(No Model.) 3 Sheets—Sheet 1.

H. H. EAMES.

APPARATUS FOR AMALGAMATING AND CONCENTRATING PRECIOUS METALS.

No. 581,106. Patented Apr. 20, 1897.

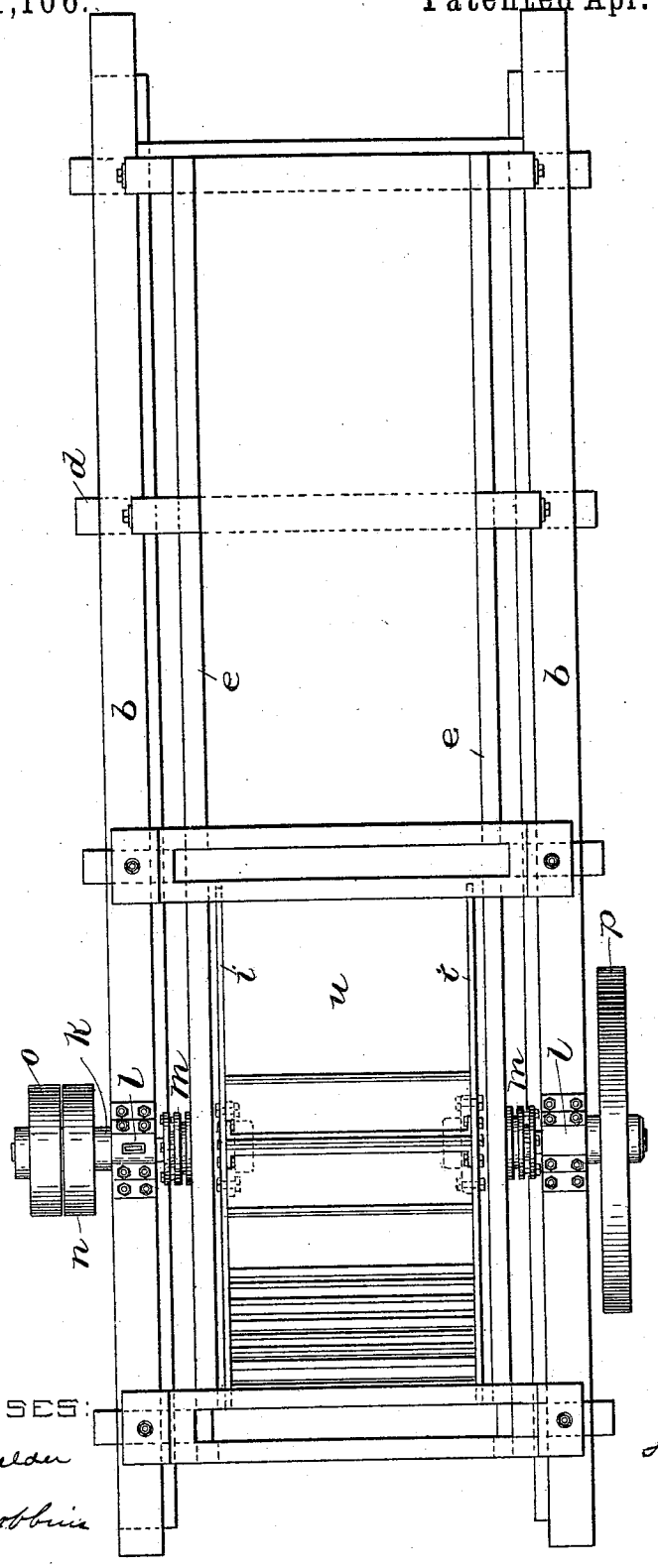

FIG. 1.

WITNESSES:
E. Batchelder
H. L. Robbins

INVENTOR:
Henry H. Eames

(No Model.) 3 Sheets—Sheet 2.

