

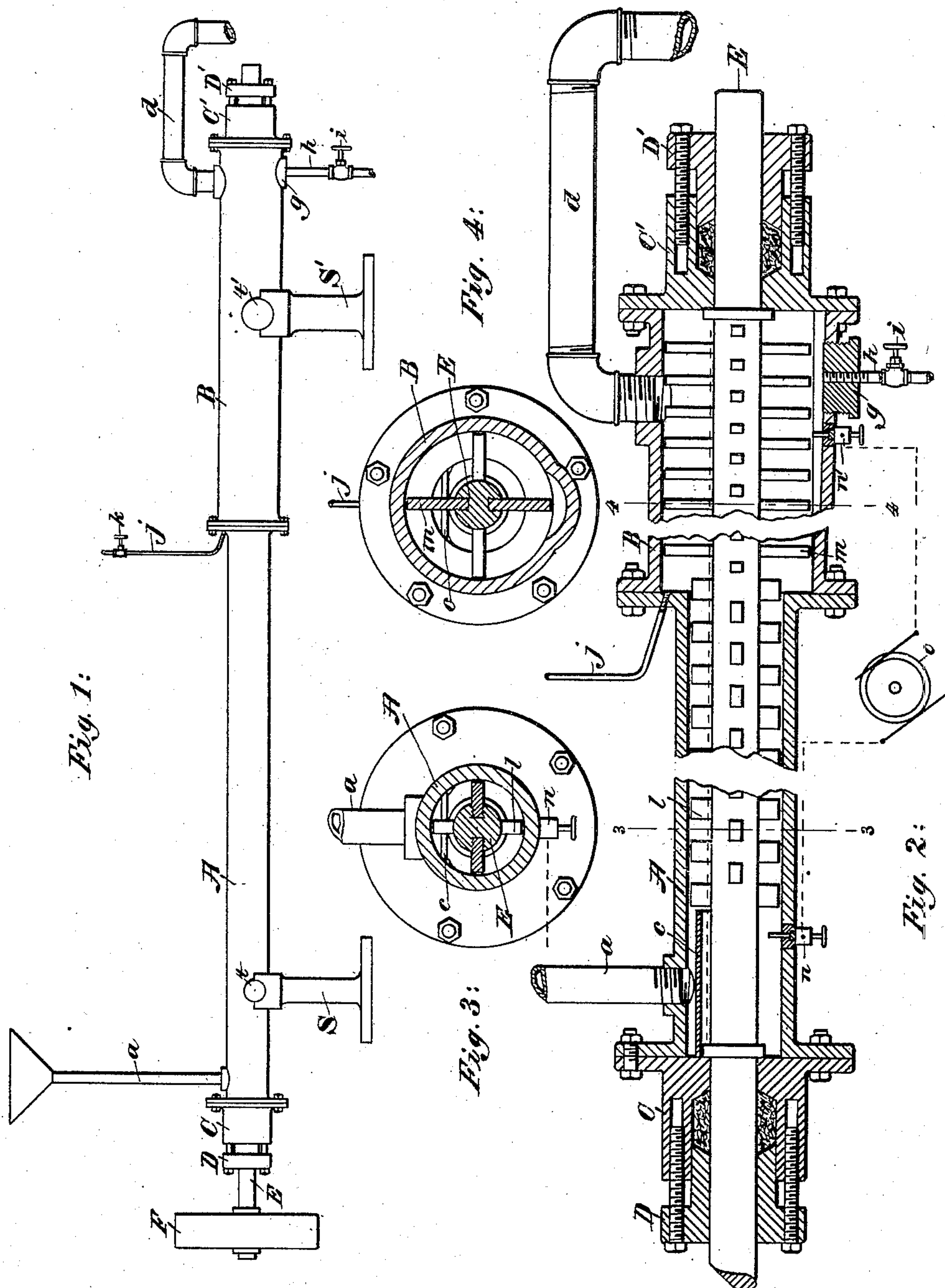
No. 705,095.

