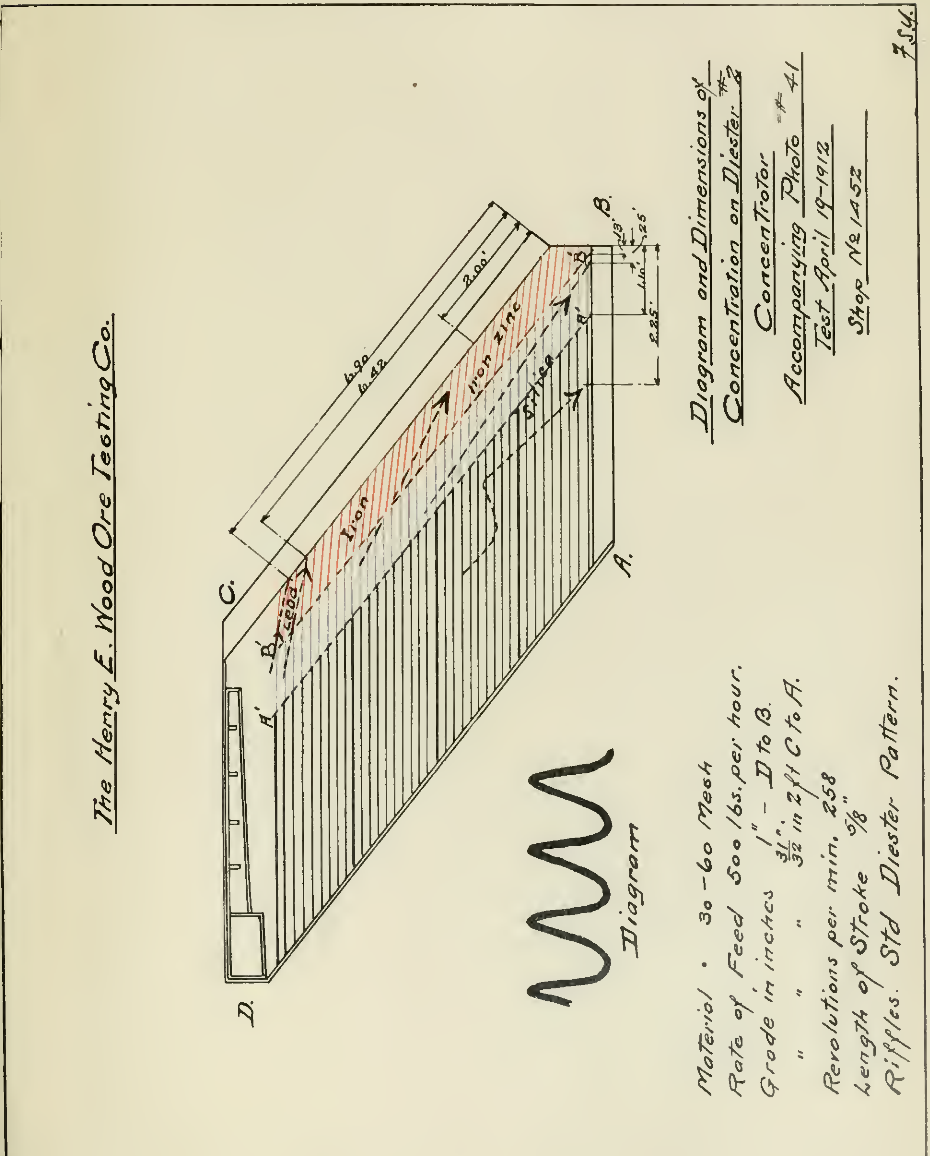
Complainant's Exhibit No. 104. Photograph No. 41, Deister Table No. 1452.

Almon E. Hart, Special Examiner.



Complainant's Exhibit No. 104-A. Diagram of Photograph Exhibit No. 104.

Almon E. Hart, Special Examiner.



Complainant's Exhibit No. 104-A. Diagram of Photograph Exhibit No. 104.

Alton E. Hart, Special Examiner.

The Henry E. Wood Ore Testing Co.

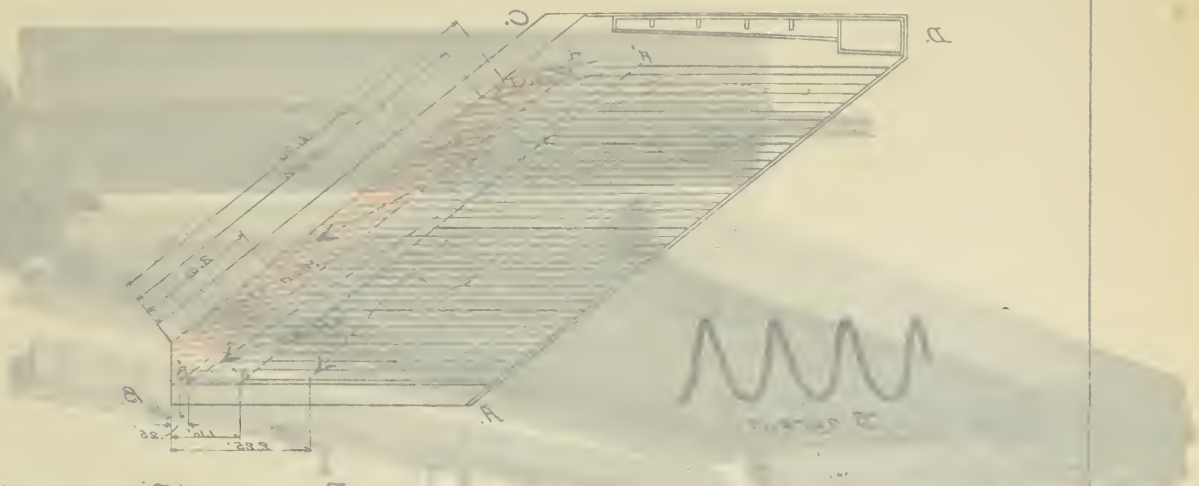
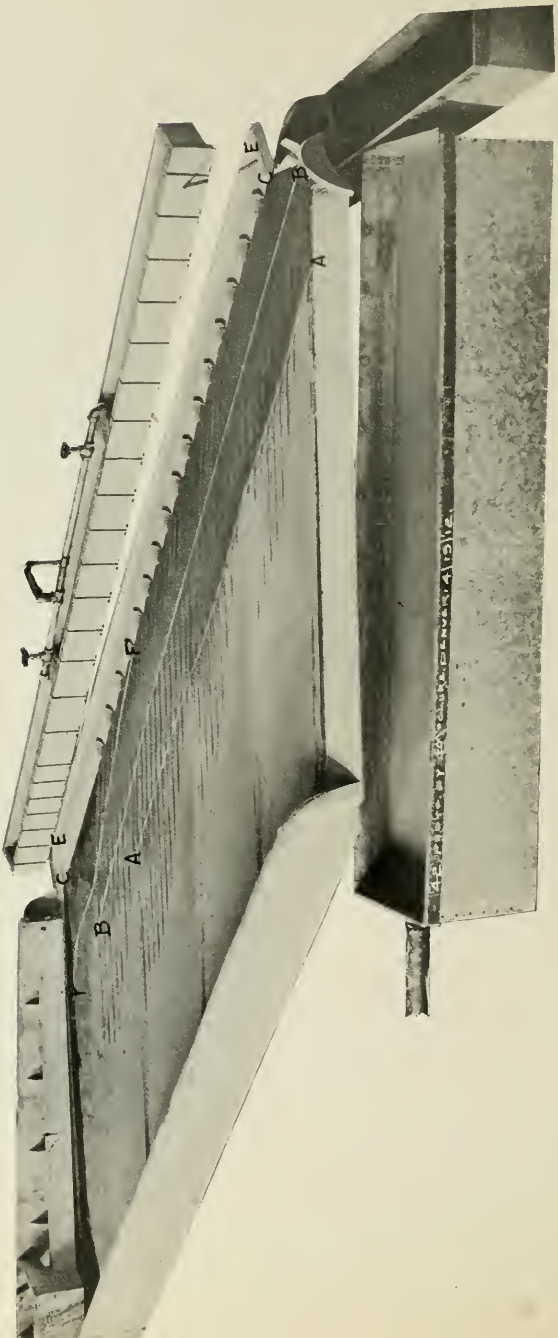


Diagram and Dimensions of Concentration on Diester #2 Concentrator.
Accompanying Photo #41
Test April 19-1912
Stop No 1452

Material · 30-60 Mesh
Rate of Feed 500 lbs. per hour.
Grade in inches 1" — D to B.
" " $\frac{31}{32}$" in 24' C to A.
Revolutions per min. 258
Length of Stroke 5/8"
Riffles Std Diester Pattern.