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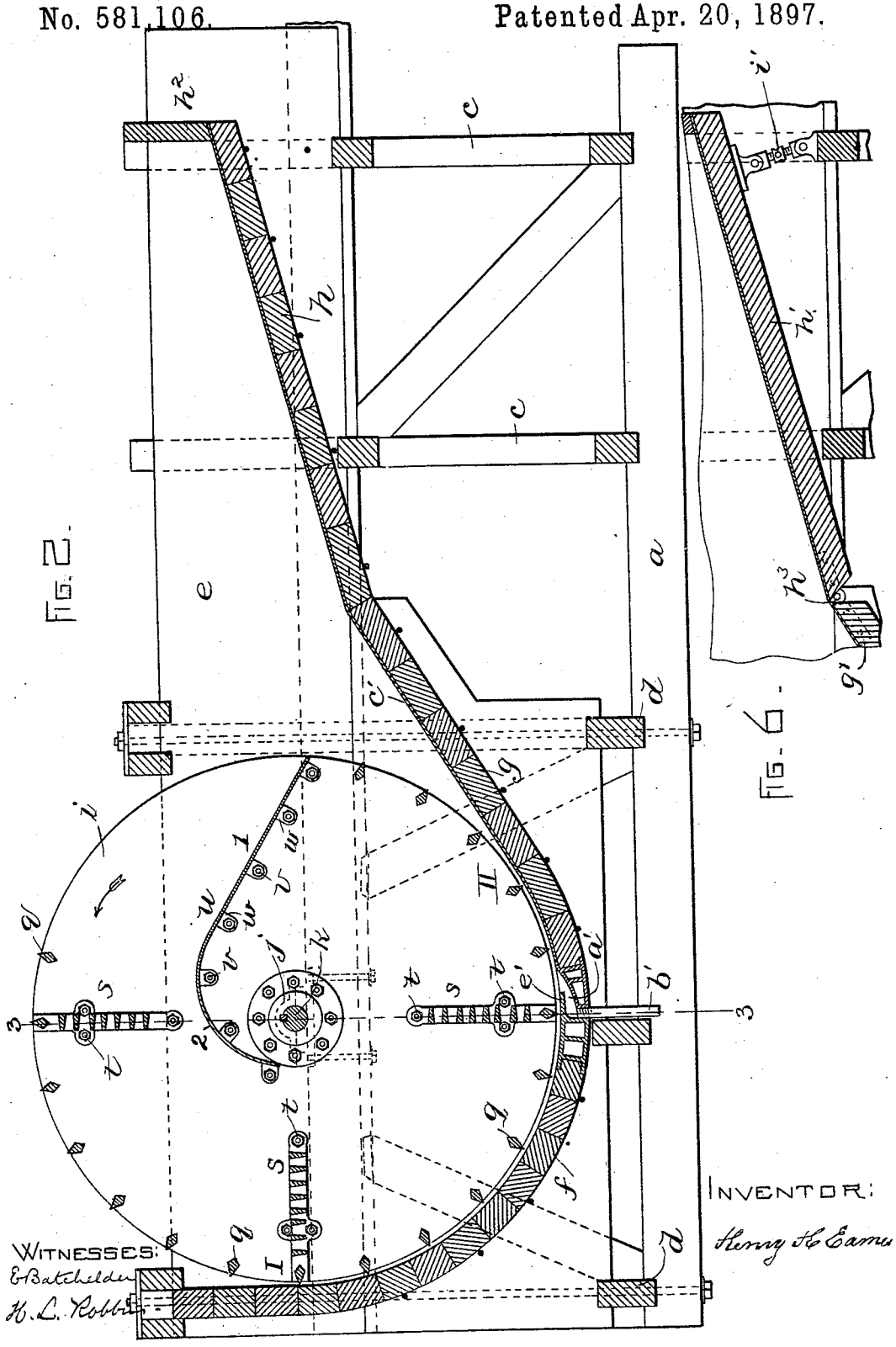

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H. H. EAMES.

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FIG. 3.

