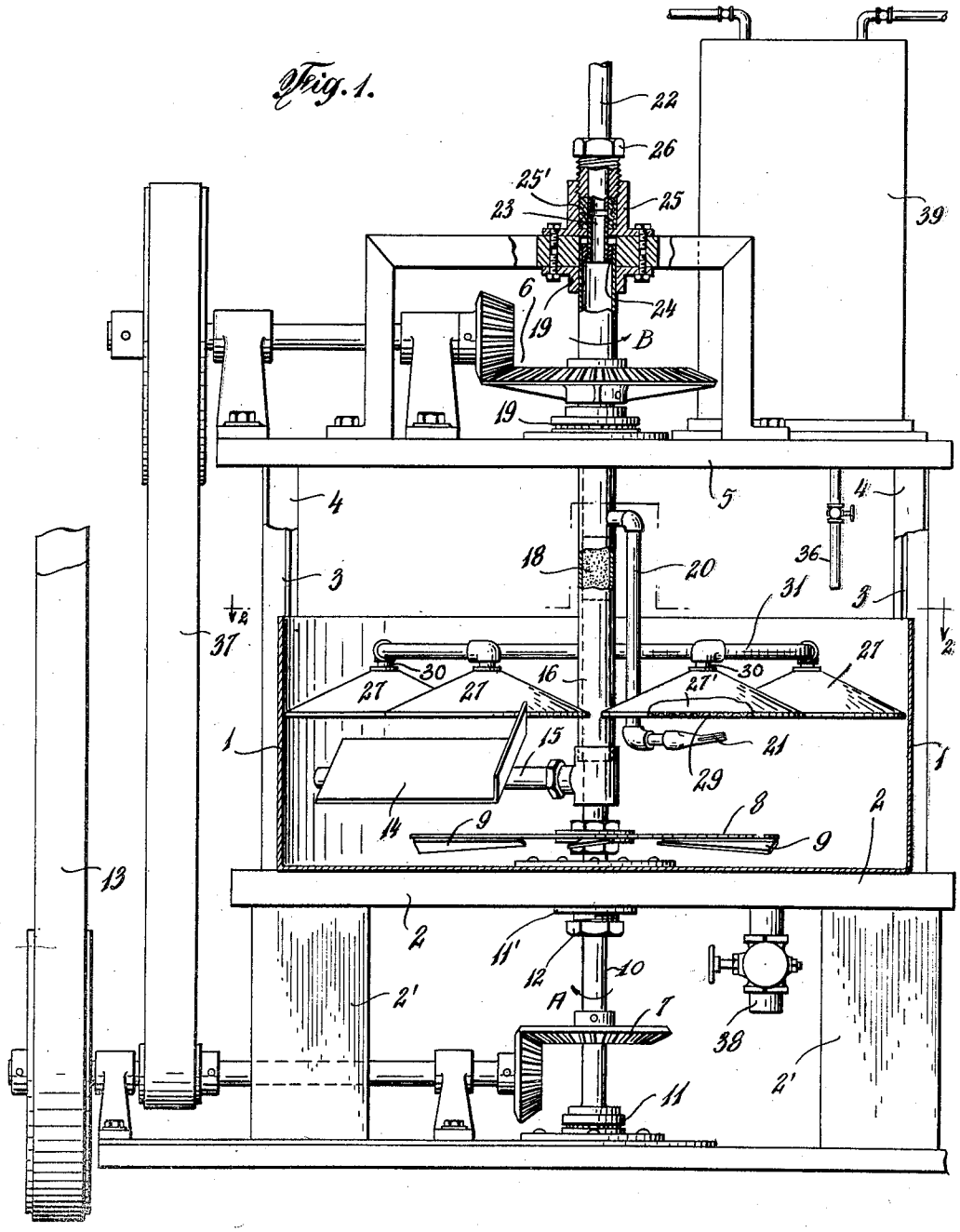
Dec. 24, 1940. A. J. ELIAN ET AL 2,226,164

ORE EXTRACTION

Filed March 10, 1938 2 Sheets-Sheet 1

Fig. 1.



