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H. R. CASSEL.

APPARATUS FOR EXTRACTING PRECIOUS METALS BY ELECTROLYSIS.

APPLICATION FILED OCT. 25, 1902.

NO MODEL.

FIG. 1.

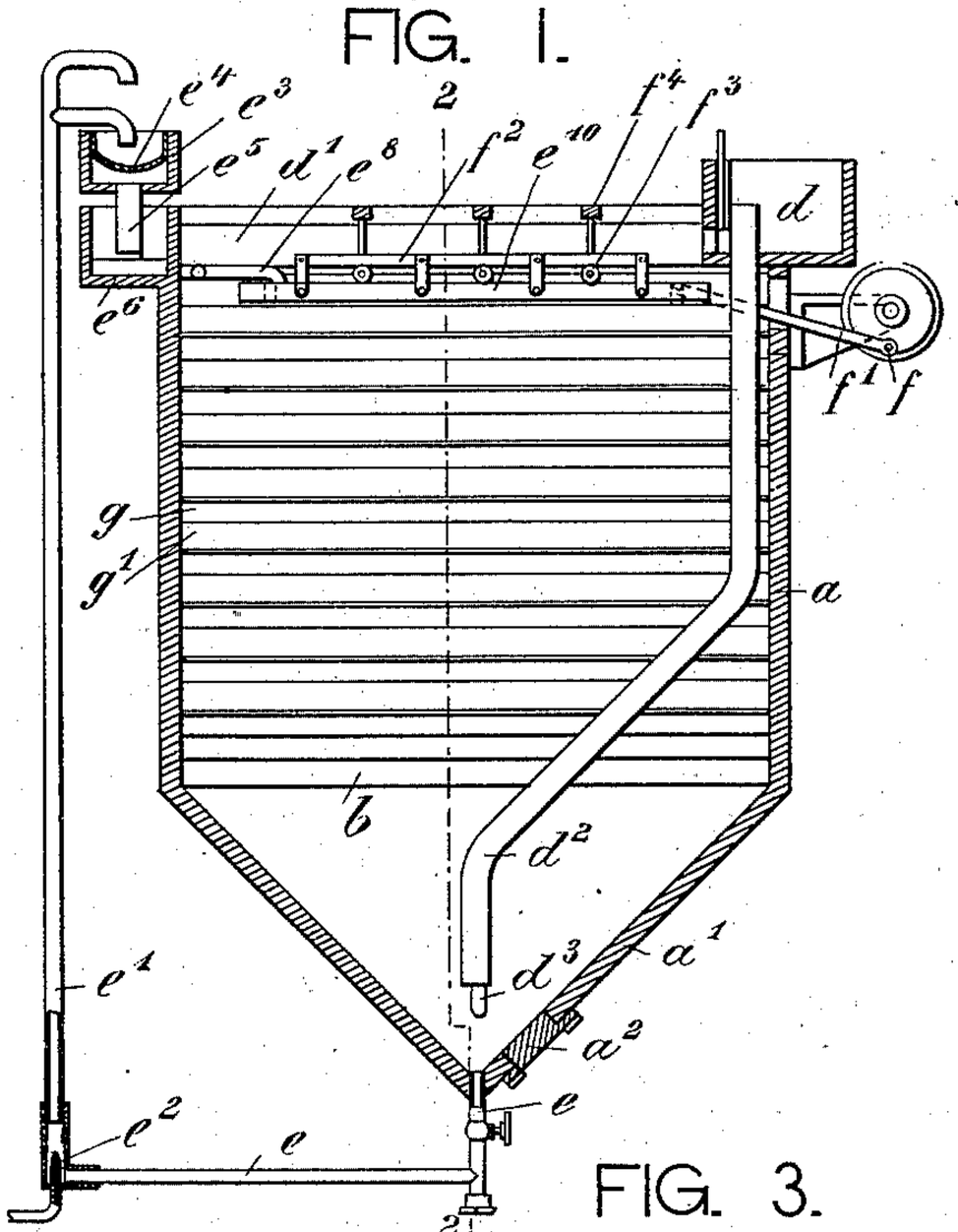


FIG. 2.

