

(No Model.)

5 Sheets—Sheet 1.

G. LANG.
CONCENTRATOR.

No. 460,814.

Patented Oct. 6, 1891.

Fig. 3.

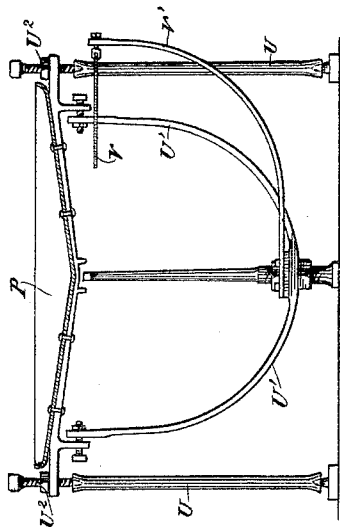
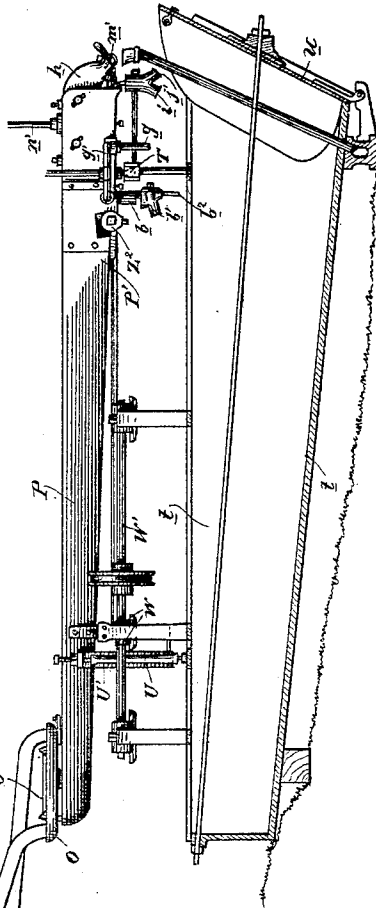
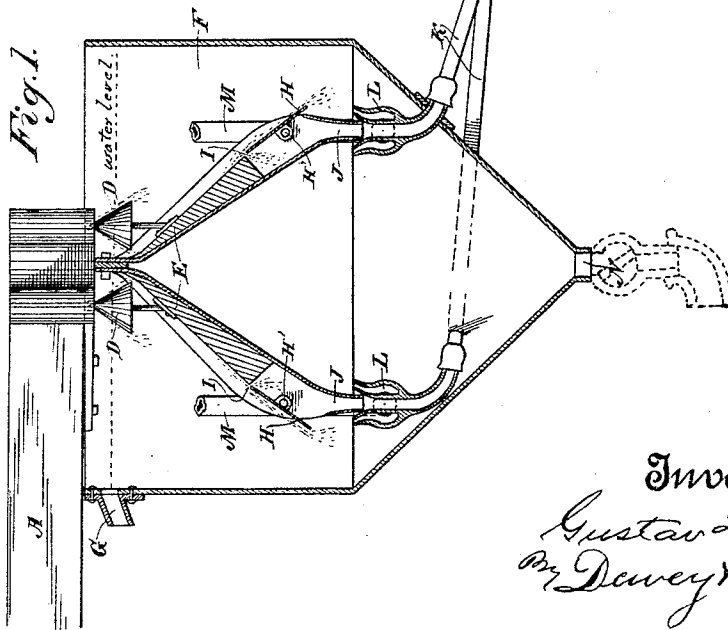


Fig. 1.



