

UNITED STATES PATENT OFFICE

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IMPROVEMENT IN PROCESSES FOR TREATING COPPER ORES.

Specification forming part of Letters Patent No. **153,796**, dated August 4, 1874; application filed May 16, 1874.

To all whom it may concern:

Be it known that I, FRANCIS ZWICKL, of Jersey City, in the county of Hudson and State of New Jersey, have invented a new and Improved Process for the Treatment of Argentiferous, Auriferous, and other Copper Ores, of which the following is a specification:

My invention is an improved process by which argentiferous, auriferous, or other copper ores may be treated either independently or in auxiliary manner to other processes for the extraction of gold, silver, and copper therefrom. The invention consists of a combination of operations, viz., smelting of the ores in a reverberatory furnace to a mat with admixture of sulphate of soda, for the purpose of disintegration; oxidation of the disintegrated mat in a furnace similar to a common roast-furnace suitably adapted to prevent the heat from rising above the desired degree; repetition of this oxidation after the first is finished, and the product of it has been soaked with water; dissolving the sulphate of copper formed during said oxidation in a tank with water, and after removal of the solution dissolving the copper still left in residue with a solution of sulphate of iron, this latter process to be repeated as long as any copper is left in the residue, the copper in solution to be precipitated with iron. The residue, containing peroxide of iron and all the gold and silver, being much reduced in bulk can be treated by any known method for the extraction of the gold and silver, or used as flux for smelting the ores, and to accumulate the bullion as far as desired.

As the success of this process depends mainly upon the perfect disintegration and treatment of the ores during the oxidation or calcination processes, I will more fully describe the same, and the tests for controlling the progress of the operations.

First, the sulphureted copper ores are smelted either alone or blended with other ores in a reverberatory furnace to a mat or regulus, and are then treated, after the removal of the dross, with sulphate of soda or salt-cake, say, about ten per cent. of the weight of the mass to produce the disintegration of the mass to fine

powder without mechanical grinding, in the well-known method.

Second, the powdered mat is to be calcined or better oxidized in a furnace similar to a common roast-furnace, with this difference, however, that the floor is not made of solid masonry, but cast-iron plates or brick tiles resting on flat-laid bricks, for allowing the free circulation of the air under the floor for keeping it cool, and preventing thereby the decomposition of the sulphate of copper after same is formed. The furnace is furthermore divided by a low brick wall into two compartments, the front part near the fire-bridge, and the rear part of larger size toward the chimney. From the rear compartment preferably several flues ought to connect with the smoke-stack, in order to better spread the flame over the same. The mat is first charged into the rear compartment, say, in quantities of about three thousand pounds, and spread out there to lay not over four or five inches deep, to be exposed to a moderate flaming fire, by which it will be soon ignited, and burn with a faint blue flame all over the same. As long as this continues the fire must be kept low, and the whole mass be often stirred. After the blue flame has entirely disappeared the fire must be slightly increased, so as to maintain a faint cherry-red heat for about two hours longer. After that time the charge is drawn out and deposited in proximity to the doors of the front compartment, where it will cool down sufficiently to be mixed with water until it has the consistency of stiff masons' mortar, in which state it is to be left. The rear compartment is, during the preparation of this mass, charged again with disintegrated mass for oxidation. The moistened mass becomes after four or five hours outwardly dry and hard, and has to be stirred up with a copper spade and the lumps mashed, to be then charged before being completely dry into the front compartment.

Third, the mass is there exposed for two or three hours to a dark cherry-red heat, slightly more than the former, and raked thoroughly and often, to be then drawn out clean. Should at any time the heat increase

so that the mass comes to a red heat, or gets sticky and balling together, it must be drawn out at once.