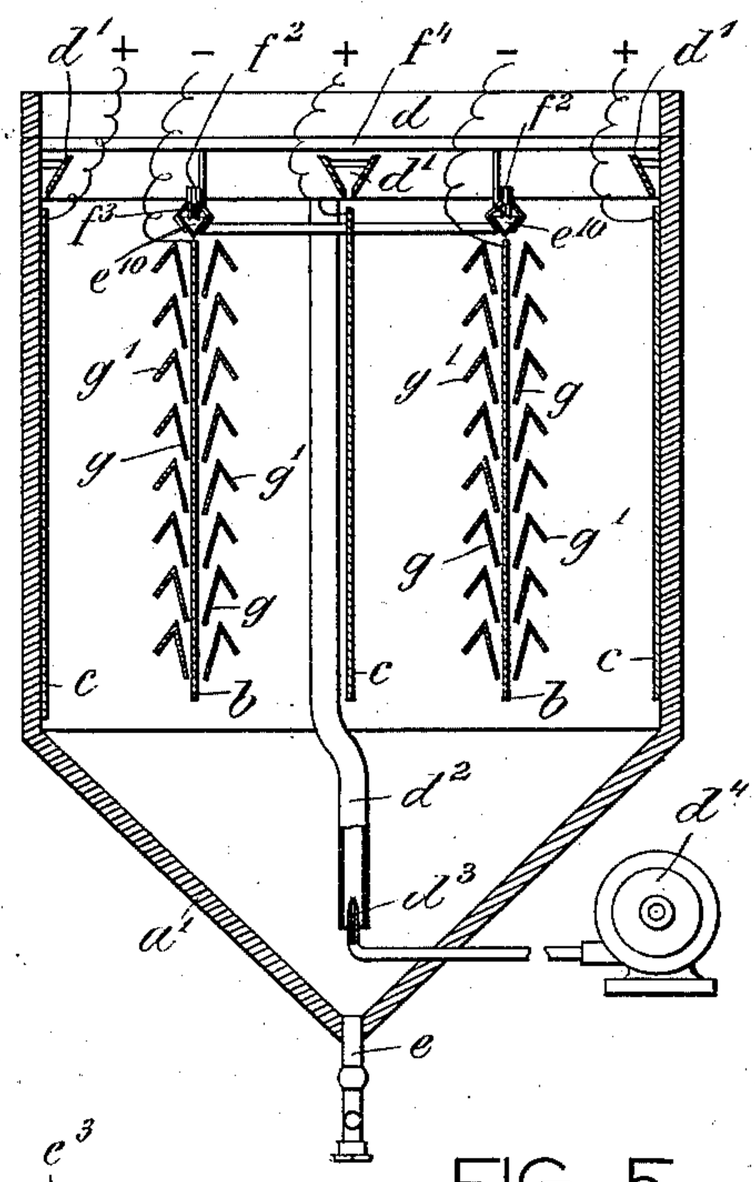


FIG. 3.

