J. B. ROSSMAN.

PROCESS OF TREATING GOLD.

APPLICATION FILED AUG. 17, 1900.

943,317.

Patented Dec. 14, 1909.

2 SHEETS—SHEET 1.

Fig. 1.

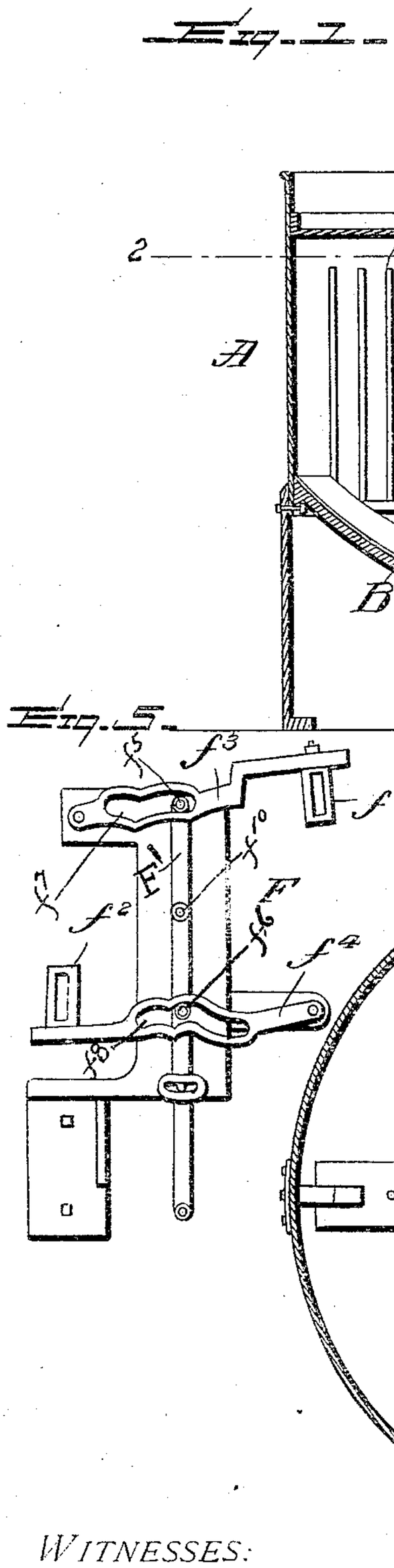

Fig. 6.

