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H. L. SULMAN & H. F. KIRKPATRICK-PICARD.

APPARATUS FOR THE RECOVERY OF PRECIOUS METALS.

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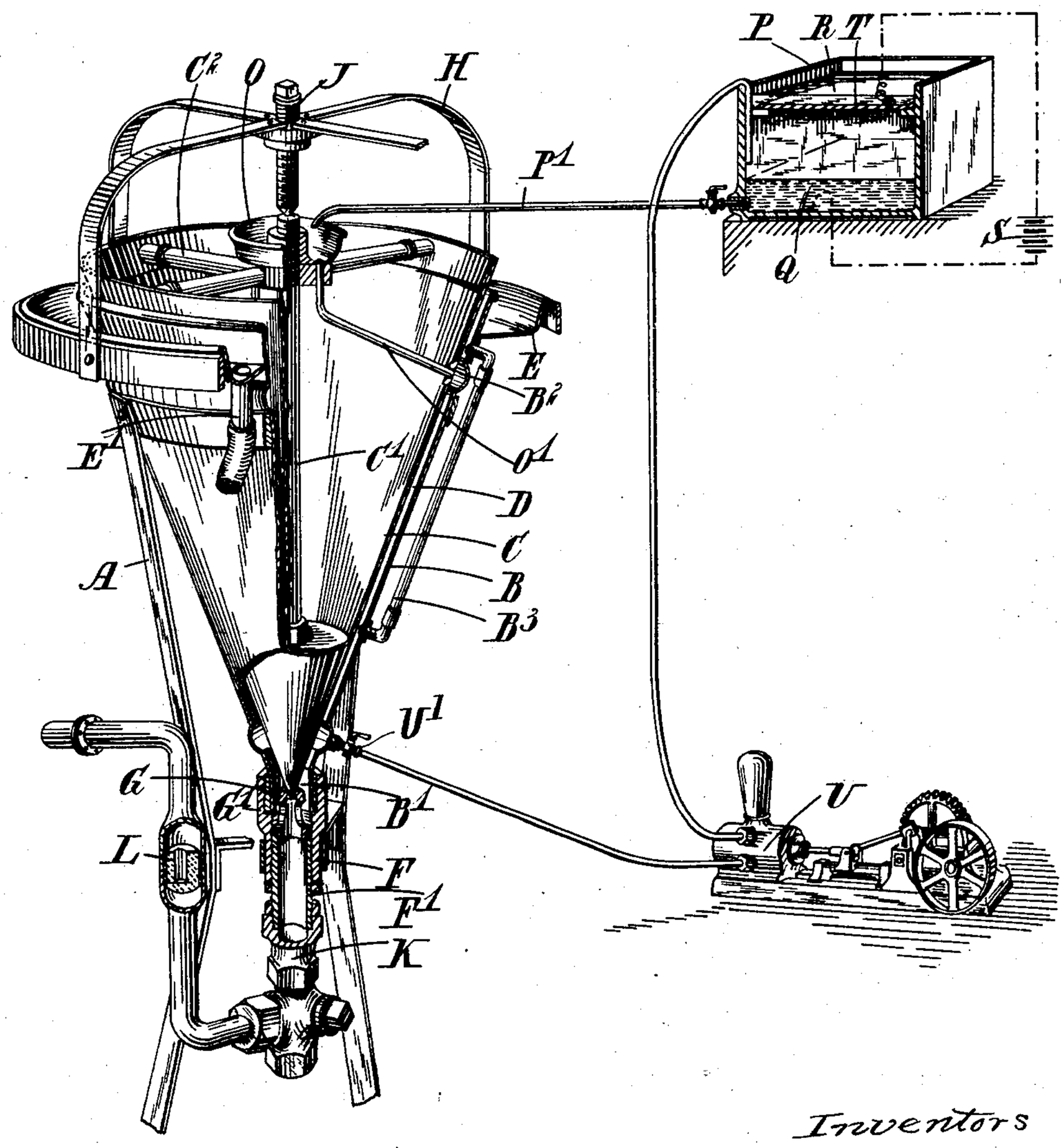
NO MODEL.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR THE RECOVERY OF PRECIOUS METALS.