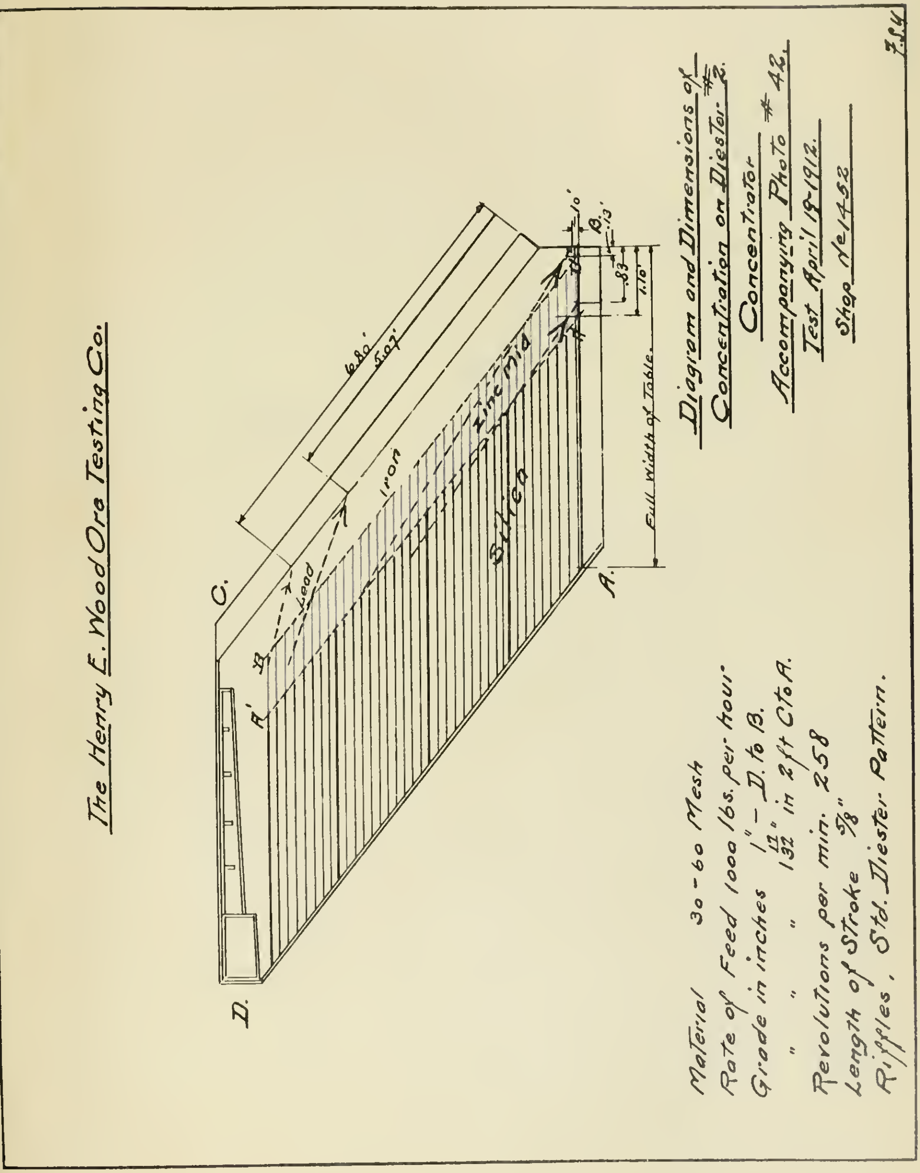
754

Complainant's Exhibit No. 105. Photograph No. 42, Deister Table,
Increased Inclination from C to A.
Almon E. Hart, Special Examiner.



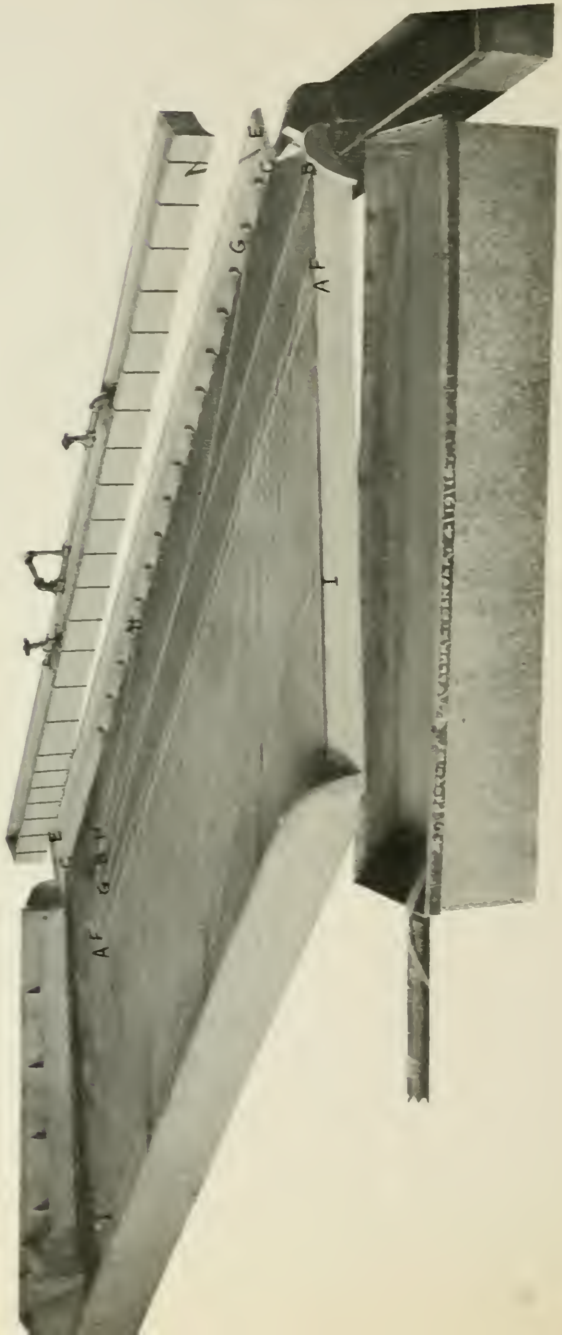
Complainant's Exhibit No. 105-A. Diagram of Photograph Exhibit No. 105.

Almon E. Hart, Special Examiner.



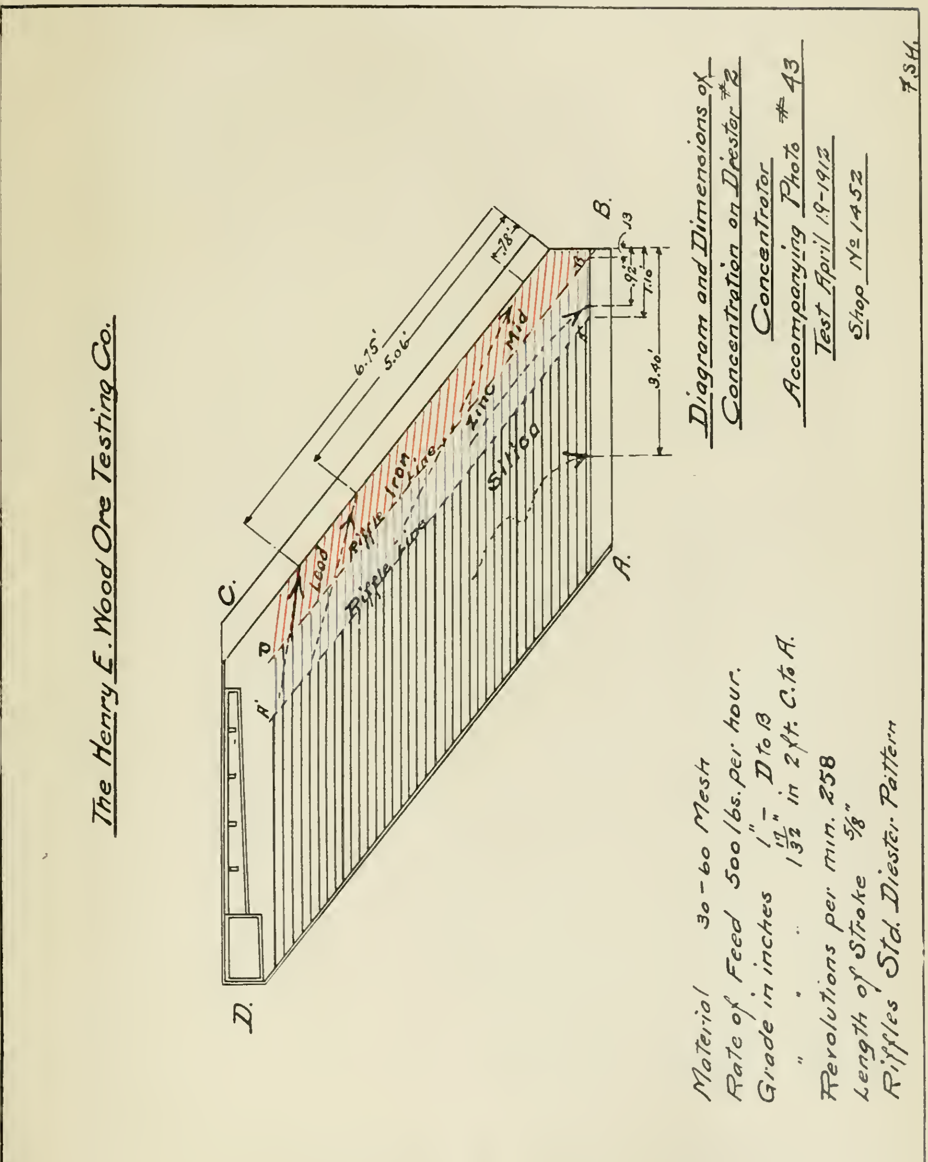
Complainant's Exhibit No. 106. Photograph No. 43. Deister No. 2. Sand Table.