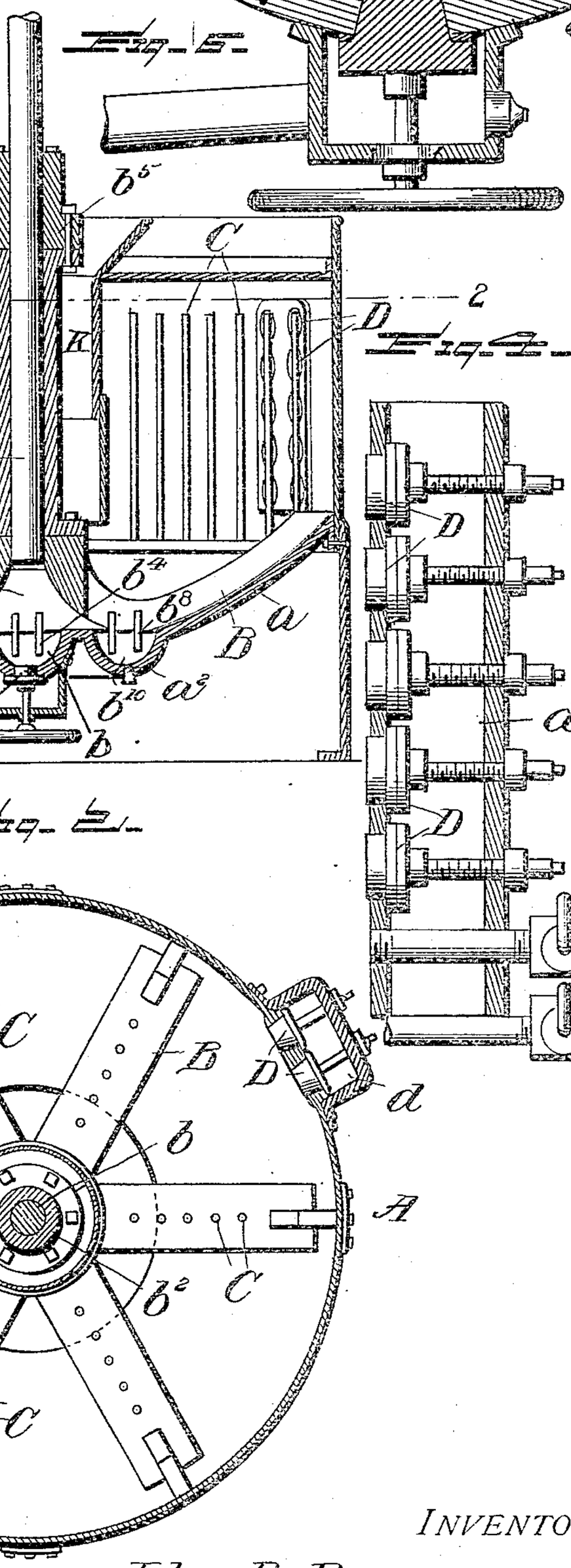

Fig. 2.

Fig. 5.

Fig. 3.

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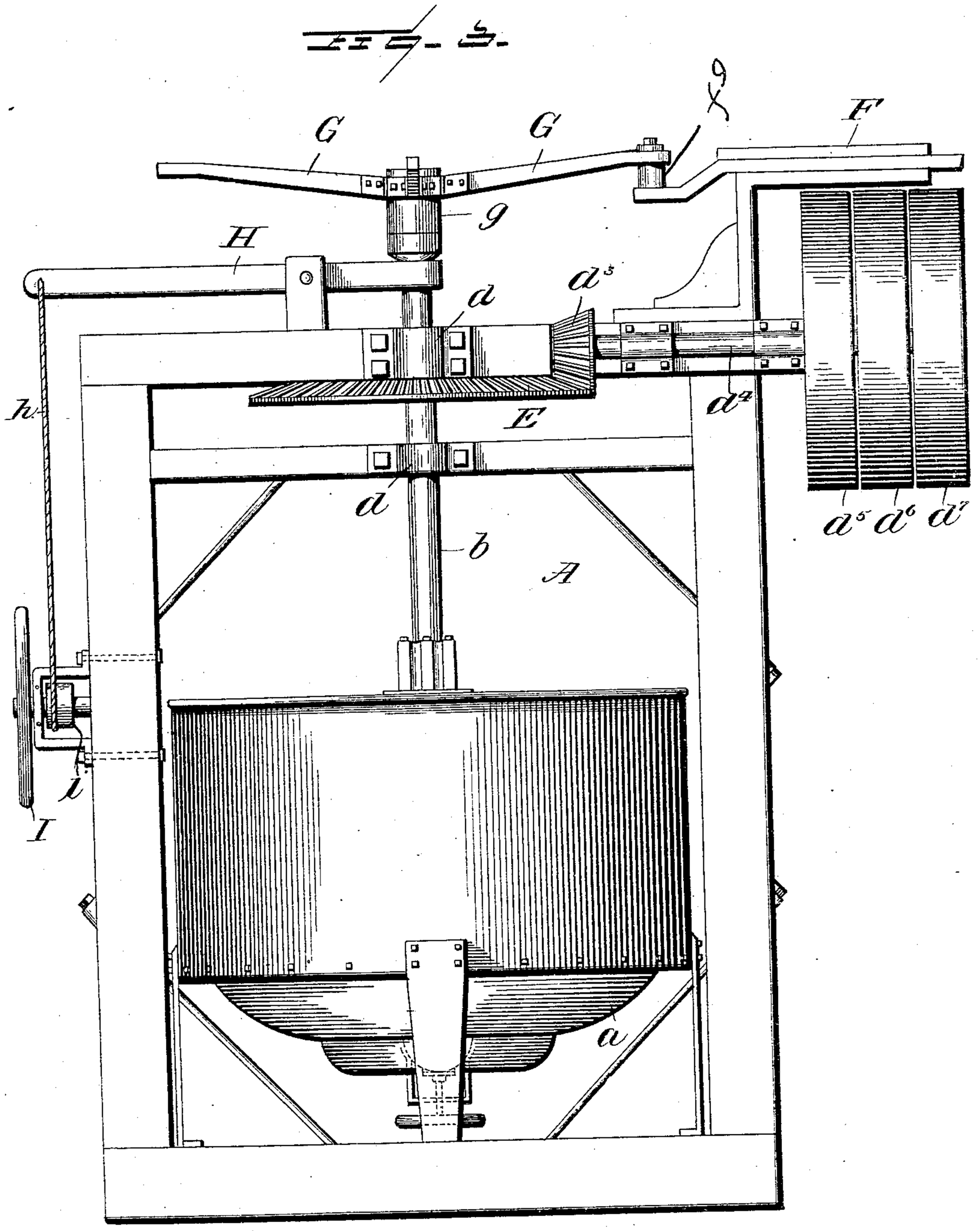
2 SHEETS—SHEET 2.

