(No Model.)

C. E. BALL.

PROCESS OF AND APPARATUS FOR AMALGAMATING GOLD AND SILVER.

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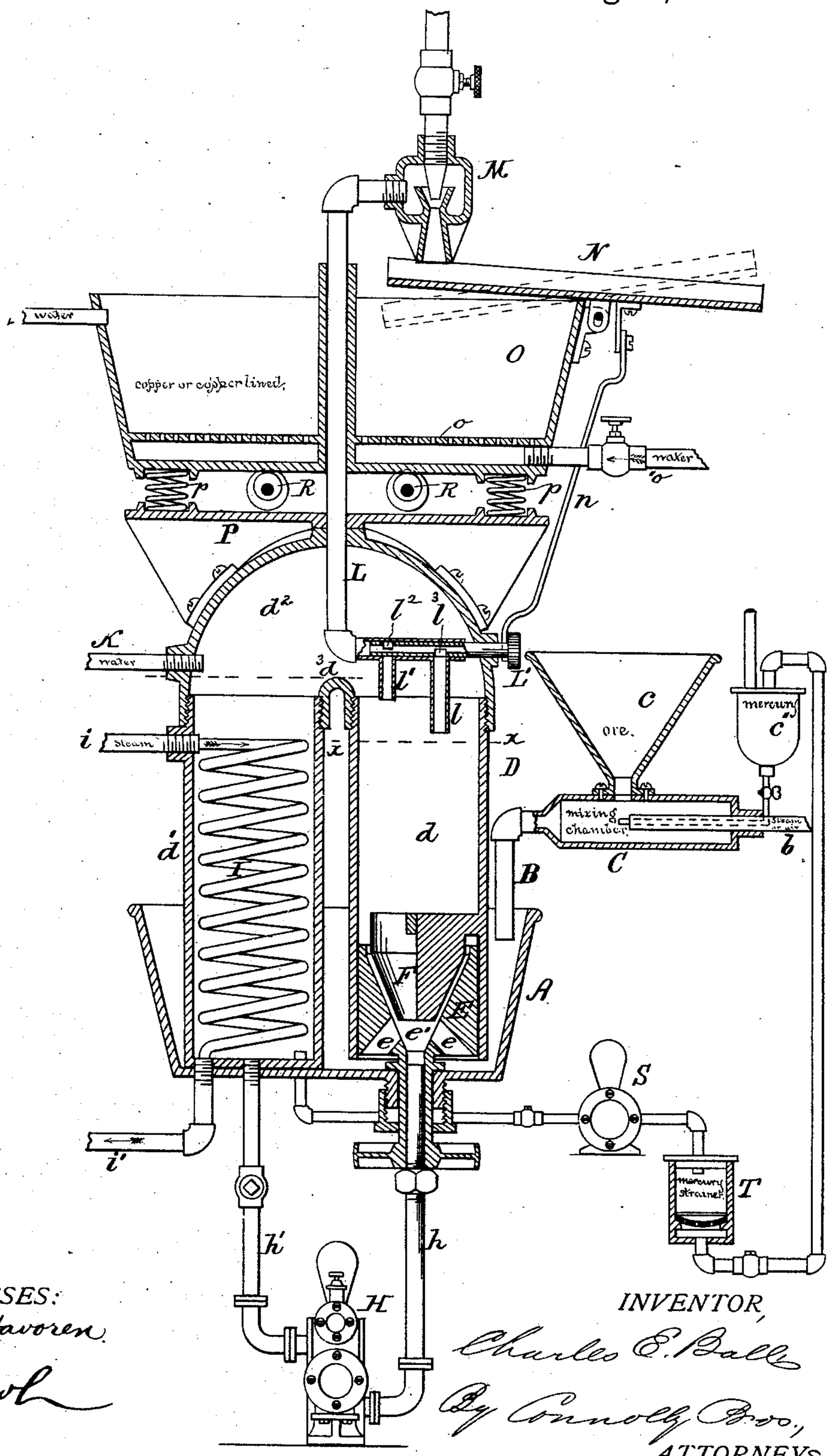

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PROCESS OF AND APPARATUS FOR AMALGAMATING GOLD AND SILVER.