INVENTORS
Arthur J. Elian
Charles F. Parraga
BY
Sheffield & Betts
their ATTORNEYS

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Fig. 2.

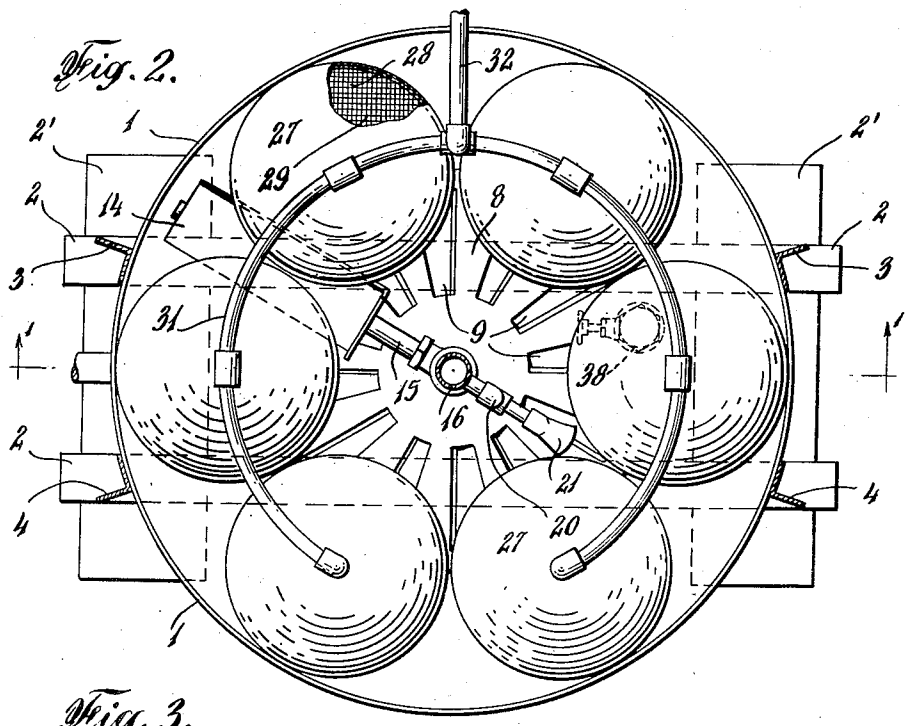


Fig. 3.

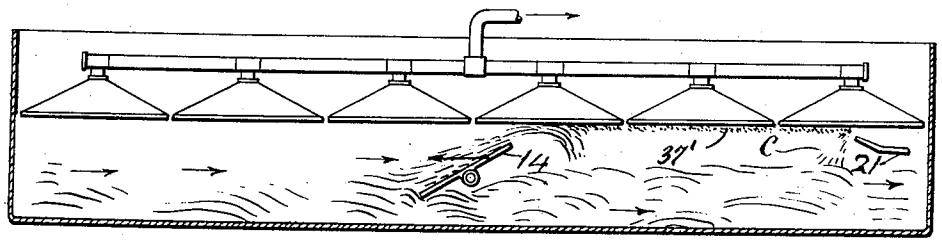
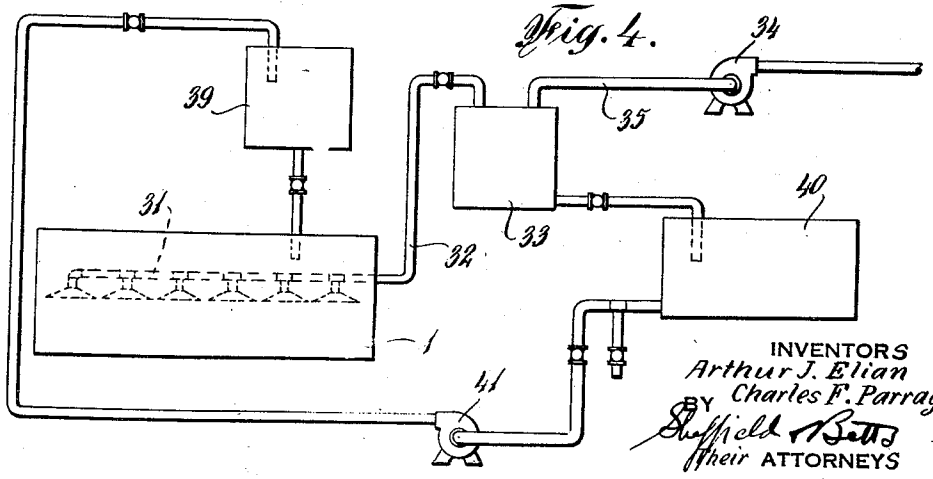