Patented July 22, 1902.

P. A. KNAPPE.
AMALGAMATOR.

(Application filed Mar. 7, 1902.)

(No Model.)



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UNITED STATES PATENT OFFICE.

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AMALGAMATOR.

SPECIFICATION forming part of Letters Patent No. 705,095, dated July 22, 1902.

Application filed March 7, 1902. Serial No. 97,035. (No model.)

To all whom it may concern:

Be it known that I, PAUL A. KNAPPE, a citizen of the United States, residing at Grantville, in the county of Coweta and State of Georgia, have invented an Improvement in Amalgamators, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention relates to amalgamators of the type employing free mercury. Amalgamation by free mercury when carried out successfully possesses many advantages over other methods of extracting the precious metals; but in its practical application difficulties are encountered which have heretofore rendered the amalgamators employed commercially inefficient. One of the essential requisites is that the pulp or mixture of comminuted ore and water should be so thoroughly intermingled with the mercury that the greatest possible portion of metal may have contact therewith to form the resultant amalgam. On the other hand, this intermingling must be carried out in such a manner as to prevent too violent an agitation of the mercury, since the latter is easily "floured" or finely dissipated, in which condition it is unfit for further amalgamation, being carried off with the waste product, resulting in a loss of the mercury as well as of the more precious amalgam with which it may be associated. During this intermingling process, owing to the difference in specific gravity, the bulk of the mercury tends to remain at the bottom of the receptacle in which the amalgamation is being carried on, and the pulp tends to remain uppermost, there being a strong tendency to resist any force impelling the mercury upward or the pulp downward. It has heretofore been practically impossible to obtain a form of agitation that would cause proper mixture without flouring the mercury. The subsequent separation of the waste, commonly called "gangue" or "sand," from the amalgam is ordinarily a process of settling dependent upon the difference in specific gravity between the two substances. The mixture during the separation must be undisturbed to the extent of permitting the par-

ticles to rise or descend according to their relative specific gravity. On the other hand, some disturbance of the mass must still be maintained to free the intermingled particles of mercury and amalgam from the gangue or sand and admit of their free circulation and ready response to the laws of gravitation; otherwise a large percentage of the amalgam will pass off with the gangue.

My invention aims to provide an amalgamator which shall so combine the various essentials above mentioned as to produce better results than have heretofore been possible.

An understanding of my invention will be best obtained from consideration of a structure illustrating the same, it being understood, however, that the invention is not restricted to the particular structure disclosed.

Referring to the accompanying drawings, Figure 1 is a side elevation of my improved amalgamator. Fig. 2 is a broken central longitudinal sectional view of the same shown on a larger scale. Fig. 3 is a cross-sectional view taken on the line 3 3 in Fig. 2, and Fig. 4 is a similar sectional view on the line 4 4.

In the drawings, A represents a cylindrical tube having flanged ends, by which it is coaxially bolted at one end to a similar tube B of greater diameter and at the other end to a head C. At the opposite end of the tube B is a similar head C', bolted through similar flanges. The heads C C' provide stuffing-boxes D D', forming therewith bearings for the shaft E, which passes throughout the length of the two tubes and is provided at one end with a suitable pulley F, through which proper rotary movement may be imparted to said shaft E.

The amalgamator-tubes formed as above described carry trunnions $t t'$, resting in uprights S S'. An inlet or feed pipe a for the introduction of pulp enters near the leading end of the tube A through an opening in a boss cast on the upper side of said tube A. Directly beneath the entrance of said tube A is placed a shield c , which may be of metal or other suitable material and is removably fitted in the side of the tube A in any convenient manner. A gangue or waste discharge pipe d has communication with the

tube B, preferably near the upper outer end thereof. At the under side of the tube B and preferably near its outer end is cast a boss, in which is screwed the plug *g*, containing a draw-off pipe *h* for the mercury, controlled by the valve *i*.

