Sept. 25, 1923. 1,469,007

C. MEYER ET AL

AMALGAMATOR AND SEPARATOR

Filed Jan. 26, 1921 2 Sheets-Sheet 1

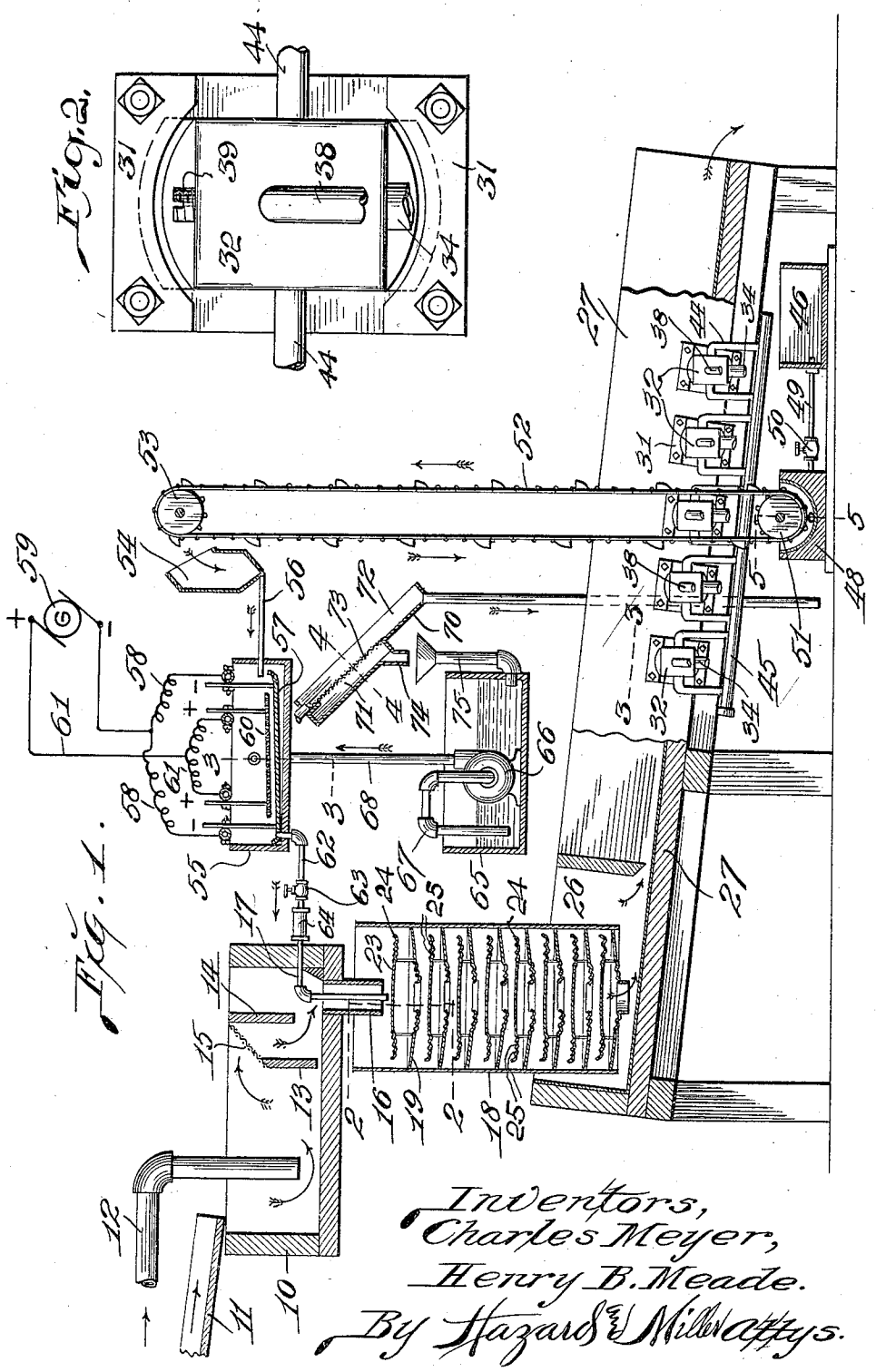


Fig. 2.