Fig. 4.



INVENTORS
Arthur J. Elian
Charles F. Parraga
BY
Sheffield & Betts
their ATTORNEYS

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ORE EXTRACTION

Arthur J. Elian and Charles F. Párraga, Mexico, D. F., Mexico, assignors to Vacuum Process Extraction Corporation, a corporation of Delaware

Application March 10, 1938, Serial No. 195,073

17 Claims. (Cl. 210—153)

This invention relates to metal extraction by processes such as, for example, the well known cyanide process for obtaining gold, silver and other valuable metals.

One object of the invention is to improve the means for obtaining the chemical action so that the valuable content of the disintegrated ore is more quickly extracted.

Another object is to more completely extract the valuable content than can be accomplished by present processes and apparatus.

Another object is to successfully extract the valuable content in difficult or rebellious ores such as those containing manganese compounds.

Other objects will appear in the following description, reference being had to the drawings in which:

Fig. 1 is a partial section of the apparatus taken on line 1 . . . 1 of Fig. 2.

Fig. 2 is a section taken on the line 2 . . . 2 of Fig. 1, the power driving mechanism being omitted for clearness of illustration.

Fig. 3 is a development in diagrammatic form showing the operation more clearly.

Fig. 4 is a diagrammatic illustration of the operating cycle.

Referring to Fig. 1, the tank 1 is adapted to contain a mixture of disintegrated ore and cyanide solution. It may be supported in any way such as on beams 2 extending across between foundations 2'. A pair of vertical angle irons 3 and 4 are welded or otherwise secured to the tank at each side to support the upper driving gears and shafts generally indicated at 6. The lower driving gears and shafts are generally indicated at 7. The purpose of these two separate drives will be later described.

At the bottom of the tank 1 is an agitating device 8 which by way of example we have shown as a circular disk of metal having projecting vanes 9 to give an impeller action. This agitator is fastened to a rotatable shaft 10 journalled in bearings 11, 11'. The upper bearing 11' has a packing gland with a suitable screw plug 12 to make the bearing watertight. This agitator is rotated by the gear mechanism 7 connected to power drive 13. Alternatively the driving gears may be located at the top of the tank with avoidance of the packing gland.

A deflector or scoop 14 is mounted in inclined position on an arm 15 fastened to a tubular shaft 16 extending over but out of contact with the upper end of shaft 10. The tubular shaft 16 may have a sealing plug 18 so that air pressure supplied to the upper part of the tube, as hereinafter more fully described, will not pass down through the tube and out of its lower end. Any other arrangement may be used to accomplish the same purpose.