SPECIFICATION forming part of Letters Patent No. 736,036, dated August 11, 1903.

Application filed May 23, 1903. Serial No. 158,517. (No model.)

To all whom it may concern:

Be it known that we, HENRY LIVINGSTONE SULMAN and HUGH FITZALIS KIRKPATRICK-PICARD, subjects of the King of England, residing at London, England, have invented certain new and useful Improvements in or Relating to the Recovery of Precious Metals, of which the following is a specification.

The present invention relates to an improved method and apparatus for the recovery of precious metals from liquids containing them either in solution or suspension.

According to this invention the sufficiently finely ground ores or pulps mixed with a solvent or leached, filtered, or decanted solutions containing the values are passed up through a continuous vertical or inclined column, film, or sheet of mercury kept continuously charged with an electropositive metal, such as sodium, in order to decompose the compounds of the precious metals presented to the so-prepared mercury.

In carrying out the process the mercury is conveniently contained in the narrow interspace between two or more inclined or vertical surfaces, and in practice a convenient form of apparatus comprises a series of two or more concentric inverted conical vessels, of which the center one may be a core, so arranged that an interspace of suitable width is maintained between the inner surface of one vessel and the outer surface of the next vessel. The vessels or cones are constructed of or covered with copper or other suitable metal, and the metal surfaces being amalgamated insure the maximum contact between the ore or solvent passing upward through the apparatus and the amalgam. Any other convenient form of apparatus may be used—for example, vertical hollow concentric cylinders, plain or fluted, or a vessel containing a number of small tubes, rods, or baffles. In order to maintain the mercury in an efficient condition, a stream of sodium amalgam, preferably continuous, is run into the extraction apparatus, while a corresponding amount of mercury depleted of electropositive metal is withdrawn. Such amalgam may be prepared by any well-known electrolytic method, as by the decomposition of an electrolyte—such as sodium chlorid, hydrate, or carbonate—with a cathode of mercury, by the introduction of metallic sodium into mercury, or otherwise. The electrolytic cell for preparing the desired amalgam may be separate from and placed outside the extraction apparatus and may be of any suitable type, so arranged that mercury may be continuously fed into it and the sodium or other amalgam produced therefrom continuously run off into the extraction apparatus, or the electrolytic cell may be part of the extraction apparatus, and the electrolyte is then separated from the mercury amalgam by a porous diaphragm, such as a porous pot or cell or equivalent, the whole being so arranged that the material under treatment is not submitted to direct electrolysis, but that the electropositive metal is continually deposited into the mercury from the electrolyte.

The accompanying drawing is a perspective view, partly in section, of one form of apparatus suitable for carrying out this invention.

On a base A is supported an inverted conical vessel B, of copper, and within it is a concentric copper cone C, a narrow interspace D being left between the surfaces. The outer cone B is provided at the top with a launder E, having an outlet-pipe E′, and the cone B terminates at the bottom in an inlet B′, attached to a sleeve F. The apex of the inner cone C rests in a hollow socket G, which is carried on an externally-screwed tube F′, which engages the inside of the sleeve F, and by screwing the tube F′ within the sleeve F the socket G and inner cone C can be raised or lowered and the distance between the cones varied. Apertures G′ are provided in the sides of the socket to allow of free passage of liquid through the socket G, which thus acts also as a distributer. The launder E carries a frame H, in which is screwed a central vertical pin J, serving as a support for the inner cone C, and for this purpose the cone C has an axis C′, rigidly held in the center of the cone by stays C^2 and engaging with the pin J. When adjusting the inner cone C in position, the pin J can be correspondingly screwed up or down. The tube F′ is

attached to a union K, which is connected, through a non-return valve L and a pump, with suitable mixing or dissolving apparatus.

