

Nov. 15, 1938.

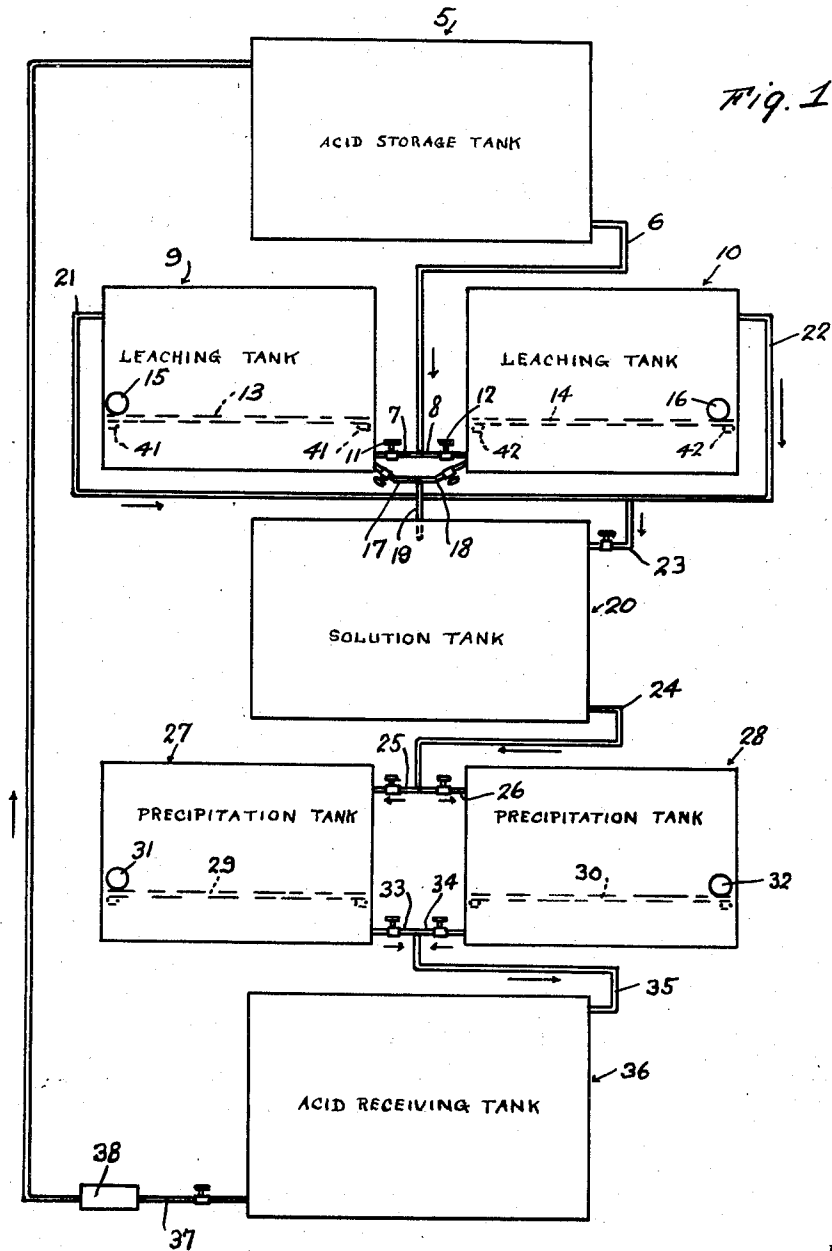
J. L. BURNETT

2,136,372

LEACHING AND PRECIPITATING PROCESS AND APPARATUS

Filed March 25, 1936

3 Sheets-Sheet 1



Inventor

John L. Burnett

By *Clarence A. O'Brien* and
Hyman Berman Attorneys

Nov. 15, 1938.