FIG. 5.



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UNITED STATES PATENT OFFICE.

JOHN B. ROSSMAN, OF ST. PAUL, MINNESOTA.

PROCESS OF TREATING GOLD.

943,317. Specification of Letters Patent. **Patented Dec. 14, 1909.**

Application filed August 17, 1900. Serial No. 27,308.

To all whom it may concern:

Be it known that I, JOHN B. ROSSMAN, a citizen of the United States, residing at St. Paul, in the county of Ramsey and State of Minnesota, have invented certain new and useful Improvements in Processes of Treating Gold; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to an improved process in which the particles of gold in auriferous ores are so freed that they may be brought into amalgamating contact with mercury, and it consists in the novel features hereinafter described and claimed.

My invention is designed for use with auriferous ores in which the separate gold particles occur enveloped by a refractory coating which prevents amalgamating contact of the gold with mercury. Such coating may consist of an envelop of silicates, or of sulfur, arsenic, antimony, tellurium, or other elements, or their compounds, which prevents amalgamating contact of the gold with mercury. Greases and oils may also be present inclosing the gold particles. And my method differs from prior processes in that it employs suitable chemical agents for weakening or destroying the union between the gold particles and their enveloping coatings sufficiently to permit the separation of such coatings by attrition; thus leaving the gold particles in a clean or free condition suitable for amalgamation, the mechanical action serving at the same time to effect the amalgamation, while the chemicals tend to prevent flouring of the mercury during the operation.

In the accompanying drawings, forming a part of this application, and in which similar reference symbols indicate corresponding parts in the several views, there is illustrated one form of apparatus for carrying out my invention, and in these drawings:

Figure 1 is a detail central vertical sectional view of a concentrator and scourer; Fig. 2 is a sectional view on the line 2—2 of Fig. 1; Fig. 3 is an elevation of the concentrator and scourer; Fig. 4 is a detail sectional view, showing the gates for drawing off the tailings; Fig. 5 is a detail view, showing a reversing mechanism; and Fig. 6 is a detail sectional view of a sluice-box.

Referring to the drawings, A indicates a concentrator and scourer provided with an inclined bottom *a*, which is formed with a sluice-box b^9. A vertical series of gates D is provided in the wall of the concentrator for drawing off the tailings. A plurality of rubbers B, closely fitting the bottom of the concentrator, are provided with upwardly-extending rods C, which constitute beaters to disintegrate the clayey ores. The rubbers B are provided with projections b^8, extending downward into the sluice-box b^9, and a central plug b^7 carries projections b^4 extending downward into a depression $b^\times$ in the center of the concentrator bottom; this depression being provided with a removable piece b^{11} to permit discharge of the concentrates. The rubbers are secured to an operating shaft *b* by means of a sleeve b^2 and collar b^5. This shaft carries a beveled gear E arranged to mesh with a beveled pinion d^3. Mounted on the shaft d^4 of the beveled pinion are two loose pulleys d^5, d^7 and a fast-pulley d^6, which are adapted to receive a straight and a cross belt, whereby the rotation of the beveled pinion can be reversed by shifting the belts in the usual way.

