

UNITED STATES PATENT OFFICE.

ADOLPHE CHALAS, OF PHILADELPHIA, PENNSYLVANIA.

PROCESS OF RECOVERING NICKEL FROM SILICIOUS ORES.

No. 887,735.

Specification of Letters Patent.

Patented May 12, 1908.

Application filed September 6, 1907. Serial No. 391,676.

To all whom it may concern:

Be it known that I, ADOLPHE CHALAS, a citizen of French Republic, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Processes of Recovering Nickel from Silicious Ores, of which the following is a specification.

This invention is a process of recovering nickel from nickel-iron silicate ores, free from copper, such as are found in New Caledonia.

In the first stage of the process, the ore is reduced with the production of an alloy of nickel and iron. The reduction is preferably effected at a high temperature in an electric furnace, to insure good separation of the alloy from the highly-silicious and magnesian slag. The iron is eliminated from the alloy, as far as possible, by oxidation and scorification, for example by bessemerizing the alloy in an acid converter. The resulting ferro-nickel is then cast into convenient shape for use as anodes.

In the second stage of the process, the ferro-nickel anodes are placed in an electrolytic cell having nickel-sheet cathodes and containing as an electrolyte an aqueous solution of a nickel-ammonium-salt, preferably the sulfate. As electrolysis proceeds, pure nickel is deposited on the cathode, while nickel and iron are dissolved from the anode as double ammonium sulfate. During electrolysis, the solution is continuously circulated from the cell through a filter containing a body of precipitated nickelic hydroxid, which reacts upon the dissolved ferrous salt with production of nickel sulfate and precipitation of ferric hydroxid. The solution, thus freed from iron and containing an additional amount of nickel equivalent to the removed iron, is continuously returned to the cell. The nickelic hydroxid used for the precipitation of iron is electrolytically produced from anodes of ferro-nickel, such as result from the first stage of the process. For this purpose, the ferro-nickel anodes are placed in an auxiliary electrolytic cell having sheet cathodes of nickel or iron and containing as an electrolyte an aqueous solution of an alkali-metal salt, for example sodium chlorid. As electrolysis proceeds, nickel and iron are dissolved from the anodes as chlorids, while a sodium hydroxid solution is produced at the cathode. These two solutions, when mixed, react with the production of nickelous and ferrous hydroxids, which precipitate, and so-

dium chlorid, which dissolves and regenerates the electrolyte. It is preferable to prevent the mixing of the anodic and cathodic solutions within the cell, by providing it with a diaphragm and mixing them as they flow out of their separate compartments. The brine, carrying the precipitates in suspension, is circulated through a filter-press, which retains the hydroxids, the clear solution returning to the cell.

When the filter-press has been filled with the precipitated hydroxids, their peroxidation is effected by circulating through the mass an aqueous solution of an alkali-metal hypochlorite, produced, for example, by the electrolysis of a cold dilute solution of sodium chlorid. The nickelous and ferrous hydroxids are thus readily peroxidized and the hypochlorite is reconverted into sodium chlorid, which is reelectrolyzed. After complete peroxidation, the body of hydroxids in the filter is washed by circulating water through it and is then ready for use in the second stage of the process. The nickelic hydroxid, alone, enters into reaction, the small amount of ferric hydroxid mixed with it remaining inert. When the nickel hydroxid in the filter has been completely dissolved and replaced by precipitated ferric hydroxid, the stream of electrolyte is diverted to a second filter, filled with nickelic hydroxid, and the first filter is emptied, cleaned and refilled. Commercially, four filters, or sets of filters, are preferably employed, which are worked in rotation. As one filter is being filled with nickelic hydroxid, the contents of a second previously-filled filter are undergoing peroxidation; a third filter containing the peroxidized precipitating agent is being used in the second stage of the process; and a fourth exhausted filter is being emptied and cleaned.

The process of recovering nickel from the ferro-nickel anodes is cyclic, the reagents being continuously regenerated. The nickel precipitated in the second stage of the process is in its purest commercial form. The ferric hydroxid remaining in the filter is a by-product of some value, and may be calcined to colcothar of the finest quality.

I claim:

1. The process of recovering nickel from nickel-iron ores, which consists in smelting the ore and producing ferro-nickel, casting the alloy into anodes, electrolytically dissolving the anodes, continuously precipitat-

ing the dissolved iron by circulating the electrolyte in contact with a body of a precipitating agent, and redepositing the dissolved nickel.

5 2. The process of recovering nickel from nickel-iron ores, which consists in smelting the ore and producing ferro-nickel, casting the alloy into anodes, electrolytically dissolving the anodes, continuously precipitat-
10 ing the dissolved iron by nickelic hydroxid, and redepositing the dissolved nickel.

3. The process of recovering nickel from nickel-iron ores, which consists in smelting the ore and producing ferro-nickel, casting
15 the alloy into anodes, electrolytically dissolving the anodes, continuously precipitating the dissolved iron by circulating the electrolyte through a body of nickelic hydroxid, and redepositing the dissolved nickel.

20 4. The process of recovering nickel from nickel-iron ores, which consists in smelting the ore and producing ferro-nickel, casting the alloy into anodes, electrolytically dissolving the anodes, continuously precipitat-
25 ing the dissolved iron by circulating the electrolyte through a body of nickelic hydroxid, redepositing the dissolved nickel, electrolytically dissolving other anodes of ferro-nickel in an aqueous solution of an alkali-metal salt,
30 mixing the anodic and cathodic products and precipitating nickelous hydroxid, peroxidizing the precipitate, and employing the nickelic hydroxid to precipitate dissolved iron in the second stage of the process.

35 5. The cyclic process of recovering nickel from ferro-nickel, which consists in electrolytically dissolving anodes of ferro-nickel, rede-

positing the nickel, precipitating the dissolved iron by continuously circulating the electrolyte through a vessel containing a
40 body of nickelic hydroxid until the reagent has been exhausted, then diverting the electrolyte to a second vessel containing a body of nickelic hydroxid, emptying the first ves-
45 sel, filling it with a body of nickelous hydroxid, peroxidizing said nickelous hydroxid, and subsequently re-passing the electrolyte through the first re-charged vessel.

6. The cyclic process of recovering nickel from ferro-nickel, which consists in electrolyt-
50 ically dissolving anodes of ferro-nickel, redepositing the nickel, precipitating the dissolved iron by continuously circulating the electrolyte through a vessel containing a body of nickelic hydroxid until the reagent
55 has been exhausted, then diverting the electrolyte to a second vessel containing a body of nickelic hydroxid, emptying the first vessel, filling it with a body of nickelous hydroxid, peroxidizing said nickelous hydroxid,
60 subsequently re-passing the electrolyte through the first re-charged vessel, successively diverting the electrolyte to third and fourth charged vessels, and successively re-
65 charging and re-diverting the electrolyte to the second, third and fourth vessels, in sequence with the first.

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

ADOLPHE CHALAS.

Witnesses:

E. J. LAVINO,
J. W. HALE.