Witnesses,
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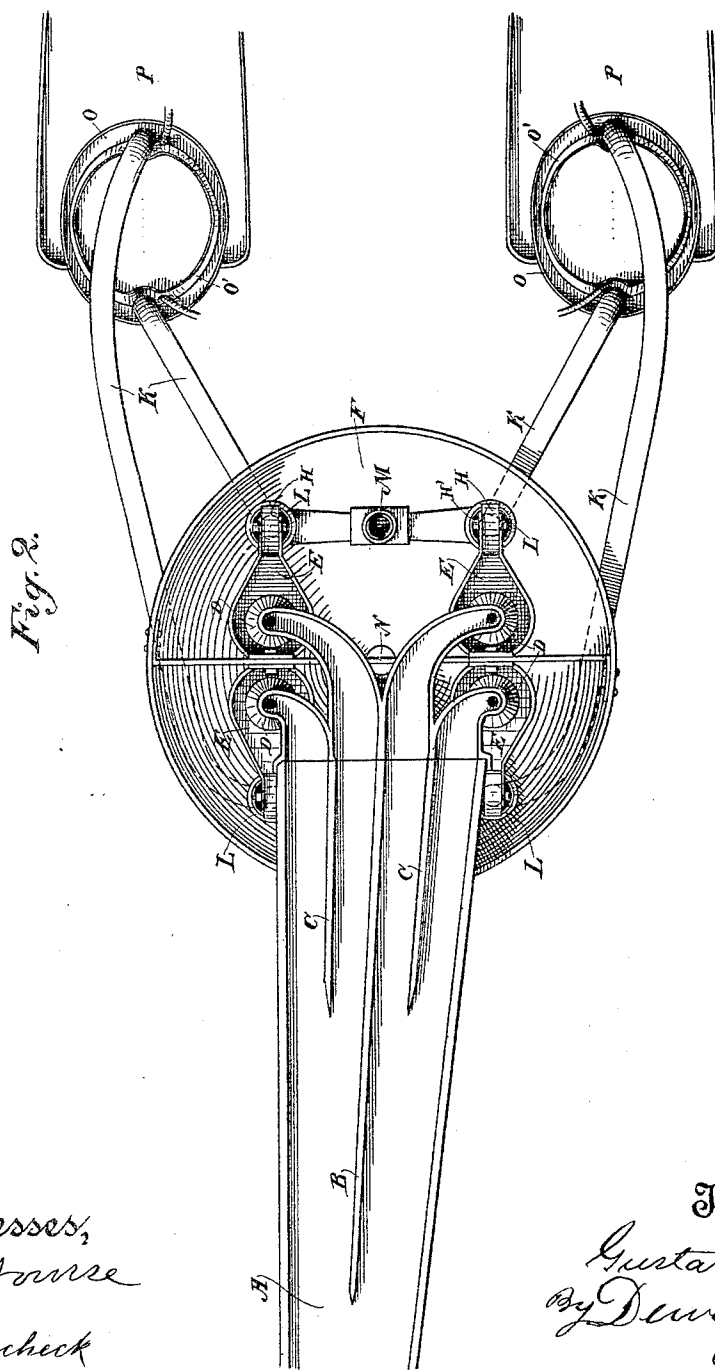
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5 Sheets—Sheet 2.

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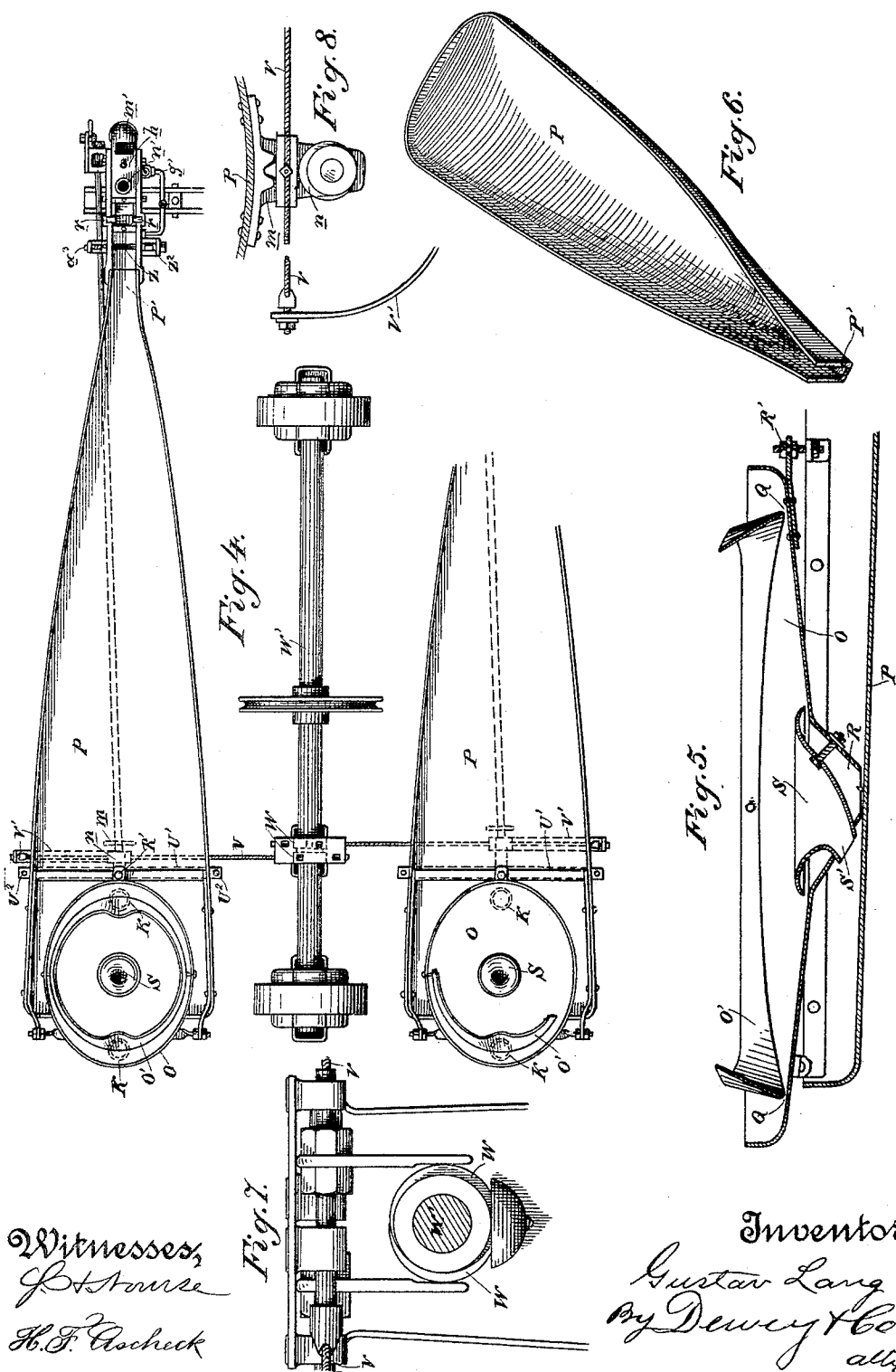
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5 Sheets—Sheet 3.

