No. 682,612. Patented Sept. 17, 1901.

E. L. GODBE.

METHOD OF LEACHING ORES.

(Application filed Jan. 24, 1901.)

(No Model.) 2 Sheets—Sheet 1.

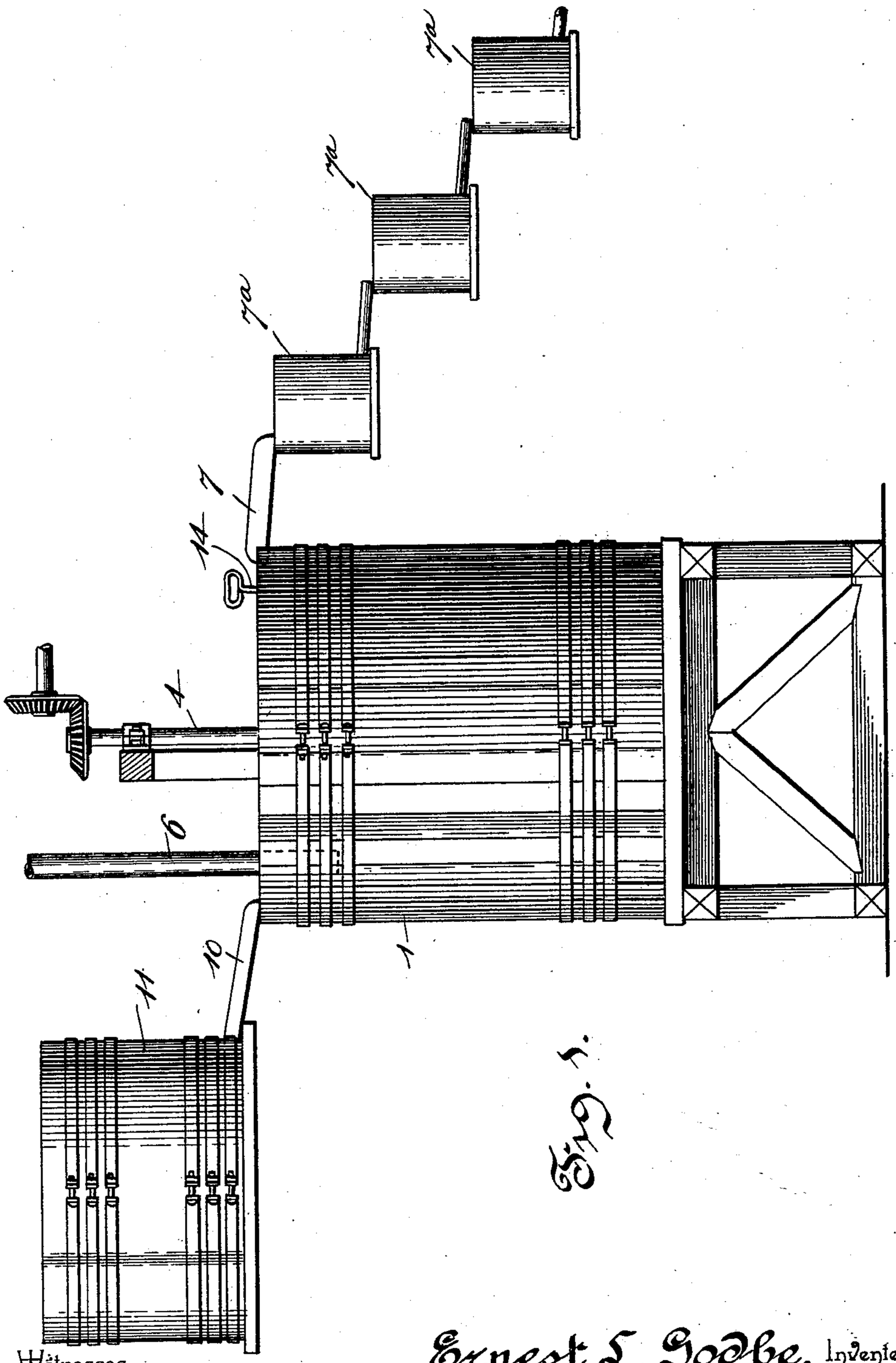

Fig. 1.

Witnesses
J. Stramplewherwell.
Chas. S. Hoyer.