J. L. BURNETT

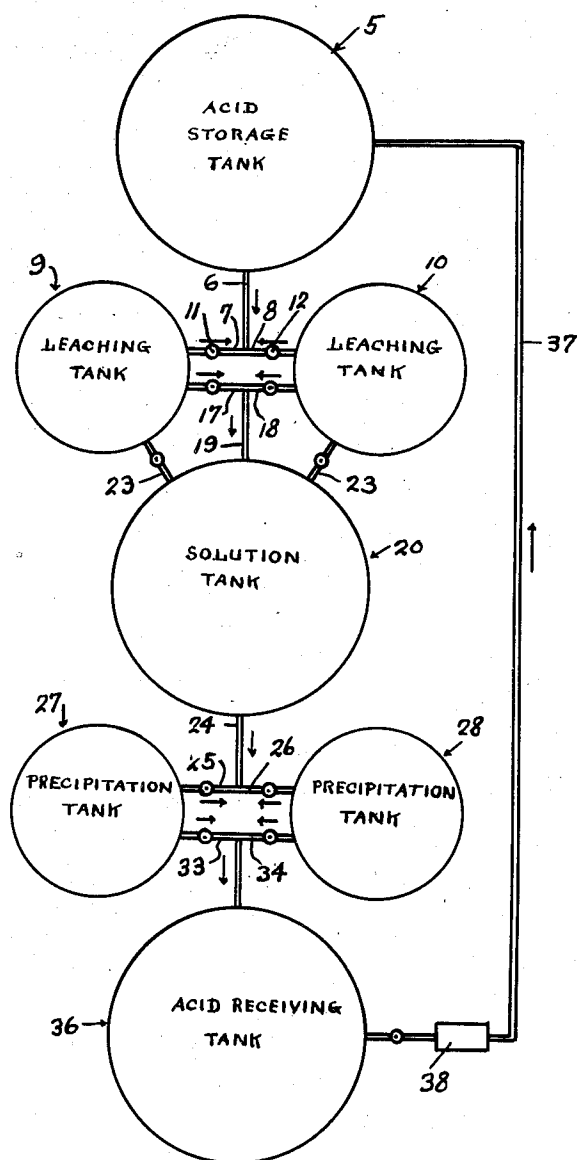
2,136,372

LEACHING AND PRECIPITATING PROCESS AND APPARATUS

Filed March 25, 1936

3 Sheets-Sheet 2

Fig. 2.



Inventor

John L. Burnett

By *Clarence A. O'Brien* and
Hyman Berman Attorneys

Nov. 15, 1938.

J. L. BURNETT

2,136,372

LEACHING AND PRECIPITATING PROCESS AND APPARATUS

Filed March 25, 1936

3 Sheets-Sheet 3

Fig. 3.

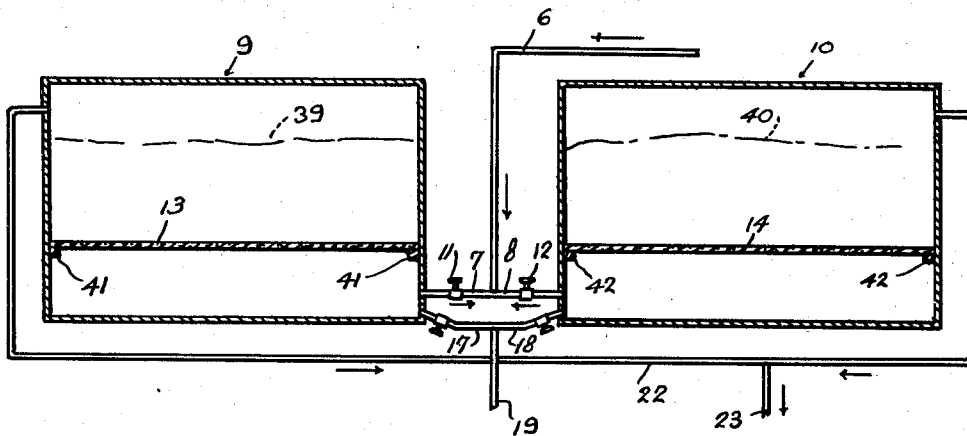
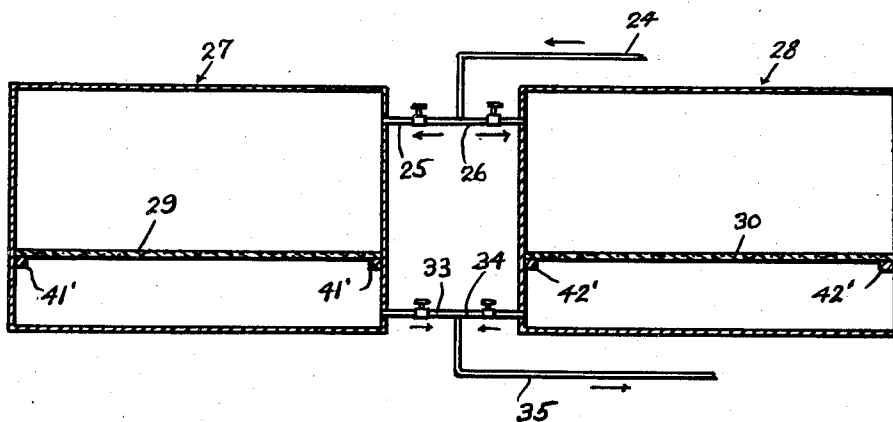