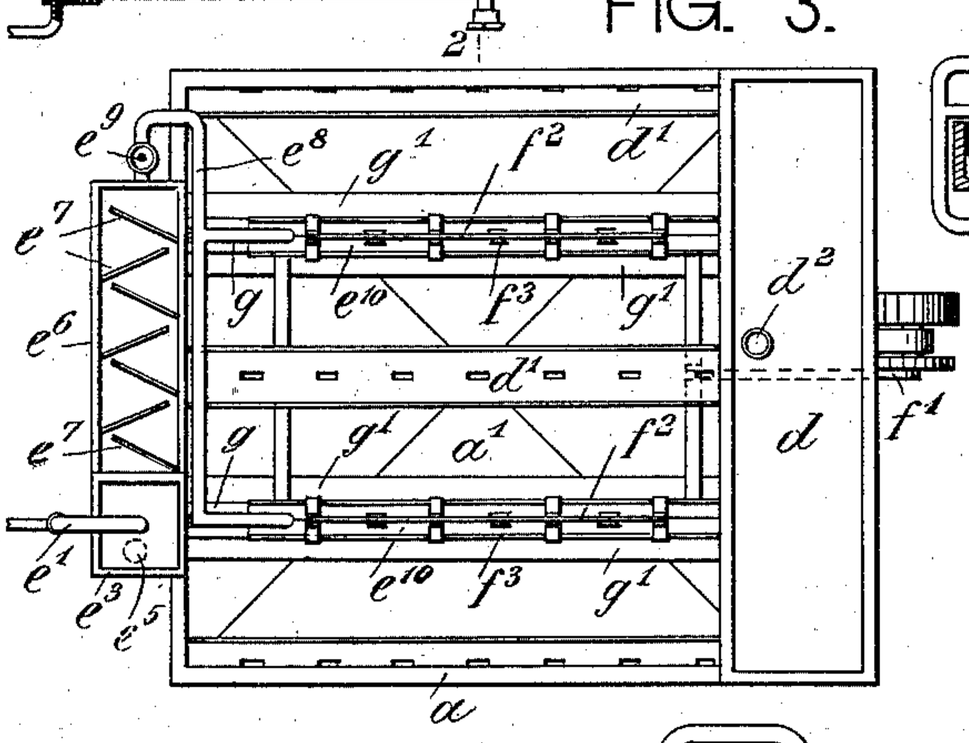


FIG. 5.

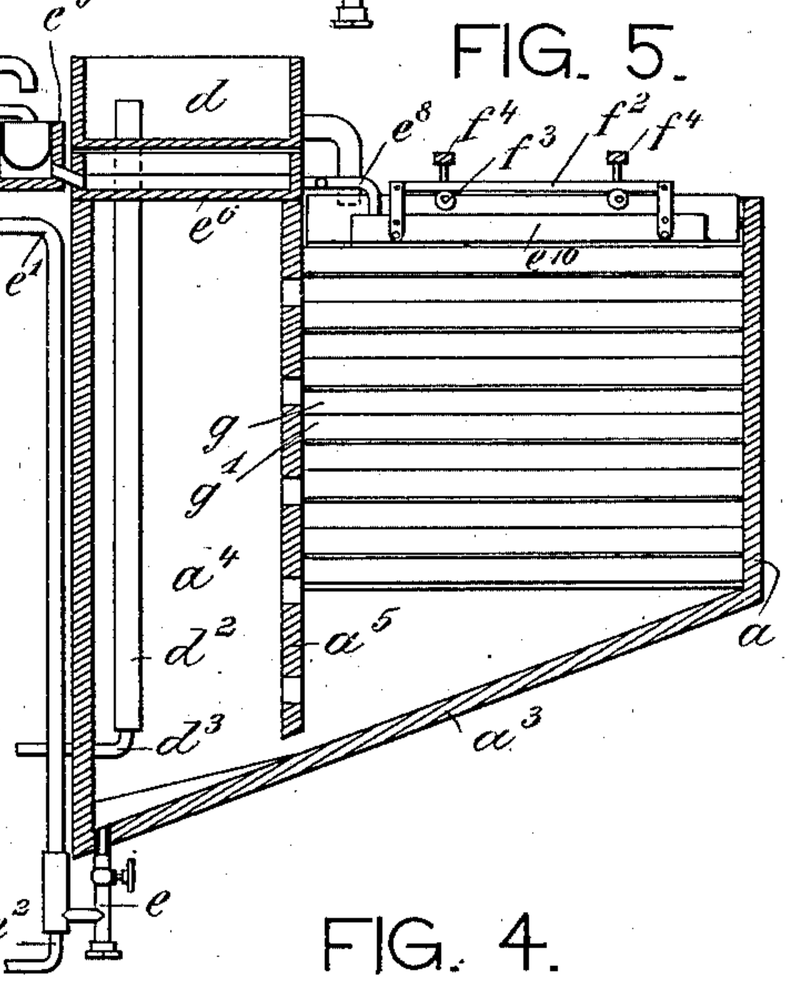


FIG. 6.

