(No Model.)

H. L. SULMAN.

METHOD OF RECOVERING PRECIOUS METALS FROM THEIR SOLUTIONS.

No. 587,408. Patented Aug. 3, 1897.

Fig. 1.

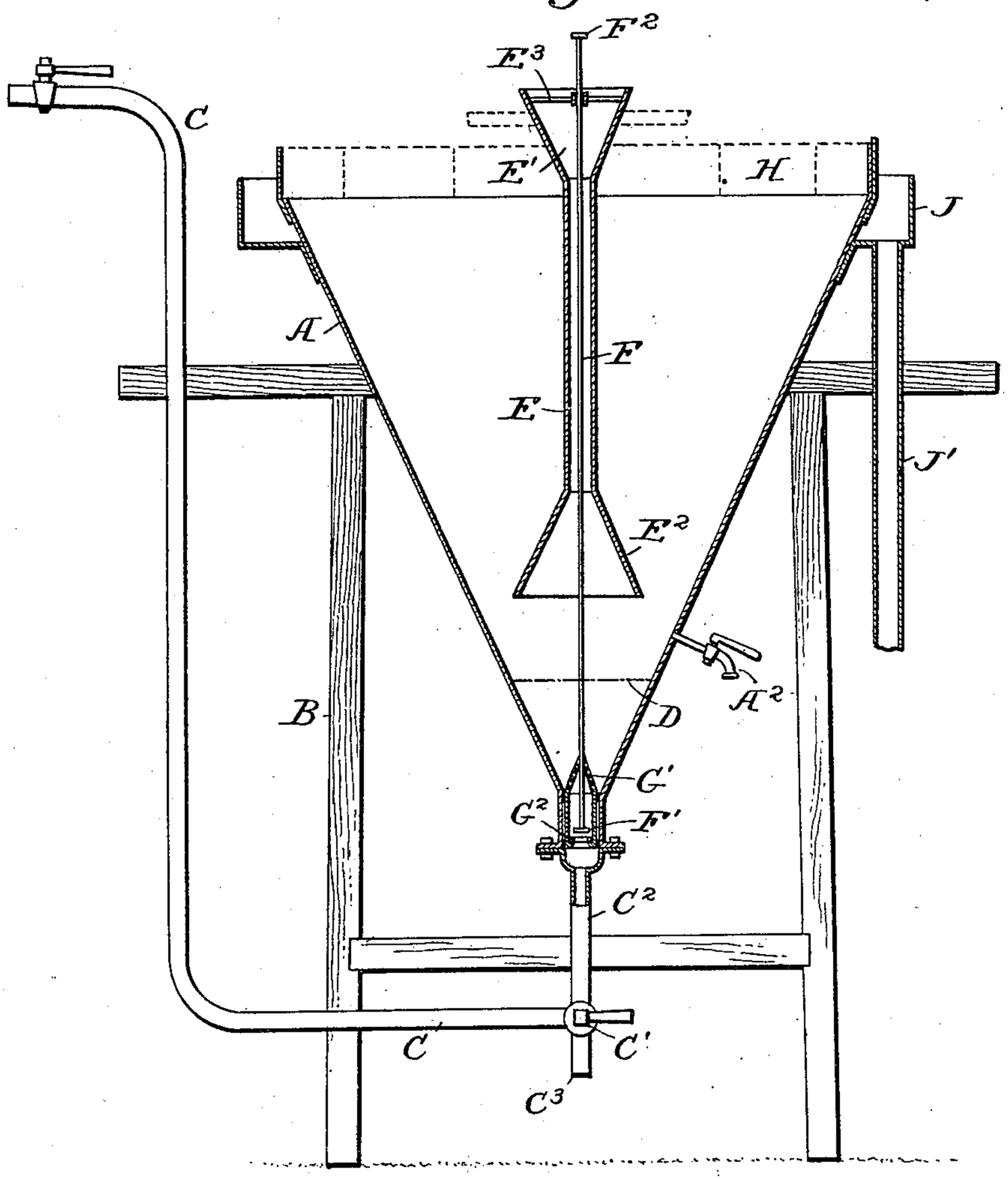
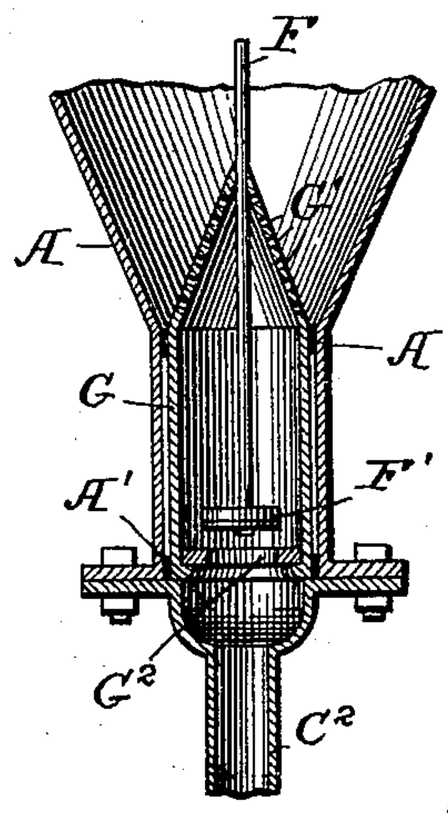


Fig. 2.