Fig. 4



Inventor

John L. Burnett

By *Clarence A.'Brien* and
Hyman Berman Attorneys

UNITED STATES PATENT OFFICE

2,136,372

LEACHING AND PRECIPITATING PROCESS
AND APPARATUS

John L. Burnett, St. Louis, Mo.

Application March 25, 1936, Serial No. 70,901

7 Claims. (Cl. 266—12)

My invention relates generally to means for obtaining precious and semi-precious metals from their ores and particularly to a leaching and precipitating process and to apparatus for carrying out the process, and an important object of my invention is to provide means of the character indicated which greatly reduces the time usually required for treating ores, particularly copper ores, and ensures a higher percentage of recovery, and obtaining the metal in a purer state.

Another important object of my invention is to provide process and apparatus of the character indicated above in which upward gravity flow of precipitating and leaching agent is advantageously arranged continuously through the ore beds, the leaching agent rising to a fixed point so as to overflow therefrom.

Another important object of my invention is to provide in method and apparatus as indicated above, means and operations procuring gravity upward flow of the leaching solution through false bottoms of stone of a filtering nature, and wherein force pumping is done away with except for returning the acid from the receiving tank to the acid storage tank to be rejuvenated or fortified to the required strength.

Another important object of my invention is to provide apparatus of the character indicated which is simpler and lower in cost than other types of apparatus now being used.

Another important object of my invention is to provide apparatus affording a continuously operating system, and which is adapted without major changes to the leaching and precipitation of any ores which can be treated by presently known agents.

Other important objects of my invention will be apparent from a reading of the following description of my method or process, in connection with the drawings, wherein for purposes of illustration I have shown a preferred embodiment of the apparatus of the invention.

In the drawings:—

Figure 1 is a general diagrammatic representation of apparatus in accordance with the present invention, showing the tank and connecting pipes in side elevation.

Figure 2 is a general diagrammatic representation of the apparatus of the invention showing the tank and connecting pipes in top plan, so as to show the relative size of the various tanks.

Figure 3 is a longitudinal vertical sectional view taken through the two leaching tanks.

Figure 4 is a longitudinal vertical sectional

view taken through the two precipitating tanks.

Referring in detail to the drawings, the numeral 5 generally designates the acid storage tank which is of suitable size and capacity and has a pipe 6 leading from near its bottom in a downward direction to connect with the lateral branches 7 and 8 which lead to the leaching tanks 9 and 10, the branches 7 and 8 having control valves 11 and 12, respectively, therein.

The lateral branches 7 and 8 communicate with the interior of the leaching tanks 9 and 10 at a level below that of the porous stone false bottoms 13 and 14, respectively, which are arranged above the bottoms of the said leaching tanks. Clean-out manholes 15 and 16, respectively, are provided in the sides of the leaching tanks to enable handling the ore beds resting on the false bottoms 13 and 14.

The stone used for the false bottoms 13 and 14 is a porous synthetic stone of filtering character, such as the "Filtros" which is manufactured by Filtros Incorporated of East Rochester, New York, under Patent Nos. 1,117,601, 1,118,441 and 2,008,327 and composed principally of silica sand bonded together with an artificial silicate fusing at temperatures above 2000° Fahrenheit.

Below the branches 7 and 8 are valved drain pipes 17 and 18 which lead into the drain discharge pipe 19 which empties into the solution tank 20.

At the selected level above the false bottoms 13 and 14, the leaching tanks have overflow pipes 21 and 22 both of which feed the valved discharge pipe 23 which leads into the upper part of the solution tank 20.