SPECIFICATION forming part of Letters Patent No. 245,117, dated August 2, 1881.

Application filed June 1, 1880. (No model.)

To all whom it may concern:

Be it known that I, CHAS. E. BALL, of Philadelphia, Pennsylvania, have invented a new and useful Improvement in Process of and Apparatus for Amalgamating Gold, Silver, and other Ores, of which the following is a specification, reference being had to the accompanying drawing, forming part of this specification, wherein the figure is a vertical longitudinal section, partly in elevation, of an amalgamating apparatus embodying my improvements.

The objects of my invention are as follows: first, to facilitate amalgamation by rubbing, polishing, or abrading ore in its passage through a column of mercury; second, to secure a downward circulation of mercury in the amalgamating-chamber, so as to retard the upward movement of the ore through the same; third, to relieve the amalgamating-chamber of the coarse, unamalgamated portions of ore which accumulate on the surface of the mercury, by drawing off the same separately from the waste, in order to restore them to the mill to be recrushed; fourth, to collect any mercury which may escape from the amalgamator with the waste; fifth, to effect, without resorting to washing or settling, the separation of the waste from ore which has been mingled with mercury by means of a blast.

My improvements consist in, first, the means hereinafter described and claimed for polishing, or subjecting to rubbing or abrasion, ore while passing through a column of mercury, and herein relate to the provision, in the mercury-suspension chamber of an amalgamator, of a polishing-roller or equivalent device for polishing, rubbing, or abrading the ore in its ascent through such chamber; second, the combination, with a mercury-chamber having two compartments, of a pump for producing a downward circulation in the amalgamating-apartment of said chamber; third, the combination, with an amalgamating-chamber, of a discharge-pipe having branches or inflows at different altitudes, whereby the course unamalgamated portions of ore may be drawn out of said chamber separately from the waste; fourth, the provision of a pan having amalgamating-surfaces and provided with a false bottom and water-inlet, and having means whereby a vertically-reciprocating movement is communicated to it; fifth, the method of separating waste from ore which has been mingled or mixed with mercury, by means of a blast, and herein, in the combination, with a blasting ore and mercury mixer, of a suspension-chamber having an ejector or exhaust device, whereby the mingled ore and mercury are drawn upwardly through a column of suspended mercury, thus detaining the metals while the waste is permitted to escape; sixth, certain details of construction and combination hereinafter fully set forth.

Referring to the accompanying drawing, A designates a vat or tub designed to hold mercury and to act as an ore-receiver.

B represents a feed-pipe for ore, which may connect with a cylinder, C, forming a mixing-chamber for ore fed from a hopper, *c*, and mercury from a cup, *c'*, such ore and mercury being mingled in said chamber by means of a blast of steam, air, or other like medium admitted through a pipe, *b*.

D represents the amalgamating-chamber, consisting of a cylinder, *d*, whose lower open end is elevated slightly above the bottom of tub A, and another cylinder, *d'*, which rests upon said bottom, said cylinders *d* and *d'* being connected at their upper ends by a curved section or coupling, d^2. Within said cylinder *d* is a roller, E, having inwardly-inclining passages *e e*, leading to a flaring chamber, *e'*, within which is located a conoidal block or follower, F, which is made fast to the wall of cylinder *d*. The roller E is designed to fit snugly, yet rotate freely on its vertical axis, within the cylinder *d*, and is made vertically adjustable on its shaft, so as to increase or diminish, as may be desired, the distance between it and the block or follower F.

