

UNITED STATES PATENT OFFICE.

DARIUS P. SHULER, OF SUDBURY, ONTARIO, CANADA.

PROCESS OF SEPARATING NICKEL AND COPPER FROM MATTES.

967,072.

Specification of Letters Patent.

Patented Aug. 9, 1910.

No Drawing.

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To all whom it may concern:

Be it known that I, DARIUS P. SHULER, a citizen of the United States, residing at Sudbury, in the Province of Ontario, Canada, have invented certain new and useful Improvements in Processes for Separating Nickel and Copper from Mattes; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a process of refining copper-nickel matte and has for its object to separate out the nickel in a more efficient and less expensive manner than heretofore.

To these ends, the invention consists in the novel steps and combinations of steps constituting my process more fully hereinafter disclosed and particularly pointed out in the claims.

In carrying out this process converter or other high grade matte containing little or no iron is preferably used and is brought into a fine state of subdivision as by pulverizing. Such high grade matte may be readily obtained from the treatment of the well known Sudbury or other ores of copper and nickel, and after being pulverized it is treated with diluted sulfuric acid while keeping the materials hot and agitated to hasten the reaction. The nickel sulfate solution thus formed is next separated in any suitable vessels, whereupon the said sulfate may be dried and heated to a red heat or higher to convert the sulfate into the oxid of nickel. The oxid may finally be reduced to metallic nickel by any of the usual methods.

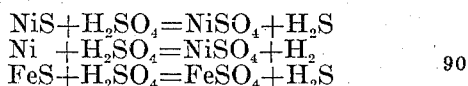
In those cases where the matte carries more iron than would be desirable in the finished nickel the solution of nickel sulfate before being evaporated is treated with a blast of air to oxidize the iron; the latter is then separated in any suitable manner, as by precipitating it with lime; and the iron oxid and lime is then filtered out.

In order to get substantially all of the nickel dissolved in a minimum of time it is preferable to carry on the dissolving step in a reducing atmosphere and in a plurality of acid baths. That is to say, in practice it is preferred to treat an excess of the matte in one bath with an unsaturated solution of nickel sulfate containing

free acid that was left over in finishing up a previous batch of matte, thus getting a practically pure nickel sulfate solution with the expenditure of very little free acid. This supplies a finished nickel sulfate solution, which, when it contains substantially no iron, is heated and converted into the oxid as above described. In another bath the residue of matte which still contains nickel is again treated with one or more fresh portions of diluted sulfuric acid; and it is again heated, and agitated while sufficient hydrogen sulfid is retained in the solution to prevent any copper being dissolved with the nickel. The final residue of matte will now be nearly or quite free from nickel, but will contain all the copper and precious metals originally present in the matte. This residue can now be treated in any well known and suitable manner, as by refining, to separate the copper and other metals.

In order to be successful in carrying out this process the matte should be very finely sub-divided, two or more portions of sulfuric acid should be employed, accompanied by heat and agitation and an excess of hydrogen sulfid which is given off during the reaction, should be maintained in the solution, all as above pointed out.

The process proceeds in accordance with the following reactions:—



The copper sulfid Cu_2S , is not acted on so long as there is H_2S in the solution; but should the H_2S be all driven off and the solution exposed to the air some copper will oxidize and go into solution.

That some of the nickel in nickel copper matte is soluble in sulfuric acid is a well known fact, but that it is commercially practicable or even possible to get substantially all the nickel into solution has been heretofore considered impossible by those inventors who have employed this reaction. But I have repeatedly and practically demonstrated that this process will dissolve 99.9 per cent. of the nickel in a matte consisting of a mixture of Cu_2S , NiS , FeS , with some Ni , Pt , Pd , Ag , and Au . I am also aware that it has been heretofore proposed to use sulfuric acid on roasted matte, but this contained the oxids of the metals instead of the sulfids.

The process of heating the nickel sulfate is carried out in a neutral or in an oxidizing atmosphere; and the matte may be conveniently ground wet along with the acid in order to save time and power while the acid driven off during the decomposition of the nickel sulfate may be recovered and used again.

When the nickel copper matte contains iron, I have found it useful under certain conditions, to finely grind the matte while wet with one portion of diluted sulfuric acid to dissolve out a portion of the nickel and iron; to then further grind the residue while wet with another portion of diluted sulfuric acid to dissolve out the rest of the nickel and any iron that might be left and to subject the solutions to heat during these operations. Of course, the iron may be oxidized and separated from the nickel sulfate obtained in this manner.

What I claim is:—

1. The process of separating nickel from copper-nickel matte, which consists in finely dividing the matte; subjecting the same to the action of diluted sulfuric acid to dissolve out the nickel; and in maintaining a sufficient quantity of hydrogen sulfid in the solution to prevent the copper from being dissolved, substantially as described.

2. The process of separating nickel from copper-nickel matte, which consists in finely dividing the matte; subjecting the same to the action of one portion of diluted sulfuric acid to dissolve out a part of the nickel; in subjecting the residue of matte to another portion of dilute sulfuric acid to dissolve out substantially all of the nickel; and maintaining at all times in the solutions sufficient hydrogen sulfid to prevent the copper from being dissolved, substantially as described.

3. The process of separating nickel from copper-nickel matte, which consists in finely dividing the matte; subjecting the same to the action of one portion of diluted sulfuric acid to dissolve out a part of the nickel; in subjecting the residue of matte to another portion of dilute sulfuric acid to dissolve out substantially all of the nickel; and maintaining at all times in the solutions while subjecting the same to heat and to agitation sufficient hydrogen sulfid to prevent the copper from being dissolved, substantially as described.

4. The process of separating nickel from copper-nickel matte which consists in finely dividing the matte; subjecting the same to the action of one portion of diluted sulfuric acid to dissolve out a part of the nickel; in subjecting the residue of matte to another portion of dilute sulfuric acid to dissolve out substantially all of the nickel; maintaining at all times in the solutions while subjecting the same to heat and agitation sufficient hydrogen sulfid to prevent the copper from being dissolved; separating the nickel sulfate thus obtained; and converting said sulfate into nickel oxid, substantially as described.

5. The process of separating nickel from copper-nickel matte which consists in finely grinding the matte while wet with diluted sulfuric acid to dissolve out the nickel; and in maintaining sufficient hydrogen sulfid in the solution to prevent the copper from being dissolved, substantially as described.

6. The process of separating nickel from copper-nickel matte containing a small quantity of iron, which consists in finely dividing the matte; subjecting the same to the action of diluted sulfuric acid to dissolve out the nickel and iron; maintaining in the solution sufficient hydrogen sulfid to prevent the copper from being attacked; and in suitably oxidizing the iron and separating it from the nickel sulfate thus obtained, substantially as described.

7. The process of separating nickel from nickel-copper matte, containing a small quantity of iron, which consists in finely grinding the matte while wet with one portion of diluted sulfuric acid to dissolve out a portion of the nickel and iron; in further grinding the residue while wet with another portion of dilute sulfuric acid to dissolve out the rest of the nickel and any iron that might be left; in subjecting the solutions to heat during these operations; in oxidizing the iron and separating the same from the nickel sulfate thus obtained; and in converting the said sulfate into nickel oxid, substantially as described.

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

DARIUS P. SHULER.

Witnesses:

R. D. MILDRUM,
CHARLOTTE O'CONNOR.