As a convenient means for draining the amalgamator, but forming no essential feature thereof, I have shown a slight trough-like depression formed, preferably, in the under wall of the tube B and diminishing in depth from the outer end of said tube toward the initial end, where the cross-section of the tube is substantially circular. This depression is so slight as to be scarcely perceptible in the view shown in Fig. 1, but will be more readily understood by inspection of Fig. 2 and the cross-section shown in Fig. 4.

A pipe *j* for the discharge of water or other fluid into the amalgamator enters the same, preferably, at the point of juncture of the tube B with the tube A, being adapted to discharge its contents in a forwardly-inclined direction under the control of the valve *k*. It is to be understood, however, that I am not limited to the construction shown and that any suitable means of bringing the fluid into the amalgamator may be employed.

On the shaft E within the tube A, except where they would conflict with the shield *c*, is placed a series of radial mixing-arms *l*. As shown in the drawings, they appear in staggered sets of two, screwed into the shaft E or otherwise suitably attached thereto and adapted to be revolved within the tube A with but slight clearance. The shaft E carries another series of freeing-arms *m*, adapted to revolve within the tube B. These arms *m* are suitably dimensioned and disposed to produce a disturbance of the contents of the tube B without producing any substantial intermingling of the mercury and the gangue. Other means for mixing and freeing may be employed, and I am not limited to those above described, which are merely such as I have found well adapted in practice to effect an efficient mixing and freeing.

In Fig. 2 is diagrammatically shown a generator of electric current, *o*, which is omitted from Fig. 1 for the sake of clearness. This is electrically connected with the terminals *n n'*, which have access to the interior of the tubes A B, respectively, through suitable insulating-plugs and are adapted to have contact with the mercury therein contained to cause passage of the current through the mass of intermingled pulp and mercury in the mixing-chamber. The electric current is employed to increase and sustain the activity of the mercury and to prevent the latter from "sickening." Any means for the passage of a current through the intermingled pulp and mercury may be used; but in practice I have found the employment of an interrupted or alternating current most effective. This amalgamation is employed in the following manner: The two chambers are filled to the

desired level with mercury, which for the sake of illustration may be indicated by the dotted line in Fig. 2, but in practice is subject to variation. The pulp is fed through the inlet-pipe *a* to substantially fill the chamber of the tube A, but on entering the said chamber is prevented from dropping on the mercury immediately below and flouring the same by the protecting-shield *c*. The pulp is preferably fed to the amalgamator, conducted therethrough, and finally removed therefrom through the agency of pressure. As a convenient means for obtaining this pressure I have shown the pulp-inlet pipe surmounted by a hopper suitably elevated above the outlet-passage, so that the desired pressure may be obtained on feeding the pulp to the hopper. Any other means, however, for obtaining a suitable pressure may be employed. Under the influence of pressure the pulp is gradually worked from the initial end of the mixing-tube A to the settling or freeing tube B. During its passage through the mixing-tube it is subjected to the steady action of the mixing-arms *l*. This action is sufficiently mild to avoid the flouring of the mercury, and yet the available space within the mixing-chamber is so restricted that the particles of pulp are brought into contact with the mercury on slight movement, and the mixing-arms are so dimensioned and disposed that a thorough intermingling of the mercury and pulp is effected before the pulp reaches the settling-chamber. The proportions of the settling-chamber and the size and disposition of the freeing-arms are such that the mixing action ceases here, and the particles of sand and pulp, now intermingled with bits of mercury and amalgam, are set into free circulation. This disturbance of the mixture and the resultant movement of the particles cause a freeing and separation of the heavier bits of mercury and amalgam, which pass downward, while the lighter particles of sand rise and are carried off through the outlet.