G. LANG.
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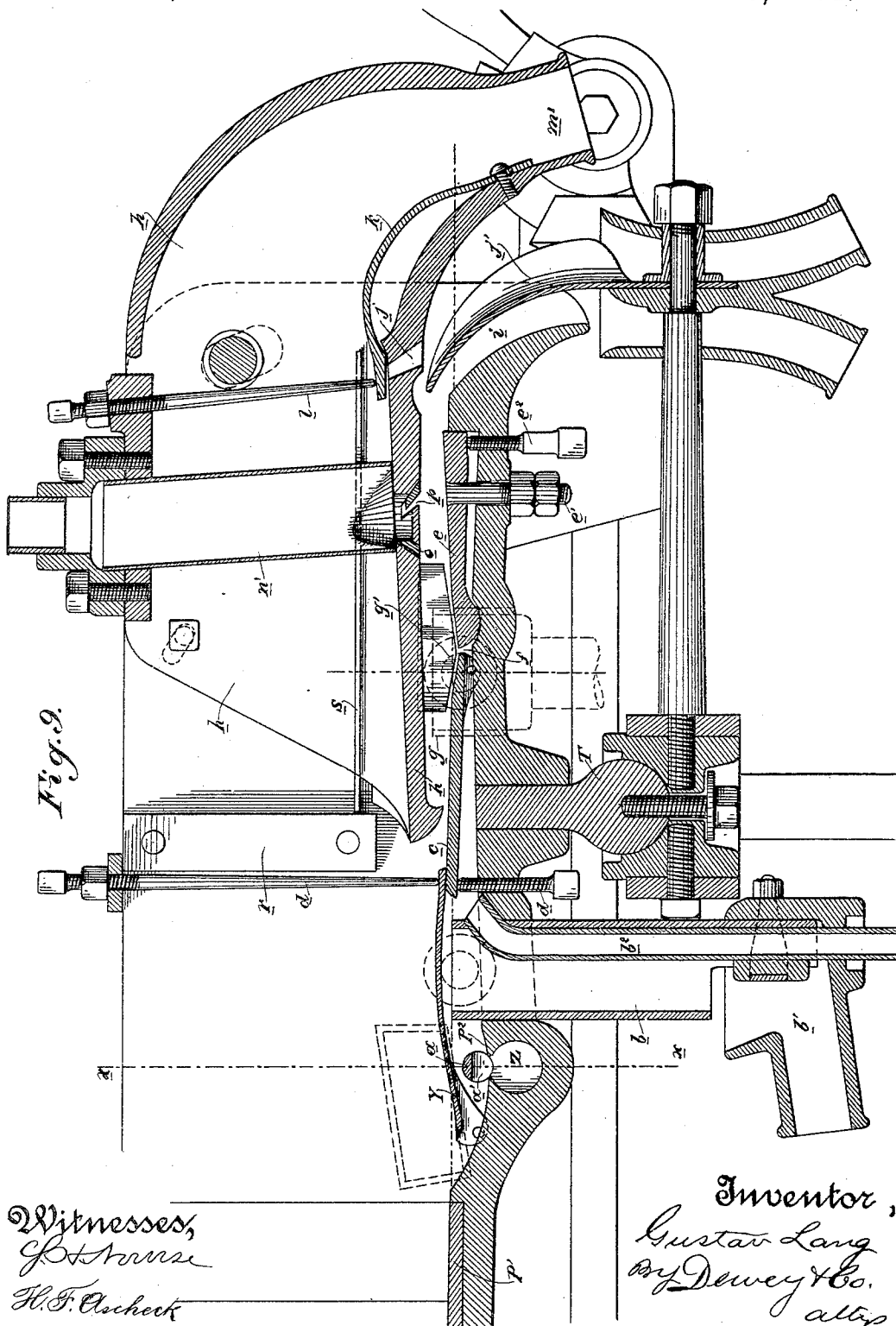
(No Model.)

5 Sheets—Sheet 4.

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5 Sheets—Sheet 5.

