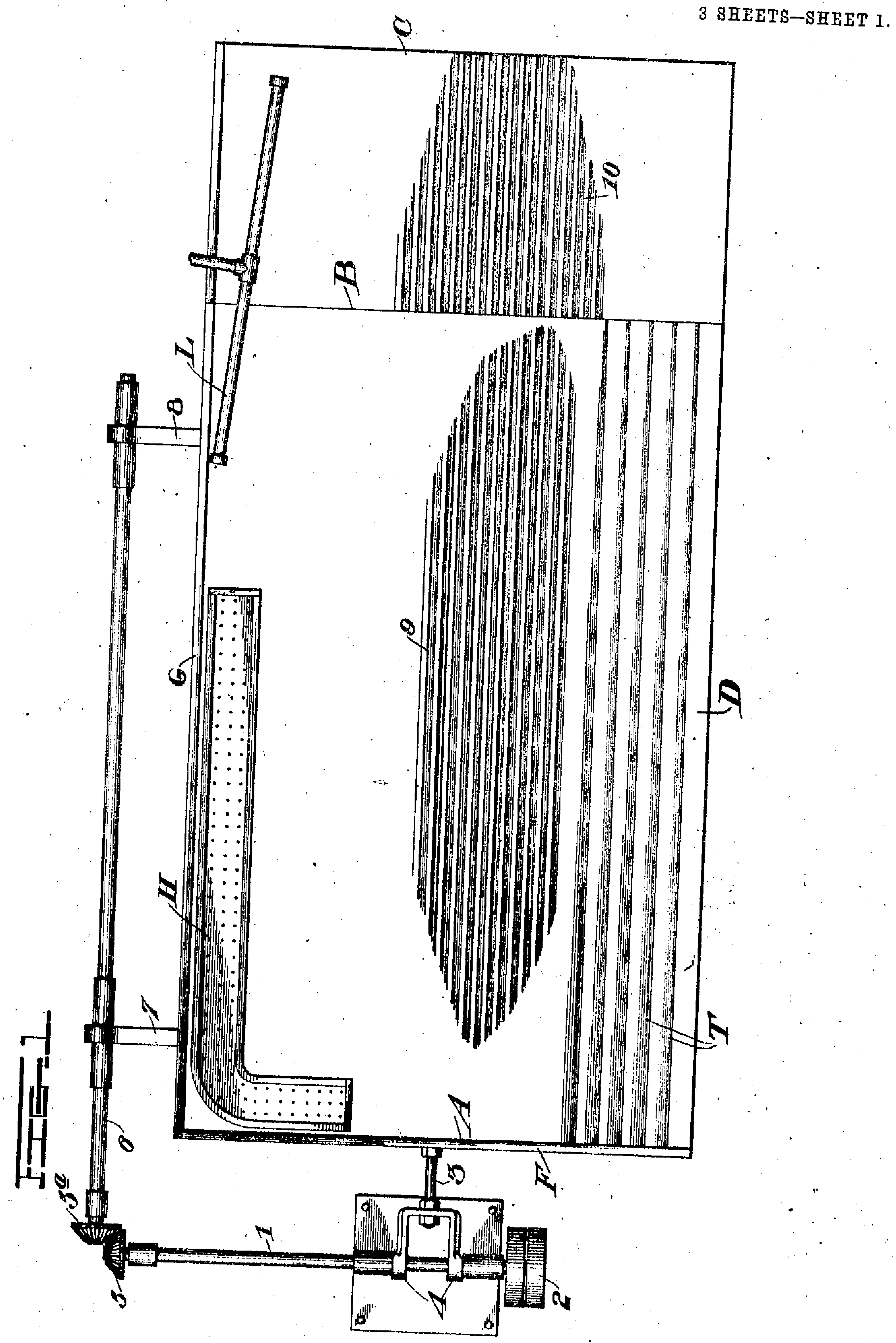
962,990.

S. R. SWAIN.
ORE CONCENTRATOR.
APPLICATION FILED FEB. 6, 1907.

Patented June 28, 1910.
3 SHEETS—SHEET 1.