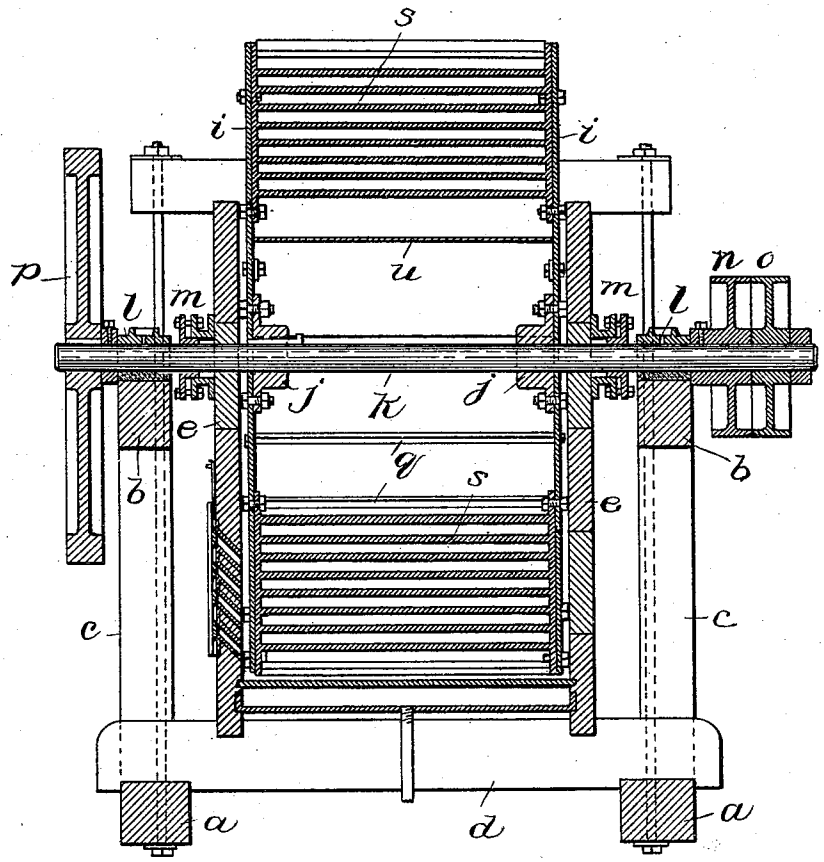


FIG. 4.

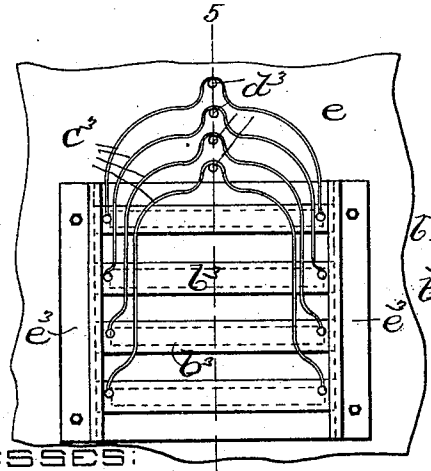
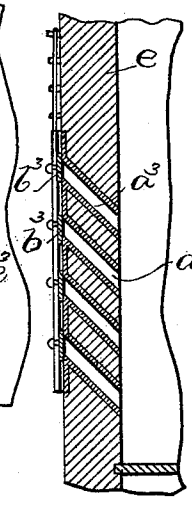


FIG. 5.



WITNESSES:
E. Batchelder
H. L. Robbins

INVENTOR:
Henry H. Eames.

UNITED STATES PATENT OFFICE.

HENRY H. EAMES, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO THE NOVA MANUFACTURING & MINING COMPANY, OF PORTLAND, MAINE.

APPARATUS FOR AMALGAMATING AND CONCENTRATING PRECIOUS METALS.

SPECIFICATION forming part of Letters Patent No. 581,106, dated April 20, 1897.

Application filed August 19, 1896. Serial No. 603,177. (No model.)

To all whom it may concern:

Be it known that I, HENRY H. EAMES, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Apparatus for Amalgamating and Concentrating Precious Metals, of which the following is a specification.

This invention has relation to an amalgamator or machine for separating the precious metals from their matrix and causing them to adhere to an amalgamated plate or plates in such a manner as to prevent practically any loss.

The object of the invention is to provide a machine of the character described of great efficiency, ease of manipulation, and economy in operation, by means of which the metals may be separated from the quartz or gangue with a minimum of loss.