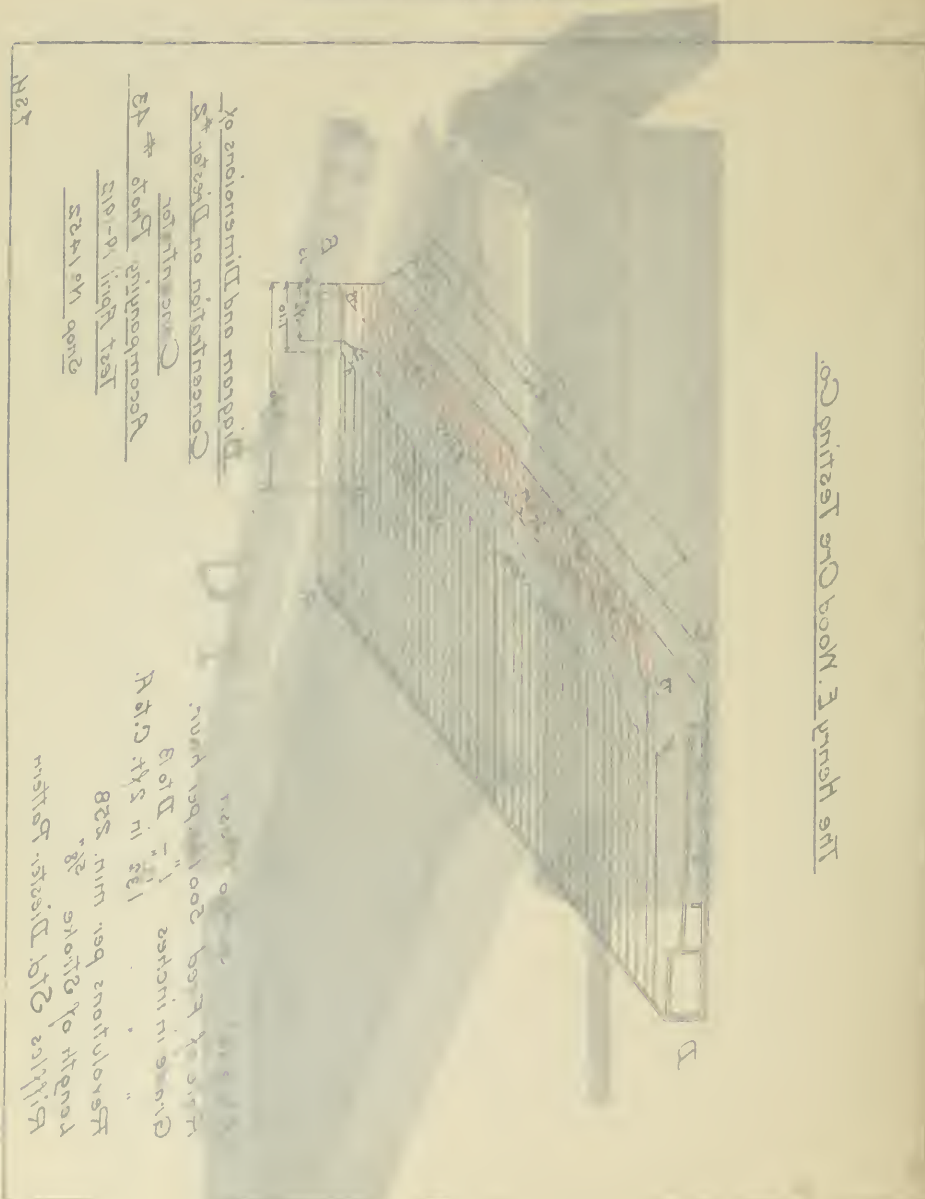
Almon E. Hart, Special Examiner.



Complainant's Exhibit No. 106-A. Diagram of Photograph Exhibit No. 106.

Almon E. Hart, Special Examiner.

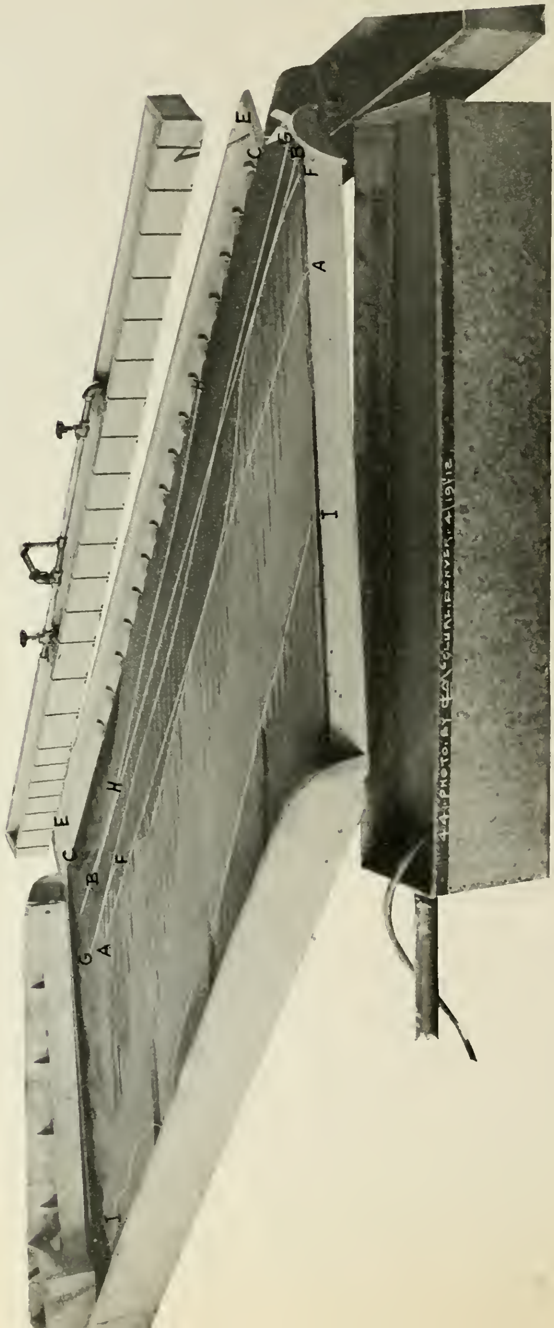




The Henry E. Wood Ore Testing Co.
Diagram and Dimensions of
Concentration on Deister #2
Concentrator
Accompanying Photo #43
Test April 19-1912
Shop No 1452
Rate of Feed 500 lbs. per hour.
Revolutions per min. 258
Length of Stroke 5/8"
Riffles Std. Deister Pattern
734

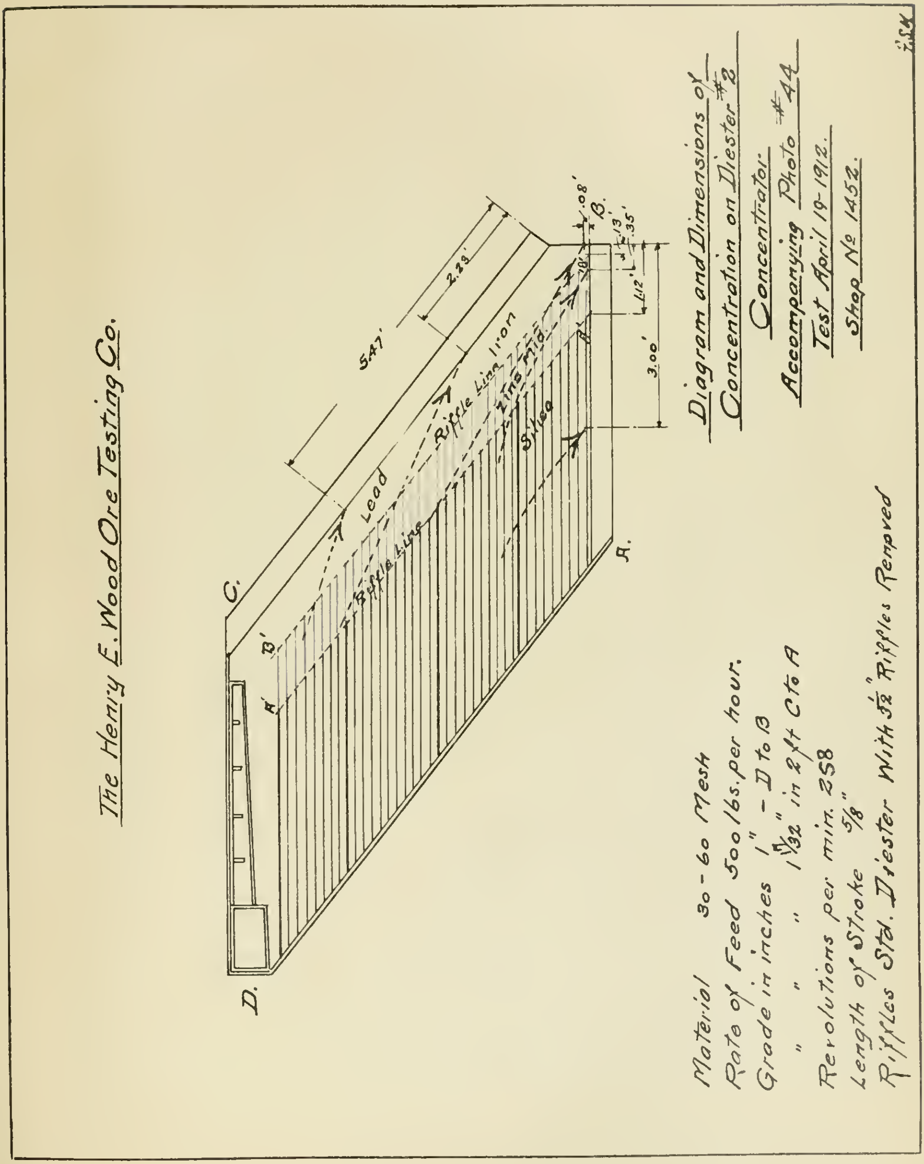
Complainant's Exhibit No. 107. Photograph No. 44, Deister Sand Table No. 2.