Witnesses
Lloyd W. Patch
H. A. Johnson

Inventor
Seth R. Swain
By Anson E. Hodges
his Attorney

S. R. SWAIN.

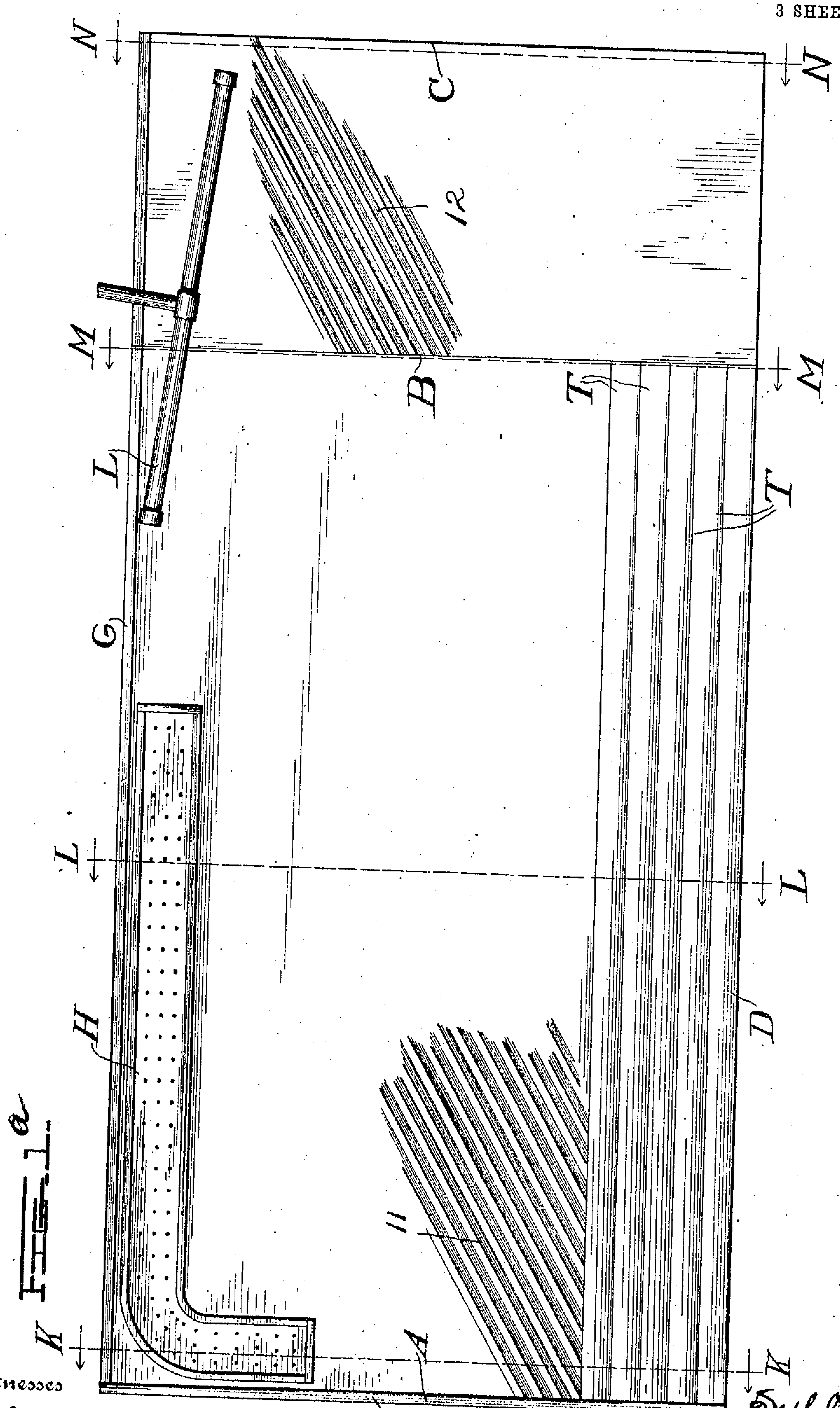
ORE CONCENTRATOR.

APPLICATION FILED FEB. 6, 1907.

962,990.

Patented June 28, 1910

3 SHEETS—SHEET 2.



Witnesses
Lloyd W. Patch
A. A. Hammond.