Ernest L. Godbe, Inventor.
By Church & Co.
Attorneys

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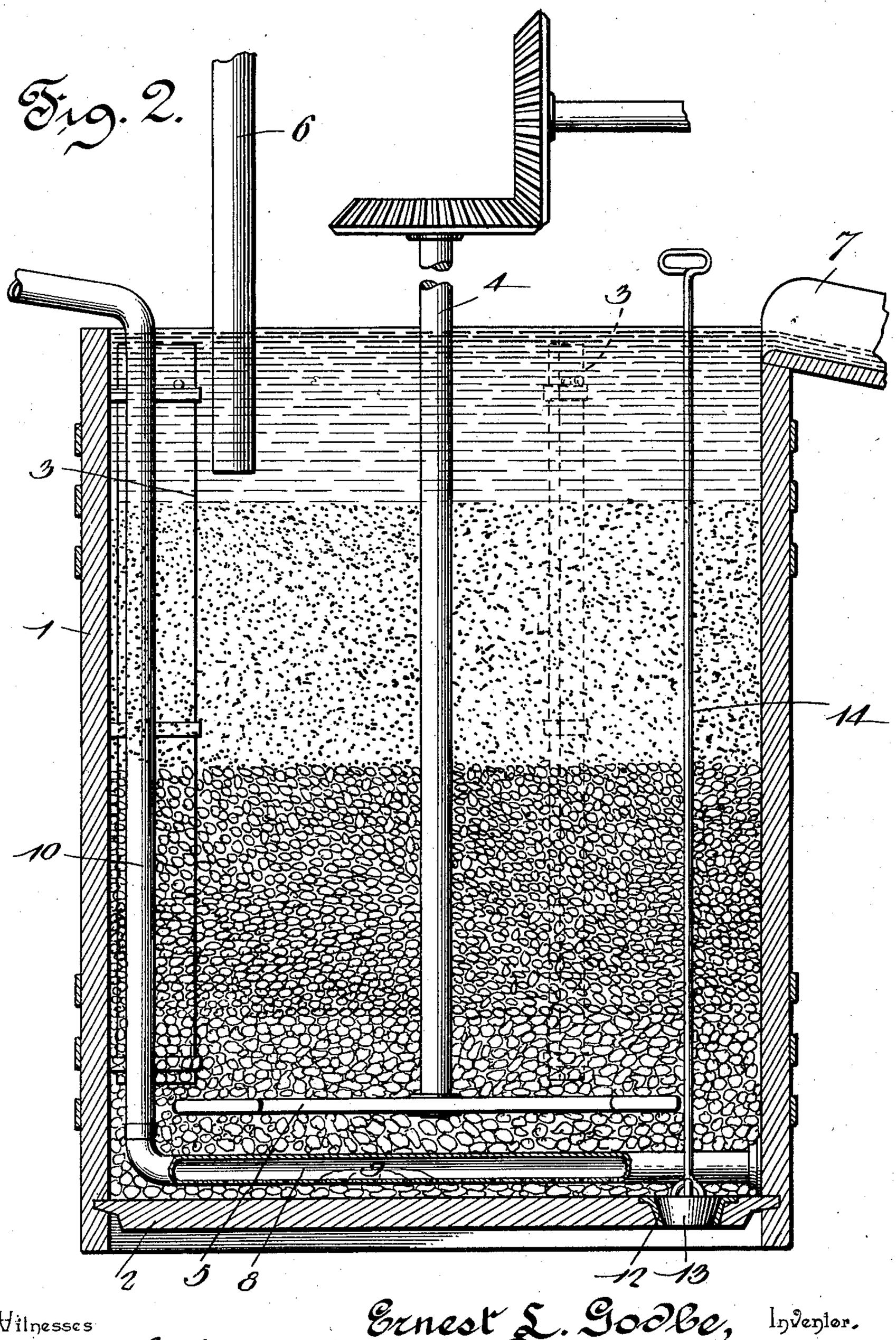
Fig. 2.



Witnesses
J. Frank Lenberwell.
Chas. S. Hyer.

Ernest L. Godbe, Inventor.
By Cachow & Co.
Attorneys

UNITED STATES PATENT OFFICE.

ERNEST L. GODBE, OF SALT LAKE CITY, UTAH.

METHOD OF LEACHING ORES.

SPECIFICATION forming part of Letters Patent No. 682,612, dated September 17, 1901.

Application filed January 24, 1901. Serial No. 44,641. (No specimens.)

To all whom it may concern:

Be it known that I, ERNEST L. GODBE, a citizen of the United States, residing at Salt Lake City, in the county of Salt Lake and State of Utah, have invented a new and useful Method of Leaching Ores, of which the following is a specification.

This invention relates to a method of leaching ores; and the object of the same is to more economically and cheaply obtain the separation of metals, particularly gold and silver, from ores bearing the same with less delay and a greater output or desired result.

