2 Sheets—Sheet 1.

C. E. BALL.

Amalgamator.

No. 227,716. Patented May 18, 1880.

Fig. 1

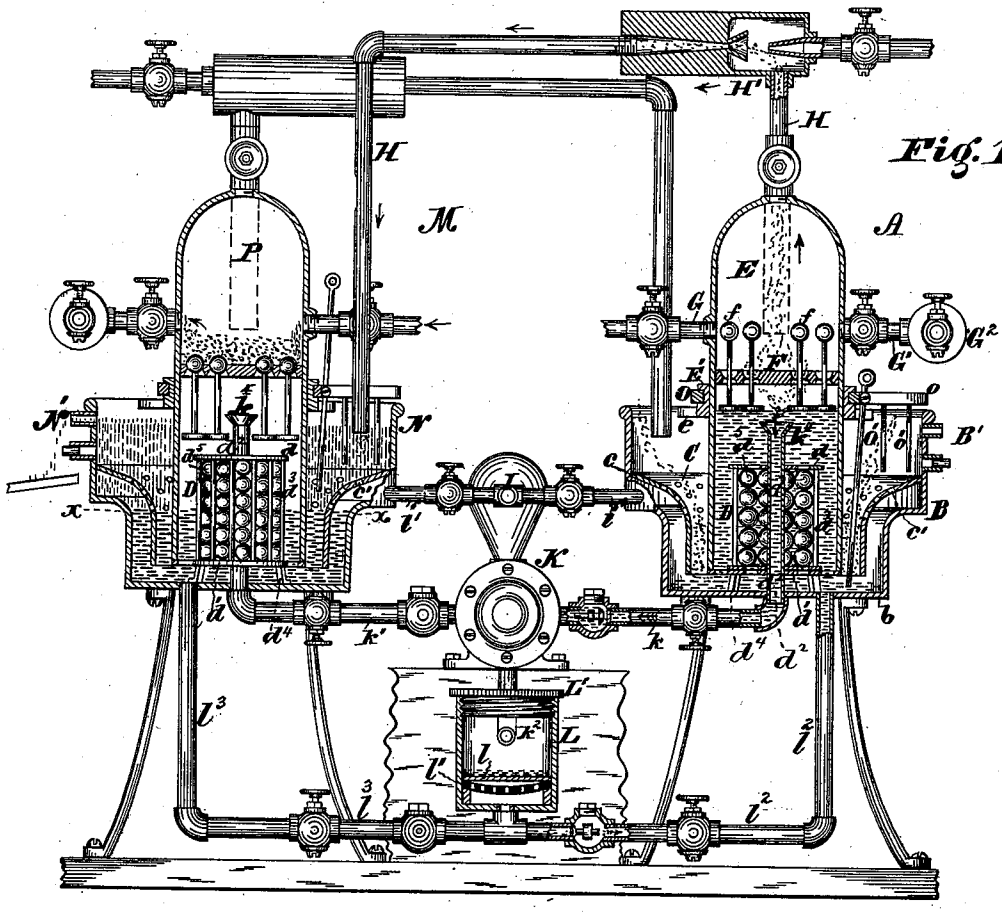
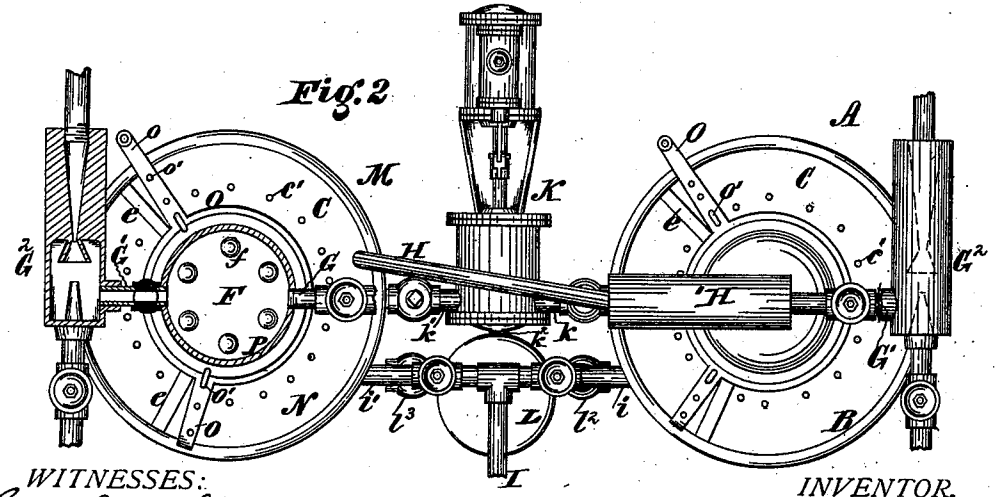