The tubular shaft passes through one or more bearing members 19 of ball bearing or any desired type and is connected to the gear mechanism 6 hereinbefore mentioned. The pipe connection 20 leads into the upper part of the shaft 16 and terminates in an air nozzle 21 directed upwards at an angle. Compressed air is admitted to the interior of rotatable pipe 16 by pipes 22 and 23, the former being stationary and the latter being rotatable with shaft 16. Pipe 23 is threaded into a plug 24 screwed into the top of tube 16. A packing gland 25 surrounds the adjoining ends of pipes 22 and 23 with packing 25' and compression nut 26 to prevent escape of air at the joint. Any desired air pressure may be used but we have found thirty pounds or over more suitable for the purpose.

Above the rotatable deflector and air nozzle are arranged a series of leaching chambers 27. Each chamber consists of a cone shaped housing open at the bottom. The bottom is closed by a filter medium 28 of canvas or other suitable material. The arrangement is preferably such that this filter medium is flat and horizontal. To make the filter medium rigid a supporting grill 29 is secured to the open end of the housing and the filter medium is stretched tightly across this grill. Each housing has a suction pipe 30 leading from its top to a suction ring 31. This suction ring is connected by a suction pipe 32 to precipitation chamber 33 containing the usual zinc shavings or particles. The general arrangement is shown diagrammatically in Fig. 4. A vacuum pump 34 is connected with the precipitation chamber by pipe 35 so that a suitable vacuum is maintained in the suction line and leaching chambers. The operation of our improvement may now be described.

The tank is charged with pulp or mixture consisting of disintegrated ore and cyanide solution, through pipe 36. The height of the mixture in the tank should be such that it will not reach the filter mediums either when it is quiescent or when it is thrown up into a vortex by the agitator 8 as hereinafter described. With the shafts and gears generally indicated at 7, rotating, say in the direction indicated by the arrow A, the agitator will be rotated to the left as viewed in Fig. 1. The belt 37 will then rotate the gears and shaft arrangement generally indicated at 6 in the direction indicated by the

arrow B. This rotates the deflector or scoop 14 to the right as viewed in Fig. 1. The rotation of the agitator draws the mixture downward at the center and throws it out against the sides of the tank where it flows upwards and then downwards towards the center again. The agitator also gives the mixture a rotary motion to the left. The agitator thus maintains the mixture in a vortex.

As the deflector or scoop revolves to the right with its lower edge immersed in the mixture the combined action of the rotating vortex and the reversely rotating scoop forces a stream of mixture upwards along the scoop and into contact with each of the filter mediums in succession. The vacuum draws the cyanide-metal solution through the filter medium as soon as the mixture strikes the filter cloth and causes a thin filter cake 37' to adhere thereto. The thickness of the adhering cake is exaggerated in Fig. 3 for purposes of illustration. As the agitator sweeps around and the scoop forces the mixture into engagement with the filter mediums in rapid succession the vacuum draws out the solution contained in the thin layers of adhering filter cake which thus become substantially dry but which still have adhering layers of pregnant solution particularly on the bottom sides of the ore particles and in the minute crevices and irregularities of the particles. The moving, upwardly directed air jet 21 sweeps along behind the scoop under the substantially dry filter cake and the air pressure greatly aids the vacuum in stripping the filter cake of its last vestige of adhering film of pregnant solution which by its position cannot be sucked out by the vacuum. We have found this final stripping action of the air jet very important and that it adds greatly to the efficiency and speed of the operation. Each time the scoop throws the mixture against the filter a thin film adheres until a certain thickness is reached when gravity and the force of the air jet dislodge, as at C of Fig. 3, a part, or all, of the adhering cake. By the combined action of gravity and the air jet this adhering layer is limited to a definite thickness which is always sufficiently thin to permit the vacuum to function with full efficiency. As the operation continues the agitator stirs up the mixture and new portions are repeatedly brought into intermittent engagement with the filter mediums in succession. The combined action of the vacuum and air jet is such that after a relatively short run the valuable content is almost entirely removed and the worthless sludge can then be discharged, for example, through pipe 38. The tank is then recharged and the operation repeated.