The invention primarily consists in the method of leaching ores by continuously stirring up the same in a tank or vat while being introduced into the latter in a pulpy or moist comminuted condition from a battery of stamps or crushing mechanism and the devices incidental thereto by mechanical means of agitation and causing the formation of a dense lower stratum of the heavier part of the ore near the agitating means, a lighter stratum next above said heavier parts and having a less degree of agitation, and an upper still lighter stratum which remains practically without agitation and having thereabove a clear stratum which overflows from the top of the tank or vat during the charging step, the delivery end of the feeding device for introducing the ore into the tank or vat being below the upper surface of the clear stratum, continuing the agitation after the charge is complete, introducing a cyanid solution into the bottom of the tank or vat below the agitating means, and continuing said introduction until the water in the charge is eliminated or substantially replaced by said solution and then increasing the agitation and precipitating or otherwise treating the overflow cyanid solution at this time carrying the gold, silver, or other metal.

The invention further consists in the construction and arrangement of the several parts, which will be more fully hereinafter described and claimed.

In the drawings, Figure 1 is a diagrammatic view of the improved apparatus in the preferred form in which the method is carried out. Fig. 2 is an enlarged transverse vertical sectional view of the tank or vat in which the method is mainly pursued and showing a charge of ore therein.

Similar characters of reference are employed to indicate corresponding parts in both views.

The numeral 1 designates a tank or vat of any suitable dimensions, but preferably slightly greater in depth than in diametrical extent. In some practical uses of this vat to carry out the method a false bottom or strainer of coarse canvas or burlap has been arranged near the bottom 2 of the tank or vat; but better results have been obtained by leaving the inside bottom portion of the tank or vat entirely clear, except in the particulars which will be hereinafter noted. Removably mounted in and extending vertically over the interior of the vat are breakers 3, preferably three in number, the said breakers being of suitable width and operating to break up the peripheral concentration of the ore due to centrifugal action of the agitating means. The top of the tank or vat is completely open, and extending downwardly into the central portion thereof is a vertical shaft 4, having suitable operating gearing in connection with the upper portion thereof and adapted to be arranged to control the speed of the shaft and vary the same at will. On the lower extremity of the shaft and held suspended by the latter a short distance above the upper surface of the bottom 2 of the tank or vat is a muller 5 of any preferred form and horizontally extending over a greater portion of the bottom 2.

Projecting over the upper open end of the tank or vat and extending downwardly thereinto a suitable distance is a feeding-pipe or conveyer 6, which leads from a battery of stamps and incidental devices, and at an opposite point on said upper end of the tank or vat is an outflow trough, sluice, or like device 7, which conducts the overflow to suitable receptacles or appliances 7^a, which are preferably connected in series for causing a complete precipitation of the metals desired to be saved from the solution carrying the same, the said precipitating receptacles or appliances being of any well-known form in the art.

In the tank or vat near the upper surface of the bottom 2 a feeder 8 is horizontally dis-

posed and has its free end closed and a series of perforations 9 formed in its lower portion to prevent clogging with sediment or sand, and an obvious modification of this single length of feeder would be a radially-branched feeder to increase the surface extent of delivery of the liquid fed through the same. This feeder is connected by a pipe 10 with a supply-tank 11, and said pipe may enter the tank or vat and connect with the feeder at a low point on said tank or vat, or it may be passed down through the interior portion of the latter from the top. The purpose of this pipe 10 and the feeder 9 is to introduce into the lower portion of the vat a secondary quantity of water for washing purposes after the main operation or method has been pursued; but its principal purpose is to feed a cyanid or other equivalent solution into the bottom of the tank or vat below the agitated stratum of ore and cause the same to leach or percolate upwardly through said stratum and the strata above the same.

The proportions and capacities of the various parts shown and described will be varied as may be found necessary, and to relieve the tank or vat of the contents after completion of the operation on a charge an outflow-opening 12 is formed at one side in the bottom 2 and closed by a withdrawable plug 13, having a rod 14 secured thereto and extending upwardly through the interior of the tank and accessible from the top of the latter.