Fig. 2



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2 Sheets—Sheet 2

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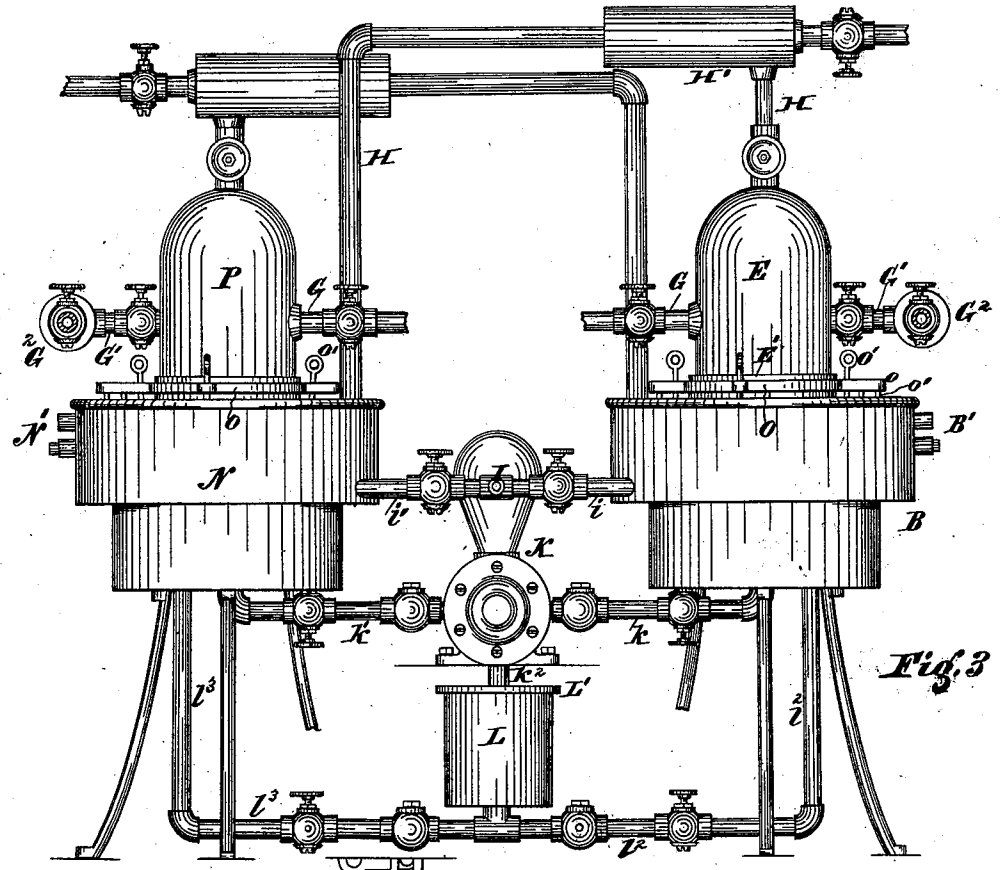