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Fig. 10.

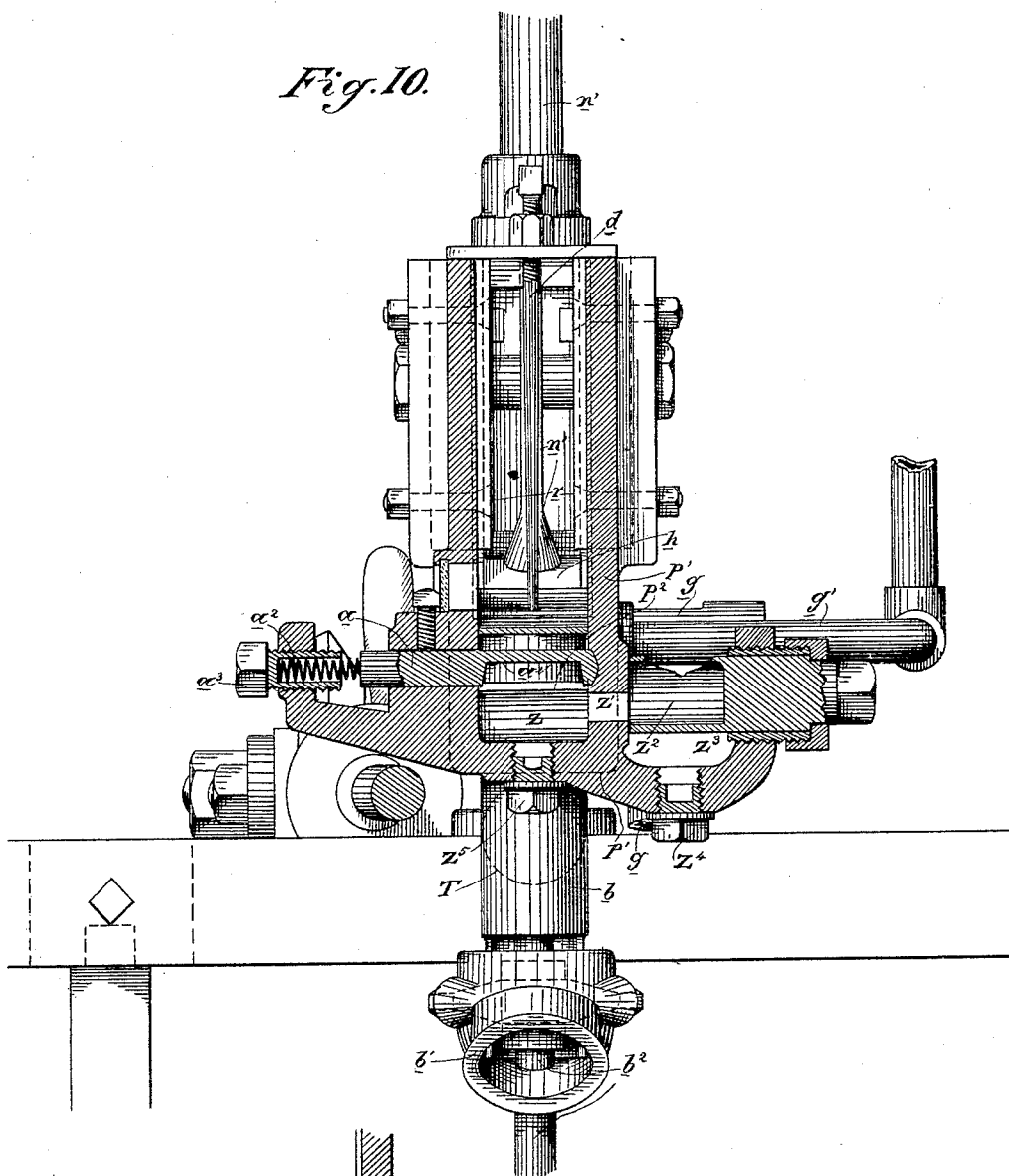
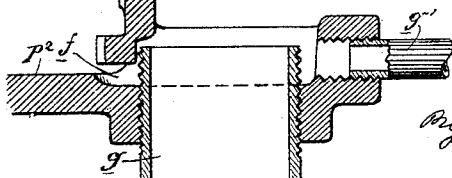


Fig. 11.

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UNITED STATES PATENT OFFICE.

GUSTAV LANG, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR OF ONE-HALF
TO LIVINGSTON GILSON AND JULIUS JACOBS, OF SAME PLACE.

CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 460,814, dated October 6, 1891.

Application filed January 3, 1891. Serial No. 376,658. (No model.)

To all whom it may concern:

Be it known that I, GUSTAV LANG, a citizen of the United States, residing in the city and county of San Francisco, 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 an improved concentrator for the purpose of saving the valuable metals and sulphurets from ores or tailings containing the same.