Since the outlet-passage is located at the top of the chamber and the pulp passes therethrough under the influence of pressure, the settling-chamber is substantially filled with pulp above the line of mercury. It is to be understood, therefore, that the term "restricted" or "confined" space as applied to the available space in the mixing-chamber is used in a relative sense, and, further, that it is only used to distinguish a space in which the particles of sand cannot move freely without coming into mixing contact with the mercury from a space in which greater freedom of movement is allowed the sand particles for the separation therefrom of the mercury and the amalgam. It is also to be understood that this term has no reference to the dimensions of such spaces either actual or relative, for it is obvious that greater freedom in the movement of particles of pulp may be obtained in the settling-chamber by a mere change in the shape or proportions of said

chamber as well as by an actual change in the dimensions of the same. My invention is not, therefore, limited to chambers of the particular shape, size, or proportions shown and described. It is also to be observed that distinct mixing and settling spaces may be obtained in a receptacle of uniform size and shape by altering in a variety of ways the characteristics of the space in different parts thereof. By distinct mixing and settling chambers, therefore, I include all such distinct spaces which possess the characteristics described without reference to the inclosing receptacle. The freeing action of the revolving arms employed in this larger chamber as distinguished from the mixing action in the first chamber is calculated to increase the circulation of the particles of sand and amalgam and aid the setting process; but as various means may be employed for accomplishing this purpose I am not limited to any particular kind of agitation. It is only necessary that this step should be carried out under such conditions as to aid the free circulation of the sand and the separation of the lighter from the heavier particles by gravitation. As the pulp passes through the settling-chamber it loses more and more of the entrained mercury, and by the time it reaches a position near the outlet-pipe it is free from substantially all of the mercury and amalgam and is ready to be carried off through the outlet-passage in the form of gangue. In addition to giving the particles of the mixture greater freedom of movement and a mild freeing action within this settling-chamber in distinction to a restricted movement and a mixing action in the amalgamating-chamber I have found it sometimes advantageous to intermingle with the gangue a quantity of water or other vehicle fluid, preferably, as it passes from the amalgamating-chamber into the settling-chamber. This I accomplish in the above-described apparatus by admitting water through the pipe *j*. The addition of liquid at this point dilutes the pulp, aids the free circulation of the heavier particles, thereby materially improving the settling, and also acts as a vehicle to carry off the gangue through the outlet-passage. I do not, however, regard the means for diluting the pulp as an essential element to my invention.

It is to be observed that by placing the settling-chamber in open communication with the mixing-chamber I obtain an unimpeded circulation of the sand or pulp throughout the entire process and that there is no interruption in its passage from the mixing to the settling chamber. The process as above described is a continuous one. The pulp fed into the hopper is brought into contact with a body of mercury and mingled therewith. Under pressure it is carried through the mixing-chamber, and while still under the moving influence of pressure it is so acted upon as to permit a complete separation by settling and a removal of the gangue.

The amalgamation is carried on without interruption until it is desired to withdraw the mercury and replace it with a fresh charge. The withdrawal of the mercury is readily effected through the pipe *h*.

It is to be understood that the structure described and shown, although well adapted, as I have found, to carry out my invention in practice, is submitted for illustrative purposes only and that I am not limited to any particular structure or means for carrying it into effect.

I claim—

1. In an amalgamator, the combination of a mixing-chamber having a pulp-inlet, means for intermingling the pulp and mercury therein, a settling-chamber having a less restricted space than the mixing-chamber in communication therewith and adapted to receive the intermingled pulp and mercury therefrom, means in said settling-chamber for circulating and opening up said intermingled mass, a gangue-outlet therefrom and a settling-space therein out of the path of travel of the intermingled pulp and mercury.

2. In an amalgamator, the combination of a mixing-chamber, mixing means therein, a settling-chamber communicating with said mixing-chamber and having less restricted space than said mixing-chamber, so located as to receive the intermingled substances from said mixing-chamber, freeing means therein for aiding the free circulation of the particles of pulp, an outlet for said settling-chamber, said settling-chamber having a settling-space out of the path of travel of the intermingled pulp and mercury, and means to cause the passage of the pulp under pressure through said mixing-chamber, settling-chamber and outlet-passage.