The following tests serve as a guide in treating the mass in the oxidizing-chamber: If the part taken out shows after cooling olive-green spots, it is not sufficiently long in the furnace, or not heated enough. If it shows a pale-brick color, with a gray dusty tinge, it is in the required condition. If it should show a dark-brown color, bordering on black, the heat applied was too great, and the mass is partly roasted dead, so that less copper will be precipitated, and the treatment with concentrated iron solution has to be prolonged. The oxidized matter is further treated wet, in a series of tanks, of which No. 1 may be made of iron with a fire under it, or of wood if heated by steam. Tank No. 2 is placed in front of the former and below, made of wood, with several plug holes on one side. Tank No. 3 is in front of and under No. 2, and serves as precipitating-tank, is made of wood if steam be at hand for heating, of copper if it is to be heated by a fire below. Tank No. 4 is made of wood large and shallow, and contains the more or less concentrated solution of sulphate of soda and iron coming from precipitating-tank. Tank No. 5 is made like No. 4, and contains very diluted solutions of copper, iron, and soda sulphates, obtained from washing residues, and intended to be evaporated and to be used in the other operations instead of pure water. Tank No. 6 is also made like the former, and contains diluted solutions of sulphates of iron and copper deposited for slow evaporation, and to be used for washing residues containing no sulphate of soda.

It is obvious that instead of tanks Nos. 4, 5, and 6 any number of smaller tanks instead of larger ones may be used.

Fourth. The mass drawn from inner compartment is thrown hot into tank No. 2, which was filled previously with water or liquid from tank No. 5, sufficiently to cover the mass when spread and settled to about three or four times its height. After stirring well and trimming the mass more to the side opposite the plug-holes, and being settled well the solution is allowed to run down into tank No. 3 through a filter hung below the plug and acidulated with a few ounces of sulphuric acid.

Fifth. The copper is here precipitated with scrap iron or iron sponge or both at full boiling heat. The residue in tank No. 2 is to be washed once or twice with pure water or with liquid from tank No. 5. Those liquids are to be used in preference to water in order to avoid unnecessary increase of their bulk. After the wash water becomes weak in copper it will be thrown back into tank No. 3, whence it came. The precipitation being completed the remaining liquid is to be drawn hot from precipitation-tank, and poured back on residue in tank No. 2, stirred well, and

after settling let down once more into No. 3 for precipitation, after which it is poured into tank No. 4 for evaporation to recover the soda and iron salts.

Sixth. The residue which has now lost from fifty per cent to eighty per cent of the copper it contained and half of its weight is further treated with a fully concentrated boiling hot solution of sulphate of iron run down on it from tank No. 1 in sufficient quantity to cover it three or four times, and after stirring it well several times during one hour, allowing it to settle, the solution is drawn into the precipitation-tank. This treatment with iron solution is to be repeated once or twice, according to richness of mass in copper until the latter is all, or nearly all, extracted. The water used to wash the residue at last after getting weak in copper is returned to tank No. 6, whence it came, the liquid, after precipitation, to be returned to tank No. 1. If circumstances admit, instead of throwing the oxidized mass hot into tank No. 2, as described in operation fourth, it is more preferable to soak it again with water and leave it in a bin, the longer the better, stirring it up once per day, and keeping it damp. This will produce sub-salts, and the fall of copper in first precipitation will be greater. The residue, which has shrunk in the treatment of rich mass to less than two-fifths in weight, contains practically nothing but peroxide of iron, and all the silver and gold which the ores contained, and either practically no copper, or as much as was left in it purposely for shortening process. If rich in bullion it will at once be delivered over to extraction by any of the known methods; if poor, it goes back to smelting as a flux for the ores which are, with rare exceptions, silicious, and are in need of iron for flux. The bullion can be accumulated with the repetitions of this proceeding to any extent desired.

The residue from pure copper ores being peroxide of iron can be easily converted into iron sponge for precipitation, which at once will recover what copper was left in it, or it may be used, as mentioned above, for flux, or both uses may be made of it simultaneously. For the treatment of mass above thirty-five per cent. this method is impracticable as a self-sustaining process, but it may be made a great auxiliary to other processes.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In combination with the process of disintegration of the copper ore by smelting with sulphate of soda, the process of oxidization of the disintegrated mass in a furnace having a floor made of cast-iron plates or thick tiles resting on flat-laid bricks, for the purpose of allowing the free circulation of the air under the floor for keeping it cool, and preventing thereby the decomposition of the sulphate of

copper after the same is formed, substantially as and for the purpose specified.

2. The process of treating the charge with water until reduced to the consistency of stiff mortar, in which condition it is allowed to become hard, the lumps being broken and the mass frequently stirred, and of manipulating the same in a front and rear compartment of the furnace, substantially as and for the purpose specified.

3. The process of treating the oxidized matter in a series of tanks, arranged and constructed as described, for the purposes of solution and precipitation, substantially as and for the purpose specified.

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Witnesses:

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