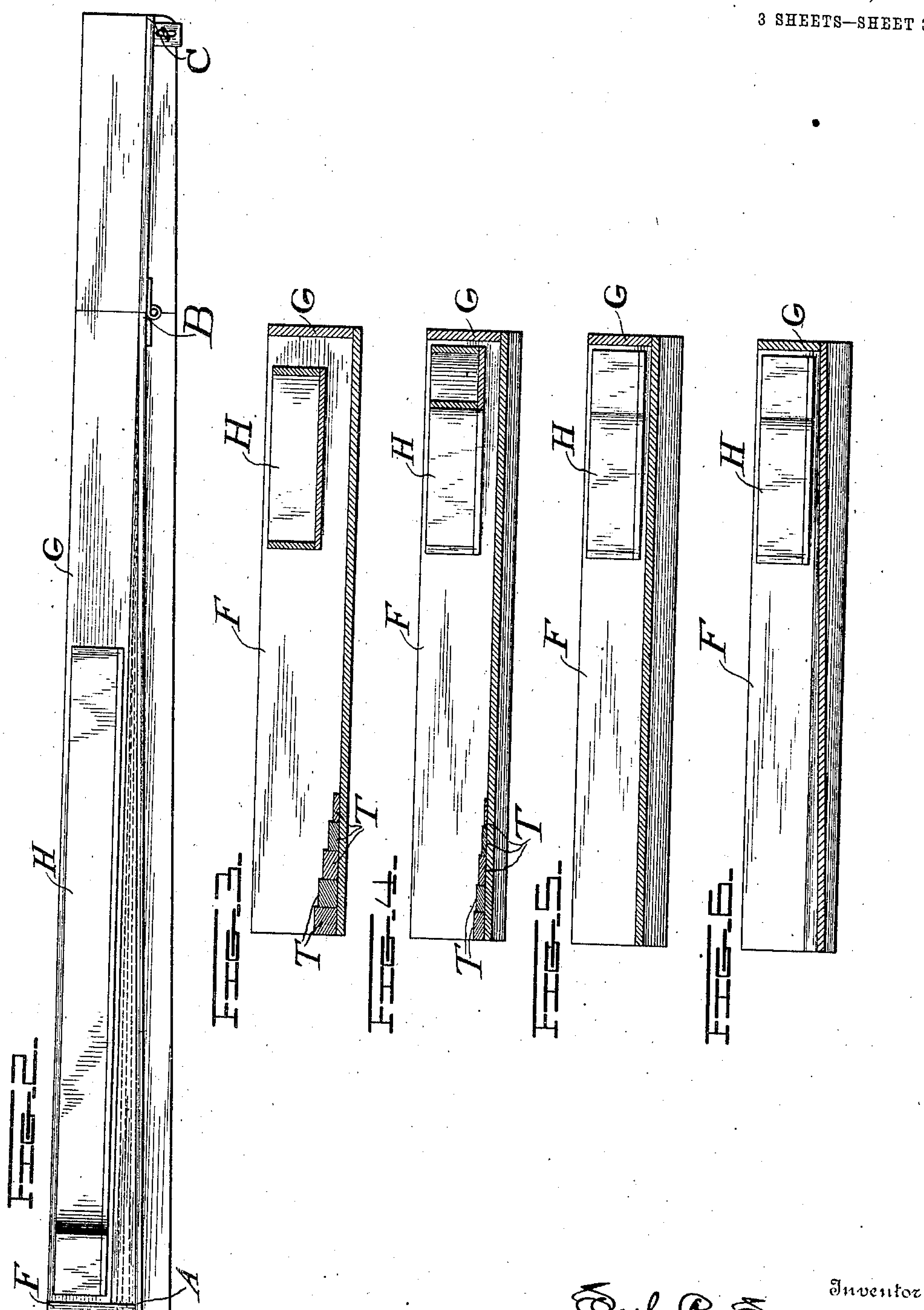
Inventor
Seth R. Swain

By
Vernon E. Hodges
his Attorney

S. R. SWAIN.
ORE CONCENTRATOR.
APPLICATION FILED FEB. 6, 1907.

962,990. Patented June 28, 1910.

