UNITED STATES PATENT OFFICE.

VICTOR HYBINETTE, OF FREDERICKTOWN, MISSOURI.

PROCESS FOR SEPARATING COPPER FROM NICKEL AND COBALT.

1,098,443. Specification of Letters Patent. Patented June 2, 1914.

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To all whom it may concern:

Be it known that I, VICTOR HYBINETTE, a citizen of the United States, residing at Fredericktown, in the county of Madison and State of Missouri, have invented certain new and useful Improvements in Processes for Separating Copper from Nickel and Cobalt, of which the following is a specification.

My invention relates to a process for separating copper from nickel and cobalt.

There exists in nature a certain mixture of minerals of copper, nickel and cobalt which has heretofore never been successfully treated for the separation of these metals. This ore consists of a mixture of chalcopyrite and linnæite or siegenite with silica and dolomite as a gangue. There are also present varying quantities of marcasite and galena. An average sample of this ore will analyze, chalcopyrite 10 to 20%; linnæite 4 to 8%; galena 1 to 6%; marcasite 2 to 10%; silica sand stone 50 to 70% and dolomite 10 to 30%. I have now discovered a process whereby this complex ore may be successfully treated. I have found that it is extremely difficult to concentrate this ore directly by smelting, partly on account of the preponderance of silica in the mixture, and partly also on account of the heavy loss of cobalt in the slag. Furthermore, if, as nearly always is the case, lead is present in considerable quantities, it will always be lost in such matte smelting process.

My first process of concentration consists, therefore, in a process of mechanical concentration. Ordinary wet concentration may very well be used for this purpose, but I have found that the linnæite will, even with the most careful water concentration, go into the tailings to such an extent that great losses of cobalt will thereby be occasioned. If, however, the ore should contain large quantities of lead, it will be found advantageous to begin the process with such wet concentration thereby saving the bulk of the lead as concentrates. The middlings and tailings from such water concentration will in that case be the proper raw material for my process.

My way of concentrating the ore is by magnetic separation, preceded by roasting the finely ground material to such an extent as to make chalcopyrite and linnæite magnetic. There seems to be no limit to the fineness to which the ore should be ground, but I prefer to have it pass a screen containing 10 meshes to a lineal inch. The roast should be conducted at a low temperature and be carried on until about one half of the sulfur which is present in the linnæite and chalcopyrite has been removed. I have discovered that linnæite can be made magnetic by roasting, as well as chalcopyrite, but it requires much harder roasting to make the former magnetic.

The type of magnetic separators which is to be used is absolutely immaterial and I prefer to arrange the strength of my magnets so as to make a self fluxing concentrate. The tailings obtained from this concentration will contain some nickel and copper, and practically all the lead that was present and the bulk of these minerals may be saved by subjecting the tailings to ordinary wet concentration. The concentrates from this process contain about 12 to 20% copper, 2 to 5% cobalt and 2 to 5% nickel. Probably the first process that would suggest itself for the treatment of these concentrates would be to smelt them making copper in the form of blister copper or Bessemer copper, and separating the nickel and cobalt as a slag. It is generally known that cobalt will slag very easily, but for some reason or other it seems to have a peculiar affinity for copper, and I have found that it is impossible to smelt this material to copper directly, because the cobalt as well as the nickel will remain with the copper until such a large quantity of copper has been slagged off that the process becomes absolutely impractical.

Resorting to wet processes, it might suggest itself to dead roast the concentrates and dissolve the more easily soluble copper oxid in sulfuric acid, leaving the cobalt and nickel in the residue. In attempting to do this, I have found that such large quantities of iron are dissolved with the copper that it is impossible to effect a separation of copper economically in this way. When, however, the concentrates have been smelted down to a matte and said matte is dead roasted, the copper may be leached out without dissolving any appreciable quantity of iron, nickel and cobalt. Cobalt may or may not be present together with the nickel without materially changing my process. The way I treat my concentrates is, therefore, to smelt them into a matte with or without a

previous roasting, eliminating more or less of the sulfur. The amount of sulfur so removed regulates the amount of iron left in the matte, and it is necessary to leave a large quantity of iron—say 15% in the matte because the cobalt is otherwise slagged off in considerable quantities. The matte so obtained contains 40 to 50% copper, 10 to 20% cobalt and 10 to 20% nickel. I grind this matte to pass through a screen containing 10 meshes to a lineal inch and roast the same until all or practically all of the sulfur is removed. In leaching this dead roasted material with sulfuric acid, the solution of copper so obtained may be turned into a commercial product in various ways, such as crystallizing into blue stone, cementation on iron, etc., but as the solution will always contain small quantities of iron, cobalt and nickel, all of these processes will leave the product contaminated with the said metals. I have, therefore, found it practically advantageous to electrolyze the solution making use of an insoluble anode such as lead, thereby obtaining pure copper, and using the solution over and over again for leaching new portions of dead roasted matte. I effect a very thorough separation of the copper in a very pure state and the residue contains practically all the nickel and cobalt.

While the various steps of my process are well known in the art of metallurgy, I am not aware that a process embodying all of them has ever been employed.

What I claim, is:

The process of separating copper from nickel and cobalt in sulfid ores and products from concentration, consisting in roasting the material, thereafter subjecting it to magnetic separation making concentrates, when necessary partly removing the sulfur from the concentrates by roasting, smelting said concentrates into a matte, roasting said matte, leaching said roasted matte with diluted sulfuric acid, thereby obtaining a solution containing principally copper.

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

VICTOR HYBINETTE.

Witnesses:

I. A. SCHWANER,

B. S. MCCULLOUGH.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."