Almon E. Hart, Special Examiner.



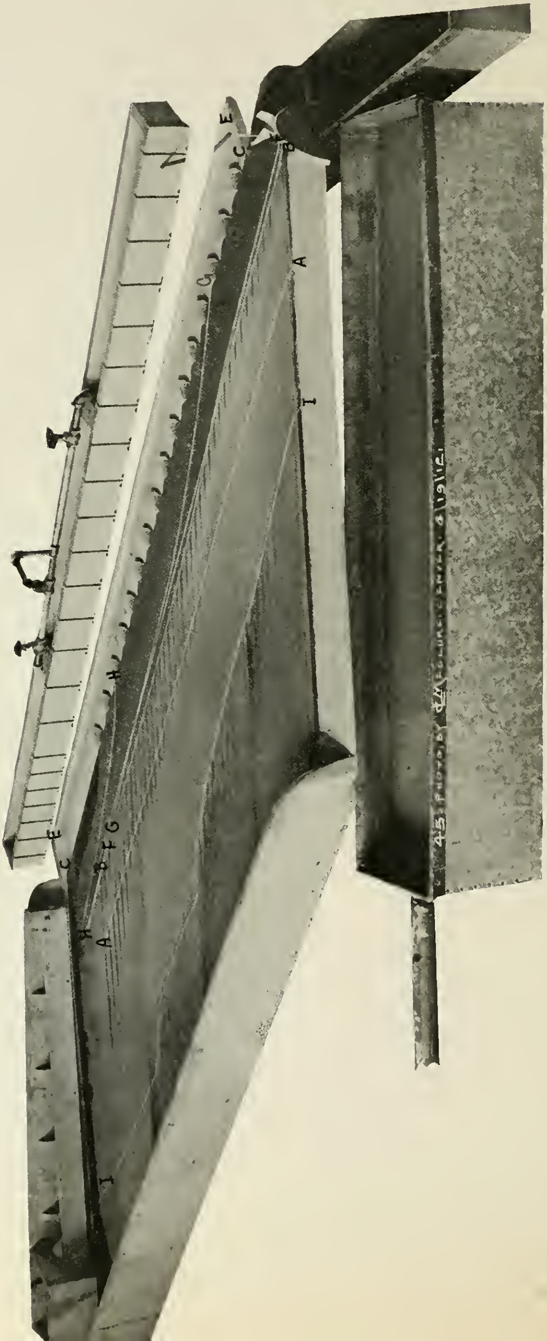
Complainant's Exhibit No. 107-A. Diagram of Photograph Exhibit No. 107.

Almon E. Hart, Special Examiner.



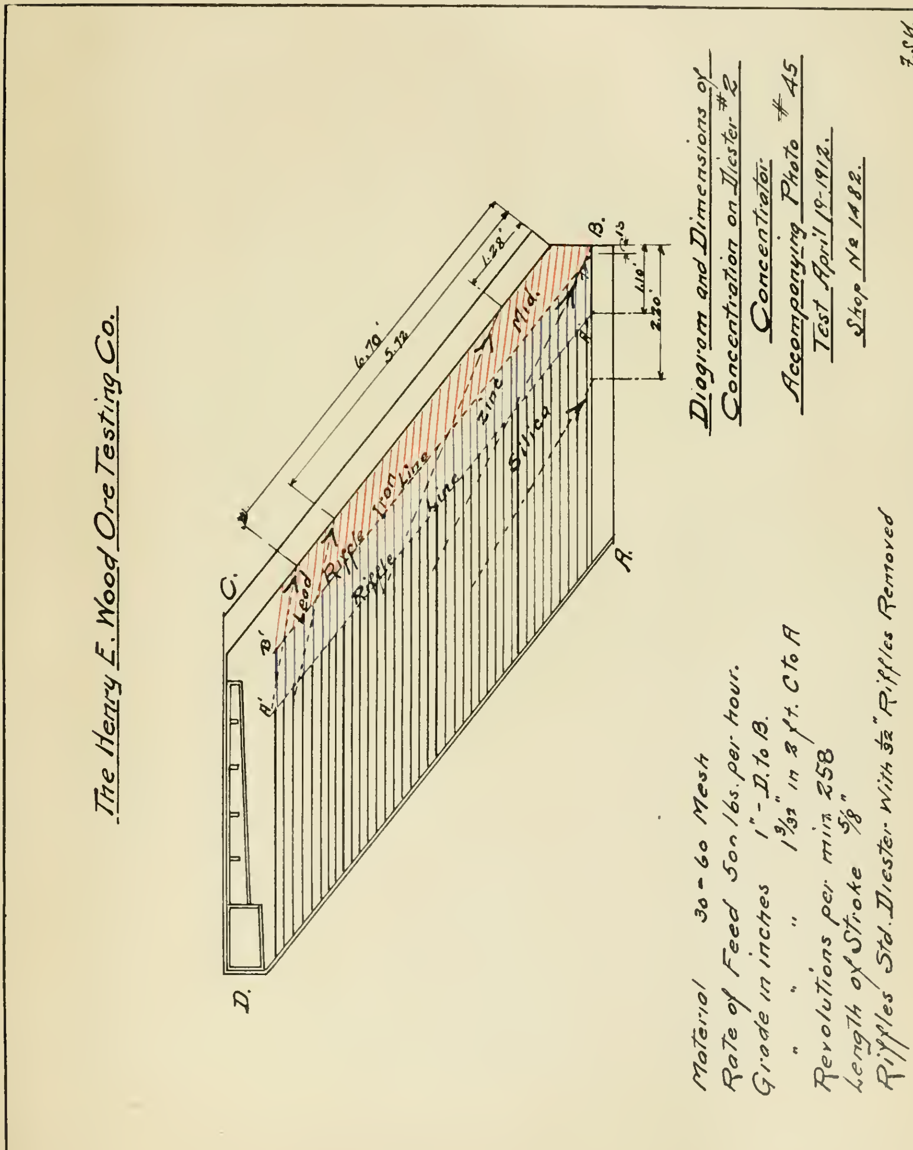
Complainant's Exhibit No. 108. Photograph No. 45, Deister Table, Inclination from C to D, Decreased.

Almon E. Hart, Special Examiner.