It consists of conveying sluices with means for subdividing the flowing material and grading it progressively through the different parts of the apparatus in such a manner that the heavier particles are separated from the lighter until nothing but waste or worthless material is left to be discharged, and in certain details of construction which will be more fully explained by reference to the accompanying drawings, in which—

Figure 1 is a side view of the apparatus with a vertical section of the first receiving-tank and the interior separating devices. Fig. 2 is a plan view of this receiving-tank with the supply-sluice, the discharge-pipes, and the upper ends of the shaking-tables. Fig. 3 is a transverse section taken through one of the tables, showing the oscillating devices. Fig. 4 is a plan view of two of these tables, with the intermediate shaft and shaking mechanism. Fig. 5 is an enlarged section of the pan-receiver at the upper end of one of these tables. Fig. 6 is a perspective view illustrating the shape of the table. Fig. 7 is an enlarged view showing the transverse section of the shaft and a view of the oscillating mechanism. Fig. 8 is a detail showing the connection of the oscillating mechanism with the table. Fig. 9 is an enlarged vertical section of these separating mechanism at the lower end of the table. Fig. 10 is a vertical section taken through *xx* of Fig. 9. Fig. 11 is a section of one of the discharges.

The great difficulty experienced in concentrating and saving the very minute and light valuable particles which are usually carried away with the water and waste material makes the percentage of loss very considerable.

The object of my invention is to progress-

ively separate out and convey away, first, the slimes and clayey matter from the heavier sulphurets, metals, and sands; second, to grade and deposit these heavier substances in strata in a pan, with means for drawing off each different grade until every possible portion has been saved and separated from the waste material.

The material to be concentrated is first delivered into a sluice or box A, which in my present illustration has the central dividing-strip B, and the strips C, which subdivide the channels made by the central strip into two, so that at the discharge end of the sluice the material has already been separated into four equal distinct portions. Further subdivision may be made if necessary. The channels thus formed in the sluice are curved outwardly, as shown plainly in Fig. 2, and in the bottom of each of these channels is a discharge-opening through which the material flows over cones D. The apex of each cone is placed centrally beneath the discharge-opening and the material flowing through this opening is thus spread and separated and falls off the lower edges of the cone into the inclined troughs E, Fig. 1. The angle of inclination of these troughs is sufficient to cause the heavy material to flow down toward the lower ends of the troughs. The cones and troughs are contained within a tank or chamber F, having an overflow-pipe at G, and this chamber is constantly supplied with clear water, so that at the first entrance of the material into the chamber the light impalpable and clayey waste material will be separated from the heavier materials, and being held in suspension in the water will be discharged through the overflow-pipe G.

Water is admitted into the lower part of the tank F, and as it rises within the tank the tendency is to lift and carry off this light impalpable waste material. From this point it enters a settling-tank, where the water slowly passes through burlaps or other filtering-surfaces, and if soluble chlorides are contained they are precipitated by a salt solution and retained upon the surface of the filter with any minutely-divided or float gold. These deposits are afterward amalgamated in any well-known manner.

At the lower end of each of the inclines E is mounted a plate H, these plates being adjustable about the supporting pivot-pin H', so that their position may be varied to suit the necessities of the case. A small space I is left between the upper edges of these plates and the lower end of the inclined troughs E, and through this space the heavier sulphurets with any metal and sand having sufficient specific gravity will flow into the pipes or funnels J beneath the plates H. The lower ends of these pipes discharge into the conveying-pipes K, which deliver the material upon the upper end of the shaking-tables. Surrounding these pipes are the annular chambers L, into which clear water is delivered through the pipes M, and as there is a narrow annular space around the lower ends of the pipes J and their junction with the pipes K this water flowing upward constantly encounters the second grade of material, which, not passing down through the openings I, will flow over the plates H and be discharged at their lower ends. This upwardly-flowing water, producing a gentle current, acts to distribute the material which discharges off the lower ends of the plates H and carries it outward until it is beyond the influence of the current, when it will gradually settle around the sides and conical bottom of the chamber F, and may be eventually drawn off through the central discharge-opening N. The material which continues to settle upon the inclined sides of the lower part of the chamber F gradually accumulates above the discharge-opening N, and when a sufficient depth has deposited to make the discharge flow as thick as is desired, the cock, gate, or other controlling device is opened enough to allow the accumulating material to flow out from below at about the same rate that it is deposited from above. The continual deposit and discharge go on as long as the apparatus is in operation and are so slow that no effect is produced upon the light slimes which are flowing off through the surface-discharge G. A glass may be introduced at some point in the discharge-passage to allow the discharging material to be inspected for the purpose of regulating its flow. This material may pass into the filter-tank before described and be afterward treated with the material already there, or it may be taken to other receptacles and treated separately and by other processes, as investigation may determine. The material which flows through the pipes K, consisting of metal, sulphurets, and clean sand, is then delivered around the periphery of the oval pans O, which are situated at the upper ends of the shaking-tables P. As will be seen, a separation into three distinct parts takes place within the tank—first, the fine slimes floating on the surface; second, the fine sand, too heavy to float on the surface and too light to descend the inclined troughs E, and, third, the heavier washed sands, sulphurets, and