In carrying out the method moistened or pulpy ore to be treated is delivered into the tank or vat 1 by the pipe or conveyer 6, the muller having been previously set in motion and so maintained without cessation throughout the entire operation. The ore in the reduced and moistened state set forth continues to enter the tank or vat until the capacity of the latter is reached, and during said introduction of the charge the heavier portions of the ore settle to a point adjacent to and are highly agitated by the muller. The stratum next above, composed of lighter particles or portions of the ore, are affected to a less degree by the operation of the muller, and the highest stratum, composed of slimes and the like, are held in suspension in a practically immobile state or condition, and at the top of the contents of the tank or vat there will always be a few inches of clear supernatant solution, which overflows and is carried off through the trough, sluice, or like device 7, the lower end of the pipe or conveyer 6 being below the upper surface of the said supernatant solution to prevent surface riffles or agitation of the upper stratum above the muller, or, in other words, to set up a counteracting current that would interfere with the desirable preservation of the strata of the ore in suspension above the muller. The agitation of the muller must be sufficient to prevent the ore from settling on the bottom of the tank or vat and the formation of channels or courses that would interfere with after steps, but not strong enough to throw the ore or slimes up to the top of the charge. After the charge is complete in the tank or vat the operation and agitation of the muller is regularly continued and a solution of cyanid of potassium is introduced into the bottom of the tank or vat below the muller through the feeder 9 from the supply-tank 11, and this introduction continues until the overflow from the tank or vat is found to indicate that said solution has substantially replaced the water in the charge, when the agitation will be immediately increased by accelerating the speed and power of the driving-gearing for the shaft 4. The introduction of the cyanid solution will be progressive for a proper period of time and the strength of the same may be varied to suit different peculiarities of the ore treated and insure a complete separation of the metal or metals sought to be separated. This upward leaching of the cyanid solution through the superimposed strata causes a more thorough permeation of the mass and absorption of the metals desired to be separated, and the variation in degree of agitation of the two lower strata induces a greater amount of friction of the portions, particles, or molecules in each stratum that will facilitate the absolute saving of the desired metals, and in passing through the upper stratum of slimes and lighter particles, which is of a dense character from the bottom of the same, the said upper stratum becomes thoroughly treated by the slow permeation that will ensue in this upward direction without the least loss of the metals sought. The overflowing cyanid solution—carrying the gold and silver, for example—is conveyed by the trough, sluice, or like device 7 into suitable precipitating devices, as shown, containing zinc chips or other material having the necessary and natural affinity, and subsequently subjected to steps to set free the metals taken up thereby from the cyanid solution from the tank or vat 1. After thorough leaching in the manner set forth and as a final auxiliary step a charge of water may be run into the tank or vat from the feeder at the bottom and overflow as before, and subsequent to this step a weaker cyanid solution may be introduced to follow up the action of the primary stronger solution and render the separation complete.

Many incidental changes in the mode of procedure might be adopted without departing from the principle of the invention, and also changes in the details of structure of the apparatus might be made. The broad principle of upward leaching, filtration, or percolation is not new; but the particular application of this step to strata of ore which are partially agitated and maintained under continuous agitation without cessation at any time is the gist of the present improvement. In this connection it is obvious that other solutions aside from those containing cyanid of potassium might be similarly employed on

certain ores with like results—such, for instance, as caustic soda, hyposulfite of soda, or caustic potash, either cold or in heated condition—and it is intended at times to use these equivalents, and they are understood to be included in the method heretofore disclosed.

Having thus described the invention, what is claimed as new is—

1. The herein-described method of leaching ores which consists in disposing moistened ore in superimposed strata within a containing-receptacle by a continuous mechanical agitation in the lower portion of the latter to form a lower thoroughly-agitated stratum of heavier portions of the ore, a stratum of lighter portions or particles next above which are agitated to a less degree, a stratum of slimes and other lighter portions next above which remain substantially immobile, and a top covering of a clear supernatant solution, introducing the ore below the upper surface of said latter solution, overflowing and carrying off the clear solution, introducing a leaching solution at the bottom of the containing-receptacle below the lower stratum of heavier portions of the ore and causing said leaching solution to filtrate or percolate upwardly through the strata above and at the same time increasing the agitation, and carrying off the overflow leaching solution and the metal in conjunction therewith for precipitation.

2. The herein-described method of leaching ores which consists in disposing moistened ore in superimposed strata within a containing-receptacle by a continuous mechanical agitation in the lower portion of the latter to form a lower thoroughly-agitated stratum of heavier portions of the ore, a stratum of lighter portions or particles next above which are agitated to a less degree, a stratum of slimes and other lighter particles next above which remain substantially immobile, and a top covering of a clear supernatant solution, introducing the ore below the upper surface of said latter solution, overflowing and carrying off the clear solution replacing water in the charge by a cyanid of potassium solution introduced at the bottom of the receptacle below the lower heavier stratum and causing it to percolate upwardly through the strata above, increasing the agitation during the introduction of said cyanid solution, carrying off the metal-bearing cyanid solution which overflows from the top of the charge, and precipitating the said overflow metal-bearing solution after it leaves the receptacle.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

ERNEST L. GODBE.

Witnesses:
C. E. DOYLE,
FRANK S. APPLEMAN.