No. 639,766. Patented Dec. 26, 1899.

L. E. PORTER.

APPARATUS FOR EXTRACTING PRECIOUS METALS FROM ORES.

(Application filed Mar. 17, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

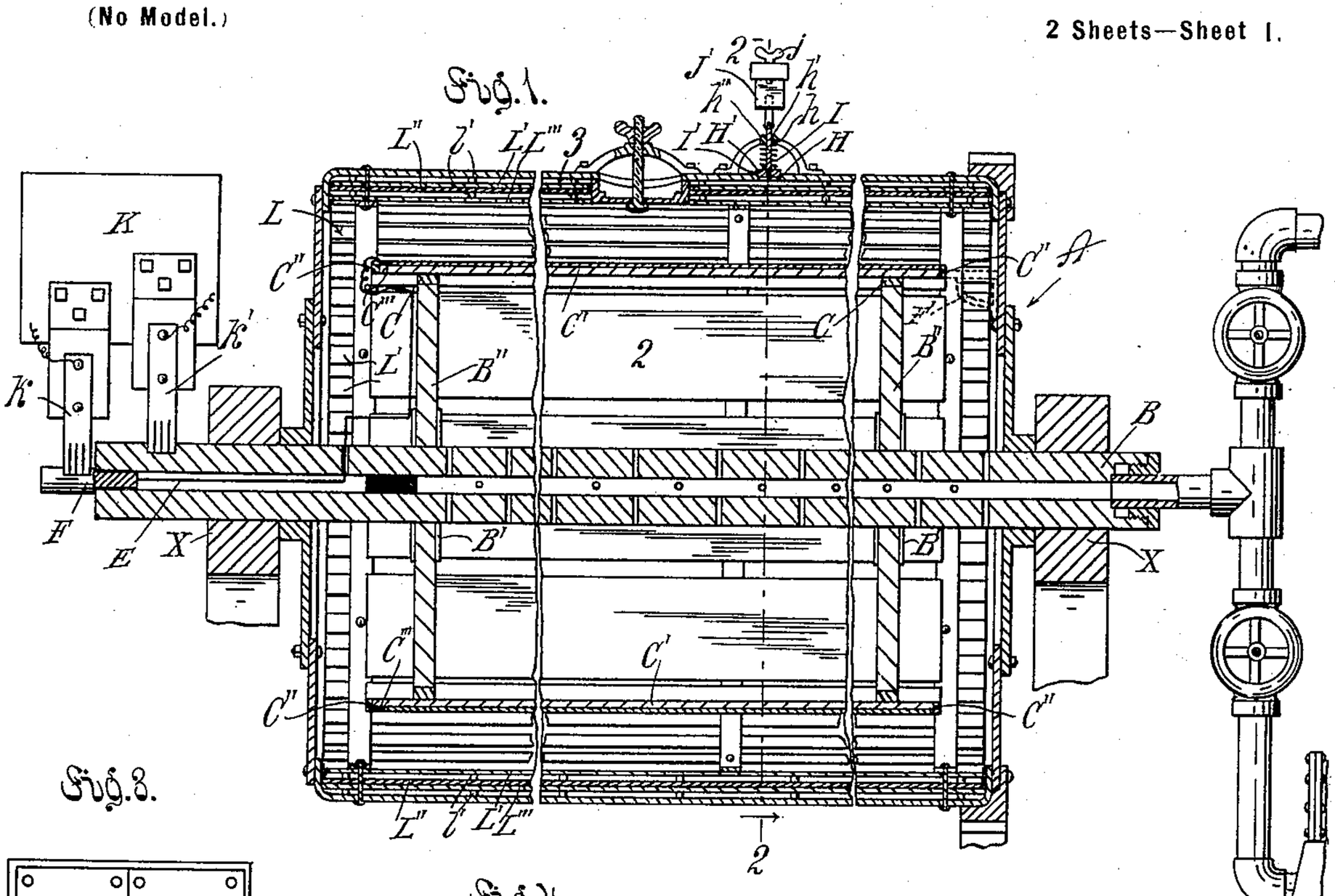


Fig. 3.