metallic particles. The construction of these pans is well shown in Fig. 5, where an inner rim O' is shown extending around, so as to leave an annular channel exterior to it, into which the discharges from the pipes K are received. The heavier particles settling to the bottom and being assisted by the shaking motion which is given to the tables P, will find their way through the narrow passages Q beneath the edges of the interior rings or flanges O', and as they flow down the slightly-inclined bottoms of the pans O another separation takes place, the heavier portions flowing immediately down into the discharge-cones R at the center of each of the pans O, and being delivered through these cones upon the bottoms of the tables P, while the lighter portion of the material which has passed through the openings Q will pass over the rolling edge of the circular conical discharge-funnel S, which is supported concentrically above the funnel-shaped discharge R.

The discharge of material through the cone R is controlled by the adjusting-screw R', by which the pan O is varied or lowered to increase or decrease the opening between the bottom of the cone and the bottom of the pan. A sufficient space is left between the edge of the cone R and the edge of the funnel S to allow the heavier concentrates to pass while the lighter ones, flowing over the edge and into the funnel S, will pass out upon the table P through the discharge-opening S', which is curved off to one side, and delivers the material which has reached it at a point behind the discharge of the cone R. The material is thus graded so as to move down the table P, the metal being precipitated into the central deepest portion of the concave tables with the sand above and toward the sides, and as they move slowly down toward the separating-box they become more dense and deeper.

Clear water may be delivered into the pans O, near the discharge-openings of the pipes K, so as to assist in the separation of the material.

As many of the tables P may be employed for the subdivision of the material as thought proper. In the present case I have shown two of these tables parallel with each other having the lower ends supported upon the swivel or ball joints T, Fig. 9. To allow them a side motion about these swivel-joints the upper ends of the tables are supported upon the pivoted rocking posts U and the curved springs U', which act to return and hold the tables central, (shown in Fig. 3,) and they are caused to oscillate by means of wire ropes or connecting-rods V, which extend from an eccentric or cam mechanism W, Fig. 7, upon the driving-shaft W', and are connected with the tables and with the spring-arms V', upon which they are supported by a clutch or locking device m, Fig. 8, to which the rope is attached and it is continued to the returning-spring V'. The grade of the table is adjusted by the screws U² upon the posts U.

Any suitable or desirable shaking device may be employed to oscillate the pans. In the present case I have shown the flexible connecting-ropes V, and each of these ropes
 5 has connected with it an elastic arm V', which acts to return the rope after it has been drawn to one side by the movement of the eccentric W, and to keep the proper tension upon the flexible connecting-ropes. The clutch *m* is
 10 moved by a lever or an eccentric *n* so as to be thrown into or out of engagement with the table, and when it is disengaged the table is returned and held central by the elastic arms U'. It will be seen that by this movement
 15 the tables P have a considerable oscillation applied to their upper receiving ends, and that this oscillation gradually decreases until at the point of support upon the pivot T the motion is practically reduced to nothing.
 20 The table extends a short distance beyond the pivot T, and consequently the end thus extending receives a slight oscillating motion which is reverse to that of the upper end of the table. The shape of the table is as near
 25 as possible that of the horn spoons used for careful hand-work upon small quantities, and is well illustrated in Fig. 6. The concentrates being acted upon by the shaking-table flow gradually toward the narrow discharge
 30 end P', and at this point the material is delivered into the separating-box, where any mercury amalgam or metal which is heavy enough flows beneath the curved plate Y and into the slight depression or concavity formed
 35 in the lower end of the table P at this point, as shown at P² in the enlarged view, Fig. 9. At the bottom of the concavity P² is a narrow channel extending transversely across this
 40 portion of the table, and beneath it is an opening Z, extending horizontally across within the metal which forms the bottom of the table P at this point, and which is thickened sufficiently for this purpose. Any material which passes through the channel will
 45 pass into this opening Z, and thence passing out through the passage Z' it will pass into the pipe Z², from which it overflows through an opening in the top, (shown in Fig. 10,) into the receptacle Z³, from which it may be drawn
 50 off from time to time when a sufficient amount has been collected by removing the screw-plug Z⁴. The thick amalgam is drawn out from the chamber Z by removing the plug Z⁵.

In order to close the slot or channel in the depression P² when the collected material is to be drawn off from the chamber Z, I have shown the cylindrical pin *a* extending through the side of the chamber and having a portion
 55 of one side cut away at the point above the discharge-slot, as shown at *a'*. It will be manifest that when the pin *a* has been turned so as to bring the portion which is cut away over the slot the latter will be left open for the flow of the material into it, and when the
 60 pin is turned half around so as to bring its uncut periphery over the slot the latter will be temporarily closed. A spring *a*² is fitted

into a chamber in the end of an adjustable screw *a*³, and it presses against the end of the pin *a*, so as to keep it in place.

b is a vertical discharge-pipe extending up into the concavity P², so that the concentrates will be kept at a uniform depth at this point, and that portion which rises above its upper
 75 open end will flow down through it and be delivered into the discharge-pipe *b'*.