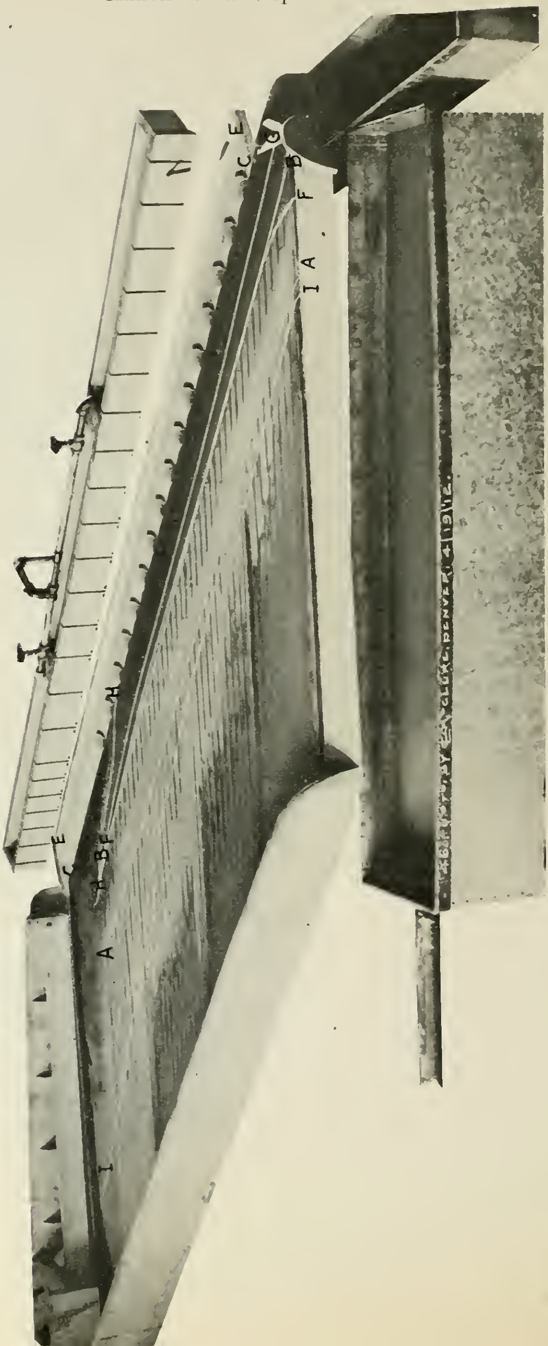
Complainant's Exhibit No. 108-A. Diagram of Photograph Exhibit No. 108.

Almon E. Hart, Special Examiner.



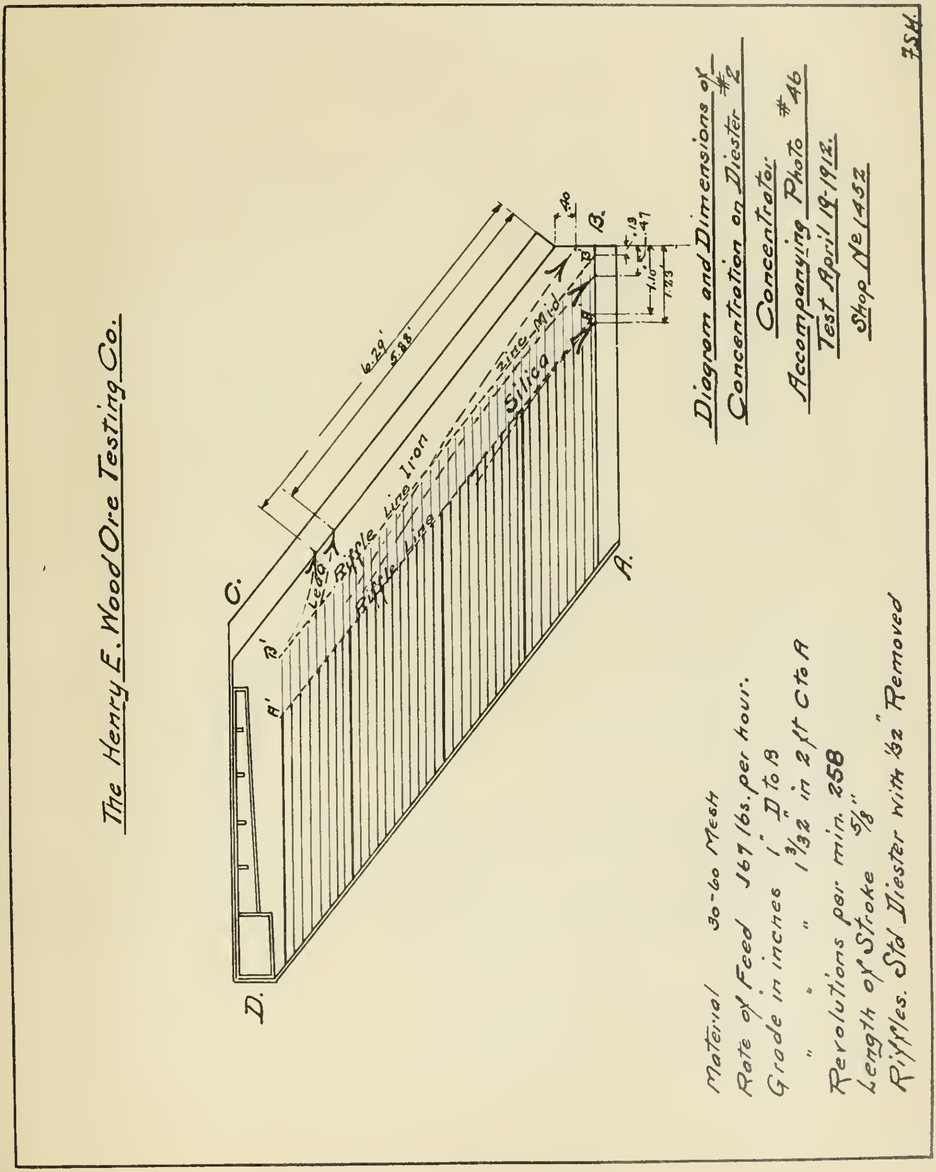
Complainant's Exhibit No. 109. Photograph No. 46, No. 2 Deister Sand Table.

Almon E. Hart, Special Examiner.



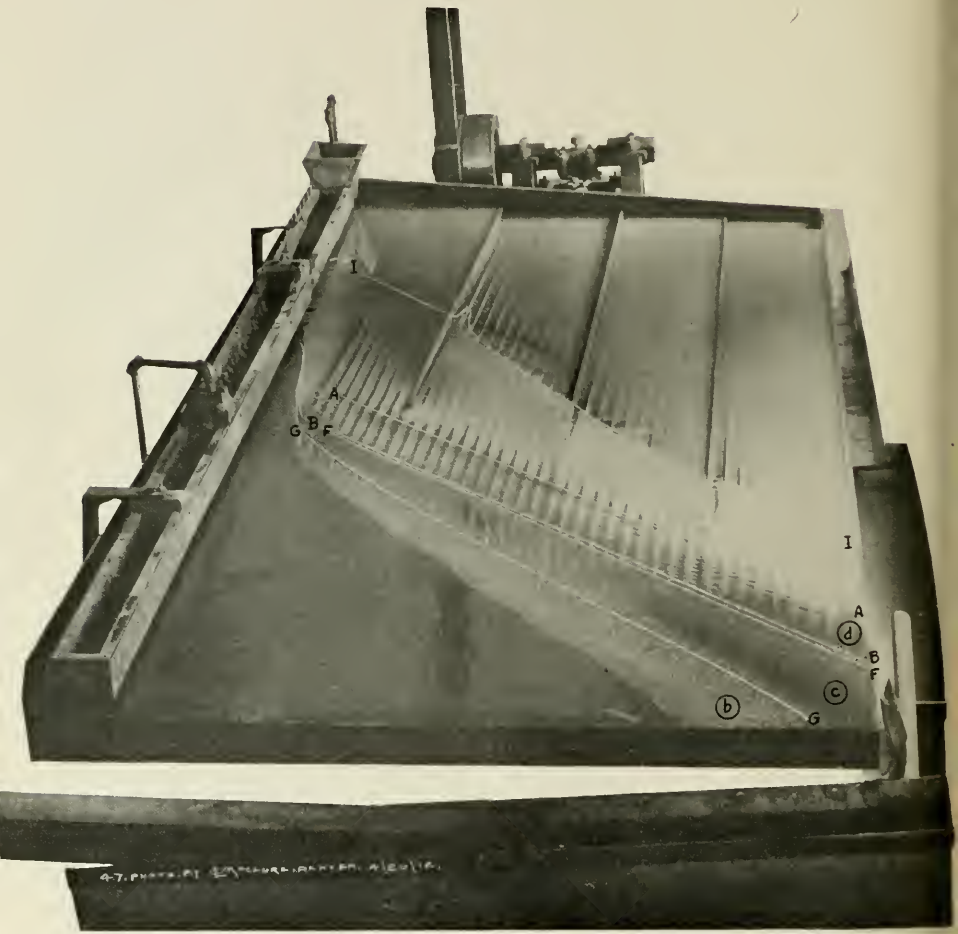
Complainant's Exhibit No. 109-A. Diagram of Photograph Exhibit No. 109.

Almon E. Hart, Special Examiner.