Fig. 1.

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Fig. 3.

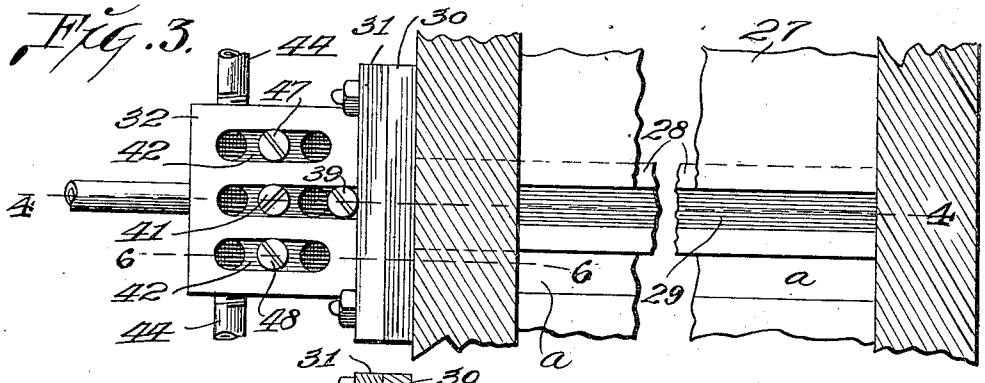



Fig. 4.

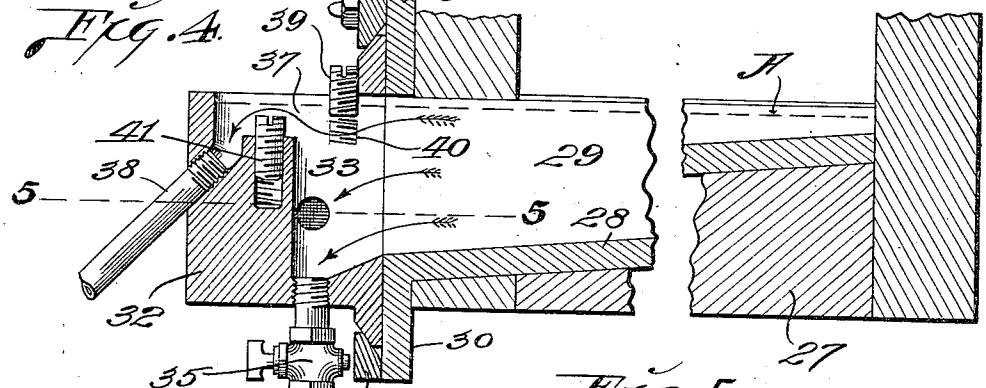



Fig. 5.

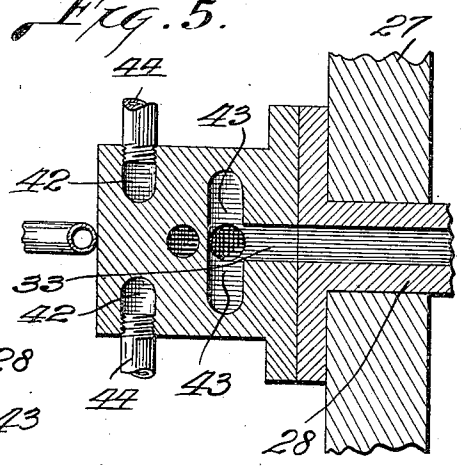
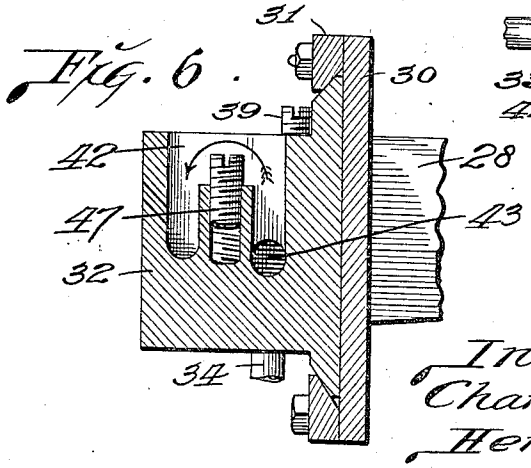



Fig. 6.