3 SHEETS—SHEET 3.



Witnesses
Lloyd W. Patch
A. A. Hammond

Inventor
Seth R. Swain
By Vernon E. Hodges
his Attorney

UNITED STATES PATENT OFFICE.

SETH R. SWAIN, OF DENVER, COLORADO, ASSIGNOR TO THE SWAIN CONCENTRATOR COMPANY, A CORPORATION OF COLORADO.

ORE-CONCENTRATOR.

962,990. Specification of Letters Patent. Patented June 28, 1910.

Application filed February 6, 1907. Serial No. 356,100.

To all whom it may concern:

Be it known that I, SETH R. SWAIN, 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 Ore-Concentrators, of which the following is a specification.

My invention relates to an improvement in ore concentrators.

The object of my invention is to economically and effectively separate and save the heavier mineral particles from the lighter ones in an ore.

This invention is adapted to, and particularly devised for, treating the very finest particles, but is not limited to that size. The general principles are such as are used in nature, with mechanical additions to perfect and make continuous the operation.

The tendency of crushed ore in water is to settle as soon as it is possible for it to do so, and the settling is retarded in proportion to the rapidity of the flow of the mixture. It will be well to remark that for an ore mixture in water, in a confined space, the natural and proper shake or motion of the material to keep it loose and allow of the settling of the heavier particles to the bottom is slow and quite long for the finest sizes, while shorter and quicker movements are given as the particles increase in size or in weight. This is the natural tendency in washing with a gold pan, and experiment has proved it to be correct in all cases.

Particles of ore in water will settle quickly in a pool or pond, and in flowing currents finer particles will come to the bottom with each diminution of current, and the less the current, the less will be the scouring or moving force of the current on settled particles. In a mixture (ore and water), confined in a mechanical pond, a shaking movement can be given if carefully regulated, that will keep the mixture loose enough to allow of the settling of the heavier minerals, and hold the lighter ones in suspension, and at the same time not be violent enough to move the heavier mineral particles, when once in contact with the bottom of the pond. This regulation is accomplished by the combination of the length and of the number of shakes per minute.

A plane surface, influenced by a progressive motion, will force forward in the line of progression any susceptible material in contact with it; this applies either to a dry surface, or to one on which the material is submerged, but material under water will progress slower and be influenced by water currents and eddies. The particles or material will travel faster and with more precision when in masses or accumulations, than when isolated as individuals. When *en masse* each piece helps its immediate neighbor, not only ahead in the line of progression, but as to speed; while as individuals, owing to irregularities of surface contact, each piece is less susceptible to the progressive movement. Thus it is that the particles to be cleaned and saved should be kept *en masse* to be best controlled.

My invention is to cause, with the smallest possible surface, an ideal settling arrangement, by using a surface current over the entire area, thereby lessening the force of the carrying or surface current; and also a correct mechanical motion to allow the heavier particles to settle on a submerged surface or bottom; and another motion to cause the aforesaid heavy particles to continuously move away on this submerged surface, to a proper receptacle, while the lighter particles will flow, also continuously, away in the surface current already mentioned.

In explaining the device, use will be made of the term "side-shake," for the settling movement, but it is understood that I do not confine myself to such a movement, and will, or may, use a "rotary movement" or a "differential side-shake," or any other means for imparting this particular motion; also that the progressive movement used may be either an "accelerated," "differential" or other movement that will progress material in contact with a surface. Therefore I do not limit myself to any specified mechanical combination to effect these two movements, nor, except in a general way, to limit myself to the "settling" or to the "progressive" motions.

It is understood that the proper progressive motion for the purpose mentioned above is short and very quick for the finest material and a proportional longer and slower one as the material increases in size. The settling motion is the opposite requiring a long, slower movement for fine material and a quicker, shorter stroke for increased sizes and weights. I propose to use both movements acting at an angle to each other, each doing its proper proportion of the work, but with no interference, and the two movements to be so arranged as to allow of different speeds for each, or, at least, different proportions of speed of one motion, compared with the other. For instance, should the progressive motion be three hundred revolutions per minute, the "side-shake" or "settling" motion may be adjusted, as circumstances require, to 75, 100, 150 or 200 revolutions per minute, thus giving a wide field of action to accommodate the size and class of material to be treated.