I have illustrated a belt-shifter F provided with the two belt-guides *f*, f^2, which are carried, respectively, by the pivoted arms f^3, f^4. A lever F^1, pivotally supported at f^{10}, is provided with projections f^5 and f^6, which operate in cam-slots f^7, f^8, formed, respectively, in the pivoted arms f^3, f^4. The lever F^1 carries a projection f^9, which is arranged to be engaged by the arms G secured to the shaft *b*.

The shaft *b* is provided with a plurality of such arms G secured thereto, any one of which is arranged to engage the projection f^9 and rock the lever F^1 on its pivot f^{10}. Assuming that the shaft is rotating in one direction, actuated by the straight belt, as an arm G strikes the projection f^9, the lever F^1 is moved, thus shifting the belt guides, whereby the straight belt is moved off the fast-pulley d^6 and the cross belt moved on, to rotate the parts in the opposite direction. As soon as such reverse motion is set up, another arm G strikes the projection f^9 from the opposite side, and the reverse action from that just described takes place.

The rubbers B are of considerable weight and can be adjusted relative to the concentrator bottom by means of a lever H, one end of which engages a shoulder on the shaft *b*. To the other end of the lever H is at-

tached a rope *h*, which is arranged to be wound on a drum *i* operated by a hand wheel I.

A supply tube K is arranged concentrically with the shaft *b*, and is provided with a flaring top for the introduction of the ore-charge.

In the operation of my process, the ore is first thoroughly ground, and then the pulp from the stamp-mill or pulverizer is fed to the tube K and by it delivered to the top of the rubbers. There being no current of water at the center of the apparatus, the heavier gold particles quickly settle to the bottom. Since the oscillating motion of the rubbers creates no current to carry the fine gold, all of the precious metal on account of its weight settles quickly to the bottom, there to be amalgamated. The slime and light material, on the other hand, is kept in suspension by the agitation of the water, thereby being prevented from settling upon the gold and interfering with amalgation.

Where the ore contains clayey matter, which would prevent the gold from readily settling to the bottom, the beaters, by passing backward and forward through the pulp, effect a thorough disintegration of the clayey material and allow the gold to settle to the bottom.

When the machine has been run for such time that there is danger of losing valuable material through the gates D, the flow of pulp will be switched off into the next apparatus; it being understood that a series of these apparatus may be employed.

A suitable chemical solution for weakening or destroying the adhesive bond of union existing between the gold particles and their enveloping refractory coatings is then added to the concentrates remaining in the concentrator, and the rubbers again started in operation. During this stage of my operation, the refractory coatings of the gold particles are sufficiently loosened by the chemical solution to permit their separation by the action of the rubbers, and the gold particles are thus left in a clean or free condition suitable for amalgamation.

I have discovered two preferred solutions which operate satisfactorily in weakening or destroying the union between the gold particles and their enveloping refractory coatings, and in my process I employ one of these solutions, or the two in succession, depending on the particular character of the ore. The first of these solutions consists of a mixture of a chemical containing cyanogen with an alkali. As an example, I employ a saturated solution of cyanid of potassium and water and a saturated solution of caustic soda and water in the proportions of one pint of cyanid of potassium to six pints of caustic soda; this mixture then being diluted with sixty gallons of water, either hot or cold water being employed. In place of the caustic soda, carbonate of soda, or any of the alkalies, may be employed.

The second solution consists of some dilute acid, as, for example, one pint of sulfuric acid to sixty gallons of water. When the ore contains zinc, antimony, arsenic, and tellurium, I may use, in connection with the second solution, but not admixed therewith, a mixture of one pint of hydrochloric acid to thirty gallons of water. This last solution can be used in connection with the rubbing process, or the pulp can remain in it a suitable time previous thereto. In any case, the pulp should be washed with pure water between the employment of the different solutions. This washing is effected by stopping the machine and allowing the pulp to settle. The gate D immediately above the pulp is then opened, and the solution allowed to escape, after which the gate is closed and pure water is admitted. The rubbers are now rotated until the pulp is thoroughly cleansed from the cyanid and alkali by the water. The pulp is again allowed to settle; and the water is then drawn off through gate D, the gate is closed, and fresh water and the sulfuric acid solution is added. After the refractory coatings have thus been separated from the gold particles, these particles are left in a clean or free condition suitable for amalgamation contact with the mercury.