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Patented Sept. 25, 1923. 1,469,007

# UNITED STATES PATENT OFFICE.

CHARLES MEYER AND HENRY B. MEADE, OF LOS ANGELES, CALIFORNIA, ASSIGNORS TO FRANK A. GILLESPIE, OF LOS ANGELES, CALIFORNIA.

## AMALGAMATOR AND SEPARATOR.

Application filed January 26, 1921. Serial No. 440,186.

*To all whom it may concern:*

Be it known that we, CHARLES MEYER and HENRY B. MEADE, citizens of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in Amalgamators and Separators, of which the following is a specification.

Our invention relates to an amalgamating or metal separating apparatus, and the principal objects of our invention are to generally improve upon and simplify the existing types of amalgamators; to provide an apparatus that can be very economically operated; to provide a construction wherein an apparatus of given size has a relatively large capacity; to provide relatively simple and novel means for insuring the separation and collection of the relatively finer or microscopic particles of metal, to provide in an amalgamating apparatus simple and efficient means for automatically effecting a separation of the heavy metal carrying volume of mercury from that carrying the relatively lighter metals, and, likewise, from the metal free mercury, and further, to provide simple and efficient means for continuously regenerating or rendering nascent the mercury that is utilized in the system, thereby enabling the same body of mercury to be continuously used in effecting the separation of metallic values.

With the foregoing and other objects in view, our invention consists in certain novel features of construction and arrangement of parts that will be hereinafter more fully described and claimed, and illustrated in the accompanying drawings in which:

Figure 1 is a diagrammatic view of our improved amalgamator and separator, the parts thereof being in vertical section.

Figure 2 is an end view of the head of one of the mercury troughs or pockets, and which forms a part of our invention.

Figure 3 is an enlarged horizontal section taken on the line 3—3 of Figure 1.

Figure 4 is a vertical section taken on the line 4—4 of Figure 3.

Figure 5 is a horizontal section taken on the line 5—5 of Figure 4.

Figure 6 is a vertical section taken on the line 6—6 of Figure 3.

Referring by numerals to the accompanying drawings, which illustrate a practical embodiment of our invention, 10 designates a mixing box or container, into one end of which discharges a material feeding chute or trough 11, and a water supply pipe 12.

Arranged within the mixing box or container is a pair of transversely disposed partitions 13 and 14, the lower edges of which are elevated with respect to the bottom of the box or container, and arranged between the upper edges of these partitions is an inclined screen 15. Depending from the chamber between the partition 14 and the adjacent end of the box is a pulp discharge pipe or chute 16, and extending downwardly therethrough is a nascent mercury supply pipe 17, which leads to a mercury regenerating apparatus which will be hereinafter more fully described.

Chute 16 and pipe 17 discharge into the open upper end of a vertically disposed cylindrical member 18 that is made up of a series of superposed nested ring sections. Positioned in the lower portion of each ring section is a concavo-convex disc 19 formed of thin sheet metal, said disc being arranged with its convex surface on the under side. The center of the disc is formed with an opening 20, and the wall of this opening is bent outwardly to form a relatively narrow retaining lip 21. The body of the disc 19 adjacent to the opening is provided with a series of concentric corrugations 22, the same serving to retard the flow of mercury over the disc while the apparatus is in operation.

