No. 745,472. PATENTED DEC. 1, 1903.

W. H. ADAMS, Jr.

APPARATUS FOR TREATING ORES.

APPLICATION FILED OCT. 7, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. I

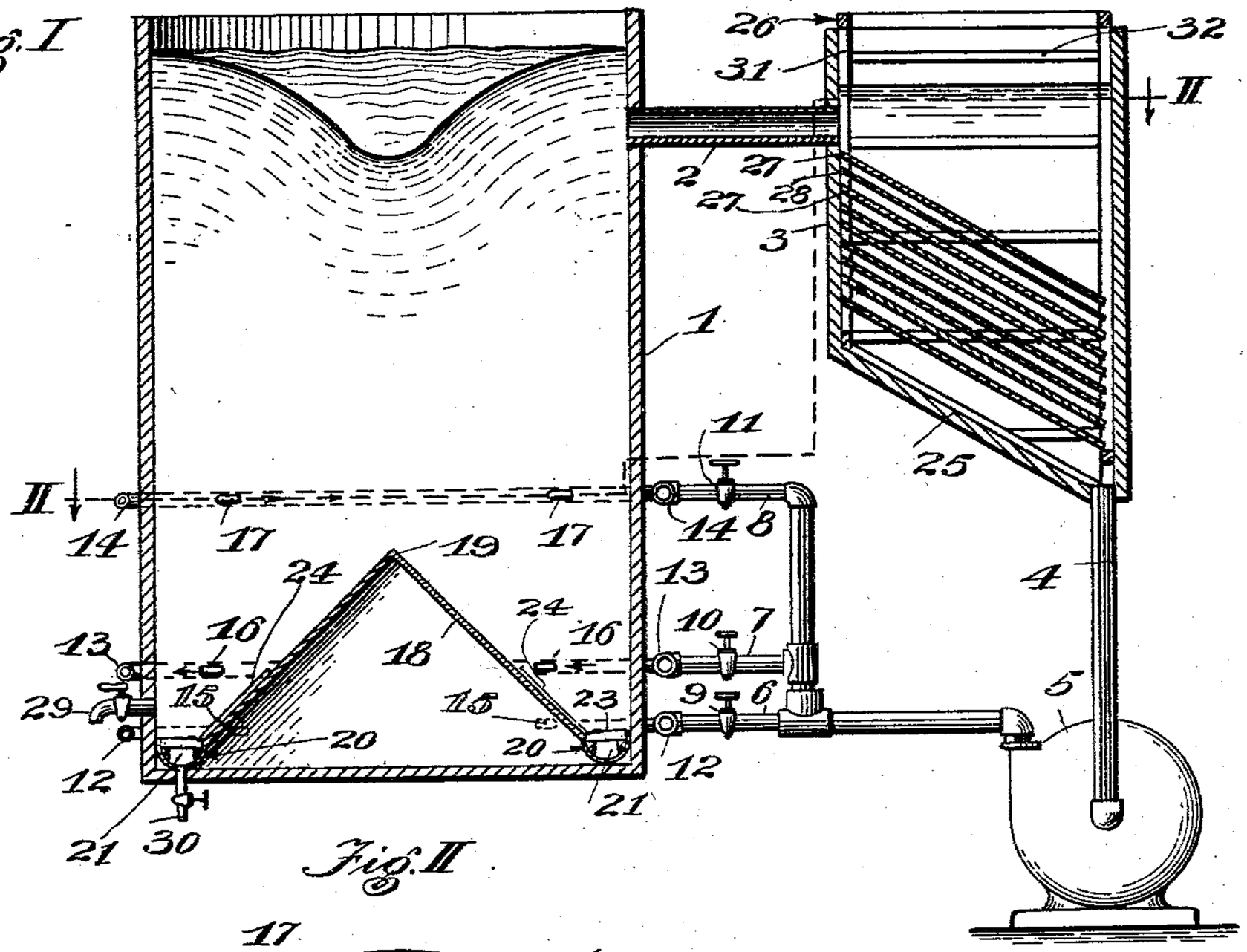

Fig. II

Fig. III

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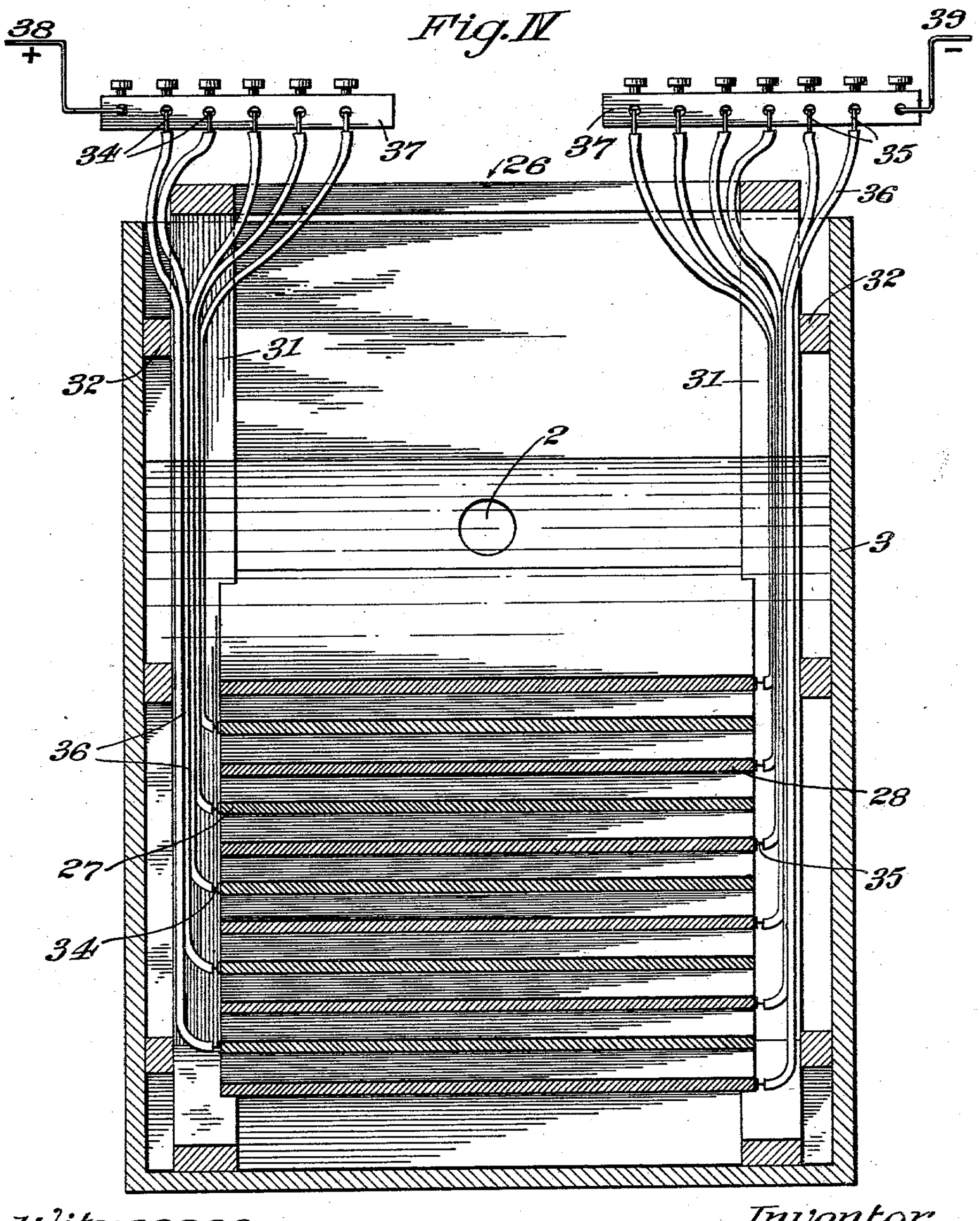
NO MODEL. 2 SHEETS—SHEET 2.

Fig. IV



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No. 745,472. Patented December 1, 1903.

UNITED STATES PATENT OFFICE.

WILLIAM H. ADAMS, JR., OF LOS ANGELES, CALIFORNIA, ASSIGNOR OF ONE-THIRD TO OMAR H. HUBBARD, OF LOS ANGELES, CALIFORNIA.

APPARATUS FOR TREATING ORES.

SPECIFICATION forming part of Letters Patent No. 745,472, dated December 1, 1903.

Application filed October 7, 1902. Serial No. 126,344. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. ADAMS, Jr., 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 Treating Ores, of which the following is a specification.