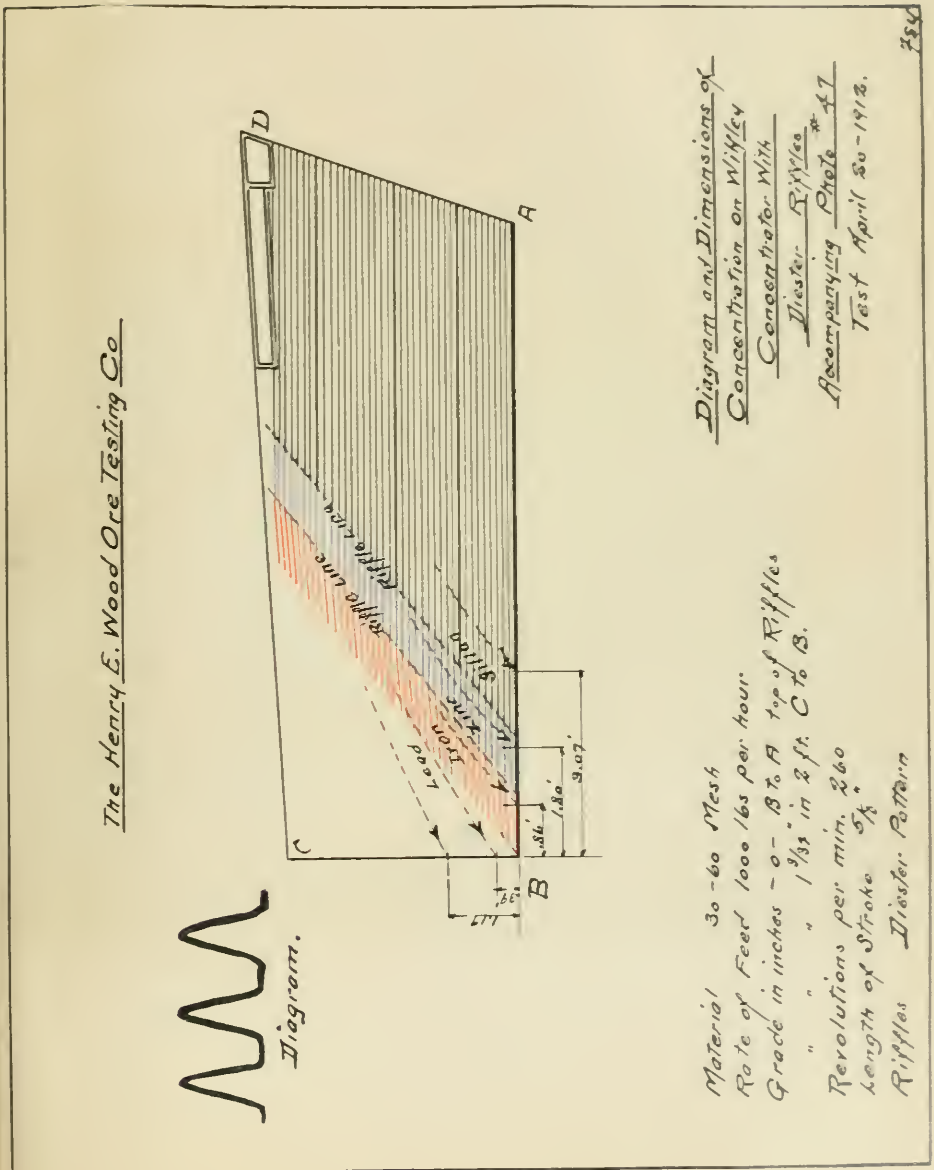
Complainant's Exhibit No. 110. Photograph No. 47. Wilfley Table Deck, Riffles, Deister Pattern.

Almon E. Hart, Special Examiner.



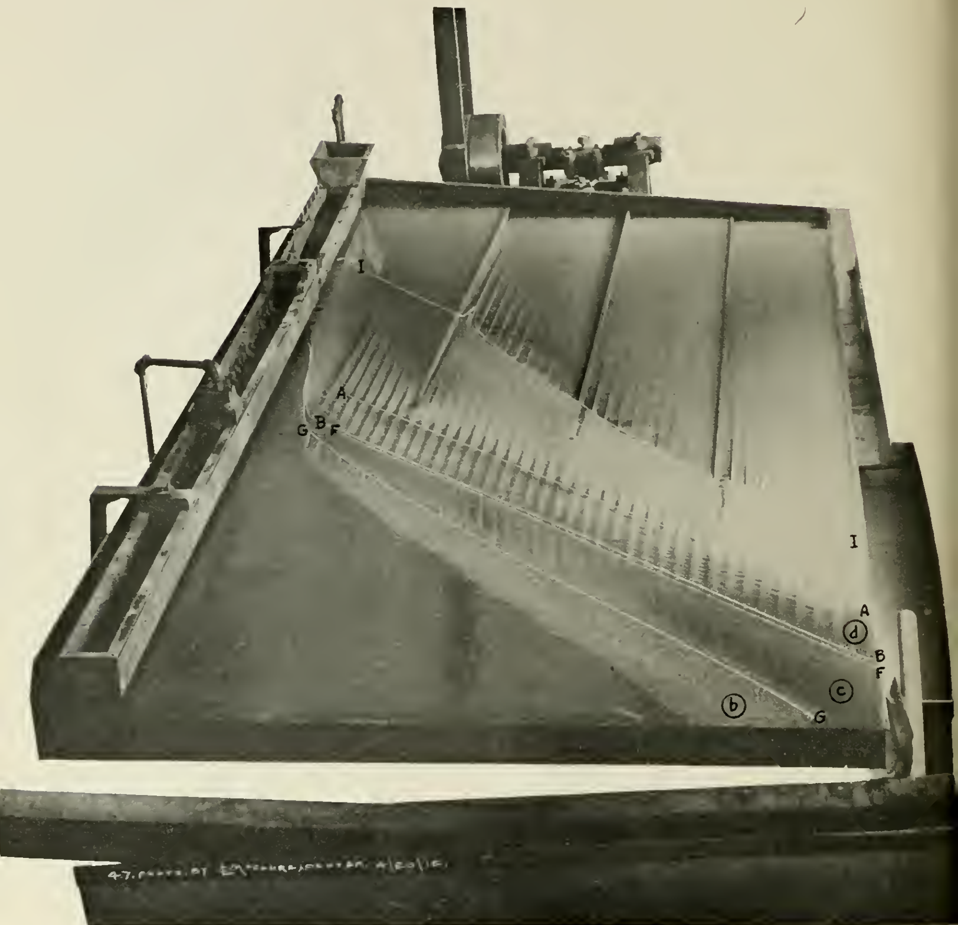
Complainant's Exhibit No. 110-A. Diagram of Photograph Exhibit No. 110.

Almon E. Hart, Special Examiner.



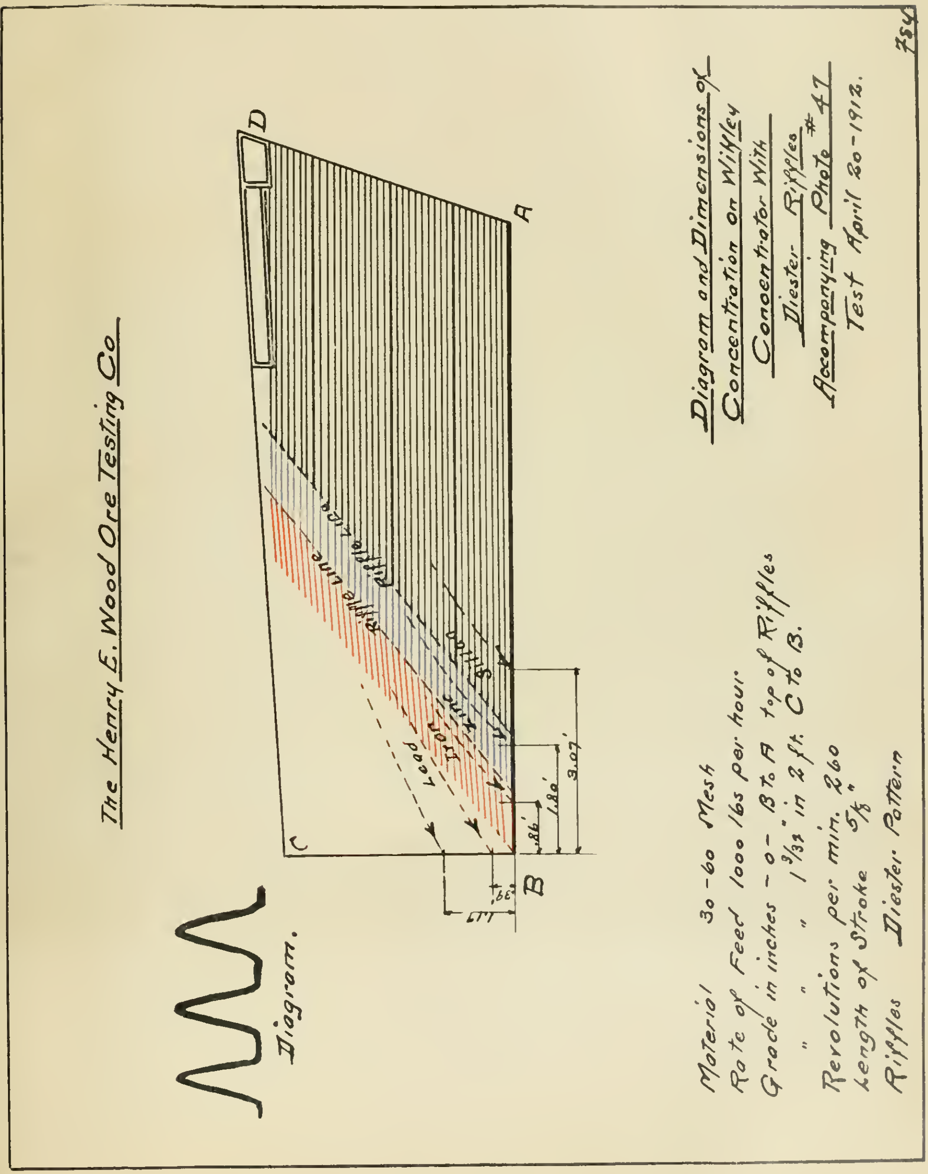
Complainant's Exhibit No. 110. Photograph No. 47, Wilfley Table Deck, Riffles, Deister Pattern.