Heretofore machines for mechanically separating metals from their ores have been constructed in any one of three different ways.

Machines of one class have been constructed so as to be placed in a sluice and have been provided with pockets for mercury and stirring-blades arranged over the pockets and rotating in such way as to cause the mass to be mixed with the mercury as it passes through the sluice, the mercury causing amalgamation of the metals and their separation from the quartz or gangue; but it has been found by experience that machines of this kind are exceedingly wasteful and that it is impossible to save the floured quicksilver and float-gold. Moreover, the mass of metal and quartz passes through the machines too quickly to save or abstract all of the metal, even the heavier particles being lost at times.

The second class of machines comprises those which are built or constructed in such way as to have a pan to which is given a gyratory motion, such as that given to a washing-pan by a miner. The mass of unseparated metal or ore is placed in the pan with a quantity of water, and by means of suitable mechanism the pan is gyrated or given a circular motion and at times a vertical motion for the purpose of swirling the mass around in such way as to cause the amalgamation of the particles of gold with the mercury on the face of the pan. Machines of this class are also wasteful of the floured quicksilver and the float-gold, besides requiring expensive machinery for their manipulation and a waste of time in the amalgamation of the metal. Moreover, it is impossible with these machines to bring all the metal into contact with the amalgamating-surface.

The third class of machines employed for the separation of the precious metals from their ores comprises machines each having a receptacle in which the unseparated mass is placed and which is lined with copper plates covered with mercury and a shaft passed therethrough with stirring-blades projecting outward therefrom, so as to cause the mixing of the mercury, which is also placed in the receptacle with the mass in such way as to amalgamate the metal. Machines of this class are frequently made to operate continuously—that is to say, the material is passed in at one end of the receptacle and is discharged at the other end, the stirring-blades being so constructed as to force the material along the sides which are coated with mercury.

In machines of all these classes the mass or gangue is agitated by the movement of the pan or by mechanical stirrers against the amalgamating plates or surfaces, and it is practically impossible to save, as has been heretofore stated, the finer particles of gold and the floured quicksilver which float off with the tailings and the discharged water.

My machine is constructed on a principle entirely different from any embodied in machines of the classes described. It consists of a receptacle in which a mass of pulverized quartz with the metal unseparated therefrom is placed, from which receptacle extends an inclined amalgamating-plate, up which the whole mass of material is thrust by a blade with a slow single wave-like motion similar to a wave on the seashore, so that the finer particles as well as the heavier particles of gold are carried up with the wave along the inclined plate and pass downward over the same with an undertow in such way as to bring them in actual contact with the mercury on the amalgamating-plate.

In machines as above described it is true

that the gangue and quartz, as well as the metals, are forced against the sides of the receptacle, but in no one of them is the entire mass thrown in a single wave-like motion up the amalgamating-plate, so as to flow downwardly thereon, similar to the way that an ocean-wave dashes up a sandy beach, carrying with it flotsam and jetsam and sand and depositing them upon the beach as it returns.

My improved machine comprises other novel features of construction and arrangement illustrated in the drawings and now to be described in detail and pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which like characters indicate like parts or features, as the case may be, wherever they occur.

Of the drawings, Figure 1 is a plan view of one embodiment of my invention. Fig. 2 is a vertical longitudinal section through the machine or amalgamator illustrated in Fig. 1. Fig. 3 is a cross-section on the line 3 3 of Fig. 2. Fig. 4 is a side elevation of a portion of the machine, in which are located the discharge-apertures for the tailings or material from which the precious metals have been separated, which apertures are closed by movable shutters. Fig. 5 is a section on the line 5 5 of Fig. 4. Fig. 6 illustrates a slightly-different construction of the amalgamator with relation to the inclined amalgamating-plates.

In carrying out my invention, only one embodiment of which is illustrated in the drawings and to which embodiment I do not wish to be understood as limiting myself, as it may be varied in form and the details of construction therein may be changed without departing in any way from the spirit and scope of the invention, I employ a main frame consisting of parallel bottom sills *a a*, upper sills *b b*, uprights *c c*, and bottom cross portions *d d*. In this frame thus formed is supported a receptacle having end walls *e e*. The bottom of the receptacle is of a peculiar shape—that is to say, it is provided with a semicylindrical bottom and side walls *f*, an inclined portion *g*, leading forward therefrom, and a second inclined portion *h*, which is at a less inclination than the portion *g*. The receptacle thus formed may be of wood or of any other desired material suitable for the purpose.