Witnesses
J. J. Finkel
Laurence Stevens

Inventor
H. L. Sulman
by Foster & Freeman
Attorneys.

UNITED STATES PATENT OFFICE.

HENRY LIVINGSTONE SULMAN, OF LONDON, ENGLAND.

METHOD OF RECOVERING PRECIOUS METALS FROM THEIR SOLUTIONS.

SPECIFICATION forming part of Letters Patent No. 587,408, dated August 3, 1897.

Application filed November 9, 1896. Serial No. 611,550. (No model.)

To all whom it may concern:

Be it known that I, HENRY LIVINGSTONE SULMAN, a subject of the Queen of England, residing at London, England, have invented certain new and useful Improvements in or Relating to the Recovery of Precious Metals from Their Solutions, of which the following is a specification.

My invention has for its object the recovery of precious metals—such as silver, gold, platinum, &c.—from solutions of the same by means of a new and improved apparatus, the apparatus being constructed to effect the deposition or "precipitation" of the precious metal or metals in solution upon a "precipitating" substance or "precipitant" which is in a solid but more or less finely-divided state.

The apparatus, for instance, is designed to recover gold, silver, platinum, &c., from solutions of their haloids by means of the employment therein of dense but more or less finely-divided carbon, subsulfid of copper, or other suitable precipitant; again, also, for the recovery of the same metals from their cyanid solutions by means of the finely-divided zinc product commercially known as "zinc-fume," and generally for analogous requirements.

It is necessary that whatever the nature of the precipitant used and the degree of fineness to which it is found desirable to reduce it primarily it shall be of greater specific gravity than the liquid or solution desired to be precipitated by it, so that the precipitant shall tend to settle from the liquor by gravitation. Further, it is necessary to my invention that the solution or liquor to be precipitated shall percolate upward through the mass of solid finely-divided precipitant.

In an apparatus with parallel vertical sides the upward flow of liquor would tend to carry off finely-divided particles of precipitant unless special means were taken to prevent this. Filters tend to become clogged and are generally useless for my purpose, so that I retain the particles of the solid precipitant, upon whose surfaces the precious metals are in course of deposition, within my apparatus by inducing subsidence of them. This I effect by continually reducing the upward rate of liquor flow, which is secured by constantly increasing the area of the liquor column as it rises higher in the apparatus.

My apparatus takes the form of a funnel. The liquor enters (under a sufficient pressure or "head") through the bottom orifice. It then meets with and thoroughly mixes with the mass of finely-divided precipitant in a condition of suspension in the liquor. The solid finely-divided particles do not sink against the comparatively rapid inflow or are prevented from doing so to any extent by means of an automatic valve of ordinary type. By this intimate admixture of liquor with precipitant the deposition of the precious metals in solution in the former is effected upon the minute surfaces of the latter. It now only remains to remove the depleted liquor from the particles of the solid precipitant containing the gold, silver, &c. As the liquor continues its upward flow by virtue of the continually-diverging sides of the apparatus the area of the liquid column becomes greater and greater. The rate of the vertical upflow is thereby correspondingly reduced. This continues until a point is reached at which the upflow is vertically so slow that the finest particles are able to settle or subside against it. At any point therefore above this limit or "zone" the absolutely clear liquid may be drawn off from the apparatus free from suspended particles and depleted of its precious-metal contents.

I do not confine myself to any special section of the funnel in a horizontal direction. It may be square or polyangular oval, &c.; but I prefer it for many purposes circular, as giving more uniform admixture and flow throughout the whole space.

If the precipitation of the precious metals be deemed to be incomplete in one apparatus, owing to the richness of the original liquor or to other causes, the outflow may be caused to pass into a second similarly-arranged apparatus or through two or more such apparatus placed in series; but in general one apparatus can be made to secure practically perfect removal of the precious metals dissolved in a given liquor by the use of a suitable precipitant. If a series of two or more of such apparatus be employed, the first of the series may be used to enrich quantities

of precipitant which have only been partially used up to their fullest capacity of precipitating the precious metals, while the succeeding members of the series are supplied with the necessary amounts of less rich or quite fresh precipitant in order to remove any remaining traces of gold, silver, &c., which may escape unprecipitated in the outflow from the first apparatus. The poorer precipitates in these last apparatus are in course of time removed through the bottom of the apparatus and transferred to the first one of the series, there to be enriched to their full capacity, while their place is taken by fresh quantities of poorer or quite unused precipitating agent, and so on.