The lower part of the solution tank 20 has a pipe 24 leading therefrom and communicating with the adjoining valved branch pipes 25 and 26 which lead respectively into the upper part of the precipitation tanks 27 and 28, which have false bottoms 29 and 30 of similar character and arrangement to the false bottoms 13 and 14 in the leaching tanks, as well as ore handling manholes 31 and 32. The precipitation tanks have valved branch pipes 33 and 34 which lead from the lower part thereof below the false bottoms 29 and 30 and which empty into the discharge pipe 35 which leads into the upper part of the acid receiving tank 36.

For purposes of leading back into the acid storage tank 5 the solution which is regenerated in the acid receiving tank, and for no other purposes, there is provided the valved pipe 37 which leads from the lower part of the acid receiving tank 36 and enters the top of the acid storage

tank 5, and in which is interposed a suitable force pump 38. It is to be understood that the effect of the pump goes no farther than simply supplying the acid storage tank with the proper solution which then enters the leaching tanks and moves upwardly through the ore charges 39 and 40, respectively, by gravity alone.

The respective sizes of the various tanks is made evident in Figure 2 of the drawings. The various tanks are of acid resisting material and the tanks are so placed that the flow of acid from one to the other of the tanks is by gravity, and the various pipes are of the required size of lead pipe controlled by suitable acid resisting valves.

The acid storage tank which is the source of acid supply for the entire apparatus, is placed in such a manner that it is at the highest elevation of any of the tanks of the apparatus, the regulation of the acid flow therefrom being under the control of the valves 11 and 12.

The actual leaching of the metal from the ore being treated occurs in each of the leaching tanks 9 and 10. The false bottoms 13 and 14 the nature of which has already been described, are placed about 14 or 16 inches above the true bottom of the tanks and cover the entire cross sectional area of the tanks. The false bottoms rest upon timber supports 41, 41 and 42, 42, respectively. A proper charge of ground ore is placed upon the false bottoms and spread to a uniform depth to expedite the process of extraction.

From the acid storage tank 5 the acid supply enters each of the leaching tanks at the bottom and below the false bottom thereof, and then passes upwardly through the porous false bottom and enters the ore charge at its base, by gravity. From this time forward the process of leaching the metal from its native rock is expedited materially compared to the time customarily required for this process, due to the fact that the introduction of the acid at the base of the ore charge sets up agitation which quickly throws the entire charge into a foment and permits contact of the acid with the ore in considerably less time than is required under present practice. Percolating upwardly through the ore charge enables the acid to extract the metal from its native rock and the metal enters into solution with the acid and passes through an overflow pipe near the top of the tank and into the solution tank next in the system.

The extraction is completed when the supply of acid shows no discoloration or stain, and the flow thereof is then shut off. The acid content of the tank is then drained through the proper drain pipe, which is valve controlled, at the true bottom of the tank and discharged into the solution tank 20. The tailings are cleaned therefrom and a new ore charge is placed in the leaching tanks and the process of extraction is repeated. Each of the leaching tanks 9 and 10 is connected with the source of supply, and discharge by the drains through the medium of individual connections, thereby making it possible for each of these leaching tanks to be operated as a separate unit without interfering with the function of the other leaching tank or with the apparatus as a whole. The capacity of each of the leaching tanks is one half unit by volume.

Regarding the solution tank 20, this is third in the series in point of elevation and sequence of process, entrance thereto being by proper pipe connections 19 and 23 near the top thereof, by reason of which the metal in solution is introduced therein. No processing of the metal occurs

in the solution tank 20, its sole function being to store the solution. Discharge of the solution therefrom is by means of proper pipe connections 24 regulated by valves connecting with the precipitation tanks 27 and 28 which are next in the system. The capacity of the solution tank 20 is one full unit by volume.

The precipitation tanks 27 and 28 of which there may be two or more are fourth in point of elevation and sequence of process. The precipitation of the metal from its state of solution in the acid occurs in each of the tanks 27 and 28. As already stated each is equipped with a "Filtros" stone false bottom identical in size, location and arrangement with the false bottoms of the leaching tanks 9 and 10.

The tanks 27 and 28 have the described pipe connections regulated by appropriate valves, the intake from the solution tank 20 being at the top of the precipitation tanks above the false bottoms, and the discharges of the precipitation tanks being at the bottoms of the tank below the false bottoms, and the discharge being into the acid receiving tank 36 which is next lower in elevation in the system.