In the accompanying drawings:—Figure 1 is a plan view of my improved table, showing the operating mechanism. Fig. 1ª is also a plan view but with the operating mechanism omitted, and with the riffles shown as running in another direction. Fig. 2 is a side elevation. Fig. 3 is a section on the line K—K of Fig. 1ª. Fig. 4 is a section on the line L—L of Fig. 1ª. Fig. 5 is a section on the line M—M of Fig. 1ª. Fig. 6 is a section on the line N—N of Fig. 1ª.

The deck is, preferably, a rectangular (but is not limited to that shape) water-tight table, set so that the movement end at "A" is somewhat lower than at "B"; along the tailing side is fastened a fillet "D", tapered to accommodate the depth at "A", thus giving a level surface along the tailing side from the movement end to "B".

"F" is a high board along the "movement end," and "G" the same on the "feed side", both being of sufficient height to provide against splash or spill.

The deck, from the point "B" to the end "C", is a plane surface or it might be a surface with slight grooves in it, and is flexible so that by adjustment it can be bent or warped, making its "end corners" or "end center" high or low, as circumstances may require.

"H" is the feed box, where the crushed ore, mixed with water, is supplied.

The wash water feed L is movable so that it can be placed where it will give the best results.

It will be understood from the foregoing that the deck will be composed of a "pond", bounded by the high walls "F" and "G", and a level "dam" D, on the "tailing side." The "pond" is deep at "A", because of the slight inclination of the table in that direction and it shallows gradually to nothing at "B", which is its other boundary, and which is about on a level with the dam. From the point "B", to the end of the deck, is a surface which is flexible, and which may be higher or lower at either corner, or the center, than it is at the point "B".

Attached to the "deck," at a convenient point or points on the "feed-side," is a mechanism to give it a reciprocal motion from side to side, or rotary or such similar movement that will cause settling. To the "movement end", and acting toward the "concentrate end", is attached a progressive motion that will progress particles on its surface toward the concentrate end.

The mechanism for imparting progressive motion consists of a shaft 1 on which is mounted a pulley 2 connected with a suitable source of power (not shown), and a rod 3 attached to one end of the table and connected with the shaft by means of an eccentric 4. A gear wheel 5 at the end of shaft 1 meshes with a gear wheel 5ª on shaft 6, extending in the direction of the length of the table, to which shaft are connected rods 7 and 8, by means of eccentrics, said rods being designed to impart lateral motion to the table.

Reference has already been made in considerable detail to the progressive and settling motions, and further particulars will be given following the technical description of the table.

The "tailing side" is to be set level, or so that any excess of water feed, on to the deck, will flow toward that side and discharge in an even film the length of the tailing side from the "movement end" to "B". Transversely the "deck" is set level, or about so, at the point "B".

Bounding the "pond" is one low side and one low end, the low end for the continuous discharge of the settled material by progression, and the low side for the discharge of waste or light material in suspension.

The bottom of the "pond" may have a slight inclination toward the "feed-side", or may be level, and it may be a smooth plane surface, or may contain slight grooves, and may combine both inclination and grooves. The object of both inclination and grooves, if used, would be to cause any desired particles, that had settled near the "dam" on the "tailing-side" to be influenced away from the "dam", toward the "feed-side", where *en masse* they would be more susceptible to the progressive motion.

Any adjustment of inclination to the "pond" bottom, or the making in it of slight "grooves," is for the purpose of accumulating, in a more or less compact mass, the settled material, thus making that material more susceptible to progressive motion.

In Figs. 1 and 1ª of the drawings, I have also shown the apron as being provided with grooves. These grooves on the table proper and on the apron may be parallel with the line of progression as shown at 9 and 10, respectively, in Fig. 1; or they may be oblique or at an angle with the line of progression as shown at 11 and 12 in Fig. 1ª.

The "dam" "D" is made of sufficient width that it may if desired be formed into a set of terraces, T, T, the number not limited, each terrace, considering the number used, a proportionate height of the dam at the "movement-end", and regularly tapering to nothing at the opposite end at "B". These steps or terraces will present, on the inner or "pond" side, a comparatively long, gentle slope, broken by the steps, the slope being less abrupt as the height lessens. This arrangement will present an ideal slope for the waves, caused by the "side-shake", while the steps will prevent the scouring over the dam of settled material on the bottom, close to the dam. The "steps" or "terraces" are not limited in number or width; they may be either wider or narrower at either end, or slightly curved in their length, and may be parallel to the tailing side, or at an angle to it either way.