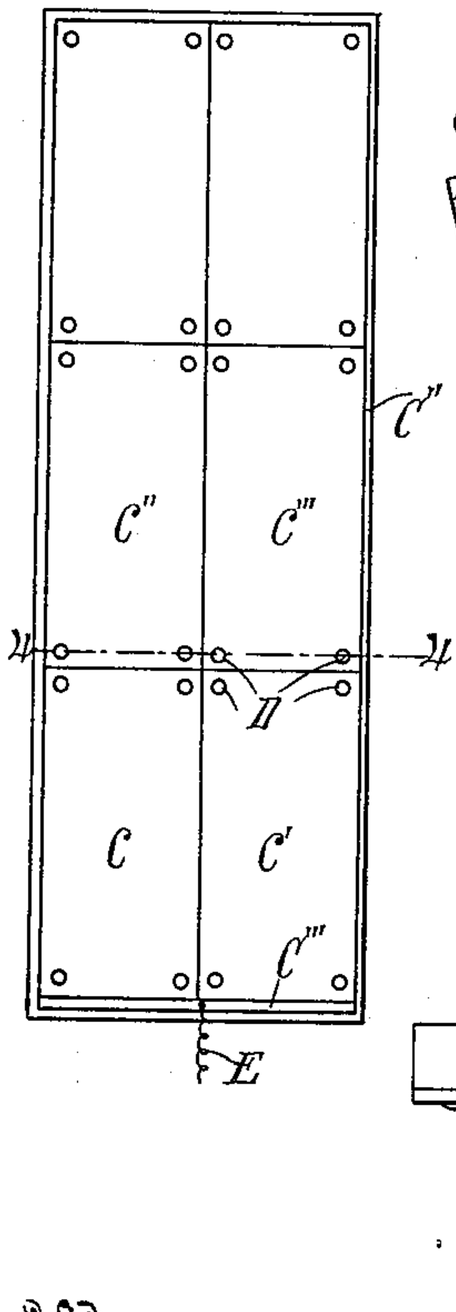


Fig. 4.

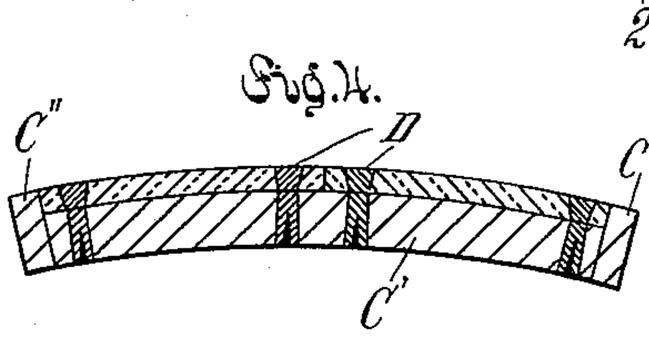


Fig. 2.