In the rear or receiving end of the receptacle is mounted a drum consisting of disks *i i*, secured to hubs *j j*, which latter are keyed to a supporting-shaft *k*, the latter being journaled in bearings *l* on the upper sills *b b*. The shaft passes through the end walls *e* of the receptacle, which are rendered water-tight by the glands *m m*, thus preventing the escape of the material operated upon. The shaft is provided with a fast pulley *n* and a loose pulley *o* at one end and at the other end is equipped with a fly-wheel *p*, as shown in Figs. 1 and 3. The drum-heads or disks *i i* lie close to the end walls *e e* of the receptacle and are connected by stirring or agitating rods *q*, which are arranged at regular intervals around the peripheries of the drum-heads, a space being left unprovided with the stirrers for a purpose to be described. The drum-heads are also provided with grids *s s s*, extending from one head to the other and secured thereto by bolts *t*. There are three of these grids, two being arranged diametrically opposite each other and the third grid being placed intermediate of the other two. The grids are arranged radially relatively to the shaft *k* and extend from the peripheries of the drum-heads for a distance substantially three-fifths the length of the radius of the drum-heads. When the drum is revolved by the shaft *k*, the stirrers and the grids agitate the mass of ore and water which has been placed in the receptacle, so as to mechanically induce the separation of the particles of the precious metals from the ore, which has been previously reduced to the required size by any of the methods now in use.

u is a blade extending continuously between the ends of the receptacle and from the peripheries of the drum-heads to a point on the other side of the shaft *k*, said blade having a straight portion 1 and a curved portion 2, and being secured to the drum-heads by bolts *v*, passing through lugs *w* on the blade. The outer edge of the blade is flush with the edges of the drum-heads and is secured to these drum-heads so as to lie opposite the part where the stirrers *q* are omitted.

The curved bottom of the receiving end of the receptacle is concentric with the drum-heads, which latter lie in proximity thereto, so that the stirrers or agitating-rods *q* will sweep near the bottom of the receptacle from I to II, as shown in Fig. 2.

There is a mercury-trap *a'* in the lowest part of the receptacle, with which is connected a pipe *b'*, which eventually forms a siphon in the usual manner. From the mercury-trap extends a copper amalgamated plate *c'*, which covers the inclined portions *g* and *h* of the bottom of the receptacle, extending throughout their entire length. The plates *g* and *h* are secured to the bottom of the inclines. If silvered copper plates are used, they may be amalgamated at once, but if the ordinary copper plates are used they must be scoured and amalgamated in the usual manner. With this done the machine is ready for operation.

The material is retained in the machine by placing a stop or head h^2 at the upper end of the incline *h*.

The two inclined portions *g* and *h* may be secured permanently together, as shown in Fig. 2, or else the incline *h'*, as shown in Fig. 6, may be connected to the incline *g'* by means of a hinge h^3 and be elevated or lowered by means of a screw *i'*.

The operation of the machine is as follows:

Mercury is first put into the mercury-trap, so as to fill the siphon, and sufficient water is then run into the receiver of the receptacle. Motion being imparted to the drum the proper amount of pulverized or crushed ore is then introduced and the amalgamation of the precious metals begins. The stirrers gently agitate the mass of water and ore, the grids going entirely through the mass, and the whole tending to assist in separating the metals from the mass. As the drum revolves the blade *u* enters the material and forces it with a single slow wave-like motion up the inclines *g* and *h*, causing an impact of the heavier portions of the material against the lower portion of the inclines, the lightest portion being carried with the wave up upon the upper incline *h*. The first or larger wave is followed by two or three smaller ones. These meet in succession at the upper end of the incline *h*, the action of which causes the very lightest particles of the precious metals contained in the ore to be deposited on the amalgamated plate and there retained until sufficient amalgam has accumulated to cause its gradual descent on the plate, eventually reaching the mercury-trap at the bottom of the machine. It will be seen that the waves being forced up the inclines forms a great feature of the machine, for the lighter portions of the material will have greater accelerated motion than the heavier or metallic portions, thus causing the latter to adhere or amalgamate with the mercury on the inclined plate. The receding wave acts in like manner, and by the slightly-increased speed of the wave at the end of the upper incline causes the heavier particles to impinge directly upon the lower incline *g*. The drum is rotated at such speed that the receding wave will have time to descend and the mass come to a state of comparative quietude before the blade shall again carry the mass up on the inclines. The waves have a comparatively gradual and slow motion, so that all of the metallic particles will remain at the bottom of the moving mass, the precious metals sinking by reason of their weight through the material and onto the amalgamating-plate, where they are thoroughly amalgamated. The plate is kept moist with the mercury, so that the material passes over practically a bath of mercury. The amalgam forming on the plate may be softened by pouring in mercury on the upper portion of the plate and made to descend therefrom over the remainder of the plate into the mercury-trap, where it is combined with the mercury contained in the same, and eventually finds its way to the siphon.

The mass of material may be retained in the receptacle as long as desired, the drum revolving the entire time, so that practically the whole material may be forced up upon the amalgating-plates any number of times or until the whole of the precious metal which it previously contained may be extracted therefrom and formed into amalgam on the plates.

The coarser gold is caught on the lower or steeper incline by the impact of the mass against it, while the finer gold is caught on the upper incline. The amalgam separated from the plates passes by gravitation into the mercury-trap and is saved.

Preferably a shield *e'* is placed partially over the mercury-trap to protect the mercury from the action of the blade as it passes over the latter.

I do not confine myself to any length of plate for the upper incline *h*, as it may vary under certain conditions, but have found a length of six feet eight inches to be a desirable length to do the requisite work, the amount of surface over which the ore and water or pulp is passed being vastly greater than in any device now employed for that purpose.

The mass is thrown upon the amalgamating-plates twice at each revolution—that is to say, the wave passes up the incline and then down it. Hence the material is caused to pass over a large surface of amalgamated plate without the least liability of scouring the same or any loss occurring from breaking from the plate, and is retained in the mercury-trap at the bottom of the machine, the ore or pulp being retained for any desired length of time until all the precious metals are extracted.

After the metals have been extracted from the ore or pulp the latter is discharged through upwardly and outwardly inclined apertures a^3 a^3 in the end of the machine, which discharge-apertures are normally closed by independent shutters b^3 b^3, held in place by angle-pieces e^3 and operated by the bails c^3 c^3, suspended upon pins or projections d^3 above the apertures.

By means of the upwardly and outwardly inclined apertures in the end of the receptacle and the independent shutters the mass from which the metal has been abstracted may be discharged gently and without effecting the wastage or loss of any of the fine float-gold, which will be retained either on the amalgamating-plates or in the trap.

From the foregoing it will be observed that I have provided a peculiarly simple machine for accomplishing the extraction of the precious metals from the pulp with the highest degree of efficiency, and by the action of the upper inclined plate I am able to save practically all the fine or float gold that is usually lost by any of the present mechanical methods. This not only gives higher percentage of yield, but the saving of both the fine and the coarse metals is of greater efficiency when in a free state than by means of any chemical method now in use.

By employing a receptacle having three portions or parts—namely, a receiving end, a steep incline leading therefrom, and a slighter incline extending out from the steep incline,

both of which inclines are covered by amalgamated plates—the entire mass of material may be forced or pushed upon the plates by a slow wave-like motion in such way that the particles of precious metals will of their own gravity pass down through the mass and become amalgamated upon the plates; and while I prefer a blade having that peculiar shape which I have described for throwing the mass in a wave upon the inclined end it will be understood that it may be of a different shape, since I do not wish to limit myself to the particular details of construction which I have described.

The receptacle is closed and stationary, so that the mass does not flow continuously through it, but, on the contrary, is manipulated without any of it escaping therefrom.