Objects of this invention are as follows, viz: to provide for a thorough mixing, agitation, and commingling of the liquid pulp and chemical solution and to maintain the same at all times and to provide for precipitation of values by electricity and for ready cleaning up. Provision is made for saving the free gold, and further provision is made whereby the precipitation-box can be cleaned up without stopping the operation of the apparatus.

Another object is to so construct the apparatus as to accomplish the perfect and constant agitation of the liquid material with the least expense of power and without any appliance in the tank which will at any time be an obstruction in the way of the liquid or of the workmen.

Another object is to provide an apparatus for carrying on the cyaniding or other chemical processes in which a pump is used for producing circulation and in which it is not necessary to prime or charge the pump before starting the process into operation.

Another object is to make provision for keeping the coarse-ore values in constant suspension and continual motion and to pass only the fine material through the pump, thereby avoiding wear on the pump.

I also make provision for supplying excess of oxygen to the lighter and finer constituents of the charge and for then forcing the said lighter and finer material into the lower portion of the charge, where the oxygenized solution may act on the coarser material, and to continue the circulation of the lighter material from one reservoir into and through another reservoir, and so on.

Provision is also made for reversing the current of circulation and agitation and also for circulating different portions of the contents of the main reservoir from right to left and from left to right at the same time.

I also make provision for directing the coarser material downward and outward to that portion of the agitation-tank where the highly-oxygenized solution is forced in.

The accompanying drawings illustrate the invention.

Figure I is a vertical section of apparatus adapted for carrying out my invention. Fig. II is a plan section on line II II, Fig. I. Fig. III is an enlarged detail illustrating the construction of the free-gold saving and removing appliances. Fig. IV is a transverse section of the precipitation-box, showing the electrical connections thereof.

1 is the main reservoir or agitation-tank, in which the charge of pulverized ore and cyanid potassium or other chemical solutions are placed.

2 is a pipe leading from the upper end of the main reservoir to a second reservoir, which may be a precipitation-box 3, from the bottom of which a pipe 4 opens downward to supply a centrifugal pump 5, which is connected to discharge into the agitation-tank 1. The connection from the centrifugal pump may be through one or more pipes, as 6, 7, and 8, which are independently controlled by valves 9, 10, and 11. The agitation-tank or reservoir 1 is desirably cylindrical.

12, 13, and 14 are main pipes extending around the tank 1 and respectively connected with the pipes 6, 7, and 8, which lead from the centrifugal pump. 15, 16, and 17 designate nozzles connected with said pipes 6, 7, and 8 and arranged to discharge at intervals tangentially inside the agitation-tank. Each pipe is desirably furnished with a number of nozzles, so that the liquid thrown by the centrifugal pump 5 will be forced at a number of points tangentially into the agitation-tank and will produce a rotation of the contents thereof. Said nozzles may be turned in different directions. In ordinary practice the lower nozzles 15 will all point in one direction, so that when the valve 9 is open and valves 10 and 11 are closed the liquid will be discharged through said nozzles 15 and the liquid at the bottom of the agiation-tank will be caused to rotate in one direction. The nozzles 16 may be turned in the direction opposite to the nozzles 15, and if both valves 9 and 10 are open while the valve 11 is closed

the lower strata of liquid in the tank will be rotated in one direction, while the strata immediately above will be rotated in the other direction. If the upper nozzles 17 are turned in the direction corresponding to that of the nozzles 15 and the three valves 9, 10, and 11 are left open at the same time, then the liquid at the top and bottom will be whirled in one direction, while the intermediate body of liquid will be rotated in another direction, thus producing a more thorough agitation and stirring up. By first opening the valves for supplying only those nozzles which point in one direction, and thereby setting up a rotation of the charge in one direction and then closing said valves and opening valves for supplying nozzles which point in a reverse direction, a thorough breaking up of the charge may be effected at any time desired.

18 is a conical bottom in the agitation-tank. This desirably terminates in an apex 19 at the axis of the tank 1.

20 is a riffled gutter around the base of the cone 18 to receive the coarse gold which may settle to the bottom of the tank.

21 designates riffle-plates, which may be of cast-iron or other suitable material, fitted around the base of the cone 18 and furnished with transverse slots 22 and cross-bars 23 and adapted to be readily removed.

24 designates amalgamating-plates fitted upon the conical surface of the floor or bottom 18.

The precipitation-box may be of any desired construction and preferably has a sloping floor 25, leading to the pipe 4.