3. In an amalgamator, the combination of a mixing-chamber having a pulp-inlet, mixing means therein, a settling-chamber communicating with said mixing-chamber having a less restricted space than said mixing-chamber and so located as to receive the intermingled pulp and mercury therefrom, said settling-chamber having a settling-space out of the path of travel of the intermingled pulp and mercury, and means for diluting the intermingled pulp and mercury during its passage through the amalgamator to aid the circulation of the same and the separation of the heavier from the lighter particles.

4. In an amalgamator, the combination of a mixing-chamber having a pulp-inlet, means for intermingling the pulp and mercury therein, a settling-chamber having a less restricted space than the mixing-chamber in communication therewith and adapted to receive the intermingled pulp and mercury therefrom, means in said settling-chamber for circulating and opening up said intermingled mass, a gangue-outlet therefrom, a settling-space therein out of the path of travel of the intermingled pulp and mercury, and a source of electricity connected with the interiors of said

chambers to cause passage of the current through the intermingled pulp and mercury.

5 In an amalgamator, the combination of a mixing-chamber, mixing means therein, a
5 pulp-inlet therefor, a substantially horizontal settling-chamber communicating therewith
10 and having an outlet for the gangue at the other end thereof, said settling-chamber having a less restricted space than said mixing-
10 chamber and having a settling-space outside the path of travel of the intermingled pulp and mercury and means to dilute the pulp during its passage through the amalgamator.

6 In an amalgamator, the combination of
15 a cylinder, a pulp-inlet therefor, mixing means within said cylinder, a larger, substantially horizontal, stationary cylinder opening therefrom having unobstructed communication and being in substantial alinement there-
20 with, freeing means therein, and an outlet-passage leading from said latter cylinder.

7 An amalgamator comprising distinct mixing and settling chambers in open communication, having respectively distinct mix-
25 ing and freeing means therein, said settling-chamber having less restricted space than said mixing-chamber and having a settling-space out of the path of travel of the intermingled pulp and mercury, and means for
30 causing the pulp to circulate through said chambers under pressure.

8 An amalgamator comprising distinct mixing and settling chambers in open communication, mixing means in said mixing-
35 chamber, said settling-chamber having less restricted space than said mixing-chamber and having a settling-space out of the path of travel of the intermingled pulp and mercury, means for causing the pulp to circulate
40 through said chambers under pressure, and means for diluting the pulp in its passage.

9 In an amalgamator, a closed amalgamating-receptacle having inlet and outlet passages and comprising a mixing-chamber with mixing means therein, and a settling-cham- 45
ber, of less restricted space than said mixing-chamber, with settling or freeing means therein and having a settling-space out of the path of travel of the intermingled pulp and mer-
50 cury.

10 In an amalgamator, an amalgamating-receptacle, comprising a substantial horizontal mixing-chamber having mixing means therein communicating with a substantially horizontal stationary settling-chamber, of 55
less restricted space than said mixing-chamber, having settling means therein and a settling-space out of the path of travel of the intermingled pulp and mercury.

11 An amalgamator, comprising a mixing- 60
chamber, a settling-chamber having a less restricted space than said mixing-chamber leading therefrom, and vehicle-fluid-inlet passage near the initial end of said settling-chamber, said settling-chamber having a set- 65
tling-space outside the path of travel of the intermingled pulp and mercury.

12 In an amalgamator a mixing-chamber, a pulp-inlet therefor, mixing means therein, a horizontal chamber of less restricted space 70
communicating therewith at one end and having an overflow-outlet at the other end, and having a settling-space out of the path of travel of the pulp between the inlet and outlet ends. 75

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

PAUL A. KNAPPE.

Witnesses:

EVERETT S. EMERY,
THOMAS B. BOOTH.