UNITED STATES PATENT OFFICE.

ALEXIS DROUIN, OF PARIS, FRANCE.

PROCESS OF EXTRACTING METALS.

SPECIFICATION forming part of Letters Patent No. 290,548, dated December 18, 1883.

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To all whom it may concern:

Be it known that I, ALEXIS DROUIN, engineer and chemist, of 33 Rue Beaubourg, Paris, in the Republic of France, have invented certain Improvements in Processes for Extracting Metals; and I do hereby declare that the following is a full, clear, and exact description of the same.

My improvements consist in a process for extracting, by wet treatment and at a low temperature, lead, silver, nickel, copper, and cobalt from all ores or mattes which contain them. This process admits of the extraction and the separation in a pure state of all these metals—lead, silver, copper, nickel, and cobalt—which may be found combined in the same ore, or in matters resulting from smelting operations, &c., and it is equally applicable to the treatment of ores, of mattes or slag, and to the extraction of the metals named from slimy residues, resulting from the mechanical preparation of ores containing such metals. These residues are in the condition of a fine powder, and are too poor to be available by smelting or other similar operations. It will be readily understood that the economical extraction of lead, silver, copper, and other metal contained in the slimes resulting from the mechanical preparation of these ores would be an important source of profit.

My process consists in chloridizing at a low temperature, and as hereinafter set forth, the metals contained in the ores and in the mattes by means of a solution of sea-salt obtained by evaporating or otherwise treating sea-water, and of an acid in variable proportions, according to circumstances. When the ore contains lead, the treatment must be accompanied by heat.

The operation is made in wooden vats having a false bottom provided with a filter, and on which the pulverized ore is placed. The layer of ore may vary from one foot four inches to one foot eight inches. The dissolving-liquid, which is prepared beforehand, is placed in a reservoir situated at a higher level than the filter-vat, and it is conducted into the vats by means of lead pipes; but when the treatment is to be accompanied with heat amounting to from 176° to 194° Fahrenheit the mixture of the liquor and the ore is heated with steam by means of any appropriate arrangement. When the ores do not contain either lead or silver, the extraction of the metals is always effected without the aid of heat.

The treatment of the ores and of the mattes by my process embraces the operations of, first, grinding; second, roasting, when required; third, chloridizing by the agency of sea-salt and an acid, and dissolving the metals; fourth, precipitation of the dissolved metals; fifth, washing, drying, and fusing the precipitated metals.

The ores and mattes should be reduced by any appropriate grinding apparatus to a fine powder and then roasted, especially if copper, nickel, and cobalt are to be extracted. This should be done at a very low temperature (from 750° to 1,000° Fahrenheit) in an oxidizing atmosphere.

The composition of the liquor by means of which the metals are chloridized, chlorinated, or treated, and the solution of the chlorides thereby formed, vary according to the nature and the composition of the ores; and I would here state that by "chlorination" I mean the lixiviation of the ores by solution of any soluble chloride acidified by any kind of acid. Generally speaking, the liquor should contain from twenty to twenty-five per cent. of salt, and from one to ten per cent of acid. The dissolving-liquors may be re-employed indefinitely after each precipitation.

The precipitation of the metals is effected with or without the aid of heat, according to whether lead and silver have to be precipitated. Since the solution of lead is effected by the above-described liquor only with the aid of heat, it is merely necessary to allow the liquor to cool off after the silver has been extracted therefrom, and then all the lead separates itself in the shape of small crystals of chloride, which are white and very easy to collect. After cooling, the copper is precipitated by means of iron. If the ore contains nickel or cobalt, the solution from which the copper has been separated is submitted during two hours to the action of a current of chlorine for the purpose of peroxidizing the metallic salts, or of forming chlorides of these metals. Then the iron is precipitated by means of carbonate of lime. The nickel and

the cobalt are then precipitated in the filtered liquor in the shape of oxides of nickel and of cobalt by means of caustic lime. The separation of the two oxides is effected by any of the known processes. The sulphurets of nickel and cobalt are roasted for the purpose of driving out the sulphur and of furnishing pure oxides.

The use of chlorine can be avoided by precipitating together the iron, the nickel, and the cobalt by means of an alkaline sulphuret. The separation of the iron is very easily effected by submitting the mixture of sulphurets to the action of a very diluted solution of hydrochloric acid in water. In this case chloride of iron is produced, which can be utilized instead of a chloride of sodium for dissolving metals under the conditions above mentioned.

The washing of the metals or of precipitated oxides should be done rapidly and with an abundance of water, in order to free them of the salts with which they are impregnated. The drying of the metals is effected without the assistance of heat in order to avoid oxidation. For this purpose a hydraulic press or a centrifugal machine is made use of. The precipitated silver is reduced in a crucible, and the remaining metals in a reverberating-furnace.

The chloride of lead obtained by this process always contains seventy-three per cent. of metallic lead, and it can be made use of for manufacturing oxides or salts of lead. The metal can also be extracted from the same by fusion with coal and limestone.

Either hydrochloric acid or sulphuric acid may be employed for preparing the dissolving-liquid, and the results obtained are identical in both cases. When hydrochloric acid or sulphuric acid is employed, the mixture is in the presence of oxidized ores, and chlorine is emitted, as is ascertained from repeated experiments and from the characteristic and unmistakable odor given off; hence my use of the word "chlorination" or "chloridizing" in this application, and as hereinbefore defined. If sulphuric acid is employed, metallic chlorides and sulphate of soda are produced. If the ores contain gold, it is dissolved, and chlorine alone can produce this solution. Chloride of sodium is not the only salt that produces the reactions indicated. Many soluble chlorides, in the shape of an acid solution, by means of any acid, produce the same phenomena. Sea-water acts as efficaciously as chloride of sodium. It is merely necessary to concentrate it to such extent that it contains about twenty-five per cent. of salt. If the sea-water were employed without being concentrated, the reactions would take place too slowly to be considered industrial and profitable.

My process is not limited to a special class of silver ores; but it is applicable to the extraction of silver from all ores, whether refractory or not, and also to the extraction of lead, copper, nickel, and cobalt. I avoid in all cases any process of roasting with chlorine.

The advantages resulting from the use of this process are numerous. Besides the perfect purity of the products, the amount of acid consumed never exceeds the quantity necessary. Since the dissolving-liquid can be used a great number of times, the cost of extraction of the metals is relatively very small.

The waste liquors left after practicing my process may be re-employed without any previous preparation or purification, just as it stands at the end of the operation, merely adding thereto, if advisable, a small quantity of acid to recommence a fresh treatment.

I am aware that it is not new to lixiviate ores with an acidulated solution of salt; also, that it is old to acidify and utilize waste solutions after the precipitation of the metal therefrom; but

I claim—

The described process of extracting metal from ores, mattes, and slimes, the same consisting in first reducing them to a fine powder, next roasting at a low temperature of from 750° to 1,000° Fahrenheit, next chloridizing and dissolving by means of salt and an acid, in the manner set forth, and next precipitating the dissolved metals at the temperature described, and, finally, adding a small amount of acid to the saline solution to prepare for reuse upon a fresh charge of ore.

In witness whereof I have hereunto set my hand this 13th day of October, 1881.

A. DROUIN.

Witnesses:
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