Fig. 3

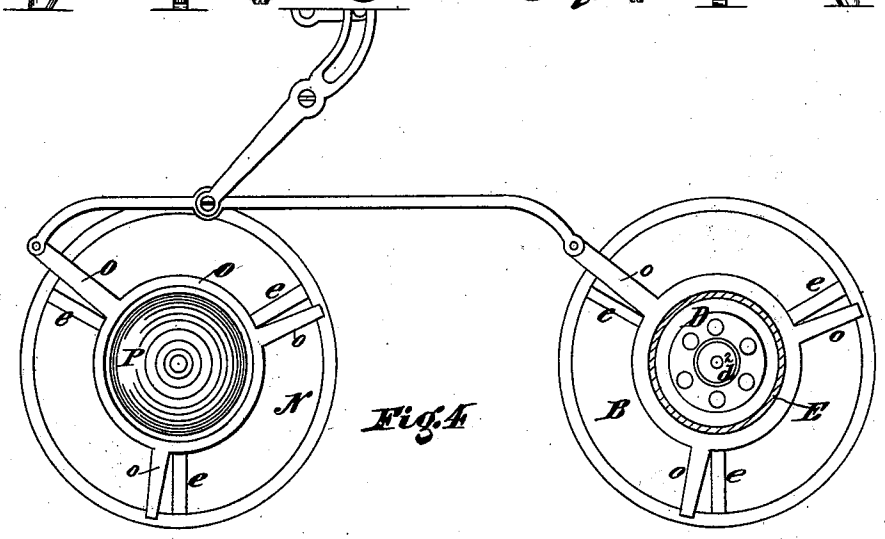


Fig. 4

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UNITED STATES PATENT OFFICE.

CHARLES E. BALL, OF PHILADELPHIA, PENNSYLVANIA.

AMALGAMATOR.

SPECIFICATION forming part of Letters Patent No. 227,716, dated May 18, 1880.

Application filed December 9, 1879.

To all whom it may concern:

Be it known that I, CHARLES E. BALL, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Amalgamators; 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 pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification, in which—

Figure 1 is a longitudinal vertical section of my invention. Fig. 2 is a plan, partly in section; Fig. 3, an elevation of the same; and Fig. 4 is a detail plan, showing mechanism for operating the agitators.

My invention has for its object to provide an improved apparatus for amalgamating the precious metals; and my improvements have special reference to the following points: first, to the provision of two communicating vessels, either of which is adapted for use as an amalgamator or as a concentrator or collector of fugitive mercury, and which are used alternatively for such purposes, both vessels being in employment simultaneously; second, to the peculiar construction of each of said vessels, whereby they are made capable of alternate use each as an amalgamator and as a concentrator of fugitive mercury; third, to the provision of peculiar means for displacing the mercury-bath, and securing the deflection or sinuous motion of the pulp through such bath; fourth, to the provision of means consisting of a diaphragm with float-valves, a water-supply pipe, and an exhaust mechanism for removing from the amalgamating-vessels particles of ore not sufficiently crushed to be amalgamated and too heavy to pass off with the pulp; fifth, to the provision of means for removing the precious metals from the amalgam and restoring the mercury to the amalgamating-chamber while the apparatus is in operation, such means consisting of a suction and force pump and a strainer, whereby the amalgam is withdrawn from the amalgamating-vessel, then strained, and the mercury restored to such vessel; sixth, to the peculiar construction of agitators which are employed to prevent the gangue from banking in the feeding-hopper of the amalgamating-vessel, and which, when said vessel is used as a fugitive-mercury concentrator, serve to disseminate the fugitive mercury over the surface of the mercury-bath in the hopper, and to incorporate it therewith; seventh, to certain details of construction hereinafter set forth.

Referring to the accompanying drawings, A and M represent two exactly similar communicating vessels, so that a description of one will answer for both.

B represents a hopper or tank having an apron or hood, C, connected to the walls of said hopper at *c*, and extending down to within a short distance of the bottom *b* of said hopper. Said apron has numerous perforations, (shown at c' c'.)