Having thus explained the nature of the invention and described a way of constructing and using the same, although without attempting to set forth all the forms in which it may be made or all the modes of its use, I declare that what I claim as new, and desire to secure by Letters Patent, is—

1. A machine of the character specified, comprising a stationary closed receptacle for the pulp, provided with inclined amalgamating-plates extending forward from the receptacle, and means for intermittingly forcing the whole mass of material with a single wave-like motion up the inclined amalgamating-plates.

2. A machine of the character specified, comprising a stationary closed receptacle for the reception of the pulp, a relatively steep incline leading from said receptacle, a relatively gentle incline leading from the steep incline, both inclines being covered with amalgamated plates, and means for intermittingly forcing the whole mass of material upwardly upon said amalgamated plates with a single wave-like motion.

3. A machine of the character specified, comprising in its construction a stationary receptacle having a receiving portion and an inclined bottom leading therefrom forwardly on one side only, and a revolving blade in said receiving portion of the receptacle adapted to intermittingly throw the entire mass of material upwardly upon the inclined amalgamated plates.

4. A machine of the character specified, comprising in its construction a stationary closed receptacle having a receiving portion, an inclined amalgamated plate leading therefrom, a trap at the lower end of said inclined plate, and means for throwing the whole mass of material with a single wave-like motion up the inclined plate.

5. A machine of the character specified, comprising in its construction a stationary closed receptacle having a receiving portion, an inclined amalgamated bottom leading therefrom, stirring or agitating devices located in said receptacle, and a wave forming or impelling device also located in the receptacle, and extending continuously between the ends of the receptacle for forcing the entire mass with a single wave-like motion up the inclined bottom.

6. A machine of the character specified, comprising in its construction a stationary receptacle having a partly-cylindrical receiver, amalgamating-plates leading upwardly and forwardly from the bottom of the said receiver, a drum revolving in said receiver, stirrers secured to said drum, and a blade extending continuously between the ends of the receptacle and also secured to said drum for forcing the material forwardly upon the inclined amalgamating-plates.

7. A machine of the character specified, comprising in its construction a stationary receptacle substantially as described, and having a mercury-trap in its bottom, and a revolving drum in said receptacle, said drum being provided with grids adapted to pass through the material, stirrers for agitating the material, and a blade extending continuously between the ends of the receptacle for forcing said material forwardly and upon its inclined bottom.

8. A machine of the character specified, comprising in its construction a receptacle having a partly-cylindrical bottom and side walls, and amalgamating-plates extending upwardly and forwardly therefrom, means for throwing the whole mass of material with a single wave-like motion upon the inclined amalgamating-plates, a mercury-trap arranged at the lower end of the amalgamating-plates, and in the bottom of the receptacle, said receptacle being provided with a series of vertical discharge-apertures in one of its ends and independent shutters for closing said discharge-apertures.

9. A machine of the character specified, having a closed stationary receptacle, and means for intermittently giving a single wave-like or undulatory motion to the material operated on, said means including an inclined plane upon which the material is forced upwardly, the material descending by gravity over the same plane.

10. A machine of the character specified, comprising a stationary receptacle closed at its ends and at its sides (in contradistinction to a receptacle through which fresh material passes in a stream), and having an inclined plane, and means consisting of a blade for forcing a succession of waves of the whole mass of material upwardly on said inclined plane, at the upper part of which they are caused to impinge on each other, the material then descending by gravity over the same plane.

11. A machine of the character specified, comprising a stationary receptacle closed at its ends and at its sides (in contradistinction to a receptacle through which fresh material passes in a stream), inclined amalgamated plates at an angle to each other and located only on one side of the machine, provisions

for causing the whole mass of material operated on to be intermittingly thrown upwardly in contact with said plates, and a receptacle for the amalgam so formed arranged to receive said amalgam by gravitation.

12. A machine of the character specified, comprising a receptacle having one side wall curved, and the other side wall which is amalgamated extending at an inclination from the bottom to a remote point, a shaft, and a single blade revolved by the shaft and extending continuously between the end walls of the receptacle.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 13th day of August, A. D. 1896.

HENRY H. EAMES.

Witnesses:
C. F. BROWN,
M. B. MAY.