Supported in any suitable manner immediately above each disc 19 is a concavo-convex disc 23 of sheet metal, the diameter of which is less than the internal diameter of the cylinder 18, and said disc 23 is reversely positioned with respect to the adjacent disc 19 so that its convex face is on top. The edge of disc 23 is turned upwardly to form a relatively short mercury retaining lip 24, and, in order to obtain highest efficiency during operation, the distance between the edge of this lip 24 and the wall of the cylinder is practically equal to the distance between said lip and the adjacent face of disc 19. A portion of the body of each disc 23 adjacent to the upturned lip 24 is provided with a series of annular corrugations 25 that are effective in retarding the flow of mercury downwardly over the surface of the disc.

The discs 19 and 23 are preferably formed of copper, although other suitable metals

may be used in their construction. The opening 20 in the lowermost one of the discs 19 discharges directly into a launder 26 formed in the upper end of an elongated inclined trough 27, the latter being lined with suitable sheet metal, preferably copper.

Arranged in the bottom of the trough 27 a suitable distance below the launder 26 is a series of transversely disposed channel shaped members 28 having pockets 29 that are adapted to receive the amalgam or metal carrying mercury as the latter flows downwardly over the inclined bottom of trough 27, and the bottom of each trough 29 is inclined lengthwise so that the amalgam will by gravity gradually flow toward one end of said pocket.

In applying the copper plates to the bottom of the trough 27 between the trough shaped members 28, said plates are arranged so that their lower edges overlie the upper side walls of said members 28 and terminate at the upper edges of the pockets 29, while on the opposite or lower sides of the channel shaped members the edges of the plates are spaced apart from said members 28, as designated by *a* in Figure 3. This arrangement forms depressions immediately below the channel shaped members, which depressions are equal in depth to the thickness of the copper plates. This arrangement greatly facilitates the flow of the amalgam that travels across the amalgam filled pockets 29 when the apparatus is in operation.

Where a relatively narrow trough 27 is made use of, the members 28 extend from one side wall of the trough across the bottom of the trough and through the opposite side wall, as illustrated in Figures 3 and 4, but where the trough is of considerable width, a pair of the members 28 are arranged in direct alinement with each other on opposite sides of the medial line of the trough, so that the amalgam will flow from the center in opposite directions toward the sides of the trough.

Channel shaped members 28 are positioned in the bottom of the trough 27 so that the upper faces of the side walls of said channel members lie flush with the top surface of the trough bottom.

Formed integral with each channel member 28 and at the end where the pocket 29 is of greatest depth, is a face plate 30 which is positioned directly against the outer face of the corresponding side wall of the trough, and detachably secured to the outer face of said face plate at its top and bottom are retaining plates 31. Adjustably positioned on each face plate 30 and retained in its adjusted position by the plate 31, is a substantially rectangular block 32, and formed in the inner portion thereof is a centrally arranged vertically disposed chamber 33 that communicates directly with the adjacent open end of the pocket or channel 29 in the corresponding member 28. Leading downwardly from the lower end of this pocket 33 is a tube 34 in which is located a valve 35, and said tube is connected at its lower end to a suitable container 36 which is adapted to receive the mercury amalgamated with the relatively heavy metals such as gold and platinum.

The upper end of pocket 33 communicates with a relatively shallow pocket 37 formed in the central portion of the block 32, at the top thereof, and extending from the forward end of this pocket downwardly and outwardly at an angle of approximately forty-five degrees, is a tube 38 that leads to a suitable container. This tube is for the purpose of carrying off the mercury that is amalgamated with the relatively lighter metals such as silver.

A short vertically disposed screw 39 is positioned in the upper portion of pocket 33, the threads of which screw are adapted to engage with corresponding threads 40 formed in the said walls of said pocket 33. This screw is utilized for preventing the flow of water and slimes over the surface of the body of amalgam within the adjacent pocket 29 and into the pockets 33 and 37.

Seated in a threaded recess formed in block 32 between pocket 33 and the outlet from pocket 37, is a vertically disposed screw 41 which is for the purpose of regulating the flow of silver bearing amalgam from pocket 33 through pocket 37 and into and from the outlet therefrom.