*b*² is a second discharge-pipe opening into the lower end of the table P, beyond the discharge *b*, and below the upper end of this discharge, and it is of so small a diameter that
 80 it will allow the heavy concentrates only to pass and will not disturb the level maintained by the overflow-pipe *b*, and through this such heavy particles as have not been delivered into the chamber Z, and which are intermediate
 85 in weight, so as not to be discharged through the overflow-pipe *b*, may be delivered. The curved plate Y, which extends above the depression P² and the discharge-opening Z receives the still lighter particles,
 90 which, flowing down the table P, are not heavy enough to descend into the depression P², and the light current of water causes them to pass over this plate and over the plate *c*, flowing on toward the final discharge.

The angle of the plates Y and *c* is adjusted by means of the two screws *d*, one pressing upon the top and the other upon the bottom
 100 of the overlapping ends of these plates, and as the opposite ends of these plates are properly pivoted or supported for the purpose, it will be manifest that they may be raised or depressed until the desired angle has been obtained.

e is a plate set into the lower end of the table P and adjustable by screws *e'* and *e*², so that it stands at any desired angle, declining toward the end of the plate *c*, so that the lowest depression is between the meeting
 110 ends of these two plates. A narrow space is left between these plates, as plainly shown at *f*, and into and through which depression the deposit from these plates will flow. This space is filled with the concentrates which may have reached this point, the level thereof
 115 being maintained by the overflow-discharge pipes *b* and *g*.

g is an overflow-discharge pipe situated at one side of the separating-box, as shown in the enlarged view, Fig. 11, through which the
 120 material thus collected at *f* is allowed to overflow and discharge into a proper receptacle.

g' is a pipe for the admission of clear water to maintain the fluidity and flow of the material.

h is a skimming-box fixed within the end of the separating-box, so that the concentrates passing over the plates *c* and *e* will flow beneath it, while the material still thinner and lighter will pass through the box *h*. The material not collected by the plates *c* and *e*
 130 passes out through the passage *i*. An opening *j* is made in the bottom of the box *h*, and a spring-plate *k* is adjusted over this open-

ing by a screw *l*, so that any small remaining valuable concentrates will flow off through the passage *j* and the discharge *j'*. The final discharge of worthless material takes place

5 through the passage *m'*.

n' is a water-pipe having passages *o* and *p*, through which water is delivered to keep the material upon the plate *e* sufficiently thin and prevent its settling and becoming clogged.

10 *r* are cheek-pieces, which are fitted to the sides of the separating-box to narrow the discharge at this point and to raise the surface and cause the light and worthless material to flow off above the horizontal plate *s*, which is
15 fixed in the skimming-box *h*, as shown. As the final discharge is free there will be a slight fall where the water passes between the cheek-pieces, and the plate *s* prevents this current from agitating the material below.

20 The material escaping from the passages *i* and *j'* is delivered into a tank *t*, the bottom of which is inclined, so that when the gate *u* at the lower end is opened the contents will discharge themselves by gravitation, and a
25 stream of water at the upper end will thoroughly clean the tank. This enables me to dispense with the expense of men to shovel out the tank, which in mining localities is often considerable. The tank is divided long-
30 tudinally into compartments corresponding, as may be desirable, with the number of concentrating-tables, and each compartment has a door *v* hinge at the bottom, so as to turn
35 about the hinge and close the end of the tank or open out and form a continuation of the bottom of the tank for the discharge of the contents. Suitable packing-strips form tight joints when the doors are closed, and the doors may be worked by block and tackle.
40 The discharges from the tank are delivered into amalgamating-pans. (Not here shown.)

The great difficulty experienced in practically saving and concentrating the valuable materials which are so light as to be carried
45 off by the slightest current or disturbance of the water is illustrated in thousands of tailings deposits from reduction-works, which show an assay value equal to and in many cases greater than what has been saved in the
50 works. Therefore the preliminary and repeated subsequent separations and devices therefor are all of value as the material passes along and becomes more and more attenuated.

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

1. In a concentrator, the receiving chamber or tank having a water-supply and a surface discharge-pipe, the spreading-cones supported
60 therein, the supply-slucice having the division strips or partitions by which the material is subdivided, and the discharge-openings situated directly above the cones, so as to deliver the material over their surfaces,
65 substantially as herein described.

2. In a concentrator, the sluice having the subdivisions and discharge-openings at the

lower ends thereof, a receiving-tank with water-supply and overflow-cones situated within
70 said tank and directly beneath the sluice-openings, so as to receive and spread the material delivered through these openings, inclined troughs situated below the cones, adjustable plates fixed at the lower ends of said
75 troughs, and passages or slots between said plates and the ends of the troughs into which the heavier portions of the material will fall, while the lighter portions will pass off over the adjustable plates, substantially as herein
80 described.