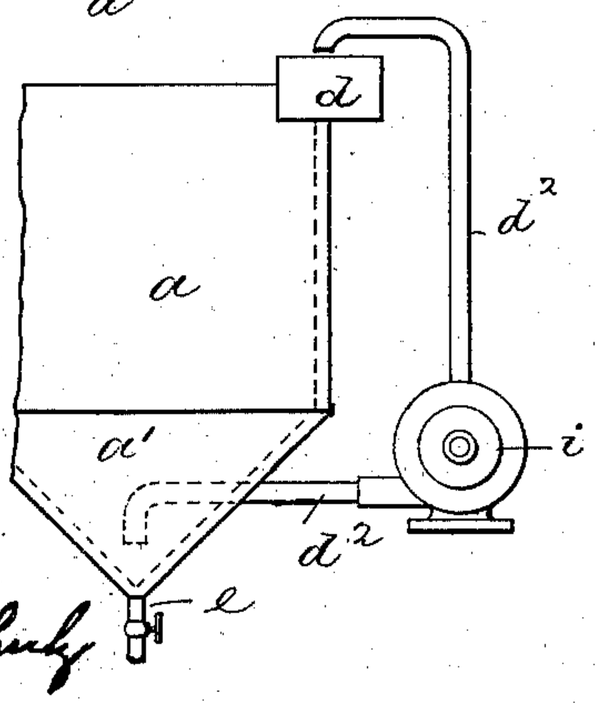
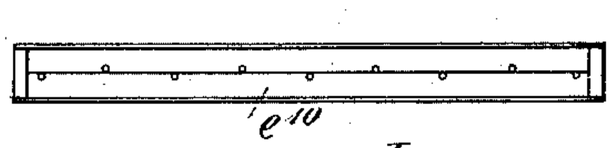


FIG. 4.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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UNITED STATES PATENT OFFICE.

HENRY R. CASSEL, OF NEW YORK, N. Y.

APPARATUS FOR EXTRACTING PRECIOUS METALS BY ELECTROLYSIS.

SPECIFICATION forming part of Letters Patent No. 749,844, dated January 19, 1904.

Application filed October 25, 1902. Serial No. 128,775. (No model.)

To all whom it may concern:

Be it known that I, HENRY R. CASSEL, a citizen of the United States, residing at New York city, (Manhattan,) county and State of New York, have invented a new and Improved Apparatus for Extracting Precious Metals by Electrolysis, of which the following is a specification.

This invention relates to an improved apparatus for extracting precious metals from ore pulp or solutions by electrolysis, the object of the invention being to insure perfect amalgamation and precipitation of the metals.

In the accompanying drawings, Figure 1 is a vertical longitudinal section of my improved apparatus. Fig. 2 is a cross-section on line 2 2, Fig. 1; Fig. 3, a plan; Fig. 4, a detail of the mercury-trough; Fig. 5, a longitudinal section of a modification of the apparatus, and Fig. 6 is a side view of a modification of the pulp-lifter.

The letter *a* represents an electrolyzing tank or cell having pointed bottom *a'* with door a^2. The alternating cathodes *b* and anodes *c* are arranged in a vertical position, the cathodes being removably suspended within the tank and so placed that both of their sides are exposed. Across the upper part of tank *a* extends an ore pulp or solution tank *d*, communicating with a number of perforated launders or troughs *d'*, preferably made of wood, that are arranged directly above the anodes *c*. Through the openings of the launders the ore-pulp falls through tank *a* and upon the tapering bottom *a'*. From this bottom the pulp is raised and returned to box *d*, so as to produce a continuous circulation. The means for returning the pulp to the box consist of a pipe d^2, made of iron, earthenware, or any suitable material, said pipe extending from the box *d* to a point above bottom *a'*. The lower end of pipe d^2 embraces the nozzle d^3 of an air-blower d^4, by means of which the pulp is forced up through the pipe back into the box.

Into the lowermost point of bottom *a'* enters a mercury-pipe *e*, that forms part of a mercury air-lift. The pipe *e* communicates with an upright pipe *e'*, into the lower end of which enters an air-jet nozzle e^2. The pipe *e'* discharges at its upper end into a pot e^3, that contains an amalgam-filter e^4. Below such filter the pot e^3 communicates by pipe e^5 with one end of an inclined acid-box e^6, within which the mercury is purified by running through dilute sulfuric acid. The box e^6 is traversed by a number of partitions e^7, having openings at opposite ends, thus forming a long sinuous course that insures thorough exposure of the mercury to the acid. The purified mercury is discharged at the opposite end of box e^6 through pipe e^8, having cock e^9, into a number of connected perforated iron troughs e^{10}, arranged directly above the cathodes *b*. The pipe e^8 is always kept filled with mercury, so as to retain the sulfuric acid in the box, or the pipe may be arranged in the form of an inverted siphon. In order to effect a thorough amalgamation of the cathodes with a limited quantity of mercury, the perforations in the troughs e^{10} are set at a considerable distance apart, and the troughs are made horizontally slidable over the cathodes, so that they act somewhat like a movable sprinkler. The means for imparting a horizontal reciprocating movement to the troughs are shown to consist of an eccentric *f*, connected to the troughs by pitman *f'*. The troughs are provided with rails f^2, traveling on overhead pulleys f^3, that are suspended from supports f^4. By the means described the mercury will thus be discharged from the troughs e^{10} over the cathodes to amalgamate them thoroughly and will then be returned by air-jet nozzle e^2 through pipes *e e'* into the pot e^3 and thence through filter e^4 and acid-box e^6 back to the troughs.