The settling motion imparted in one direction produces small waves or ripples moving toward the tailings side. The tendency of the waves is to travel faster in deep water where there is less friction, and slower in shallow water, and therefore the wave crest on arrival at the dam is at an angle of about 45 degrees to the outer edge of the dam. On the return trip little or no wave is generated from the tailings side, for, owing to the transverse inclination of the dam, there is nothing to cause the amount of compression necessary to produce such a wave. Thus it will be seen that the dam, tapering longitudinally, serves to confine the water in a pond of gradually decreasing depth, and owing to its peculiar formation (in that it represents a surface the elevation of which decreases transversely), the production of a wave traveling from the tailings side is prevented. An abrupt elevation of any character, sufficient to properly confine the water on the tailings side, or other construction producing undesirable agitation, would seriously interfere with the settling of the material.

In using a concentrating table of this type, if a settling stroke a little too long were employed, it would bring to the surface or near the surface certain particles which should be saved and not washed over the top of the dam. In order to prevent such waste, steps or terraces may be used, which on account of the uneven surface presented by them to the water, cause certain eddies and countercurrents. These eddies and currents serve to deflect the minerals and prevent them from being washed over the dam.

The action of a concentrator, as above constructed, would be about as follows: The pulp, fed on at the feed box "H," would be distributed over an enlarged area, and would fall into the "pond." The surface flow, in the pond, is spread over a considerable and increasing area, thus diminishing continually the current force, and allowing settling, and is a thin "film" flowing surface. The continued feed would fill the "pond" with pulp; the "settling movement," imparted to the "deck," would keep the pulp loose in the "pond," allowing the heavier particles to settle to contact with the bottom. The continued feed into the "pond" would also, assisted by the "side-shake" of the "settling movement," cause a flow over the level surface of the "dam" on the "tailing side." The "progressive movement," regulated for the work being performed, will cause the heavier particles, in contact with the bottom of the "pond," to move toward the "concentrate end," traveling up the slight incline of the pond bottom, to the point "B," whereby the "flexible apron," transverse inclination is given, and by the influence of the wash water, a final cleaning of minerals will be quickly effected, the desired mineral falling off the end into a receptacle, while the undesirable material is caused to flow to another point. In the "pond" the continued feed is forced, by the setting of the deck, to spread out, and the flow, which is a thin film over the surface, presents a minimum depth, and allows of the settling through it into the dead water of the "pond" of all particles, when thus impounded the proper looseness or consistency is maintained by the "settling movement," and settled material is prevented from being carried over the "dam" from the action of the wave-motion by the "terraces" or "steps" on the inside of the "dam." These are tapered from the "movement end" to nothing at "B," thus allowing only very fine material to pass over at the deep part of the "dam," while the coarser particles are discharged as the "dam" decreases in height and the "pond" shallows.

It is absolutely necessary that, with the use of the ponding feature, both a "settling" and a "progressive" motion be used in combination, for, without both, nothing practical would be accomplished, and without either a continuous operation will not result. Owing to the varied ores that may be washed and their different composition, etc., I do not wish to limit the kind of motions to be used, except in the general terms of "progressive motion" and "settling motion," for each has a distinct duty to perform, and each exerts its force in conjunction with the other to produce the results described, nor do I wish to limit myself to any particular mechanical means to impart these motions.

It is understood, of course, that the deck, movements, etc., are all mounted on a suitable frame, the design of which will allow of and contain all mechanical features necessary for all of the above-mentioned combinations.

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

1. In a concentrating table adapted to discharge tailings transversely over one side and to convey concentrates toward one end

and discharge them therefrom, a table proper, and a dam on the tailings side thereof, said dam presenting a surface the elevation of which above the table decreases transversely toward the feed side and longitudinally toward the concentrate end.

