UNITED STATES PATENT OFFICE.

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PROCESS FOR THE TREATMENT OF SILVER-NICKEL-COBALT-ARSENIC ORES.

949,058. Specification of Letters Patent. Patented Feb. 15, 1910.

No Drawing. Application filed October 13, 1909. Serial No. 522,475.

To all whom it may concern:

Be it known that I, CAMILLO C. CITO, a subject of the Grand Duke of Luxemburg, residing at Irvington, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Processes for the Treatment of Silver-Nickel-Cobalt-Arsenic Ores, of which the following is a specification.

The invention relates to the treatment of Canadian or other ores which contain, besides silver, considerable quantities of nickel, cobalts, and especially arsenic. Generally, such ores run as follows: silver 300 to 10,000 ounces to the ton; nickel and cobalt 10 to 30%; arsenic 5 to 40%; lead none.

The invention consists in the process and sub-processes hereinafter more particularly set forth, whereby through electrolysis of an anode of the alloy produced by smelting said ore in the presence of copper, the metals are separated, so that all of the silver may be recovered as a high grade product from the slimes, all of the nickel and cobalt is dissolved in the electrolyte together with the larger part of the arsenic, and all of the copper is deposited in substantially pure state on the cathode.

In carrying out my process I proceed as follows: The ore is smelted in a reverberatory furnace without any preliminary treatment, such as roasting, etc. I add to said ore a percentage of copper, preferably equal to two thirds that of the nickel and cobalt and at least the same as that of the arsenic, and not less in amount than the silver. Thus I may put in 20 per cent. of copper, but if there is 25 per cent. of arsenic present, the copper percentage should be increased to 25 per cent. If the silver present amounts to a certain number of ounces per ton, the amount of copper should not be less. Besides the copper the necessary quantity of usual fluxes is to be added. By this smelting operation is produced an alloy containing, besides copper, all the silver, nickel and cobalt and nearly all the arsenic in the ore treated. This is tapped from the furnace into molds of suitable shape to produce anodes for the electrolytic operation which next follows.

In the electrolytic bath, the cathodes are to be sheets of pure copper. The electrolyte is a solution of copper sulfate in water, and during the whole electrolytic operation the solution should contain at least ten grams of copper and five grams of free sulfuric acid per liter. The density of the electric current is to be regulated according to the composition of the anode and of the electrolyte. If the anode alloy varies in percentage of silver and arsenic, the density of the current should correspondingly vary. The density will be increased proportionately to the quantity of copper in the electrolyte. The temperature of the bath is preferably to be about 60 degrees centigrade; but is regulated by the percentage of arsenic in the anode. The higher this percentage, the higher should be the temperature so as to bring as much of the arsenic as possible into the solution.

The result of the electrolysis is practically a distribution of the metals, as follows:

1. Silver. All in the anode is quantitatively precipitated in the slimes.

2. Nickel-cobalt. All in the anode remains quantitatively dissolved in the electrolyte.

3. Arsenic. The largest part of that in the anode remains dissolved in the electrolyte, the balance going into the slimes with the silver.

4. Copper. All in the anode is deposited in the form of pure electrolytic copper on the cathode. A determination of this has yielded 99.98% Cu. Or, in other words, the copper originally added as a flux is recovered as a commercial product.

And it is further to be noted that no gases which, on account of the arsenic, would be very dangerous, are developed during the electrolysis.

To state the result of the process in another way—I have distributed the metals of the anode respectively in different places in the bath. On the cathode, is all the copper. In the slimes is all the silver and a small portion of the arsenic. In the electrolyte is all the nickel and cobalt and the greater part of the arsenic. As a consequence of this distribution, the further treatment of the products is very simple.

Treatment of the slimes.—These are rich or poor, according to the percentage of silver in the anode, but under all circumstances, they contain all the silver, since no traces of that metal appear either in the cathode or electrolyte. The small amount of arsenic which enters the slimes, together with the silver, can easily be removed by a light

roasting or a dissolving process. Thus, an ore originally containing 600 ozs. of silver per ton, 19% arsenic, and 17.5% nickel-cobalt, yielded slimes of 12,000 ozs. silver per ton; while the slimes of another or that ran 3,500 ozs. of silver per ton contained 24,500 ozs. silver per ton. These silver slimes can be refined, without difficulty, in the test furnace by the usual cupellation process.

Treatment of the electrolyte.—The electrolyte containing the whole of the nickel-cobalt and the larger part of the arsenic can be brought up to the following concentrations: silver none; copper 10 grams per liter; nickel-cobalt 55 grams per liter; arsenic 30 grams per liter. From this solution, the larger part of the copper can be precipitated by the electric current, using a carbon anode. The remainder of the copper is advantageously precipitated by H_2S in the cold, whereby very little sulfid of arsenic is formed. This copper product can be used over as a flux. All the arsenic can then be precipitated by H_2S in the heat, as sulfid of arsenic, which can be placed on the market as such. Nickel and cobalt can now be recovered, together or separate, by any of the methods usually employed—either by electrolysis or by chemical precipitation.

Particular attention is now called to the following facts resulting from my aforesaid process. 1. I obtain a direct output of the principal metals, limiting, at the same time, the forming of by-products. 2. From a complex anode, I deposit pure copper on the cathode. 3. The metals are extracted and deposited from the anode and not from the electrolyte. 4. The operation is exceedingly simple, and hence involves very low running expenses. 5. The most important metals are brought out with great rapidity: especially the silver which is recovered as a high grade product which, without difficulty, can be refined by any known process. 6. Despite the possible large amount of arsenic present, danger from arsenious gases is practically eliminated. 7. The copper added as flux is regained in the electrolytic operation as a commercial product. 8. By reason of the distribution of metals and of the quantitative deposit of all the silver in the slimes, I do not produce a plurality of different products, each containing more or less silver and each requiring separate treatment for its removal

In another application for Letters Patent Serial No. 522,476 filed by me simultaneously herewith, I have described and claimed the process of smelting silver-nickel-cobalt-arsenic ore, free from lead, in the presence of copper, which smelting process forms a step in my present process, and therefore, I do not claim said smelting process herein.

I claim:

1. The process of treating a silver-nickel-cobalt-arsenic ore free from lead, which consists in first, smelting the ore in the presence of copper to produce an alloy containing besides the copper, all the silver, nickel and cobalt and nearly all the arsenic, and second, separating the metals by electrolysis from an anode of said alloy.

2. The process of treating a silver-nickel-cobalt-arsenic ore free from lead, which consists in first, smelting the ore in the presence of copper to produce an alloy containing besides the copper, all the silver, nickel and cobalt and nearly all the arsenic, and second, separating the metals by electrolysis from an anode of said alloy in an electrolyte containing copper sulfate.

In testimony whereof I have affixed my signature in presence of two witnesses.

CAMILLO C. CITO.

Witnesses:
GERTRUDE T. PORTER,
MAY T. MCGARRY.