Leading downwardly from cylinder *d* is a pipe, *h*, which connects with a suction and force pump, H, from which proceeds another pipe, *h'*, connecting with cylinder *d'*. Within the latter is a coiled steam-pipe, I, whose inlet and outlet, respectively, are at *i i'*.

K is a water-inlet pipe to the section d^2.

L is the discharge-pipe of the amalgamator D, having two inflow-branches, *l l'*, of different lengths or terminating at unequal altitudes, the longer or lower one being designed to carry

off coarse portions of unamalgamated ore, and the higher or shorter one the fine waste or slime.

L′ is a stem having valves l^2 l^3, designed to alternately close the openings to the branches l l'.

M is an ejector on the upper end of pipe L, and discharging onto a rocking conduit, N, pivotally sustained on the upper edge of a pan, O. Said conduit is connected by a rod, n, with the valve-stem, L′, so that when the latter is turned to open the branch l the conduit will discharge the coarse particles outwardly or away from the pan O; but when said stem is turned to open the branch l' the conduit will be tilted to discharge into said pan. The pan O, which is a copper or copper-lined vessel, is supported on springs p p, which rest on a platform, P, sustained on the amalgamating-vessel D, and eccentrics R, on suitable shafts, are placed below it, as shown, so as to give a vertically-reciprocating motion to said pan. Said pan has a foraminated false bottom, o, and water-inlet o'.

S is a suction and force pump, and T a mercury-strainer, connected with each other and respectively with the cylinder d' and holder or cup c'.

The operation is as follows: Ore suitably crushed and, if desired, diluted to a fluid or slime condition, or minged with mercury by means of a blast, if the mixing device shown be employed, is fed into vat A through feeder B. Mercury having been previously supplied to tub A, and valve-stem L′ turned to close branch l and open l', the ejector M is started. At the same time pump H is set going and steam admitted to pipe I, and water caused to flow through pipes K and o'. The roller E and eccentrics R are also caused to revolve. The ejector lifts the mercury out of the tub A into cylinder d, up to or about to the line x x, mercury flowing through pump H until it finds the same level in cylinder d', enough of the metal, however, remaining in tub A to form a thin sheet on bottom of latter, the entrance to said cylinder d being unsealed. The ore, or ore and mercury from feed-pipe B, dropping into tub A, passes up through the suspended column of mercury in cylinder d, being polished, rubbed, or abraded in its passage by the roller E and follower F. The mercury in cylinder d' becomes expanded by the heat from coil I, and is forced by the pump H in a stream or current over the edge d^3, whence it drops down into cylinder d. By this means a downward circulation of mercury is secured in the amalgamating-cylinder d, thus retarding the passage of ore through the same, and thereby beneficially increasing the period of time for allowing amalgamation. The water admitted through pipe K dilutes the waste and prevents too great expansion of the mercury, such waste being drawn through branch l', and discharged by ejector M onto conduit N, whence it flows into pan O. Here any particles of mercury which may have escaped with the waste are caught upon the sides or bottom of pan, O, the agitation of latter facilitating the collection. After the operation has proceeded for some time there will be found on the surface of the mercury, in amalgamating compartment or cylinder d, an aggregation of particles of ore too coarse to amalgamate and too heavy to rise to pipe or branch l'. The stem L′ is now turned, opening branch l and closing l', the conduit N being thereby tilted, so that it inclines outwardly or away from pan O. The coarse particles on surface of mercury in chamber d are thereupon drawn upwardly through branch l, and discharged by ejector M upon conduit N, to be conveyed from latter to the mill for recrushing. After such coarse particles are removed the normal operations as first described are resumed on reversing stem L′.

The amalgam in chamber d' may be withdrawn from time to time by means of pump S and strained through T, the mercury being restored to cup c'. This straining and restoring process I do not herein claim, as it is shown in a patent already granted to me.