It should be clearly understood that the removal of the base coatings inclosing the gold particles as they come from the stamp-mill or pulverizer is effected by the mechanical action of the rubbers. It is true that the chemicals specified serve to loosen the physical union between the envelops and the granules of precious metal, and that it would be impossible for the rubbers to remove the coatings satisfactorily without the aid of these chemicals; and it is also true that the chemicals specified, cyanid and an alkali, seem to be the only ones capable of affecting the base substances in this important manner; but the chemicals do not, as in former processes, dissolve the coatings away from around the gold. The removal of the coatings is effected by the rubbers. Since the ore is ground very fine before admission to the concentrator, and since the rubbers are very heavy and may be caused to bear with their entire weight upon the bottom, it will be readily understood that the grinding action is very severe, and that it is unnecessary to use chemicals of a nature or amount calculated to dissolve the coatings. Experience has proved that this modified mechanical separation of the gold produces far more perfect results with refractory ore than any of the former processes that either dissolved the gold out of the ore, or dissolved the impurities away from the gold. A further

consideration, and one of vital importance in treating rather low grade ores, is the matter of economy. Since it is much cheaper to rotate the rubbers than it is to supply chemicals, and since my process requires but a small amount of the latter, it is obvious that a great saving must be effected.

The combined action of the cyanid and the alkali operates, as stated, to loosen the union between the coatings and the gold, as does also the sulfuric acid, when it is necessary to use the latter. In addition, the alkali acts upon the greases and slimes that also envelop the gold. These impurities are very tenacious and require one of the strong alkalies, sodium or potassium hydroxid or carbonate, to loosen them. And by the term "alkali", I wish to be understood as referring to these substances, not using the term loosely to include the alkaline earths, calcium, etc. I find that the latter are totally incapable of effecting a satisfactory result. Even with the alkalies proper, only a loosening of the greases is effected. Their removal is accomplished by the mechanical action. Experience has taught that it is impossible to deal with the greases and slimes with chemicals alone. The alkali has the further function of protecting the cyanid from the action of acids that may be present in the ore.

Having thus fully described my invention, what I claim as new and desire to secure by Letters-Patent is:

1. The process of cleaning and separating gold occurring in refractory ores in which the gold particles are surrounded by physical coatings of base substances and greases and oils, which consists in loosening such coatings and acting upon the greases and oils by treating the ground ore with a solution of a cyanid and an alkali and synchronically therewith removing the coatings and grease and amalgamating the cleaned gold by subjecting the material to attrition between opposed surfaces exterior to the body of ore in the presence of mercury, then washing the cyanid and alkali from the pulp, and finally further loosening the coatings by treating the pulp with dilute sulfuric acid and synchronically therewith completing the removal of the coatings and the amalgamation of the cleaned gold by subjecting the material to attrition between opposed surfaces exterior to the body of ore in the presence of mercury.

2. The process of cleaning gold occurring in refractory ores in which the gold particles are surrounded by physical coatings of base materials, which consists in treating the ground ore with a solution of potassium cyanid and an alkali and synchronically therewith subjecting the material to severe attrition, then washing such solution from the pulp, and finally synchronically subjecting the pulp to further attrition and the action of an acid.

3. The process of cleaning gold occurring in refractory ores in which the gold particles are surrounded by physical coatings of base materials, which consists in treating the ground ore with a solution of potassium cyanid and an alkali and synchronically therewith subjecting the material to severe attrition, then washing such solution from the pulp, and finally synchronically subjecting the pulp to further attrition and the action of dilute sulfuric acid.

In testimony whereof, I affix my signature, in the presence of two subscribing witnesses.

JOHN B. ROSSMAN.

Witnesses:
A. B. Allen,
H. E. Barkulow.