The acid receiving tank 36 is arranged to permit the same to fill with solution flowing from the solution tank 20, such flow being shut off immediately sufficient solution has been received therein. The reagent, the properties of which cause precipitation of the metals to the false bottoms of the precipitation tanks is here added, and such precipitation is allowed to proceed until all of the metal has settled upon the false bottoms, indication of which is lack of discoloration or stain in the acid. This action usually requires about forty minutes. Upon completion of the precipitation, the discharge valves at the bottom of the precipitation tanks are opened and the clear acid is permitted to percolate downwardly through the false bottom into the acid receiving tank 36.

The precipitates are then cleaned out of the tanks and the process repeated. Each of the precipitation tanks is connected by individual pipe connections with the solution tank 20 and by individual discharge pipes with the acid receiving tank 36, so that each of the precipitation tanks may be operated as a unit without interfering with the functioning of the other tank or tanks 27 or 28, or the apparatus as a whole. The precipitation tanks 27 and 28 are of approximately one-half unit capacity.

The acid receiving tank 36 is the lowest in point of elevation and sequence of operations and receives all acids passing through the various stages of the apparatus as set forth above. No processing takes place in the tank 36. Its intake from the preceding tanks is at the top and its acid discharge is at its bottom, whence the acid is pumped by a suitable acid pump into the acid storage tank 5 as already indicated.

The above describes a complete cycle of operation of the apparatus and when this is completed the cycle is repeated, indefinitely. The addition of fresh acid may be required before repetition to ensure proper strength of the acid. The capacity of the acid receiving tank 36 is one full unit by volume.

It will be evident from the foregoing description of the apparatus that the present invention contemplates gravitationally circulating proper acid medium upwardly through false stone filter bottoms into the ore charge, so that the acid engages the ore charge at the base thereof and

in circulating upwardly therethrough by gravity, causes fomenting of the ore charge and quick leaching thereof; that the circulation of the acid is kept up until it runs clear, indicating completion of the leaching. The process further comprises discharging the used acid into a solution tank from which it is led into the upper part of precipitation tanks in which the concentrates are held on false bottoms, and through which the acid circulates downwardly by gravity, so that the acid discharges into an acid receiving tank. The process further comprises the operation of treating the acid in the acid receiving tank with reagents and strengtheners, and pumping the resultant into the acid storage tank which is in direct feeding relation by gravity to the leaching tanks. Although my process and apparatus, contemplates the use of any reagents or acids or other materials now in use for the leaching and precipitation of precious and semi-precious metals, I find that—

The following acids and reagents produce quicker and more complete extraction in the operation of my process and apparatus.

For extracting gold and silver

Nitric
Hydrochloric
Bromine
Chlorine

Bicarbonate of soda being used to precipitate the gold and silver.

Copper

Sulphurous

Bicarbonate of soda being used to precipitate the copper.

Although I have shown and described herein preferred embodiments of the apparatus and of the process of my invention, it is to be definitely understood that I do not desire to limit the application of the invention specifically thereto, and any change or changes may in the structure and arrangement of the parts, and in the sequence and duration of the steps and operations concerned in the process, within the spirit of the invention and the scope of the subjoined claims.

What is claimed is:—

1. Apparatus for obtaining metal from metal bearing ore, said apparatus comprising a leaching tank, having a porous stone false bottom on which the ore charge rests, an acid storage tank gravitationally feeding the lower part of said leaching tank below said false bottom, whereby the acid is caused to rise through the ore charge, overflow means at the upper part of the leaching tank for leading off the metal bearing acid, a solution tank into which said overflow means empties, a precipitation tank having a porous stone false bottom above which said overflow means enters, an acid receiving tank, acid drain means leading from the precipitating tank below its false bottom into the upper part of said acid receiving tank, conduit means leading from the lower part of said acid receiving tank to the upper part of said acid storage tank, and force pump means interposed in said conduit means for moving the acid therein.

2. Apparatus for obtaining metal from metal bearing ore, said apparatus comprising a leaching tank having a porous stone false bottom on which the ore charge rests, an acid storage tank gravitationally feeding the lower part of said leaching tank below said false bottom, whereby the acid is caused to rise through the ore charge,

overflow means at the upper part of the leaching tank for leading off the metal bearing acid, a solution tank into which said overflow means empties, a precipitation tank having a porous stone false bottom above which said overflow means enters, an acid receiving tank, acid drain means leading from the precipitating tank below its false bottom into the upper part of said acid receiving tank, conduit means leading from the lower part of said acid receiving tank to the upper part of said acid storage tank, and force pump means interposed in said conduit means for moving the acid therein, said acid storage tank, said leaching tank, said solution tank, said precipitation tank, and said acid receiving tank being located at successively lower levels of elevation in the order named so as to procure gravitational flow of acid through the apparatus.

