

UNITED STATES PATENT OFFICE.

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EXTRACTION OF METALS FROM THEIR ORES.

No. 899,146.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, JABEZ TURTON, a subject of the King of Great Britain, residing at Johannesburg, Transvaal, have invented certain new and useful Improvements Relating to the Extraction of Metals from Their Ores, of which the following is a specification.

This invention has reference to the extraction of metals from ores.

Although primarily designed for the treatment of auriferous or argentiferous ores, the invention may, if desired, be utilized for the extraction of platinum and all metals from ores containing the same. It is equally applicable for the treatment of pyritic or non-pyritic ores.

The invention relates particularly to the process of extracting the precious or base metals from the crushed or reduced ore by means of a solvent solution.

As compared with certain processes heretofore proposed for the purposes specified, the present improvements give, among others, the following advantages, namely:—
They enable the extraction of the metal to be effected much more expeditiously; a higher extraction is obtained, and the loss of fine gold in slimes etcetera is entirely obviated. The process is extremely simple and possesses decided advantages both as regards handling and working, over the processes at present in vogue. The ore, after being crushed, goes direct into the vats for treatment with the solution; practically all the gold is extracted before the ore leaves the vats; no slimes are formed, and no further treatment of the tailings in any way is required. The gold as extracted is much purer, and finally, the initial cost of the installation of the plant is very considerably reduced.

The essence of the present invention lies in the employment of a solvent solution consisting of sulfuric acid, salt (chlorid of sodium), nitrate of an alkali metal (nitrate of soda or nitrate of potash), permanganate of soda or permanganate of potash, and water, with or without the addition of saccharin ($C_6H_{10}O_5$), all in suitable quantities or proportions. The function of the saccharin is that of an oxidizing agent.

In carrying out the invention in the case of ordinary conglomerate and non-pyritic ores, the ore as it comes from the mine is crushed or comminuted, as for example by passing it through stone crushers or crushing rollers, or

by any other suitable means, to reduce it to a suitable size to render it amenable to treatment by the chemical solvent. The degree of comminution will vary according to the nature of the ore. The crushed ore is then placed in a vat or tank (or vats or tanks) of any suitable construction. As the solvent solution is very penetrative, it is desirable that the vats or tanks shall be so constructed as to withstand the action of the solution; for example, the vats may be made of pitch-pine, and with the object of counteracting any action of the solvent which might cause shrinkage of the wood, the vats may be bound with iron bands which are adapted to make the vats liquidtight to prevent leakages. If preferred the vats may be built of bricks on a foundation of concrete and be lined with a suitable non-perishable cement. It is also desirable that all the utensils, pipes, pumps, etcetera employed in the process, either for the circulation or manipulation of the solvent, should be of vulcanite, glass, or other suitable anti-corrosive or acid resisting material. After a sufficient quantity of the ore has been placed in the tank, the solvent solution is then pumped on to the contents and allowed to percolate through, and sufficient time given for the effective working of the solvent, after which it is treated as hereinafter explained for the purpose of extracting the metal.

I prefer to treat the ore with the solvent by rotation, that is to say the vats are preferably so arranged that the solution can be drawn off from the first into the next vat or tank, and so on through the whole series, the solution being brought up to its original strength as it passes on from vat to vat. In this manner the solution can be so manipulated as to reduce the cost, in rotation, to one quarter that of the original solution. After the original solution has passed through the ore in a vat it will be understood that a certain quantity remains in the ore. This is preferably leached off with water, which, percolating or passing through the ore, carries with it all the auriferous fluid. This washing is preferably continued until the liquid passing from the vat is colorless. When this condition is reached the vat can be discharged and re-charged with the ore for treatment.

Although the solution extracts all metals from ores, it has the power of holding all these metals in solution as long as the standard strength is maintained. The ore may

be treated with the solvent solution in any other suitable and convenient manner. For each ton of ore treated I employ the several ingredients in the following quantities or proportions, namely:—water 40 gallons or 5 400 pounds, sulfuric acid 80 pounds, salt (chlorid of sodium) 40 pounds, nitrate of an alkali metal (nitrate of soda or nitrate of potash) 22½ pounds, permanganate of soda 10 or permanganate of potash 2 pounds. In addition to the permanganate of soda or permanganate of potash, saccharin may be employed and two pounds (more or less) be used in the production of the above quantity 15 of the solvent. The quantities of the several ingredients may be varied as may be found necessary or desirable to suit the nature of the ore to be treated. The solvent solution may be produced by mixing the several in- 20 gredients enumerated in any suitable and preferred manner.

In the process of treating highly pyritic ores it is necessary to roast the ore in kilns. The ore need not be finely comminuted as 25 pieces ranging from one ounce to four or five pounds in weight would be suitable for the roasting process. A "dead roast" is preferable although not absolutely necessary; the ore must be rendered highly porous by cal- 30 cination so that it is amenable to the penetrative action of the solvent solution. After the calcination of the ore is completed, it is crushed or comminuted (more or less coarse) and treated as before described with the sol- 35 vent solution.