Formed in the upper portion of block 32 to the sides of the pockets 33 and 37 are inverted U-shaped pockets 42, and the lower ends of the inner legs thereof communicate with the central portion of pocket 33 through short horizontally disposed apertures 43 arranged approximately midway between the top and bottom of said pocket 33.

Leading from the lower ends of the outer legs of the inverted U-shaped pockets 42 are tubes 44 connected to a tube 45, the same discharging into a metal free mercury receiving tank 46 which is positioned adjacent to the lower end of the trough 27. Screw seated in the block 32 between the vertical legs of the pockets 42 are vertically disposed screws 47, the purpose of which is to control the discharge of the metal free mercury from the pockets 29.

Leading from receiving tank 46 to an elevator boot 48 is a tube 49 in which is located a valve 50, and arranged for operation upon a sprocket wheel 51 that is suitably journaled in the boot 48, is an endless conveyor 52, comprising a sprocket chain and small buckets. This endless conveyor is vertically disposed, and its upper end passes around a suitably journaled sprocket

wheel 53. Either one of the sprocket wheels 51 or 53 may be driven in order to operate the endless conveyor. The buckets of this endless conveyor discharge at the upper end thereof into a suitably located receptacle 54, and leading from the lower end of the latter into a mercury regenerating tank 55 is a pipe 56. Arranged in the bottom of this tank 55 is a plate 57 of copper, that performs the functions of a cathode, said plate being slightly inclined downwardly away from the discharge end of pipe 56, and said plate being connected by suitable conductors 58 to the negative pole of a suitable source of electricity, preferably a generator 59.

Positioned immediately above plate 57 is a plate 60 of suitable metal, preferably iron, the same being perforated and connected by suitable conductors 61 to the positive pole of the generator 59, so that it performs the functions of an anode. The marginal edges of the cathode plate 57 are turned upwardly so that said plate is in the form of a shallow pan, and connected to the lower end thereof is one end of a tube 62 which is connected to the nascent mercury supply pipe 17. Suitably located in said tube 62 is a valve 63, and a sight feed tube 64.

Located at a suitable point below tank 55 is a sodium solution tank 65 in which is arranged for operation a pump 66, preferably of the rotary type, and having an intake pipe 67 and a discharge pipe 68, the latter leading upwardly and entering one side of tank 55 in a plane above the anode plate 60.

Leading from the opposite side of tank 55 is an overflow or outlet pipe 69, the same entering the upper end of a suitably located straining tank 70, the space within which is divided into a clear or strained solution chamber 71 and a waste chamber 72, said chambers being separated by a horizontally disposed screen 73, the latter being formed of any relatively fine reticulated material, preferably fabric such as canvas or burlap. The lower end of the clear solution chamber 70 is provided with an outlet 74 that leads directly into an in-take pipe 75 connected to the lower portion of tank 65. Leading from the lower end of the waste chamber 72 of the straining tank is a waste discharge pipe 76. The operation of this form of our improved amalgamator is as follows:

Prior to the delivery of pulp into the apparatus, the inner surface of cylinder 18, both surfaces of the discs 19 and 23 and the outer surfaces of the metal lining plate of the trough 27 are amalgamed or coated with mercury, and sufficient mercury is delivered into the trough to fill the transverse pockets 29. The level of the mercury within the pockets 29 indicated by the dotted line A in Figure 4, is regulated by the proper adjustment of the screws 47, and which latter are positioned between the legs of the inverted U-shaped pockets 42. The material to be treated, after being properly pulverized and screened, enters tank 10 through a chute 11, and water entering said tank 10 mixes with said material to form pulp. The relatively finer and heavier particles of the pulp will pass beneath partition 13, while the relatively lighter and larger pieces of material will pass through screen 15, which has a relatively large mesh, and said pulp passes through outlet pipe 16 into the upper end of cylinder 18.