The advantages of the improvements herein shown and claimed are, briefly, as follows: If the ore at the start be mixed with mercury by a blast, as is proposed under a process already patented, a separation of the waste from the amalgam may be instantly effected by the passage of the mixture through the column of mercury held in suspension by exhaust in cylinder d, thus dispensing with the tedious and costly processes of washing and settling hitherto resorted to. The ore, whether so mixed with mercury by the blast or not, is polished, abraded, or rubbed in its passage through the column of mercury. This is necessary with silver and flaky gold ore, and with rust-gold, in order to effect assimilation with the surrounding mercury. The circulation of the mercury retards the ascent of the ore and increases the time of amalgamation therefor. The heating of the mercury renders it lighter and reduces the amount of pressure required to maintain the circulation, besides bringing said metal into a condition which promotes its affinity for others. The separation of the coarse particles of ore, and their restoration to the mill, prevents their escape with the waste and the loss of the metal therein. Finally, the loss of mercury with the waste is prevented by its collection in the reciprocating pan.

I have shown and described the discharge-pipe as having two separate branches; but it is obvious that the pipe itself may be extended down into the amalgamating-chamber and have two separate inflow-openings at different altitudes, with means for closing the same alternately; or that two separate discharge-pipes, both communicating with the same ejector, one adapted, by reason of terminating at a certain distance above the surface of mercury, to take the waste, while the other, designed to take only the coarse particles and extended, therefore, nearer to the surface of the mercury than

the other, may be employed. The same result, requiring, however, the employment of two ejectors, which here I accomplish with one ejector, is obtainable by the means shown in my Letters Patent No. 227,716.

What I claim as my invention is—

1. In combination with the suspension-chamber of an amalgamating device provided with means for sustaining a column of mercury, a roller, E, and follower F, or equivalent device for polishing, rubbing, or abrading ore in its passage through the mercury in said chamber, substantially as specified.

2. The process herein described of retarding the passage of ore through mercury, consisting in maintaining a downward circulation of mercury in the amalgamating-chamber while the ore is ascending, substantially as specified.

3. In combination with an amalgamating-vessel in two compartments or chambers, a pump communicating with both and operating to draw from one and force into the other, whereby a downward circulation of mercury is maintained in the amalgamating compartment or chamber, substantially as specified.

4. In combination with an amalgamating-vessel having two compartments and connected with a pump for securing a circulation of mercury therein, an ejector for produing exhaust in said vessel, and a steam-pipe for heating the mercury, substantially as and for the purpose set forth.

5. In combination with an amalgamating-vessel having an ejector or equivalent suction or exhaust appliance for maintaining a column of mercury elevated therein, a discharge pipe or pipes connected with such ejector and having inflows at different altitudes, whereby the fine waste and the coarse unamalgamated particles of ore may be separately withdrawn from the amalgamator and discharged through an outlet common to both, as specified.

6. In combination with amalgamating-vessel D, the discharge-pipe L, having branches $l\ l'$, terminating at different altitudes, valve-stem L′, having valves $l^2\ l^3$, and ejector M, substantially as shown aud described.

7. In combination with amalgamating-vessel D, the pan O, rocking conduit N, discharge-pipe L, having branches $l\ l'$, valve-stem L′, with valves $l^2\ l^3$, and connecting-rod n, substantially as shown and described.

8. The pan O, having amalgamating-surfaces, foraminated false bottom o, and water-inlet o', below said bottom, with means, substantially as specified, for reciprocating said pan, substantially as set forth.

9. In combination with means, substantially as specified, for mixing ore and mercury by means of a blast, a receiving-vessel, A, a suspension-chamber, D, and a discharge-pipe, L, with ejector M or equivalent suction or exhaust device, whereby the waste is separated from the amalgam without washing or settling by drawing the mixed ore and mercury through a column of mercury.

In testimony that I claim the foregoing I have hereunto set my hand this 29th day of May, 1880.

CHAS. E. BALL.

Witnesses:
WM. M. MCKNIGHT,
S. J. VAN STAVOREN.