26 is a removable frame fitted in the precipitation-box and provided with anodes 27 and cathodes 28 to effect the precipitation and collection of the metals. The same have faces which desirably extend transversely of the vertical, so as to facilitate the collection of the metal with as low amperage as possible. Said frame 26 is removable, so that the anodes and cathodes may be removed for cleaning without disturbing the operation of the apparatus. When the frame is removed, the cathodes may be removed and replaced with others, whereupon the frame may be returned for further treatment of the flowing contents of the precipitation-box. Connection is made to these anodes and cathodes by wires or conductors 34 and 35, which are protected with insulating-coverings 36, so as to effectually insulate said wires when they pass through the liquid as far as the points where they connect with the respective anodes and cathodes. Wires 34, connected to the positive side of the circuit, are connected to the respective anodes 27, and wires 35, leading from the negative side of the circuit, are connected to the respective cathodes 28, alternating with the anodes. Connectors 37 may be used to connect the wires 34 35 with the circuit-wires 38 39, and any suitable electric generator (not shown) may be connected in said circuit to supply electric energy. Said precipitation-box serves as a reservoir for the reception of the liquid from the top of the agitation-tank.

The pipe 2, which connects the agitation tank or reservoir 1 with the precipitation-box and pump-reservoir 3, is desirably located slightly below the charge-level of the agitation-tank, so that the liquid flows gently from the agitation-tank and only the lighter gravities and the finer material are drawn into the precipitation-box and pump-reservoir 3. By the arrangement shown the pump is not required to lift any load, but is under gravity-pressure and is always charged for use, and the only work required of it is to keep the liquid in circulation and to force the same through the nozzles which may be open with sufficient velocity to set up and maintain the desired agitation and circulation within the tank 1. The pump and the number and size of the nozzles will be proportioned relative to the size of the agitation-tank 1 and the gravity of the charge to be treated.

In practical use where the gravity of the material is light all three rows of nozzles 15, 16, and 17 may be operated at the same time; but when the gravities of the material constituting the charge are heavy it may be desirable to operate only one row of nozzles at a time in order to give the discharge from the nozzles a greater velocity, and it may be desirable from time to time to change from the use of only one of the rows of nozzles to the use of two or more rows, thus changing the velocity of the current in the tank and causing the desired agitation, circulation, and mixing. This is heightened by the use at different times of nozzles pointing in different directions. In case the charge has been set to whirling in one direction at such a velocity as to suspend or carry certain of the materials in eddies then by changing from the nozzles which had set up such rotation to nozzles which point in another direction the whole body of liquid is broken up and the current changed and the liquid is fully mixed.

It is evident from the foregoing that different lines of nozzles may be so arranged that they may be operated in such a manner as to thoroughly and completely agitate and at the same time continue in constant motion all of the particles of ore being treated, so that the same may come into contact with the same strength of chemical fluid, and thereby the values may be dissolved in a short period of time. When the charge within the tank is whirling, the centrifugal action causes the surface of the liquid to rise at the periphery and lower at the center of the tank, and the tendency of the coarser material is to settle toward the center of the tank and onto the conical bottom, where it passes down over the cone and over the amalgamating-plates 24. As it approaches the base of the cone it is brought into the path of the more-rapidly circulating liquid, set in motion by the streams from the nozzles, and is thereby forced into suspension

and circulation and is carried upward and again brought over to the center of the tank, and so on during the continual operation of the pump. Any heavy free gold which escapes the amalgamating-plates may be caught by the riffles in the gutter at the base of the cone. The cone extends approximately to the wall of the tank 1 in order to thus bring the coarser and heavier materials to where they will be acted upon by the newly-oxygenized solution and also for the purpose of limiting the body of the charge which is subjected to the action of the streams from the nozzle.

29 is a draw-off valve for drawing off the treated pulp and exhausted solution.

30 is a valve for drawing off the amalgam from the bottom of the gutter.

The riffle-plates 21 are desirably cast-iron frames having transverse slots forming cross-bars, which will serve as riffles.