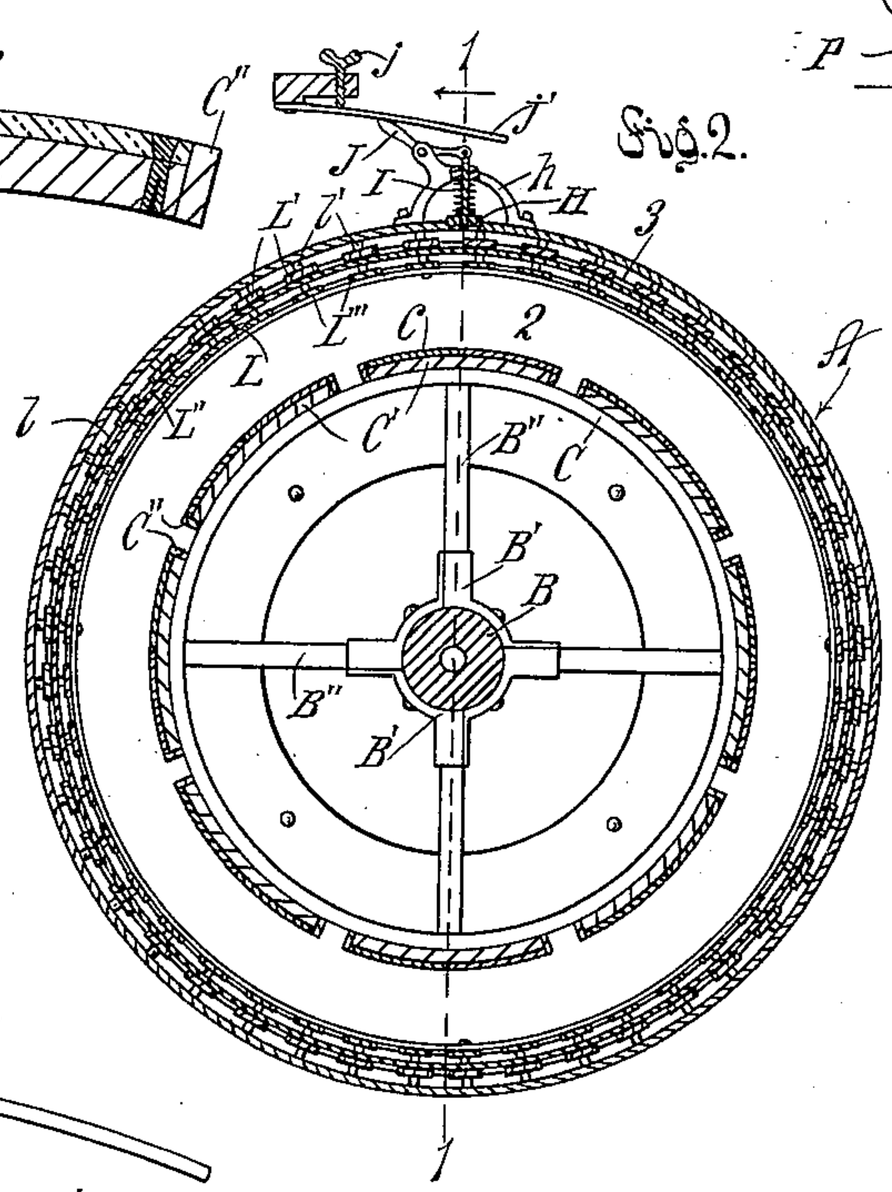
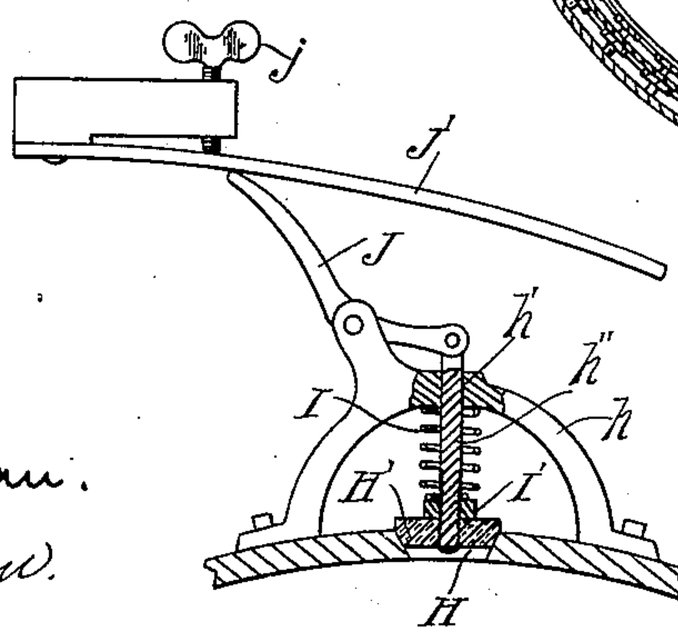


Fig. 5.