When the precipitate is deemed to be sufficiently rich, it is removed from the apparatus by a "three-way cock" at the bottom thereof or by other suitable arrangement and the precious metal it contains finally recovered by any suitable method, such as in the case of the employment of a carbon precipitant by burning, or in the case of the use of a zinc precipitant by smelting.

The apparatus is also supplied with a small central funnel for the introduction of fresh quantities of precipitant from time to time to the point of maximum precipitating action in the apparatus—*i. e.*, near the inflow. By providing this funnel with a bell-shaped or inverted-funnel termination a sort of "chamber" is produced in the lower part of the apparatus having an annular space for the passage of liquors between the rim of the smaller funnel and the sides of the large one. This chamber is of considerable aid in promoting the action of the precipitant by keeping the bulk of it constantly near the liquor inflow and securing perfect admixture by means of the vortex currents, &c., it induces. It is further desirable to break up the rapid rush of inflowing liquors at their point of entry into the apparatus and to secure their subdivision and intimate admixture with the precipitant as early as possible. This I effect by capping the end of the inlet-pipe with a small perforated cone or "distributer." The perforations may be from one-fourth to one-tenth the diameter of the inlet-pipe, but their total area must be larger than that of the sectional area of the pipe. The holes may be bored in a direction perpendicular to the cap-cone or they may be made "tangential"—*i. e.*, bored at a tangent to the internal circumference of the cone—thus securing a rotary initial flow of the inflowing liquors instead of a series of straight streams. In the majority of cases, however, perpendicular bore-holes answer equally well.

The clear precipitated liquor may be drawn off at any point above the limit of subsidence either by a pipe or preferably by allowing it to flow equally over the rim-circumference of the apparatus. The latter method secures the quieter and more uniform outflow and does not disturb the top layers of liquor undergoing final subsidence by establishing a quick current in one particular direction.

If desired, the rim may be encircled with a filter-screen of lawn, calico, or other filtering or straining medium, so as to retain within the apparatus any particles of precipitant which may be floated or "buoyed up" by bubbles of air or other gas.

The clear liquors passing over the rim and through the precautionary filter or strainer fall into and are collected by a circular trough or "launder" attached to the apparatus below the rim, whence they are conveyed away by a pipe. As before stated, this may lead into a storage-vat or into another similar apparatus, or, if deposition of the floating particles is not absolutely complete, into any suitable type of apparatus—such, for example, as the slat-partitioned tank used for freeing softened water from traces of deposit—where subsidence is finally rendered absolute. In most cases where traces of precipitant have escaped I have secured perfect final subsidence by allowing the liquors to flow through a shallow plain tank of from four to six times the area of the top of the precipitating apparatus before passing them direct to the storage liquor-vats.

Such an apparatus as I have described I term a "precipitating-cone." It may be constructed of any suitable material, such as wood, stoneware, galvanized iron, &c., according to the nature of the liquor or precipitant it is designed to treat. Its action, until the charge of precipitant it contains is exhausted and requires renewal, is perfectly automatic and continuous. Its capacity, its height, the angle of its sides, the ratio diameter of inflow-pipe to top area of cone will naturally vary with the volume of liquor to be dealt with, the rate and head of liquor inflow, the relation of the specific gravity of the liquor to that of the finely-divided precipitant, the actual coarseness or fineness of the particles of the latter, and so on. These data may be calculated or decided by preliminary experiment in any particular case. As an example, however, of the application of my invention to the recovery of gold bullion from cyanid solutions I instance the following dimensions of my apparatus: For a flow of from six hundred to eight hundred gallons per hour I find a depth of five feet with a top diameter of five feet also to be amply sufficient. The diameter of the inlet-pipe is from one and one-fourth inches to one and three-fourths inches, according to the head of the inlet liquor, while the perforations of the cap-cone or distributer are three-sixteenths of one inch in diameter. The charge of zinc-fume in such an apparatus varies from five to thirty pounds, according to requirements.

In the accompanying drawings, Figure 1 illustrates in vertical central section and by way of example a precipitating-cone and its appurtenances constructed according to this

invention, and Fig. 2 is a view of the lower part of Fig 1 to a larger scale than that to which Fig. 1 is drawn.

Like letters indicate like parts throughout the drawings.

A is the conical body of the vessel supported upon a frame B.

C is the supply-pipe by which the liquid to be subjected to the action of the precipitant is delivered into the cone A at the lower end thereof through a three-way cock C′, from which a branch C^2 extends to afford communication with the bottom of the cone, as shown. Another branch C^3 which extends in the opposite direction serves as a discharge-pipe for enriched precipitant.