In practical operation a charge of mercury will be placed in the riffled gutter, then a charge of pulverized ore may be placed in the agitation-tank 1, and then the requisite charge of cyanid solution or other chemical solution appropriate for treating the ore may be introduced into the tank 1, filling the same to above the mouth of the pipe 2, through which the liquid will flow into the precipitation-box and thence through the pump and into the pipes of the system. Then the pump will be put into operation, thus forcing the liquid into the mass of pulverized ore, soon bringing the same into suspension in the liquid and mixing and agitating the entire charge. The lighter and finer materials will be carried to the top and by centrifugal force to the wall of the tank, where the mouth of the pipe 2 is located, and will flow into the precipitation-box over the anodes and cathodes and thence to the centrifugal pump, from which it will be forced into the agitation-tank. The heavier particles which settle at the axis of the tank pass down over the amalgamating-plates, and the free gold not caught by the said plates may pass into the gutters and be caught by the riffles and mercury. The operation is thus continued until the extraction of the values is completed. This may take a greater or less period of time, depending upon the character of the ores being treated. With some ores the values may be extracted in four hours and with others it may take six, eight, or ten hours treatment. From time to time as the cathodes become plated with the precious metals the precipitation-frame 26 may be removed and the plated cathodes removed and replaced with new. This operation may not be required until a number of charges of ore have been worked. When the precious metals have been extracted from the ore, the liquid solution and tailings are drawn off through the valve into a tank (not shown) and allowed to settle, and then the clear solution will be drawn off and restandardized to be used over again. The tailings will be disposed of and the operation continued as before. Whenever the amalgamating-plates 24 have become sufficiently plated, they may be cleaned or removed when the charge has been drawn off, and when the operator upon inspection of the contents of the riffle-gutter finds that the amalgam is ready for cleaning up he will lift the riffles out of the gutter, open the valve 30, and sweep the amalgam to the valve 30 and allow it to be drawn off, after which the riffles may be recharged and the plates redressed and a new charge of ore and solution placed in the apparatus and the operation performed as before.

The cathodes may be of thin sheet-lead, copper, or other material suitable for the purpose, and the same when plated may be melted into ingots ready for shipment to the smelter or refinery.

By providing two reservoirs, a pump, and connections for drawing liquid from one and forcing it into the other of the reservoirs and means for drawing liquid from the upper part of said other reservoir to the one reservoir the charge of pulp and solution may be simultaneously subject in one portion to agitation and brought to approximate rest at another portion, so that the agitating action and the precipitating action are proceeding simultaneously in different portions of the charge being treated.

The advantages of providing a reservoir in which the charge is approximately quiet are that the anodes and cathodes are not subjected to the severe scouring action of the circulating charge and coarse and heavy gravities, and there is also provided a reservoir for oxygenizing the solution and the lighter and finer portions of the charge.

The connection 2 between the upper portions of the reservoirs is desirably of greater capacity or cross-sectional area than the pipe 4 which supplies the pump, so that the pipe 2 acts practically as a reservoir for the liquid, and the liquid flows gently by gravity from the agitation-reservoir and is not drawn therefrom, and therefore only the lighter gravities are drawn off, thus saving wear on the pump and other parts of the system.

The reservoir may be of any desired form and construction suitable for the work to which the apparatus is to be put, and in some cases it may be unnecessary or undesirable to make any provision for precipitation in the apparatus. In such cases the connections for supplying the pump from the upper portion of the charge in the agitation-tank may be constructed without any precipitation-box—as, for instance, the pipes 2 and 4 might be directly connected or formed as a single pipe. This is apparent and requires no illustration further than that shown, in which the precipitation-box forms a part of the connection between the tank and pump.

The plates 24 may be of any desired size and may be arranged either close together or with spaces between them. In the drawings they are shown arranged in contact continu-

ously around the base of the cone; but it is to be understood that where there is liability of too much scouring action a less number of plates will be employed with spaces between.

The precipitation-frame 26 may be formed of grooved uprights 31 and slats 32. The liquid will percolate down through the interstices between the slats, the anodes and cathodes, and the wall of the box 3.

The collecting-faces of the cathodes should be arranged as nearly in horizontal planes as may be found advisable in practice. In the drawings the plates are shown at as great a slant as I deem ever advisable. The object of arranging the plates transversely of a vertical is to allow gravity to assist in the deposition of the metal. By the arrangement shown an electric current of low amperage will cause a better precipitation and the metal precipitated will set more firmly upon the plate than will be the case with a high amperage. In case any of the metal to be deposited is thrown off by reason of too high amperage gravity will again bring it to rest. I have found in actual practice, furthermore, that when the plates are arranged approaching the horizontal to a greater or less extent the nearer they approach the horizontal the more solid will be the character of the metal deposited.