It will be understood that while the apparatus is in operation this cylinder is completely filled with pulp, and the latter in travelling through said cylinder must necessarily flow downwardly and outwardly over the discs 23, and thence downwardly and inwardly over the discs 19, and this continued outward and inward movement of the pulp will necessarily cause it to be continually agitated, with the result that the solid particles in said pulp will be continually rotated or turned first in one direction and then in the other. By this operation the free metal within said pulp will amalgamate with or be taken up by the mercury on the surfaces of the discs 19 and 23, and this amalgamating action will be greatly enhanced by a practically continuous flow of nascent mercury from pipe 17 which enters cylinder 18 with the pulp.

This nascent or regenerated mercury passes downwardly over the upper surfaces of the discs 19 and 23, and its flow over said discs is materially retarded by the annular corrugations 22 and 25, and by the upturned lips 21 and 24. It will be understood that in all metal carrying pulp there is a certain percentage of extremely fine or microscopic particles of metal which tend to float on the water of the pulp rather than to pass downwardly therethrough by gravity, and in our improved apparatus these microscopic particles of metal will be taken up and retained by the mercury on the under sides of the discs 19 and 23.

After discharging from the lower end of the cylinder 18, the pulp and metal carrying mercury will gradually flow downwardly through the trough 27 with said mercury in direct contact with the metal plates on the bottom of said trough, and this metal carrying mercury will finally discharge into the transverse mercury traps or pockets 29, and, in so doing they displace a corresponding volume of mercury within said traps or pockets. The mercury discharges outwardly through the pockets and outlets in blocks 32, as hereinafter more fully described.

The mercury which carries gold, platinum and like relatively heavy metals, will by gravity pass downwardly into the lower portions of the pockets 29, and, as the bottom

surfaces of said pockets are inclined, this relatively heavy amalgam will gradually flow downwardly to the discharge ends of said pockets through the lower portions of the pockets 33, and finally through pipes 34 into the receptacles 36. The mercury or amalgam containing the lighter metals, such as silver and copper, will necessarily remain near the tops of the pockets 29, and this amalgam will gradually flow outwardly through said pockets and discharge therefrom through the upper portions of pockets 33 beneath the screws 39 and from thence through pockets 37 over the screws 41, which latter are adjusted to control the discharge of this relatively lighter amalgam, and the latter will finally discharge through tubes 38 into suitable containers.

The intermediate strata of mercury within each pocket 29, or that strata between the amalgam carrying the relatively heavy metals and that carrying the relatively lighter metals, may be properly termed metal free mercury, and the same, after passing from the lower ends of the pockets 29, discharges through apertures 43, and, after passing through the inverted U-shaped pockets 42, said metal free mercury passes through pipes 44 into pipe 45, and from the latter it discharges into tank or receptacle 46.

In passing through the pockets 42, this metal free mercury must necessarily pass over screws 47, so that with the latter properly adjusted to regulate the discharge of metal free mercury, the level of the bodies of mercury maintained in receiving pockets 29 can be controlled.

Screws 39 are adjusted so that their lower ends are always a short distance below the surfaces of the bodies of mercury within pockets 29, and thus the pulp in passing through trough 27, is prevented from discharging outwardly through pockets 33 and 37.

The amalgam or metal carrying mercury that passes off through pipes 34 and 38 can be treated in any desired and well known manner, preferably by distillation, in order to recover the metallic values contained in said amalgam.

The metal free mercury passes from receiving tank 46 through pipe 49 to the elevator boot 48, and by elevator 52 this mercury is carried upwardly and discharged into receptacle 54, from whence it passes into regenerating tank 55 through pipe 56. The mercury on entering tank 55 flows downwardly over cathode plate 57, and, after being regenerated, it passes through pipes 62 and 17 and enters cylinder 18 in a nascent state, to again perform its functions of taking up the free metal in the pulp passing through the system.