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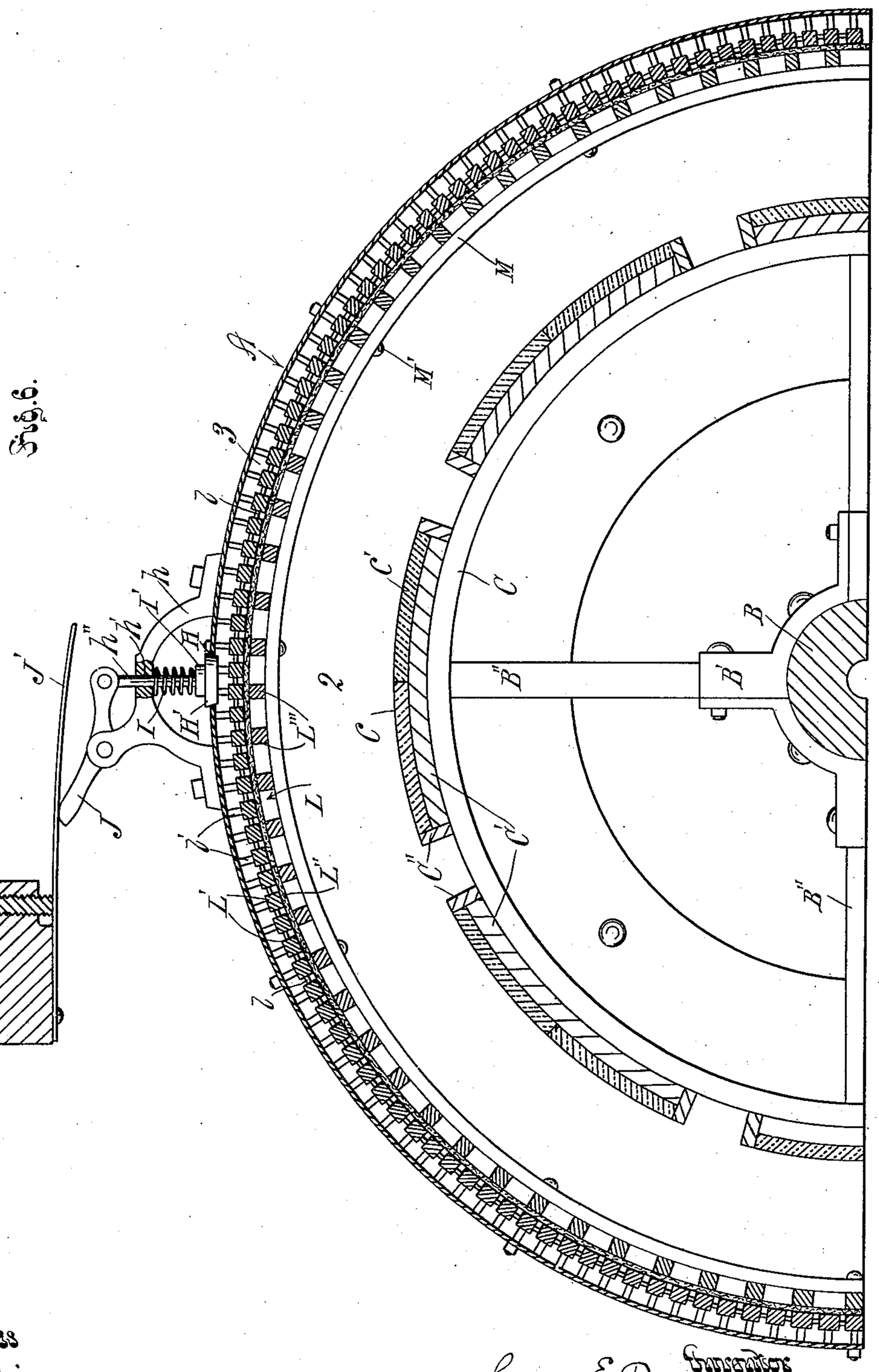

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UNITED STATES PATENT OFFICE.

LEWIS E. PORTER, OF LOS ANGELES, CALIFORNIA.

APPARATUS FOR EXTRACTING PRECIOUS METALS FROM ORES.

SPECIFICATION forming part of Letters Patent No. 639,766, dated December 26, 1899.

Application filed March 17, 1898. Serial No. 674,252. (No model.)

To all whom it may concern:

Be it known that I, LEWIS E. PORTER, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Apparatus for Extracting Precious Metals from Ores, of which the following is a specification.

My invention relates particularly to means whereby precious metal may be extracted from base ores at a minimum expense of time, labor, and money.

My invention comprises the various features of construction and combinations of parts which I employ in practicing my invention.

The accompanying drawings illustrate my invention.

Figure 1 is a vertical longitudinal mid-section of a device whereby my invention is practiced. Line 1 1, Fig. 2, indicates the line of section. Fig. 2 is a sectional view showing the arrangement of the non-conducting lining and the filtering material. Line 2 2, Fig. 1, indicates the line of section. Fig. 3 is a plan view illustrating the arrangement of the carbon-plates within the frame to form the anode-plate. Fig. 4 is a cross-section of the same on line 4 4, Fig. 3. Fig. 5 is an enlarged sectional view showing the trip-valve. Fig. 6 is an enlarged fragmental sectional view of the upper part of the barrel.

In the drawings, A represents a rotatable amalgamating-barrel which is amalgamated upon its inner side walls or may be provided with a lining of amalgam-plate slipped inside the barrel in the ordinary manner. Ordinarily I copper-plate the inside of the barrel by using a copper solution or a copper anode and an electrical current, so that after treatment the walls of the barrel form the amalgamating-plate and when electrically charged forms the cathode-plate.