The nozzles 15 are arranged to discharge into the tank exteriorly of the conical bottom tangentially in an approximately horizontal plane. The same is true of the nozzles 16 and also of the nozzles 17. By this arrangement the material in the tank is kept fluid without any tendency to drive the precious metal away from the gutter 23. The nozzles being arranged in series, as 15, 16, and 17, at different levels, enables the operator at his discretion to regulate the agitation or circulation to a nicety.

Having described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. The combination of a tank, a box, a pipe at the top of the tank connecting the same with the box, a pump connected with the box, and nozzles connected with the pump and arranged to discharge liquid into the tank at intervals tangentially in an approximately horizontal plane.

2. A tank, a pump, means connecting the pump with the tank to supply the pump with liquid from the tank, and nozzles connected with the pump and arranged at intervals to discharge tangentially into the tank in an approximately horizontal plane.

3. A tank, a precipitation-box, means connecting said tank with said box to supply liquid thereto, a pump arranged to draw liquid from the box, nozzles connected with the pump to discharge said liquid tangentially into the tank, and removable precipitating devices in the precipitation-box, said devices having collecting-faces extending transversely of the vertical.

4. A tank, a precipitation-box, a pipe connecting the tank with the precipitation-box, a pump connected with the precipitation-box, nozzles connected with the pump for discharging liquid tangentially into the tank, a removable frame in the precipitation-box, and removable plates in said frame extending transversely of a vertical.

5. A tank, a pump, means connecting the tank with the pump to supply liquid thereto from the tank, nozzles connected with the pump and arranged to discharge into the tank, some of said nozzles being pointed in one direction around the tank, and other of said nozzles pointed in the opposite direction around the tank.

6. A tank provided with a conical floor, and a gutter around the base of the cone, plates in said gutter, and means for drawing liquid from the top of the tank and returning it to the bottom of the tank.

7. A tank having a conical bottom which slopes upwardly and inwardly, amalgamating-plates on said bottom exteriorly of the cone and between the cone and the walls of the tank, and means for drawing liquid from the upper portion of the tank and discharging it into the lower portion of the tank.

8. A tank having a conical bottom, and around and exteriorly to the base of the cone, a series of riffles, and means for drawing liquid from the tank and discharging it tangentially into the tank.

9. The combination with a tank of a precipitation-box, a removable frame in the box, means in the box for precipitating the values from ore-pulp, means for conducting liquid from the tank to the box and means for returning the liquid to the tank at different levels.

10. A tank, a pump, means connecting the upper portion of the tank with the pump, nozzles arranged in a plurality of rows, the nozzles of one row pointing in one direction in the tank, and the nozzles of another row pointing in another direction in said tank.

11. Apparatus for treating ore comprising a circular reservoir having a conical bottom and a gutter around the cone; removable riffles in the gutter and means located just above the riffles for producing a circulation of liquid around the base of the cone.

12. A tank; nozzles arranged to discharge tangentially in one direction in the tank; nozzles arranged to discharge tangentially in an opposite direction in the tank; means for drawing liquid from the tank and forcing it into the tank through said nozzles; means for controlling the supply of the nozzles of one direction, and means for controlling the supply of the nozzles of the other direction.

13. A tank; nozzles for discharging liquid tangentially in one direction in the tank; nozzles above the level of the first-named nozzles for discharging liquid tangentially in an opposite direction in the tank; other nozzles above the level of the last-mentioned

nozzles for discharging liquid tangentially in the tank in a direction opposite that of the last-mentioned nozzles; means for drawing liquid from the tank and forcing the same through said nozzles; and means for controlling the nozzles of said different levels independently of each other.

14. A tank having a conical bottom; means around the cone for collecting metals; nozzles for discharging liquid tangentially in one direction in the tank; nozzles above the level of the first-named nozzles for discharging liquid tangentially in an opposite direction in the tank; other nozzles above the level of the last-mentioned nozzles for discharging liquid tangentially in the tank in a direction opposite that of the last-mentioned nozzles; means for drawing liquid from the tank and forcing the same through said nozzles; and means for controlling the nozzles of the different levels independently of each other.

15. A tank having a conical bottom; means around the cone for collecting metals, and means for circulating liquid in different directions in the tank.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, at Los Angeles, in the county of Los Angeles and State of California, this 2d day of October, 1902.

W. H. ADAMS, JR.

Witnesses:
JAMES R. TOWNSEND,
OMAR H. HUBBARD.