At the top of the inner cone C is a mercury-distributing cup O, having outlet-tubes O′, which conduct mercury to the interspace between the cones B C at any convenient height below the normal working level of the mercury between the cones, a groove B^2 being formed on the outer cone B at the level of the mercury-inlet. The mercury is supplied to the cup C through a pipe P′ from an electrolytic vessel P and may be fed either from the inside, as shown, or from the outside. The mercury Q in the electrolytic vessel forms the cathode of the circuit of an electrolytic battery S or other source, the anode being a conducting-plate T, immersed in the electrolyte R. The mercury is removed from the bottom of the cone B through an outlet-tap U′, connected with a pump U, which discharges the mercury into the vessel P. A gage-glass B^3 is provided on the outer cone B to indicate the height of the mercury.

The operation of the apparatus is as follows: The mercury is charged with metallic sodium in the electrolytic vessel and is conducted through the pipe P′, distributer O, and tubes O′ to the interspace D between the cones B C and completely fills the space D approximately to the level of the groove B^2. The sufficiently finely ground ore or slimes, mixed or previously treated with a solvent, such as potassium cyanid, are forced by a suitable pump through the valve L into the pipe F′ and up through the interspace D containing sodium amalgam, with the result that the double cyanid of precious metal and potassium or other precious-metal compounds held in solution are decomposed and the precious metal is retained by the mercury as an amalgam. At the same time any undissolved particles of free gold after these have been submitted to the action of the solvent are also recovered. A stream of the sodium mercury is passed into the apparatus, as above described, and an equal quantity of mercury partially free from sodium, but now carrying values, is withdrawn through the tap U′ and returned by the pump U to the electrolytic apparatus P to be recharged with fresh sodium and again returned to the apparatus, and so on until the mercury is sufficiently rich in precious metals to be withdrawn from the cycle of operations for the recovery by distillation, filtration, or the like of the contained precious metals. By this process of treatment filter-pressing or decantation is avoided, as is also zinc-box precipitation.

The apparatus may comprise more than two conical vessels or may be otherwise arranged to secure the distribution factor given by cones. The vertical angle of the cones may be as great as desired or the apparatus may be flat; but as hydrogen is apt to collect under the upper amalgamated plate in a flat apparatus placed horizontally it is preferable to use cones or other surfaces so shaped that the hydrogen generated tends to escape from between them. The mercury may be charged with sodium otherwise than by electrolysis.

This process is also applicable to the recovery of precious metals from solutions that have been removed by previous filtration or decantation from crushed ore or slimes.

In the treatment of some solutions and of some ores suspended therein it may be advantageous to put the mercury in circuit with an electric current in such manner that no electrolysis of the solutions containing the precious metals can take place but with the object of keeping the mercury amalgam in a highly efficient and active condition. If desired, the solution may be fed in through a central tube.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. In an apparatus for recovering precious metals the combination of a vessel having an inner amalgamated surface, a body having its outer surface amalgamated disposed within the vessel and forming therewith a narrow interspace, a body of mercury continuously charged with an electropositive metal in the interspace, and means for forcing the solution carrying the values upward through the interspace.

2. In an apparatus for recovering precious metals the combination of a vessel having an inner amalgamated surface, a body having its outer surface amalgamated disposed within the vessel and forming therewith a narrow interspace, a body of mercury charged with an electropositive metal in the interspace, an apparatus for charging the mercury with the electropositive metal, an inlet-conduit for mercury from said apparatus to the top of the interspace, an outlet-conduit for mercury from the bottom of the interspace to said apparatus, and means for forcing the solution carrying the values upward through the interspace.

3. In an apparatus for recovering precious metals the combination of a vessel having an inner amalgamated surface, a body having its outer surface amalgamated disposed within the vessel and forming therewith a narrow interspace, a body of mercury charged with an electropositive metal in the interspace, an apparatus for charging the mercury with the electropositive metal, an inlet-conduit for mercury from said apparatus to the top of the interspace, an outlet-conduit for mercury from the bottom of the interspace to said apparatus, an inlet-conduit at the bottom of the vessel for the solution carrying the values, an outlet-conduit at the top of the vessel for solution, and means for forcing the solution upward through the interspace.