B is a hollow shaft upon which the barrel is secured. This shaft is journaled to rotate in bearings X X. Upon this shaft are arranged two spiders B′, which may be made in segments or integral, as deemed expedient. To the spiders are secured wooden arms B″, and upon the ends of these arms are secured two annular supports or rings C. Upon these rings are secured frames C′, which are preferably made of wood or some other non-conducting material and are each curved to form an arc of a circle having the supporting-shaft of the barrel for center. As shown in the drawings, these frames are formed of wooden boards bent into shape and provided at the ends and at the sides with projecting ledges C″ to form a shallow box with crown bottom.

I have found in treating ores electrically that ordinarily a metal anode is unsatisfactory in operation in that it soon deteriorates and must be replaced. By practicing my invention upon a large scale and in which I employ a barrel of large size, from six to eight feet in diameter, it has been impracticable to use single carbon-plates of sufficient size to form the anodes. I therefore construct each anode-plate from a series of small carbon-plates (indicated by *c c′ c″*, &c.,) secured to and carried by the frame. These plates are secured to the frame by means of wooden pins D, having tapering heads fitted into tapering holes in the carbon-plates, passing through oppositely-tapering holes in the wooden frames and secured therein by wedging, as clearly shown in the drawings. These plates have their edges fitted tightly together to thereby electrically connect them with each other, and the plates at one end of the frame are fitted into a leaden socket C‴, which is connected with a source of electrical energy by means of an insulated wire E, which passes down into the hollow shaft and is connected with a plug F, which is fitted into the hollow end of the shaft and insulated therefrom.

If desired, the spiders B′ and arms B″ may be dispensed with and the wooden frames extended to the ends or heads of the barrel and supported by brackets F′, fastened to the heads of the barrels, as indicated in dotted lines in Fig. 1.

It will be seen that the anode-plates are curved to conform to the curvature of the side walls of the barrel, so that the distance between the anode-plates and the inner face of the cathode-plate is exactly the same at all points upon the anode-plates. This insures that the electrical current which passes from the anode to the cathode shall be uniform throughout the entire surface of the anode-plate. These plates, as shown in the drawings, are eight in number and are sepa-

rated from each other a short distance, so as to give more effective agitation of the pulp in the barrel.

H is a valve-opening provided in the outer wall of the barrel, and H′ is a valve closing such opening. *h* is a guide secured to the barrel and provided with an opening *h′* to receive the valve-stem *h″*. This valve is adapted to open by pressure within the barrel, and a tension-spring I is arranged encircling the valve-stem and engaging with the guide *h* to normally hold the valve closed. This tension is adjusted by means of a tension-nut I′, so that thereby the amount of pressure required to open the valve may be adjusted to a nicety.

J is a pivot or trip-lever which is pivoted to the guide *h* and the valve-stem *h″* and is adapted to open the valve when the arm is depressed.

J′ is a spring trip-arm which is adapted to engage with the lever J when the valve is at the highest point during the rotation of the barrel and to open the valve by depressing the lever. A bolt *j* is arranged to regulate the tension of the trip-arm so as to trip the valve at any desired pressure. While this valve is peculiarly adapted for use in my barrel in which separation of the gases is effected, it is also adapted for use in any rotary barrel in which electrical or chemical treatment releases gases sufficient to produce an excessive pressure in the barrel and in which it is desirable to relieve the pressure of the gases with or without separating them into their various classes. For this reason my claims are not limited to the exact construction of barrel and filter-lining shown, but are broadly upon an ore-treating machine comprising a rotating barrel for containing the ore and evolved gases and in which either electrical, chemical, or electrochemical treatment may be practiced with or without the filter-lining.

K is a source of electrical energy having one pole *k* connected with the anode-plates and its other pole *k′* connected with the cathode-plate or with the barrel, in which case the walls of the barrel form the cathode-plate. The electric current passes from the pole *k* through the wire E to the anode-plates formed by the carbon-plates *c c′*, &c., thence passes through the chemically-saturated pulp, the perforated insulated lining, the chemical solution in the space E to the amalgamated lining of the barrel, passes along the barrel to the shaft B, and is by the pole *k′* conducted back to the dynamo.