To insure a perfect amalgamation of the cathodes and prevent the mercury from reaching the anodes, I flank each of the cathodes by a number of slats or deflectors *g*, that are inclined from top to bottom toward the cathodes and approach the same at their lower ends to within about half an inch. The deflectors serve to continuously throw the mercury as it rebounds from the cathode back upon the same and effect a rapid accumulation of amalgam. The deflectors constitute, in effect, an open chamber around the cathodes that confines the mercury to the same. At its upper end each deflector is provided with a down-

wardly-inclined guard g', by means of which the stream of descending pulp is diverted toward the anodes. Jointly the deflectors and guards g g' form a number of inverted V-shaped open partitions between the anodes and cathodes. The guards g g' are preferably made of wood or other non-conductive material.

My improved apparatus is used in the following manner: The mercury is introduced into tank a in sufficient quantity to constantly cover the lower portion of the converging bottom. The pulverized ore is converted into a pulp, preferably in an agitating-vat, and is mixed with a solvent, such as cyanid of potassium. If necessary, chlorid of sodium or another salt may be added to render the pulp more conductive. The pulp thus prepared is run into tank a and is through pipe d^2 carried into box d by means of air-jet pipe d^3. From box d the pulp flows into the launders d' and falls thence upon the anodes c and between the electrodes, and is thus kept in circulation. As the pulp descends through the tank it is directed toward the anodes by the guards g'. The air-jet e^2 will lift the mercury through pipe e' into pot e^3, within which the coarse amalgam is retained by filter e^4. This amalgam is removed from time to time, while the filtered mercury passes through pipe e^5 into box e^6. During electrolysis the mercury takes up some lime, sodium, and other alkaline bases contained in the ore and solution. While a portion of the bases is immediately decomposed into hydrates by the water, a certain percentage remains in the mercury, thus impairing and retarding its amalgamating quality. To purify the mercury and neutralize the alkalies contained in the amalgam, I pour into box e^6 dilute sulfuric acid. The zigzag partitions e^7 will cause the mercury to traverse the entire length of the tortuous passage, thus exposing it thoroughly to the action of the acid. Through the cock e^9 the purified mercury enters the perforated reciprocating troughs e^{10} and will by them be evenly discharged over the cathodes. Of course the effective precipitation of the metals depends upon the area of the cathodes and also upon their thorough amalgamation. By using vertical cathodes both sides are rendered active and exposed to amalgamation and precipitation. It is difficult, however, to keep vertical cathodes well amalgamated, as the mercury has a tendency to run unevenly along an upright plate and when meeting the slightest obstruction, such as precipitated hydrates, it will rebound or jump off into the moving pulp. As the mercury thereby comes into contact with the anodes it is partly dissolved and loss ensues. To obtain perfect amalgamation and also prevent the mercury from reaching the anodes, I have provided the deflectors g and guards g'. The deflectors g throw the detached mercury continuously back against both sides of the cathode, while the stream of the descending pulp is by the guards directed toward the anodes. As the amalgam forms more readily at the points where the mercury impinges against the cathode, the constant throwing back of the mercury will cause a rapid accumulation of the amalgam. The pulp around the cathodes being, moreover, kept by the guards in a more quiescent state than at the anodes, the accumulated amalgam is not exposed to the scouring action of the circulating pulp, and thus the amalgam remains undisturbed on the cathodes until removed. The stream of constantly-falling pulp being diverted to the anodes, the particles of gold are brought into intimate contact with the same and are rapidly dissolved. The coarser particles of gold are immediately amalgamated and are retained by the filter e^4. The finely-divided gold is dissolved and precipitated upon the cathodes as an amalgam, which gradually accumulates on both sides and all over the plates. This amalgam is from time to time removed and collected in the usual manner. When the pulp and solution show by test that the values have been extracted and precipitated, the door a^2 is opened and the contents are discharged.