3. Apparatus for obtaining metal from metal bearing ore, said apparatus comprising a leaching tank having a porous stone false bottom on which the ore charge rests, an acid storage tank gravitationally feeding the lower part of said leaching tank below said false bottom, whereby the acid is caused to rise through the ore charge, overflow means at the upper part of the leaching tank for leading off the metal bearing acid, a solution tank into which said overflow means empties, a precipitation tank having a porous stone false bottom above which said overflow means enters, an acid receiving tank, acid drain means leading from the precipitating tank below its false bottom into the upper part of said acid receiving tank, conduit means leading from the lower part of said acid receiving tank to the upper part of said acid storage tank, and force pump means interposed in said conduit means for moving the acid therein, said leaching tank and said precipitation tank having respective manholes enabling removal of matter from the top of their respective false bottoms.

4. Apparatus for obtaining metal from metal bearing ore, said apparatus comprising a leaching tank having a porous stone false bottom on which the ore charge rests, an acid storage tank gravitationally feeding the lower part of said leaching tank below said false bottom, whereby the acid is caused to rise through the ore charge, overflow means at the upper part of the leaching tank for leading off the metal bearing acid, a solution tank into which said overflow means empties, a precipitation tank having a porous stone false bottom above which said overflow means enters, an acid receiving tank, acid drain means leading from the precipitating tank below its false bottom into the upper part of said acid receiving tank, conduit means leading from the part of said acid receiving tank to the upper part of said acid storage tank, and force pump means interposed in said conduit means for moving the acid therein, said leaching tank comprising at least two distinct compartments, and valve controlled means extending between the compartments and the acid storage tank and the solution tank enabling individual or concerted operation of said compartments.

5. Apparatus for obtaining metal from metal bearing ore, said apparatus comprising a leaching tank having a porous stone false bottom on which the ore charge rests, an acid storage tank gravitationally feeding the lower part of said leaching tank below said false bottom, whereby the acid is caused to rise through the ore charge, overflow means at the upper part of the leaching tank for leading off the metal bearing acid, a solu-

tion tank into which said overflow means empties, a precipitation tank having a porous stone false bottom above which said overflow means enters, an acid receiving tank, acid drain means leading from the precipitating tank below its false bottom
5 into the upper part of said acid receiving tank, conduit means leading from the lower part of said acid receiving tank to the upper part of said acid storage tank, and force pump means interposed in said conduit means for moving the acid therein, said precipitation tank comprising at
10 least two distinct compartments, and second valve controlled means extending between said solution tank and said compartments and between said compartments and said acid receiving tank enabling independent or concerted operation of
15 the compartments.

6. A method of obtaining metal from metal bearing ore, said method comprising confining a quantity of the ground ore on top of a porous
20 stone false bottom, then gravitationally circulating acid upwardly through said false bottom in a manner to contact the base of the ore and percolate the acid upwardly therein so as to produce fomenting of the ore, and thereby rapid
25 leaching thereof, then permitting the upwardly percolated metal bearing acid to overflow, then confining the overflowed metal bearing acid above

a porous stone false bottom and precipitating the metal, then permitting the acid to filter through the false bottom and leave the metal on the false bottom, then gravitationally conveying the filtered acid to an acid regenerating member for restoring the same.

7. A method of obtaining metal from metal bearing ore, said method comprising confining a quantity of the ground ore on top of a porous stone false bottom, then gravitationally circulating acid upwardly through said false bottom in
10 a manner to contact the base of the ore and percolate the acid upwardly therein so as to produce fomenting of the ore, and thereby rapid leaching thereof, then permitting the upwardly
15 percolated metal bearing acid to overflow, then confining the overflowed metal bearing acid above a porous stone false bottom and precipitating the metal, then permitting the acid to filter through
20 the false bottom and leave the metal on the false bottom, then gravitationally conveying the filtered acid to an acid regenerating member for restoring the same, then force pumping the restored
25 acid from said rejuvenating member to a point elevated above the originally confined ore to enable gravitationally circulating the acid upwardly through the ore charge.

JOHN L. BURNETT.