In practice in treating ores I find that in nearly all ores treated by chemical and electrical means hydrogen and other gases useless as solvents are liberated at the cathode-plate, and unless removed from the barrel this gas attacks and destroys a large portion of the solvent gases. In order to provide means whereby these non-solvent gases may be prevented from mixing with and destroying the solvent gases, I arrange inside the barrel a lining of non-conducting material L, which is preferably formed of wooden slats L′, connected by means of dowel-pins *l* and held from close contact with the walls of the barrel by means of pins *l′*, inserted into the slats and projecting therefrom. Upon this porous non-conducting lining I arrange a lining L″, of filtering material. This may be burlap, blanket, or any other suitable material which will permit the passage of the solution therethrough, but will prevent the passage of ore held in suspension in the solution. Inside the filter-lining I arrange a second non-conducting lining L‴, which is also preferably formed of wooden slats and serves to protect the filter-lining from being worn by the ore during treatment thereof. M represents wooden rings arranged inside the slats L‴ to hold them in place. Bolts M′ secure the rings to the barrel. By this means it will be seen that I divide the barrel, which is a closed chamber, into two portions 2 and 3, portion 2 being the main chamber of the barrel inside of the filter-lining and portion 3 being the space between the filter-lining and the walls of the barrel.

When the pulp mixed with its chemical solution is placed within the filter-lined chamber 2, in which the anode-plates are arranged, as soon as the electrical current is turned on solvent elements—such as chlorin, bromin, iodin, cyanogen, and oxygen, according to the chemicals used—are liberated in the anode-chamber and hydrogen and other non-solvent elements are liberated in the cathode-chamber. The filter material is preferably non-conducting and allows the passage of the solution therethrough and the passage of the electrical current without causing any deposition of metal upon the non-conducting linings or the filter-lining, and the metal is deposited upon the amalgamated lining of the barrel and hydrogen and other non-solvent gases are liberated. When the pressure of such gas becomes greater than the trip-valve is adjusted to sustain, as the barrel is rotated the trip-valve is operated by the trip-arm to open the valve to allow the gases and other solvent elements to escape from the space 3. The chlorin gas and other solvent elements, which will not readily pass through the filter-lining, remain within the chamber 2 and assist in dissolving the metals in the ore. By preventing the cathode gases from mingling or combining with the anode gas I secure much greater efficiency of operation with a smaller expenditure of chemicals and electrical force than can be otherwise attained. After the metal has all been dissolved from the ore I filter the solution from the tailings. This is done by removing the closures from the filter-barrel, which in this respect operates the same as the filter-barrel described and claimed in application for Letters Patent filed by me in the United States Patent Office August 18, 1896, Serial No. 603,129, except

that for ordinary ores I find that a large barrel may be employed and revolved at a low rate of speed, the pressure of a large body of tailings rolling over and over upon itself as the barrel is rotated serving to effectually press all the moisture out of the tailings and through the filter. During this operation air is forced from the air-pump P into the barrel through the hollow shaft, passing out through the filter-lining, acting as an oxidizing agent and at the same time assisting the passage of the solution through the lining.

Now, having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination set forth of a rotatable barrel provided with an amalgamated lining; a porous lining of non-conducting material arranged inside the amalgamated lining; a lining of filtering material arranged inside the non-conducting lining; anode-plates arranged inside the filtering-lining; a source of electrical energy, having one pole connected with the cathode-plate and the other connected with the anode-plate.

2. The combination set forth of a rotatable barrel provided with an amalgamated lining forming the cathode-plate; a porous lining of non-conducting material arranged inside the amalgamated lining; a lining of filtering material arranged inside the non-conducting lining; anode-plates arranged inside the filtering-lining; means for rotating the barrel; a trip-valve arranged opening into the space between the amalgamated lining and the filter-lining; and means for operating the valve to release the gas liberated at the cathode-plate.

3. The combination set forth of a rotatable barrel having an amalgamated lining; arms secured to the shaft of the barrel; anode-plates secured upon the ends of the arms and conforming substantially to the curvature of the wall of the barrel and arranged concentric therewith; a source of electrical energy having one pole connected with the anode-plates, and the other pole connected with the amalgamated lining.

4. The combination set forth of a rotating barrel provided with an amalgamated lining forming a cathode-plate; a lining of porous non-conducting material arranged within and supported by the amalgamated lining; a lining of filtering material arranged inside the non-conducting lining; a lining of porous non-conducting material arranged within the filtering-lining; and anodes arranged inside the inner porous non-conducting lining.