3. In a concentrator, the divided sluice, the tank with water-supply and overflow pipes, the submerged cones, inclined troughs, and adjustable plates, forming continuations of the bottoms of the troughs with slots or spaces
85 between the plates and the lower ends of the troughs, discharge-pipes into which the material passing through these slots is delivered, and annular water chambers and passages discharging upwardly around these pipes,
90 substantially as herein described.

4. In a concentrator, the receiving-tank with the subdividing cones, troughs, adjustable plates and passages, the discharge-pipes through which the collected material flows,
95 and the shaking-tables having pans at their upper ends into which the discharge-pipes deliver and within which the concentrates are received, substantially as herein described.

5. In a concentrator, the means for separating the slimes, sands, and the sulphurets and metals at a single operation, consisting
100 of a tank with an upwardly-flowing current of water and an overflow-discharge, cones over which the material to be concentrated is delivered and dispersed, inclined troughs
105 upon which the material is received from the cones, slots or passages for the escape of the sulphurets, metals, and heavy sands, and extensions over which the lighter sands are delivered through the upwardly-flowing current
110 within the tank, substantially as herein described.

6. The oscillating tables having the receiving-pans *O* at the upper end, pipes through
115 which the concentrates are delivered at opposite sides of the periphery of the pan, an interior annular dividing ring or partition with the passage beneath it through which the concentrates pass, and the double cones *R*
120 and *S*, fitted in the center of the pan, whereby the concentrates are separated at this point, substantially as herein described.

7. The concaved bottom pans *O*, with the annular rim or partition *O'* adjusted within
125 the pan, so as to leave a passage *Q* beneath it, the conical discharge *R* in the bottom of the pan, and the supplemental cone and funnel *S*, fitted above the cone *R*, and having a passage around its periphery through which
130 the concentrates may flow into the cone *R*, and thence onto the table *P*, substantially as herein described.

8. The pan *O*, with the supplemental rim

and annular passage beneath it, the separating-cones R and S, the table P, upon which the discharge therefrom is received, and an adjusting device whereby the discharge from the cone upon the table is regulated, substantially as herein described.

9. The tables P, having the receiving-pans O, into which the concentrates are delivered, and means for separating and grading said concentrates within the pans and delivering them therefrom upon the upper ends of the tables, mechanism by which the upper ends of the tables are caused to oscillate from side to side, and pivot-pins upon which the lower ends of the tables are supported, whereby the shaking motion is gradually reduced from the upper ends to the pivot-pins, substantially as herein described.

10. The concentrating-tables P, having their lower ends supported upon vertical pivot-pins and their upper ends adjustably supported upon the arms U' and the posts U, in combination with the eccentric or cam and the flexible rope connecting said eccentric with the supporting-arms of the table, and a returning-spring V', whereby the tension of the flexible connecting-rope is maintained and the tables returned after each oscillation, substantially as herein described.

11. The inclined concave concentrating-tables with pivotal support for the lower end and the rocking posts and elastic arms by which the table is returned to a central position, in combination with the eccentric, connecting-rope, and tension-spring, and the disengaging-clutch *m* and its actuating mechanism *n*, substantially as herein described.

12. The inclined shaking-tables having the concave bottom narrowing from the upper end toward the discharge, the receiving and concentrating pans fixed at the upper ends of said tables, and the separating devices at the lower ends of the tables, substantially as herein described.

13. The inclined concentrating-table with

variable shake, the depression or chamber near the pivot having a slot formed in the lower part of the depression, a receiving and discharge chamber beneath said slot, and a means for opening and closing the slot, substantially as herein described.

14. The shaking-table having a depression at its lower end for the reception and collection of concentrates, an overflow pipe or pipes whereby the level of the concentrates within this depression is maintained, a discharge-passage for mercury which collects in said depression, and a rotary segmental shaft extending above said passage, so as to open or close the passage when turned, substantially as herein described.

15. The inclined shaking concentrating-table, the separating-box forming a continuation thereof, overflow-pipes for the discharge of the graded concentrates, and pipes supplying water to the box, substantially as herein described.

16. The inclined shaking concentrating-table, the separating-box forming a continuation thereof, the overflow-pipes for the graded concentrates connected therewith, the skimming-box, and the fixed discharge-passage therefrom, with the horizontal plate fixed within the box to protect the bottom and lower strata from upper currents, substantially as herein described.

17. The inclined concentrating-table with separating-box, overflow-pipes, and discharges, in combination with a receiving-tank for the discharges situated below the concentrator, said tank having the hinged end door or doors and the inclined bottom, whereby it becomes self-discharging when the door is opened, substantially as herein described.

In witness whereof I have hereunto set my hand.

GUSTAV LANG.

Witnesses:

S. H. NOURSE,
H. F. ASCHECK.