In order to regenerate the mercury that continuously passes through the system, tank 65 is filled, or partially filled with a relatively heavy sodium chloride solution, and, as pump 66 is operated, this solution is delivered into tank 55 through pipe 68, and flows over and between the anode and cathode plates, and thus constitutes the electrolyte for the electric current that passes from the anode to the cathode, and over which latter passes the mercury that is to be regenerated.

As the current passes through this electrolyte, the metallic salts are deposited upon cathode 57 over which the mercury is constantly flowing, and said mercury takes up said metallic salts or sodium, and thereby becomes nascent or regenerated, and in such condition reenters the system through pipes 62 and 17.

In passing through the system, the regenerated mercury loses a certain percent of the metallic sodium that it absorbs in the regenerating tank 65, and this lost metallic sodium passes off with the water and treated pulp in the form of caustic soda, while the remaining sodium returns to the regenerating tank with the mercury.

To compensate for this constant loss of the metallic portion of the salt solution, it is necessary from time to time to replenish the supply of salt in tank 65. During the regeneration of the mercury in tank 55, the electrolytic action frees chlorine gas, and, if desired, a suitable hood may be placed over tank 55 to catch this chlorine gas, and the later may be utilized as desired; for instance, it can be combined with water to form hydrochloric acid.

An amalgamator of our improved construction is comparatively simple, can be very economically operated, is particularly effective in collecting the finer particles of metal in the material under treatment, and by providing means for constantly regenerating or rendering nascent the mercury that is used in the recovery of metallic values, the system can be utilized to much greater advantage than amalgamating systems wherein the mercury is reclaimed or separated from the metallic values by the distillation process.

Obviously minor changes in the size, form and construction of our improved apparatus may be made and substituted for those herein described and claimed without departing from the spirit of our invention, the scope of which is set forth in the appended claims.

We claim as our invention:

1. In an amalgamator, a trough through which the material to be treated and mercury are adapted to pass, said trough being provided with a transversely disposed mercury pocket, the bottom of which gradually declines toward one end, and means located at the end of said pocket having the greatest depth for automatically effecting a sepa-

ration of the mercury carrying the heavier metals from the mercury carrying the lighter metals.

2. In an amalgamator, a trough through which the material to be treated and mercury are adapted to pass, said trough being provided with a transversely disposed mercury pocket, the bottom of which gradually declines toward one end, and means located at the end of said pocket having the greatest depth for effecting a separation of the mercury carrying the heavier metals and the mercury carrying the lighter metals from each other and from the metal free mercury.

3. In an amalgamator, a trough through which the material to be treated and mercury are adapted to pass, said trough being provided with a transversely disposed mercury pocket, the bottom of which gradually declines toward one end, means located at the end of said pocket having the greatest depth for effecting a separation of the mercury carrying the heavier metals and the mercury carrying the lighter metals from each other and from the metal free mercury, and adjustable means for regulating and controlling the separating action between the metal carrying mercury and metal free mercury.

4. In an amalgamator, a trough through which the material to be treated and the mercury are adapted to pass, a plurality of mercury pockets in the bottom of said trough, the bottom of said trough being inclined, and a member arranged at the end of the pocket having the greatest depth, and provided with outlets located at different levels for effecting the separation and discharge of the mercury carrying the heavier metals from the mercury carrying the lighter metals and from the metal free mercury.

5. In an amalgamator, a trough through which the material to be treated and the mercury are adapted to pass, a plurality of mercury pockets in the bottom of said trough, the bottom of said trough being inclined, a member arranged at the end of the pocket having the greatest depth, and provided with outlets located at different levels for effecting the separation and discharge of the mercury carrying the heavier metals from the mercury carrying the lighter metals and from the metal free mercury, and adjustable means for controlling and regulating the separation and discharge of the metal carrying mercury from the metal free mercury.

6. In an amalgamator, the combination with a trough through which the material to be treated and mercury are adapted to pass, of a transversely disposed mercury pocket in the bottom of said trough, a block adjustably arranged at one end of said pocket, which block is provided with a pocket that is adapted to receive mercury from the pocket in the trough, the pocket in said block being provided with outlets located at different levels, and adjustable means for controlling the flow of mercury from said outlets.