As a precipitant for recovering the gold from the auriferous fluid I prefer to employ charcoal, although any other suitable re- 40 agent may be used. By employing charcoal as the precipitant the gold is obtained in the metallic state, and all the baser metals are left in the fluid.

In course of time the original solution be- 45 comes so highly charged or saturated with the gold and other metals that it can no longer be used for effecting the extraction. When this stage is reached it is finally drawn off and very freely diluted with water (say three to five parts of water to one of solution) 50 and then passed through the charcoal. The dilution of the solution is absolutely essential, otherwise, the solution, being too strong, would have a tendency to destroy the precipitating power of the charcoal. The char- 55 coal may be inclosed in bags or covers made of muslin or other similar suitable material. For effecting the recovery of the gold from the charcoal the latter is burned in a suitable vessel, the ashes containing the gold being 60 subsequently mixed with suitable fluxes and reduced in the ordinary manner.

What I claim as my invention and desire to protect by Letters Patent is:—

1. The process of extracting metals from 65 ore which consists in subjecting the ore to the

action of a solvent solution of sulfuric acid, sodium chlorid a nitrate of an alkali metal, a permanganate of an alkali metal, saccharin and water, and subsequently precipitating the metal from said solution.

2. The process of extracting metals from 70 ores which consists in crushing the ore, then treating the crushed ore with a solvent solution of sulfuric acid, salt, nitrate of an alkali metal, and permanganate of an alkali metal, 75 with the addition of saccharin and water, and subsequently precipitating the gold from said solution, substantially as described.

3. The process of extracting metals from 80 ores which consists in crushing the ore then treating the crushed ore with a solvent solution of sulfuric acid, salt, nitrate of an alkali metal and permanganate of an alkali metal, 85 and water, with the addition of saccharin, and subsequently precipitating the gold from the solvent solution on charcoal, and then burning the charcoal and adding flux to the ashes and reducing same to recover the gold, 90 substantially as described.

4. The process of treating pyritic ores for 90 extracting metals therefrom, which consists in reducing the ore to a suitable size, then roasting the same to render it porous, crush- 95 ing it after calcination is completed, then treating the same with a solvent solution of sulfuric acid, salt, nitrate of an alkali metal, and permanganate of an alkali metal, and 100 water, with the addition of saccharin and subsequently precipitating the gold from the solvent solution, substantially as described.

5. The process of treating pyritic ores for 105 extracting metals therefrom, which consists in reducing the ore to a suitable size, then roasting the same to render it porous, crush- 110 ing it after calcination is completed, then treating the same with a solvent solution of sulfuric acid, salt, nitrate of an alkali metal, and permanganate of an alkali metal, 115 and water, with the addition of saccharin, and subsequently precipitating the gold from the solvent solution on charcoal, substan- 120 tially as described.

6. The process of treating pyritic ores for 125 extracting metals therefrom, which consists in reducing the ore to a suitable size, then roasting the same to render it porous, crush- 130 ing it after calcination is completed, then treating the same with a solvent solution of sulfuric acid, salt, nitrate of an alkali metal, and permanganate of an alkali metal, and 135 water, with the addition of saccharin, and subsequently precipitating the gold from the solvent solution on charcoal, and then burn- 140 ing the charcoal and adding flux to the ashes and reducing same to recover the gold, sub- 145 stantially as described.

7. The process of extracting metals from 150 ores which consists in crushing the ore, then treating the crushed ore with a solvent solution of sulfuric acid, salt, nitrate of an alkali 155

metal, and permanganate of an alkali metal, and water, with the addition of saccharin, and subsequently diluting the solvent solution with water preparatory to precipitating the gold therefrom and finally precipitating the gold, substantially as described.

8. The process of extracting metals from ores which consists in crushing the ore, then treating the crushed ore with a solvent solution of sulfuric acid, salt, nitrate of an alkali metal, and permanganate of an alkali metal, and water with the addition of saccharin, the ore being treated with the solvent by rotation, or so that the solution can be drawn off from the first vat into the next vat and so on through the whole series, the solution being brought up to its original strength as it passes on from vat to vat, and subsequently diluting the solvent solution with water preparatory to precipitating the gold therefrom and finally precipitating the gold, substantially as described.

9. The process of extracting metals from ores which consists in crushing the ore, then

treating the crushed ore with a solvent solution consisting of eighty pounds of sulfuric acid, forty pounds of salt, twenty two and a half pounds of nitrate of an alkali metal, two pounds permanganate of an alkali metal, and four hundred pounds of water, with two pounds of saccharin per ton of ore to be treated, the ore being treated with the solvent by rotation, then washing the ore in the vat until the liquid passing from the vat is colorless, then diluting the solvent solution with water, then precipitating the gold from the diluted solution on charcoal, then burning the charcoal, and then adding flux to the charcoal ashes and reducing the same to recover the gold, substantially as described.

In witness whereof I have hereunto set my hand in the presence of two subscribing witnesses.

JABEZ TURTON.

Witnesses:

CHAS. OVENDALE,
R. OVENDALE.