In Fig. 5 the pointed bottom a' is replaced by a sloping bottom a^3. At its lowest end there is arranged above bottom a^3 and adjoining tank a a pulp-chamber a^4, which is separated from tank a by an open perforated partition a^5. The pulp flows from tank a into chamber a^4 through and below partition a^5 and is thence raised to box d by pipe d^2 and nozzle d^3 in manner above described.

In Fig. 6 the air-jet nozzle d^3 is replaced by a centrifugal pump i, while the pipe d^2 is arranged along the outer side of tank a in lieu of being arranged within the same.

What I claim is—

1. An apparatus for the extraction of precious metals by electrolysis provided with a tank, vertical electrodes, a distributing pulp-box, a mercury-pot in the upper part of the tank, a perforated movable mercury-trough, and means for lifting the pulp and mercury into said distributing-box and pot respectively, substantially as specified.

2. An apparatus for the extraction of precious metals by electrolysis provided with a tank, vertical electrodes, a pulp-box, a communicating perforated launder above each anode, and an air-jet for raising the pulp from the bottom of the tank into said box, substantially as specified.

3. An apparatus for extracting precious metals by electrolysis, provided with a tank, vertical electrodes, an elevated mercury-pot, a communicating perforated movable mercury-trough and an air-jet for raising the mercury from the bottom of the tank into said pot, substantially as specified.

4. An apparatus for extracting precious metals by electrolysis, provided with a tank

having an inclined bottom, vertical electrodes within the tank, an elevated pulp-box, communicating distributing-launders, an elevated mercury-pot, a communicating perforated movable trough, and means for returning the pulp and mercury from said inclined bottom to the box and pot respectively, substantially as specified.

5. An apparatus for extracting precious metals by electrolysis, provided with a tank, vertical electrodes, an elevated pulp-box, and a perforated launder above each anode that communicates with said box, substantially as specified.

6. An apparatus for extracting precious metals by electrolysis, provided with a tank, inclosed electrodes, and a perforated movable mercury-trough that extends over the cathode, substantially as specified.

7. An apparatus for extracting precious metals by electrolysis, provided with a tank, inclosed electrodes, a perforated mercury-trough extending over the cathode, and means for imparting a reciprocating movement to said trough, substantially as specified.

8. An apparatus for extracting precious metals by electrolysis, provided with a tank, vertical electrodes, a box having a number of open transverse partitions, means for admitting mercury to one end of said box, and means for discharging mercury from the other end of the box, substantially as specified.

9. An apparatus for extracting precious metals by electrolysis, provided with a tank, vertical electrodes, a mercury-pot, an inclosed filter, a communicating acid-box, and transverse open partitions within said box, substantially as specified.

10. An apparatus for extracting precious metals by electrolysis, provided with vertical electrodes, surrounding guards, means for circulating the mercury, means for separating the mercury from the cathode, and deflectors flanking the cathode, substantially as specified.

11. An apparatus for extracting precious metals by electrolysis, provided with a vertical cathode, and with a series of inclined mercury-deflectors at the side of the cathode, substantially as specified.

12. An apparatus for extracting precious metals by electrolysis, provided with a vertical cathode and a series of mercury-deflectors at the side of the cathode, said deflectors being inclined toward the cathode from top to bottom and approaching the same at their lower ends, substantially as specified.

13. An apparatus for extracting precious metals by electrolysis, provided with a vertical cathode, inclined mercury-deflectors at the side of the cathode, and pulp-guards projecting from the deflectors, substantially as specified.

14. An apparatus for extracting precious metals by electrolysis, comprising a tank, inclosed vertical electrodes, mercury-deflectors and pulp-guards at the sides of the cathode, an elevated pulp-box, communicating perforated launders, means for lifting the pulp into said box, an elevated mercury-pot, communicating slidable perforated troughs, and means for lifting the mercury into said pot, substantially as specified.

Signed by me at New York city, (Manhattan,) New York, this 24th day of October, 1902.

HENRY R. CASSEL.

Witnesses:
F. v. BRIESEN,
EDWARD RAY.