7. In an amalgamator, a trough through which the material to be treated and mercury are adapted to pass, said trough being provided with a transversely disposed mercury pocket, the bottom of which is inclined, and means located at the end of the pocket having the greatest depth for automatically effecting a separation of the metal free mercury from the metal carrying mercury.

8. In an amalgamator, a trough through which the material to be treated and mercury are adapted to pass, the bottom of said trough being provided with a transversely arranged pocket, the bottom of which is inclined, a block adjustably arranged at the end of the pocket having the greatest depth and adapted to receive mercury from said pocket, said block being provided with a series of connected pockets for effecting a separation of the metal carrying mercury from the metal free mercury, and adjustable means for controlling the flow of mercury through the connected pockets.

9. In an amalgamator, a mercury pocket having an inclined bottom, a block arranged at the end of the pocket having the greatest depth, and said block being provided with a series of pockets that are connected at different levels for automatically effecting a separation of the metal carrying mercury from the metal free mercury.

10. In an amalgamator, a mercury pocket having an inclined bottom, a block arranged at the end of the pocket having the greatest depth, said block being provided with a series of pockets that are connected at different levels for automatically effecting a separation of the metal carrying mercury from the metal free mercury and for effecting a separation of the mercury carrying the lighter metals from the mercury carrying the heavier metals.

11. In an amalgamator, a mercury receiving pocket, the bottom of which is inclined, a block arranged at the end of the pocket having the greatest depth, there being a series of connected pockets formed in said block, and vertically adjustable members arranged between said pockets.

12. In an amalgamator, a mercury pocket having an inclined bottom and a member adjustably arranged at the end of the pocket having the greatest depth, which member is provided with a series of chambers that are connected at different levels, so as to automatically effect the separation of the metal free mercury from the metal carrying mercury.

13. In an amalgamator, a mercury pocket having an inclined bottom and a member ad-

justably arranged at the end of the pocket having the greatest depth, which member is provided with a series of chambers that are connected at different levels, so as to automatically effect the separation of the mercury carrying the lighter metals from the mercury carrying the heavier metals.

14. In an amalgamator, a mercury pocket having an inclined bottom and a member adjustably arranged at the end of the pocket having the greatest depth, which member is provided with a series of chambers that are connected at different levels, so as to automatically effect the separation of the metal free mercury from the metal carrying mercury and to effect the separation of the mercury carrying the lighter metals from the mercury carrying the heavier metals.

15. In an amalgamator, a mercury pocket having an inclined bottom, a member adjustably arranged at the end of the pocket having the greatest depth, which member is provided with a series of chambers that are connected at different levels, so as to automatically effect the separation of the metal free mercury from the metal carrying mercury, and adjustable members arranged within the chambers for controlling the flow of mercury therethrough.

16. In an amalgamator, a mercury pocket having an inclined bottom, a member adjustably arranged at the end of the pocket having the greatest depth, which member is provided with a series of chambers that are connected at different levels, so as to automatically effect the separation of the mercury carrying the lighter metals from the mercury carrying the heavier metals, and adjustable members arranged within the chambers for controlling the flow of mercury therethrough.

17. In an amalgamator, a mercury pocket having an inclined bottom, a member adjustably arranged at the end of the pocket having the greatest depth, which member is provided with a series of chambers that are connected at different levels, so as to automatically effect the separation of the metal free mercury from the metal carrying mercury, and adjustable members arranged within the chambers for controlling the flow of mercury therethrough.

18. In an amalgamator, a trough through which mercury and the material to be treated are adapted to pass, said trough being provided with a mercury pocket, and means at one end of the pocket for automatically effecting a separation of the mercury carrying the heavier metals and the mercury carrying the lighter metals.

In testimony whereof we have signed our names to this specification.

CHARLES MEYER.
HENRY B. MEADE.