2. In a concentrating table adapted to discharge tailings transversely over one side and convey concentrates toward one end and discharge them therefrom, a table proper, and a dam on the tailings side thereof, said dam presenting a surface the elevation of which above the table decreases transversely toward the feed side and longitudinally toward the concentrate end, the upper outer edge of the dam being level.

3. In a concentrating table adapted to discharge tailings transversely over one side and convey concentrates toward one end and discharge them therefrom, a table proper, and a terraced dam on the tailings side thereof, said dam presenting a surface the elevation of which above the table decreases transversely toward the feed side and longitudinally toward the concentrate end.

4. In a concentrating table adapted to discharge tailings transversely over one side and convey concentrates toward one end and discharge them therefrom, a table proper inclined longitudinally, and a terraced dam on the tailings side thereof, said dam presenting a surface the elevation of which above the table decreases transversely toward the feed side and longitudinally toward the concentrate end, the upper outer edge of the dam being level.

5. In a concentrating table adapted to discharge tailings transversely over one side and convey concentrates toward one end and discharge them therefrom, a table proper having a riffled surface, and a dam on the tailings side thereof, said dam presenting a surface the elevation of which above the table decreases transversely toward the feed side and longitudinally toward the concentrate end.

6. In a concentrating table adapted to discharge tailings transversely over one side and convey concentrates toward one end and discharge them therefrom, a table proper having a riffled surface, and a dam on the tailings side thereof, said dam presenting a surface the elevation of which above the table decreases transversely toward the feed side and longitudinally toward the concentrate end, the upper outer edge of the dam being level.

7. In a concentrating table adapted to discharge tailings transversely over one side and convey concentrates toward one end and discharge them therefrom, a table proper, a dam on the tailings side thereof, said dam presenting a surface the elevation of which above the table decreases transversely toward the feed side and longitudinally toward the concentrate end, and a flexible apron constituting the concentrate end of the table.

8. In a concentrating table adapted to discharge tailings transversely over one side and convey concentrates toward one end and discharge them therefrom, a table proper, a dam on the tailings side thereof, said dam presenting a surface the elevation of which above the table decreases transversely toward the feed side and longitudinally toward the concentrate end, the upper outer edge of the dam being level, a flexible apron constituting the concentrate end of the table, means for imparting a progressive motion and means for imparting a settling motion to the table.

9. In a concentrating table adapted to discharge tailings transversely over one side and convey concentrates toward one end and discharge them therefrom, a table proper, a dam on the tailings side thereof, said dam presenting a surface the elevation of which above the table decreases transversely toward the feed side, and a flexible apron constituting the concentrate end of the table.

10. In a concentrating table adapted to discharge tailings transversely over one side and convey concentrates toward one end and discharge them therefrom, a table proper, a dam on the tailings side thereof, said dam presenting a surface the elevation of which above the table decreases toward the feed side, and a flexible and adjustable apron constituting the concentrate end of the table.

11. In a concentrating table adapted to discharge tailings transversely over one side and convey concentrates toward one end and discharge them therefrom, a table proper, a dam on the tailings side thereof, said dam presenting a surface the elevation of which above the table decreases transversely toward the feed side, and a flexible apron located at the concentrate end, beyond the point at which the dam terminates, and constituting a continuation of the separating surface.

12. In an ore concentrator, a table adapted to discharge tailings transversely over one side and convey concentrates toward one end and discharge them therefrom, a dam on the tailings side thereof, said dam presenting a surface the elevation of which above the table decreases transversely toward the feed side and longitudinally toward the concentrate end, means for imparting a progressive motion and means for imparting a settling motion to the table.

13. In a concentrating table adapted to discharge tailings transversely over one side and to convey concentrates toward one end, a table proper, an abrupt wall on one side thereof, and a dam on the tailings side opposite the wall, said dam presenting a sur-

face the elevation of which above the table decreases transversely toward said wall and longitudinally toward the concentrate end.

14. In a concentrating table adapted to discharge tailings transversely over one side and to convey concentrates toward one end, a table proper, an abrupt wall on one side thereof, and a terraced dam on the tailings side opposite the wall, said dam presenting a surface the elevation of which above the table decreases transversely toward said wall and longitudinally toward the concentrate end.

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

SETH R. SWAIN.

Witnesses:
H. E. Fiske,
Clark Grove.