4. In an apparatus for recovering precious metals the combination of a vessel having an inner amalgamated surface, a body having its outer surface amalgamated disposed within the vessel and forming therewith a narrow

interspace, means for varying the interspace, a body of mercury charged with an electropositive metal in the interspace, an apparatus for charging the mercury with the electropositive metal, an inlet-conduit for mercury from said apparatus to the top of the interspace, an outlet-conduit for mercury from the bottom of the interspace to said apparatus, an inlet-conduit at the bottom of the vessel for the solution carrying the values, an outlet-conduit at the top of the vessel for solution, and means for forcing the solution upward through the interspace.

5. In an apparatus for recovering precious metals the combination of a conical vessel having an inner amalgamated surface, a conical body having an outer amalgamated surface disposed concentrically within the vessel and forming therewith a narrow interspace, a body of mercury continuously charged with an electropositive metal in the interspace, and means for forcing the solution carrying the values up through the interspace.

6. In an apparatus for recovering precious metals the combination of a conical vessel having an inner amalgamated-copper surface, a conical body having an outer amalgamated-copper surface disposed concentrically within the vessel and forming therewith a narrow interspace, a body of mercury continuously charged with an electropositive metal in the interspace, and means for forcing the solution carrying the values up through the interspace.

7. In an apparatus for recovering precious metals the combination of a conical vessel having an inner amalgamated-copper surface, a conical body having an outer amalgamated-copper surface disposed concentrically within the vessel and forming therewith a narrow interspace, a body of mercury charged with an electropositive metal in the interspace, an electrolytic vesssel for charging the mercury, a mercury-pump, an inlet-conduit to the top of the interspace from the electrolytic vessel, an outlet-conduit for mercury from the bottom of the interspace to the pump, a conduit from the pump to the electrolytic vessel, and means for forcing the solution carrying the values up through the interspace.

8. In an apparatus for recovering precious metals the combination of a conical vessel having an inner amalgamated-copper surface, a conical body having an outer amalgamated-copper surface disposed concentrically within the vessel and forming therewith a narrow interspace, a body of mercury charged with an electropositive metal in the interspace, an electrolytic vessel for charging the mercury, a mercury-pump, an inlet-conduit to the top of the interspace from the electrolytic vessel, an outlet-conduit for mercury from the bottom of the interspace to the pump, a conduit from the pump to the electrolytic vessel, an inlet-conduit at the bottom of the vessel for the solution carrying the values, means for forcing the solution up through the interspace, and a launder at the top of the vessel to receive the discharged solution.

9. In an apparatus for recovering precious metals the combination of a conical vessel having an inner amalgamated-copper surface, a conical body having an outer amalgamated-copper surface disposed concentrically within the vessel and forming therewith a narrow interspace, a body of mercury charged with an electropositive metal in the interspace, an electrolytic vessel for charging the mercury, a mercury-pump, an inlet-conduit to the top of the interspace from the electrolytic vessel, an outlet-conduit for mercury from the bottom of the interspace to the pump, a conduit from the pump to the electrolytic vessel, an inlet-conduit at the bottom of the vessel for the solution carrying the values, a non-return valve in said conduit, means for forcing the solution up through the interspace, and a launder at the top of the vessel to receive the discharged solution.

10. In an apparatus for recovering precious metals the combination of a conical vessel having an inner amalgamated-copper surface, a conical body having an outer amalgamated-copper surface disposed concentrically within the vessel and forming therewith a narrow interspace, means for vertically moving the inner cone to vary the interspace, a body of mercury charged with an electropositive metal in the interspace, an electrolytic vessel for charging the mercury, a mercury-pump, an inlet-conduit to the top of the interspace from the electrolytic vessel an outlet-conduit for mercury from the bottom of the interspace to the pump, a conduit from the pump to the electrolytic vessel, an inlet-conduit at the bottom of the vessel for the solution carrying the values, a non-return valve in said conduit, means for forcing the solution up through the interspace, and a launder at the top of the vessel to receive the discharged solution.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

HENRY LIVINGSTONE SULMAN.
HUGH FITZALIS KIRKPATRICK-PICARD.

Witnesses:
CLAUDE MCKENZIE,
C. O. WILLIAMS.