Fresh barren cyanide solution is admitted from tank 39 as fast as the pregnant solution is withdrawn through the leachers. The barren solution after leaving precipitation chamber 33 is led into storage tank 40 where it is pumped back into tank 39 by a suitable pump 41.

In practice this system of extraction has proven to be remarkably efficient in recovery of gold and silver from their ores both as to percentage of recovery and time involved. The extraction is exceptionally complete and the time involved is remarkably short. We have been able to get 95% of the gold in a three hour run and practically all of it in fifteen hours. We have also found that gold and silver can be readily extracted from ores containing manganese compounds which heretofore could not be satisfactorily worked by the cyanide process.

We have shown a particular form of agitator and one scoop and air jet but this is by way of example only. The mixture may be agitated in any way and there may be any desired number of scoops and air jets. Also, various ways may be used to intermittently raise the mixture against the filters. These and various other changes may be made without departing from the spirit of the invention.

Having described our invention, what we claim is:

1. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a leaching chamber in the tank positioned normally above the level of the solution therein, a suction pipe connected to the leaching chamber, a filtering medium in the bottom of the leaching chamber, means for agitating the mixture beneath and out of contact with the filtering medium, and means to intermittently bring the mixture and the under surface of said filter into and out of contact with each other.

2. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a leaching chamber in the tank positioned normally above the level of the mixture therein, a suction pipe connected to the leaching chamber, a filtering medium in the bottom of the leaching chamber, an agitator for stirring the mixture beneath and out of contact with the filtering medium, means to intermittently bring the mixture and the under surface of said filtering medium into and out of contact with each other, and means for directing air under pressure against filter cake adhering to the under surface of the filter.

3. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a leaching chamber in the tank positioned normally above the level of the mixture therein, a suction pipe connected to the leaching chamber, a filtering medium in the bottom of the leaching chamber, means for agitating and moving the mixture beneath and out of contact with the filtering medium, and means to intermittently raise the mixture against the under surface of said filter.

4. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a plurality of leaching chambers in the tank positioned normally above the level of the mixture therein, a suction pipe connected to the leaching chambers, a filtering medium in the bottoms of the leaching chambers, an agitator for moving the mixture beneath and out of contact with the filtering mediums, a deflector for intermittently raising the mixture against the under surfaces of said filters, and means for directing air under pressure against the filter cake adhering to the under surfaces of the filters.

5. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a plurality of leaching chambers in the tank positioned normally above the level of the mixture therein, a suction pipe connected to the leaching chambers, a filtering medium in the bottoms of the leaching chambers, an agitator for moving the mixture in one direction beneath and out of contact with the filtering mediums, a deflector adapted to move in the opposite direction for intermittently raising the mixture against the under surfaces of said filters, and an air duct behind the deflector and moving in unison therewith, for directing air against the

filter cake adhering to the under surface of the filter.

6. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a plurality of leaching chambers in the tank positioned normally above the mixture therein, filtering mediums on the under sides of said leaching chambers, suction pipes connected to the leaching chambers for withdrawal of solution therefrom, an agitator in the tank below the leaching chambers, an inclined scoop above the agitator having its lower edge adapted to be in the mixture and its upper edge under and adjacent the filtering mediums, and means for rotating the agitator in one direction and the scoop in the opposite direction for raising the mixture against a filtering medium when the scoop passes thereunder.

7. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a plurality of leaching chambers in the tank positioned normally above the mixture therein, filtering mediums on the under sides of said leaching chambers, suction pipes connected to the leaching chambers for withdrawal of solution therefrom, an agitator in the tank below the leaching chambers, an inclined scoop between the agitator and the leaching chambers having its lower edge adapted to be in the mixture, and means for rotating the agitator in one direction and the scoop in the opposite direction for raising the mixture against a filtering medium when the scoop passes thereunder.

8. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a plurality of leaching chambers in the tank positioned normally above the mixture therein, filtering mediums on the under sides of said leaching chambers, suction pipes connected to the leaching chambers for withdrawal of solution therefrom, an agitator in the tank below the leaching chambers, an inclined scoop above the agitator having its lower edge adapted to be in the mixture and its upper edge under and adjacent the filter mediums, means for rotating the agitator in one direction and the scoop in the opposite direction for moving the mixture up the scoop against a filtering medium when passing thereunder, and an air nozzle trailing the scoop in the fixed relation thereto for directing air against filter cakes adhering to the under surface of the filter mediums.

9. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a leaching chamber in the tank positioned normally above the level of the solution therein, a suction pipe connected to the leaching chamber, a filtering medium in the bottom of the leaching chamber, and means to intermittently bring the mixture and the under surface of said filter into and out of contact with each other.

10. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a plurality of leaching chambers in the tank positioned normally above the level of the mixture therein, a suction pipe connected to the leaching chambers, filtering mediums in the bottoms of the leaching chambers, a deflector adapted to rotate within the tank and below the leaching chambers for intermittently raising the mixture against the under surfaces of said filters, and an air duct behind the deflector and moving in unison therewith for directing air against the filter cake adhering to the under surface of the filter.

11. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a leaching chamber having an horizontally positioned filter in the bottom thereof, means to draw pregnant solution upwardly through the filter and out of the chamber, and an independent continuously operating fluid jet adapted to direct fluid under pressure intermittently against ore particles adhering to the lower surface of the filter.

12. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a leaching chamber in the tank positioned normally above the level of the mixture therein, a suction pipe connected to the leaching chamber, a filtering medium in the bottom of the leaching chamber, means to intermittently bring the mixture and the under surface of said filtering medium into and out of contact with each other, and means for intermittently directing a jet of fluid against the under surface of the filter.

13. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a leaching chamber in the tank positioned normally above the level of the mixture therein, a suction pipe connected to the leaching chamber, an horizontal filtering medium in the bottom of the leaching chamber, a deflector adapted to rotate within the tank and below the leaching chamber for intermittently raising the mixture against the under surface of said filter, and a fluid duct behind the deflector and moving in unison therewith for directing fluid against the under surface of the filter.

14. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a plurality of leaching chambers in the tank positioned normally above the level of the mixture therein, a suction pipe connected to the leaching chambers, a filtering medium in the bottoms of the leaching chambers, an agitator for moving the mixture beneath and out of contact with the filtering mediums, a deflector for intermittently raising the mixture against the under surfaces of said filters, and means for intermittently directing fluid under pressure against the under surfaces of the filters.

15. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a leaching chamber closed at the top and having an horizontal filter in the bottom thereof, a suction pipe connected to the leaching chamber to draw pregnant solution upwardly through the filter and out of the chamber, and means for removing filter cake from the lower surface of said filter while pregnant solution is being drawn through the filter comprising a duct for directing fluid under pressure intermittently against the lower surface of said filter.

16. In ore extraction apparatus, a tank adapted to contain a mixture of disintegrated ore and an extraction solution, a leaching chamber closed at the top and having an horizontal filter in the bottom thereof, a suction pipe connected to the leaching chamber to draw pregnant solution upwardly through the filter and out of the chamber, and means for removing filter cake from the lower surface of said filter while pregnant solution is being drawn through the filter comprising a duct for directing fluid under pressure intermittently against the lower surface of said filter, said duct being located outside of said leaching chamber.

17. In ore extraction apparatus, a tank adapted

to contain a mixture of disintegrated ore and an extraction solution, a plurality of leaching chambers, each chamber being closed at the top and having an horizontally positioned filter in the bottom thereof, a suction pipe connected to the leaching chambers to draw pregnant solution upwardly through the filters and out of the chambers, and means for removing filter cake from the lower surfaces of said filters while pregnant solution is being drawn through the filters comprising a moving duct for directing fluid under pressure successively against the under surface of each filter.

ARTHUR J. ELIAN.
CHARLES F. PÁRRAGA.