D represents a cage consisting of two perforated ends, *d* d', having a central hollow column, d^2, and rods or bars d^3 d^3. The end d' has feet d^4, whereby it is elevated from the tank-bottom. Within this cage is contained a number of balls, d^5, of glass or other material which will not amalgamate.

E is a cylinder, whose lower end is open, so as to pass down over the cage D and rest upon the bottom d', its upper end being dome-shaped or otherwise suitably closed. The cylinder E is steadied in its position by a ring or collar, E′, which is supported by arms *e e*, resting on and secured to the upper edge of the tank B. Within the cylinder E is a diaphragm, F, having float-valves *f*, which open from pressure below, but close by gravity or from pressure exerted above said diaphragm.

G is a water-supply pipe entering the cylinder E above the diaphragm, and G′ is an exit-pipe leading from said vessel in or about the same plane with said supply-pipe, and provided with an ejector or exhaust apparatus, G^2. H is a discharge-pipe leading from the upper part of the cylinder E to the hopper or tank N of the vessel M, being provided, as shown, with an ejector, H′, or equivalent suction or exhaust apparatus. I is a water-pipe having branches *i* i', which lead, respectively, to the hoppers or tanks B N.

K is a suction and force pump having two inlet-pipes, *k* k', communicating respectively with the cylinders E and P, and an outlet-pipe, k^2, leading to a strainer, L. Said strainer con-

sists of a closed vessel having a diaphragm of chamois-leather, *l*, or equivalent material, which rests upon a concave perforated metal disk or plate, *l'*, as shown in Fig. 1. From the strainer *l*, and on the side of the diaphragm opposite to that of the pipe k^2, lead two pipes, l^2 l^3, which respectively proceed through the bottoms of the tanks B N. Each of the pipes *k* *k'* should, after passing through the cages, be provided at their upper ends with a flaring mouth, as shown at k^4, and they, as well as the various other pipes, should be furnished with bib-cocks or check-valves, as indicated, the tanks B N having suitable waste-pipes B' N'.

O represents a collar surrounding the ring E' and capable of being rotated thereon. From said collar radial arms *o o o* project outwardly, and from these depend fixed branches *o'*. Each of said arms is also provided with a vertically-adjustable branch, O', which may be moved downwardly, so as to dip into the mercury-bath between the apron C and the cylinder E, and may be drawn up sufficiently to clear the surface of the mercury.

The operation is as follows: Mercury is supplied to each of the tanks B N until it rises to or about the level of the dotted line *x x* in vessel M, the cocks in the pipes leading to and from the pump, as well as the cocks in the pipes G G', (and the corresponding pipes in the cylinder P,) being closed. Water is permitted to flow into the tank N through the branch *i'*, the cock in the branch *i* to tank B being closed. Steam is admitted to the ejector H', the cock in ejector-pipe over cylinder P being shut. The rods O' in the collar O are moved down nearly to the bottom of the hopper B, while the corresponding rods in collar surrounding cylinder P are drawn up, so as to clear the surface of mercury in tank N, and both said collars are caused to oscillate around their respective cylinders by any suitable mechanism. Ore in the form of pulp is fed into the tank B and rises through the mercury in the cylinder E, said mercury being held in a state of suspension by the action of the ejector H'. The ore in its upward passage is deflected by the glass or other balls in the cage D and caused to take a sinuous course, hence retarding its movement and affording a longer period for amalgamation than were a direct course permitted. The mercury, when elevated by the exhaust, raises the valves *f*, as shown in vessel A, Fig. 1, and permits the waste to pass through the diaphragm F into the upper portion of the cylinder E, the precious metal in the ore amalgamating in its passage through the mercury. Thence the waste is drawn by the action of the ejector H' and discharged through the pipe H into the tank N. Here it falls upon the mercury in said tank, and is subjected to the action of the water entering through branch *l'* and flowing through orifices *c'*, as also to that of the rods *o' o'* O', the waste passing off through one of the conduits N' to the sluice-box, the light particles or fugitive mercury which is carried out of the cylinder E with the waste being collected or deposited on the surface of the mercury in tank N, and being to some extent consolidated with the body of mercury in said tank, the consolidation being assisted by the action of the stirrers. Thus it will be seen that one of the vessels acts as an amalgamator, the other as a washer and collector of fugitive mercury.