Almon E. Hart, Special Examiner.



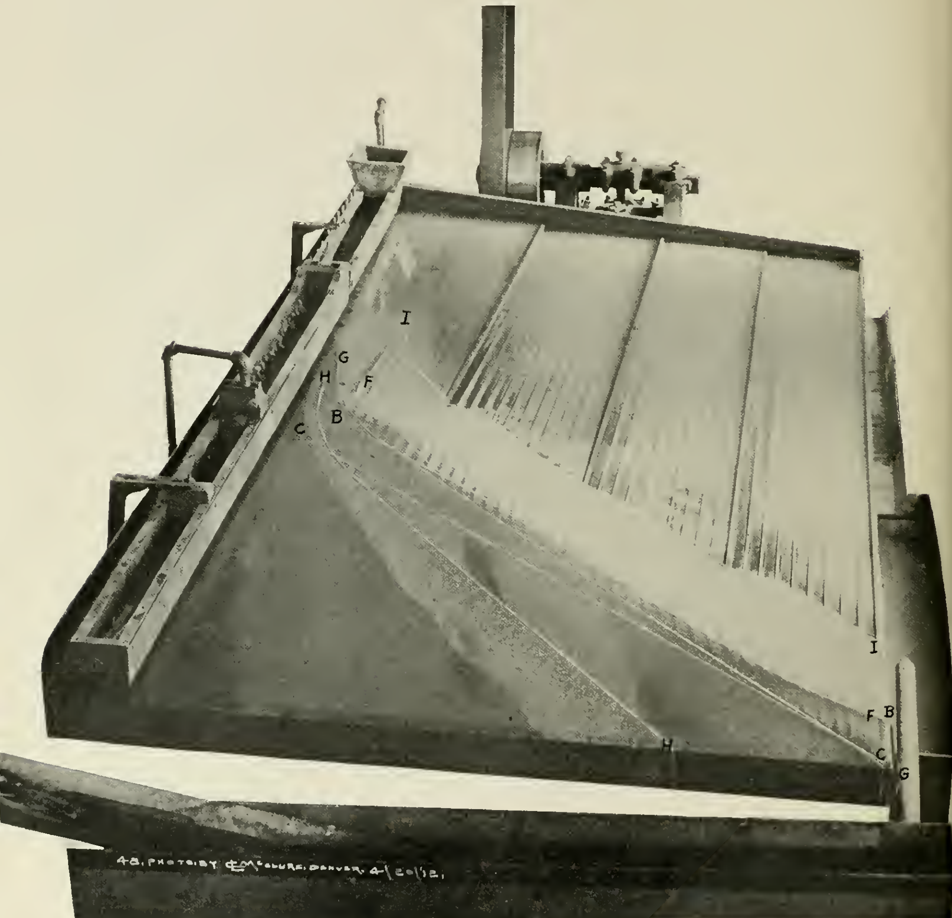
Complainant's Exhibit No. 110-A. Diagram of Photograph Exhibit No. 110.

Almon E. Hart, Special Examiner.



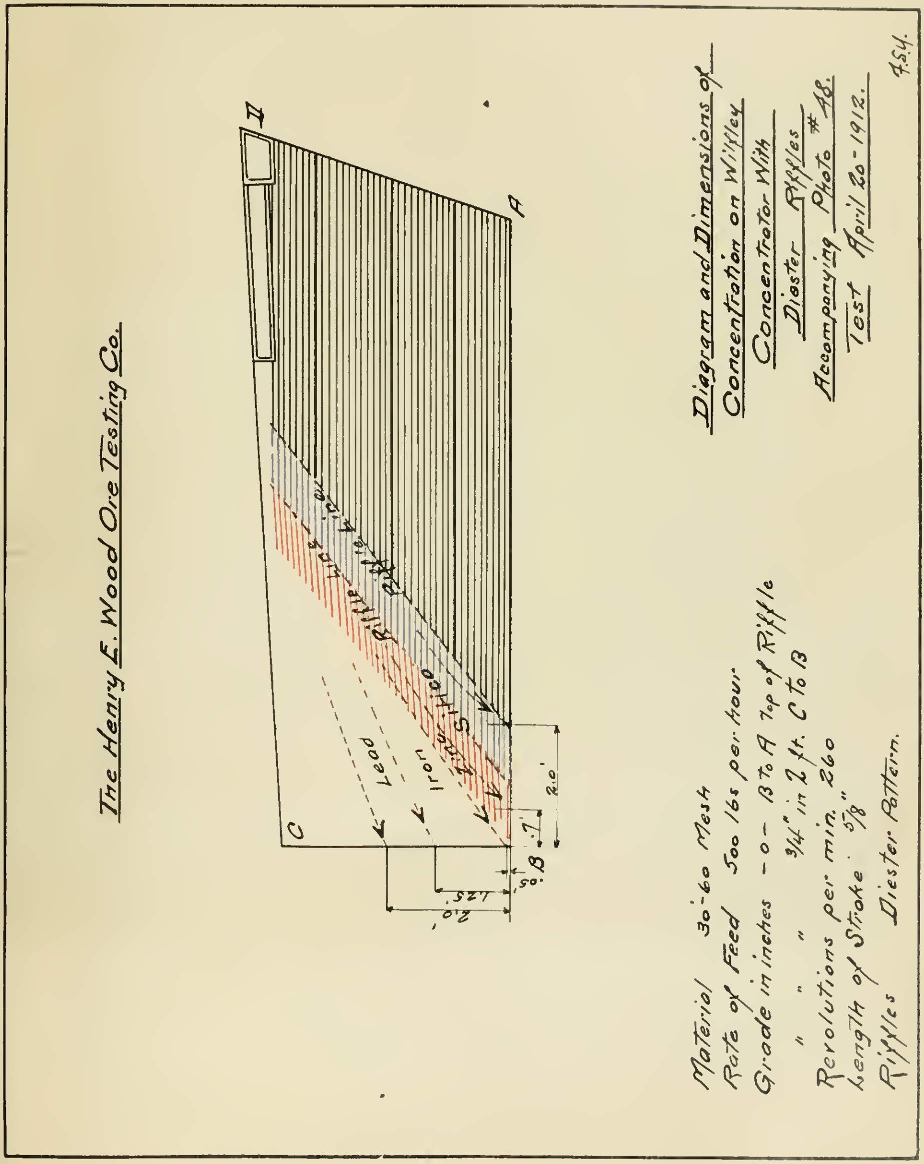
Complainant's Exhibit No. 111. Photograph No. 48, Wilfley Table Deck, Riffles, Deister Pattern, Decreased Inclination, C to B.

Almon E. Hart, Special Examiner.



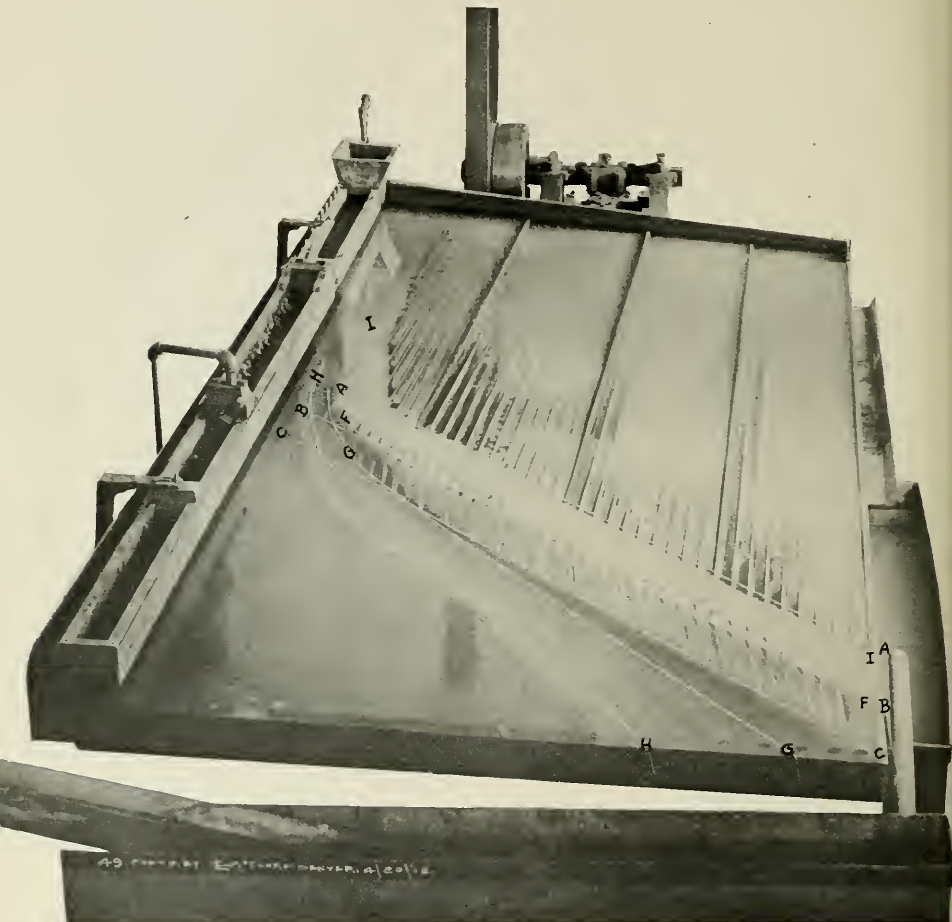
Complainant's Exhibit No. 111-A. Diagram of Photograph Exhibit No. 111.