The dotted line D indicates approximately the height to which the precipitating material would extend when first applied to the cone before the admission of any liquid thereto.

E is a central tube with a funnel E′ formed at its upper end and a funnel E^2 at its lower end. This tube is supported in its place in any convenient manner.

The precipitant can very easily be delivered to the bottom of the cone A by pouring it into the upper funnel E′, whence it descends through the pipe E and funnel E^2 to the bottom of the cone A. For the lower funnel E^2, which in the present instance is shown as having the form of an inverted cone, there can be substituted any device which will leave an annular space between its outer circumference and the adjacent part of the cone A for the purpose hereinbefore referred to. F is a spindle extending centrally through the pipe E, and guided by a guide E^3, fixed in the upper funnel E′. At the lower end of this rod is a valve F′ controlling the passage of fluid to the cone A through the pipe C^2, the rod F having a handle F^2 at its upper end.

It will be seen that the nozzle or distributer G completely fills or occupies the lower end of the cone A, and is provided with perforations G′ to break up the stream of fluid entering by the pipe C^2, suitable packing being interposed between the nozzle and the wall of the cone, as at A′, which encircles it to prevent any leakage of fluid past the nozzle. It is not necessary that the nozzle G should have the particular shape which is shown in the drawings by way of example.

The pipe C^2 is readily removable from the lower end of the cone in order to enable the nozzle G to be withdrawn, when desired, together with the seating G^2 for the valve F′, which is contained therein.

H is an annular strainer secured at the upper end of the cone A, and J is an annular launder or trough encircling the upper end of the cone just below the strainer H, so as to receive all the liquid which percolates through the latter.

J′ is a pipe by which the fluid received by the launder is removed therefrom.

A^2 is a drain-cock for the cone A.

I claim—

1. The process herein described, for the recovery of precious metals from their solutions, the same consisting in imparting to the liquor an upward flow through a mass of finely-divided precipitant within a vessel, and gradually reducing the rate of such flow by uniformly increasing the area of the liquid as the height of the column increases, substantially as described.

2. In apparatus for the recovery of precious metals from their solutions, a precipitating vessel having a uniformly-increasing cross-sectional area, and having an inlet and a controlling-valve at the smaller end thereof, a precipitant-feed pipe extending down into the vessel and terminating short of the contracted wall thereof, and a rod connected with the valve and reaching to the top of the vessel, substantially as described.

3. In apparatus for the recovery of precious metals from their solutions, a precipitating vessel having a uniformly-increasing cross-sectional area, and an inlet at the smaller end thereof and provided with an inverted funnel a suitable height from the inflow, and means leading to said funnel for the passage or introduction of a precipitant, substantially as described.

4. In apparatus for the recovering of precious metals from their solutions, a precipitating vessel having a uniformly-increasing cross-sectional area for its full height, and adapted to contain a precipitant, in combination with a perforated distributer located in the contracted bottom of said vessel, and a pipe for supplying the solution to the vessel in an upward direction or flow, substantially as described.

5. In apparatus for the recovery of precious metals from their solutions, a precipitating vessel having a uniformly-increasing cross-sectional area for its full height, and containing a precipitant, in combination with means for supplying the vessel with an upward flow of the solution, and an inverted cone arranged within the vessel with a space intermediate the lower end of the same and the wall of said vessel, substantially as shown and for the purpose described.

6. In apparatus for the recovery of precious metals from their solutions, a precipitating vessel having a uniformly-increasing cross-sectional area for its full height, and provided at its lower end with a supply, in combination with a body suspended within the vessel at near the lower end thereof, and leaving an annular space between the same and the wall of the vessel, substantially as described.

7. In apparatus for the recovery of precious metals from their solutions, a precipitating vessel having a uniformly-increasing cross-sectional area for its full height, in combination with a liquid-supply pipe at the lower end thereof, and an annular filter-screen supported at its upper end, substantially as described.

8. In apparatus for the recovery of precious

metals from their solutions, a precipitating vessel having a uniformly-increasing cross-sectional area for its full height, and provided at its lower end with an opening and an inlet-pipe for the solution, a perforated distributer located in the lower end of the vessel, a valve for closing the opening and having a rod reaching to the upper end of the vessel, and a centrally-disposed vertical pipe provided at each of its ends with a cone, all being arranged and operating substantially as shown and described.

9. In apparatus for the recovery of precious metals from their solutions, a precipitating vessel having a uniformly-increasing cross-sectional area, means for supplying the solution to the vessel at the bottom, and a perforated distributer completely occupying the lower contracted end of the vessel and adapted to break up the stream of fluid as it enters the vessel, substantially as described.

In testimony whereof I have hereto set my hand in the presence of the two subscribing witnesses.

HENRY LIVINGSTONE SULMAN.

Witnesses:
JOSEPH LAKE,
WALTER J. SKERTEN.