After the operation has progressed for a while, and without necessitating any cessation of it, the pump is started, the cocks in branches *k* and l^2, leading to the tank B, being opened, and those in branches *k'* and l^3, leading to tank N, closed. This draws the amalgam from cylinder E into the vessel or strainer L, strains the mercury through the diaphragms *l* and *l'*, and restores it to the tank B and cylinder E, thereby keeping the mercury in said cylinder and tank continually in good amalgamating condition. The precious metal left in the vessel L above the diaphragm is removed from time to time by taking off the lid L', the pump being then stopped.

After the operations of the apparatus have proceeded for some time there will usually be found in the amalgamating-cylinder, and above the valved diaphragm therein, a quantity of ore which, owing to its not having been sufficiently disintegrated, or from other cause, has not been amalgamated in its passage through the mercury and is too heavy to be drawn with the waste. To restore it to the stamp-mill for further crushing the apparatus is manipulated as follows: The supply of ore to the amalgamator is suspended, the ejector H' and pump K stopped, the ejector G^2 started, and water allowed to flow into cylinder E through pipe G. This draws the ore mentioned from cylinder E through ejector G^2, and it is thence delivered to the stamp-mill. After a considerable quantity of fugitive mercury is collected on the surface of bath in tank N the arrangements described are all reversed, so as to use the cylinder P as the amalgamator and the tank B as the concentrator. The first effect of the reversal is to elevate the mercury-bath in the tank N into said cylinder P and hold it suspended therein, the fugitive or float mercury being drawn through the suspended body and consolidated therewith. The operation then proceeds as already described.

What I claim as my invention is—

1. The hopper B, having apron C attached to its inner surface, with water-discharge orifices *c' c'*, in combination with the suction or exhaust appliances of an amalgamator, substantially as shown and set forth.

2. The cage D, with non-amalgamatable balls for the purpose of displacing mercury and deflecting the gangue in its upward passage through such mercury, in combination with the amalgamating-cylinder E and tank or hopper B, substantially as set forth.

3. In combination with cage D, having balls d^5 d^5, of non-amalgamatable material, the super-

posed and surrounding amalgamating-cylinder E, substantially as set forth.

4. The cylinder E, having diaphragm F, with valves *f f*, water-inlet G, and outlet G′, in combination with exhaust mechanism G^2, substantially as shown and set forth.

5. The combination, in an amalgamating apparatus, of two cylinders, E and P, with their connecting-tubes, having each an exhaust mechanism, H′, and two hoppers or tanks, B N, in which said cylinders are located, whereby one of said cylinders and its hopper may be employed as an amalgamator, while the other acts as a concentrator or collector of fugitive mercury, and be capable of alternate use for those purposes, as set forth.

6. The combination, with the mercury-holder of an amalgamator, of a suction and force-pump, and a strainer for withdrawing amalgam, straining out the mercury, and restoring it to said holder, substantially as shown and described.

7. The collar O, surrounding the ring E and capable of oscillation thereon, having arms *o′ o′ o′* and an adjustable rod, O′, substantially as and for the purpose set forth.

8. The process of recovering unamalgamated ore from the amalgamating-vessel, which consists in subjecting it in such vessel to the action of water and drawing it therefrom by exhaust, substantially as set forth.

9. The process of recovering fugitive mercury, which consists in collecting it on the surface of a bath of mercury in an outer vessel, suspending said bath by suction or exhaust in an inner vessel, and drawing such fugitive mercury by said suction into and through the suspended bath, so as to effect consolidation therewith.

In testimony that I claim the foregoing I have hereunto set my hand this 8th day of December, 1879.

CHAS. E. BALL.

Witnesses:

M. D. CONNOLLY,

CHAS. F. VAN HORN.