Almon E. Hart, Special Examiner.



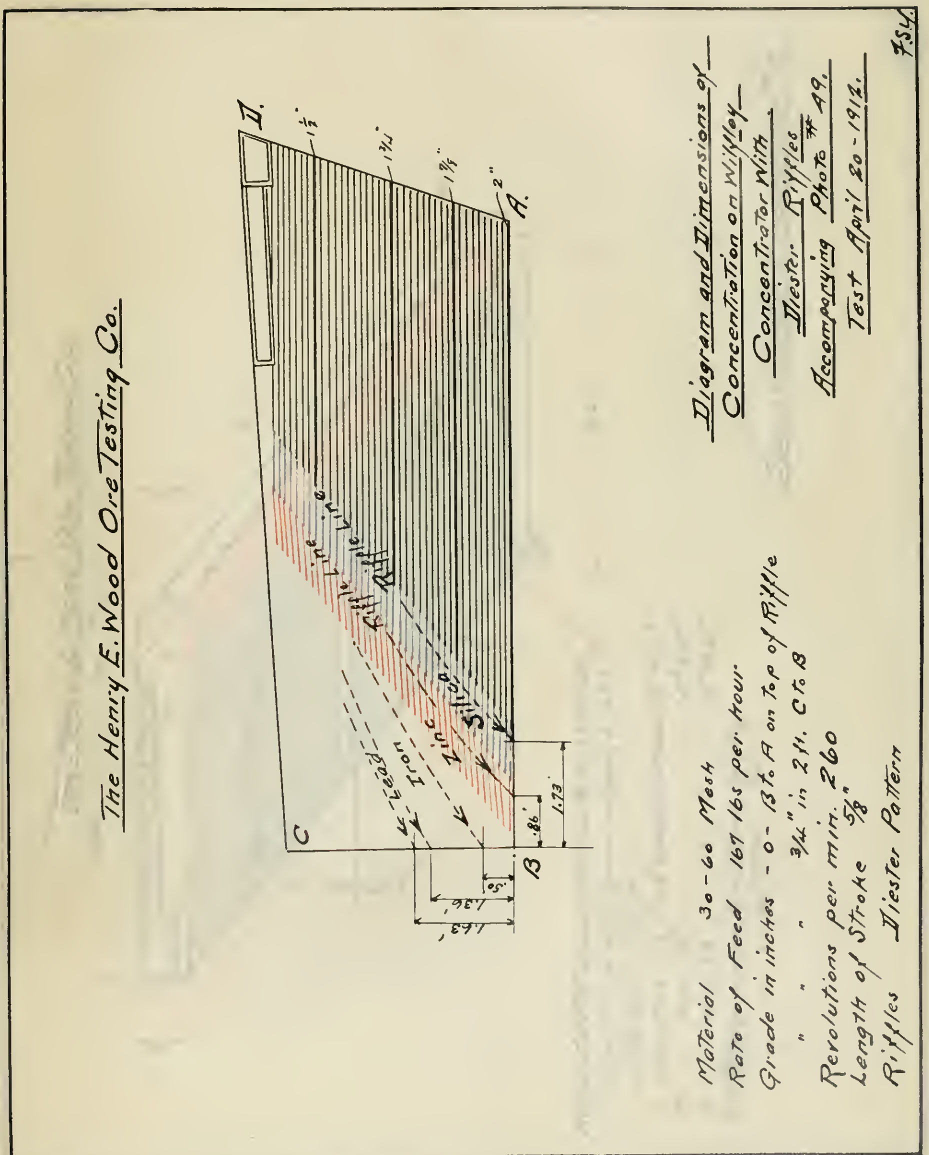
Complainant's Exhibit No. 112. Photograph No. 49, Wilfley Table Deck, Riffles, Deister Pattern, Decreased Inclination, C to B.

Almon E. Hart, Special Examiner.

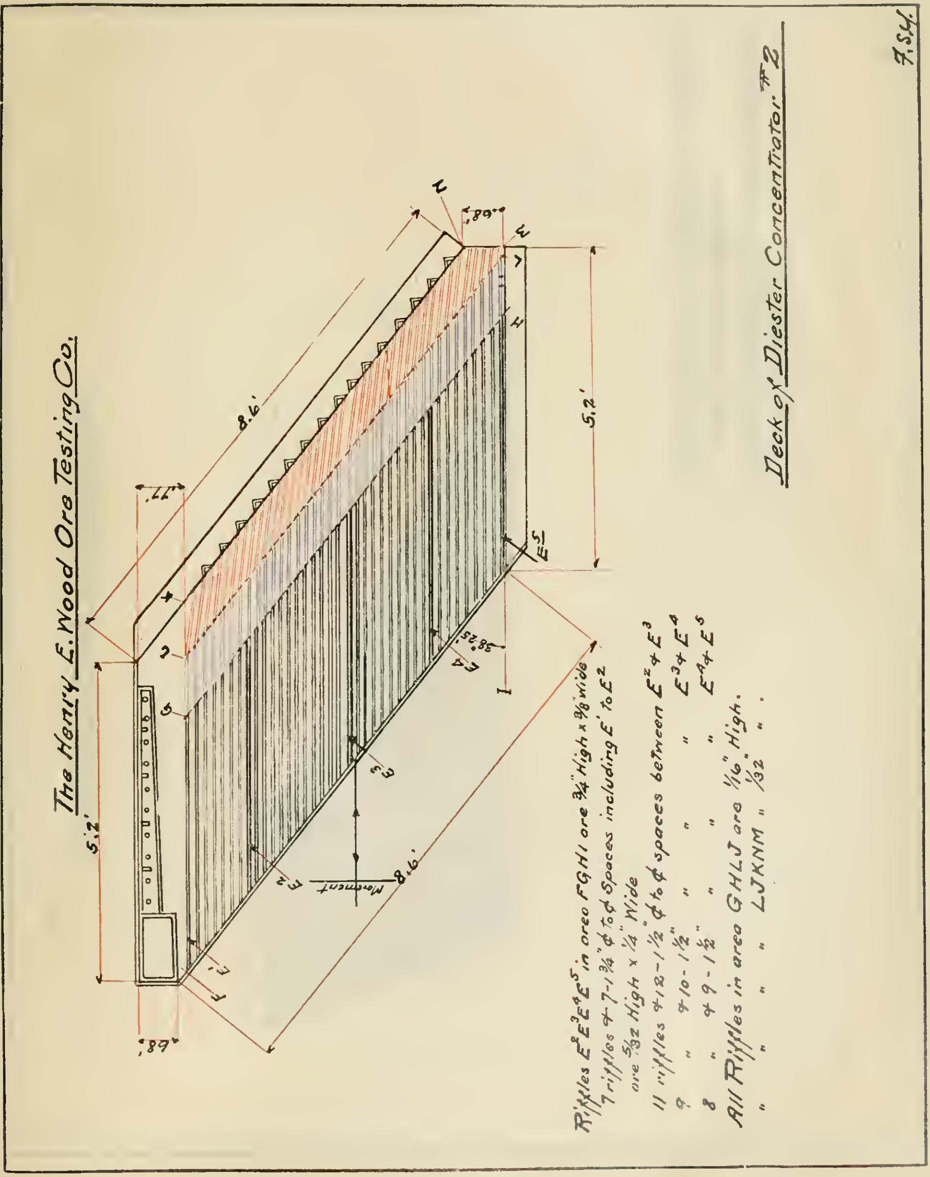


Complainant's Exhibit No. 112-A. Diagram of Photograph
Exhibit No. 112.

Almon E. Hart, Special Examiner.



Complainant's Exhibit No. 113. Diagram Deister Table No. 1452.
Almon E. Hart, Special Examiner.



Complainant's Exhibit No. 114. Diagram Wilfley Table with Deister Table Superimposed.

Almon E. Hart, Special Examiner.