5. A machine for extracting precious metals from ores, comprising a rotating barrel adapted to contain the ores, chemicals for treating the same, and also the evolved gases under a considerable pressure; said barrel being provided with a valve-opening; a valve closing the opening and adapted to be opened by pressure within the barrel; a spring having an adjustable tension and adapted to hold the valve normally closed; a yielding trip-arm adapted to open the valve during a portion of the rotation of the barrel; and an adjustable tension for the trip-arm.

6. A machine for extracting precious metals from ores, comprising a rotating barrel adapted to contain the ores, chemicals for treating the same, and also the evolved gases under a considerable pressure; said barrel being provided with a valve-opening having an external valve-seat; a valve arranged to close such opening; a valve-guide secured to the barrel and having a guide-opening to receive the stem of the valve; a coiled spring encircling the valve-stem and engaging with the valve-guide to hold the same against a given pressure of the evolved gases; a tension-nut for regulating the tension of the spring; a pivoted lever having one end secured to the valve-stem and having its other end arranged to be engaged by a trip-arm; a trip-arm arranged to engage the lever; and an adjustable tension for regulating the pressure of the trip-arm.

7. A machine for extracting precious metals from ores, comprising a rotating barrel adapted to contain the ores, chemicals for treating the same, and also the evolved gases under a considerable pressure; said barrel being provided with a shaft; spiders secured upon the shaft; arms secured to the spiders; supporting-rings secured to the arms; frames secured to the rings; the carbon-plates secured upon the frames; and a source of electrical energy having one pole connected with the barrel and the other pole connected with the carbon-plates.

8. In a machine for extracting precious metals from ores, the combination set forth of a rotating barrel provided with a supporting-shaft; spiders secured to the shaft; arms secured to the spiders; supporting-rings secured to the arms; frames of non-conducting material secured to the rings; series of carbon-plates secured to the frames; and a source of electrical energy having one pole connected with the barrel and the other pole connected with the carbon-plates.

9. In a machine for extracting precious metals from ores, the combination set forth of a rotating barrel provided with a supporting-shaft; arms secured to the shaft; supporting-rings secured to the arms; frames curved to conform to the curvature of the side walls of the barrel and secured to the rings; carbon-plates secured to the frames; and a source of electrical energy having one pole connected with the barrel and the other pole connected with the carbon-plates.

10. In a machine for extracting precious metals from ores, the combination set forth of a rotating barrel having a hollow cylindrical cathode-plate; frames of non-conducting material arranged within the cathode-plate and curved to conform to the curvature of such plate; carbon-plates secured to the frames to form the anode-plates; and a source of elec-

trical energy having one pole connected with the cathode-plate and its other pole connected with the anode-plates.

11. In a machine for extracting precious metals from ores, the combination set forth of a rotating barrel having a hollow cylindrical cathode-plate; frames of non-conducting material arranged within the cathode-plate; carbon-plates arranged upon the tops of the frames to form the anode-plates; fastenings securing such plates to the frame; and a source of electrical energy having one pole connected with the cathode-plate and its other pole connected with the anode-plates.

12. In a machine for extracting precious metals from ores, the combination set forth of a rotating barrel provided with a valve-opening; a valve closing the opening and adapted to be opened by pressure within the barrel; a spring having an adjustable tension and adapted to hold the valve normally closed; a yielding trip-arm adapted to open the valve during a portion of the rotation of the barrel; an adjustable tension for the trip-arm; cathode and anode plates arranged within the barrel; and a source of electrical energy having one pole connected with the cathode-plate and its other pole connected with the anode-plate.

13. In a machine for extracting precious metals from ores, the combination set forth of a rotating barrel provided with a valve-opening; a valve closing the opening and adapted to be opened by pressure within the barrel; a spring having an adjustable tension and adapted to hold the valve normally closed; a yielding trip-arm adapted to open the valve during a portion of the rotation of the barrel; an adjustable tension for the trip-arm; a filter-lining arranged in the barrel to divide it into two chambers, the valve-opening leading from one of the chambers; anode-plates arranged inside the filter-lining; and a source of electrical energy having one pole connected with the anode-plates and its other pole connected with the barrel.

14. The combination set forth of a rotatable barrel adapted to form the cathode; a porous lining of non-conducting material arranged inside the barrel; a lining of filtering material arranged inside the non-conducting lining; anode-plates arranged inside the filter-lining; a source of electrical energy, having one pole connected with the barrel and the other pole connected with the anode-plates.

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