

# UNITED STATES PATENT OFFICE.

HENRY MARBEAU, AINÉ, OF PARIS, FRANCE.

PROCESS OF MAKING MALLEABLE FERRO-NICKEL AND FERRO-COBALT.

SPECIFICATION forming part of Letters Patent No. 310,901, dated January 20, 1885.

Application filed March 20, 1884. (Specimens.) Patented in France April 24, 1883, No. 155,098, and in Belgium April 25, 1883, No. 61,224.

*To all whom it may concern:*

Be it known that I, HENRY MARBEAU, Ainé, of the city of Paris, France, have invented new and useful Improvements in Process of Making Malleable Ferro-Nickel and Ferro-Cobalt, of which the following is a full, clear, and exact description, and for which I obtained Letters Patent in France, fifteen years, dated April 24, 1883, No. 155,098, and in Belgium, fifteen years, dated April 25, 1883, No. 61,224.

This invention relates to the manufacture of malleable ferro-nickel and ferro-cobalt; and it consists in the direct employment of pigs or mats of these metals, which are combined by fusion with ferro-cyanide or cyanide of potassium, and with one of the oxides of manganese, (binoxide, for example,) and, at the moment of running, with a small quantity of aluminium.

The pigs or mats employed are obtained from the natural or oxidized ores called "hydrosilicates of nickel and magnesia," containing variable proportions of iron and alumina without any trace of arsenic, which are obtained in New Caledonia and its dependencies, as well as the ores of cobalt and chromium of the same origin, and more generally the ores of nickel and cobalt of all countries.

To render the alloys malleable, ductile, homogeneous, and with non-oxidizing qualities proportional to the percentage of nickel or cobalt, the pigs or the mats above described are employed; or these pigs or mats may have been previously manufactured rich or poor in nickel or cobalt, according to requirements; or they are diluted more or less by the addition either of malleable iron or pig-iron, (or crude iron,) and we melt them directly with ferro-cyanide or cyanide of potassium, and one of the oxides of manganese, (the binoxide, for example,) with the addition at the moment of running of a small quantity of aluminium, which, without altering the malleability of the product, gives it a compactness and homogeneity which it would not otherwise have. These processes for the direct malleabilization of the pigs or mats, either simple or mixed, above enumerated with the optional addition of soft or cast iron, give the alloys a special intrinsic character, a peculiar physical condition rendering them permanently malleable, even after a second fusion, which allows, on the one hand, the malleable-ized ingots to be sent away to a distance to be

worked up, and on the other hand the waste jets or defective castings to be utilized either elsewhere or on the spot. The alloys obtained by this present process are tenacious, ductile, and malleable, and adapted for casting, rolling, drawing, wire-drawing, and hammering. It should be remarked that in treating pigs or mats of nickel and of cobalt by this process the resulting ferro-nickel and ferro-cobalt can be forged much more easily than the pure nickel and cobalt, which would have been malleableized in their stead by the same means. A peculiarity of this process of malleableization should be observed. While soft iron ordinarily loses by the second fusion its fibrous texture and become crystalline and brittle, like cast-iron, this same soft iron preserves its malleability after the second fusion, if it had been previously mixed with a certain quantity of the malleableized products of the process of this invention, whether these products be the ferro-nickel or ferro-cobalt above mentioned, or pure nickels or pure cobalts malleableized by the same process. The fusion of these alloys can be effected either in a crucible-furnace or an open-hearth furnace—such as the ordinary reverberatory or Siemens furnace, as well as in a cupola—by employing appropriate fuel. If one or other of the large apparatus above mentioned be used, the considerable wear and tear and the costliness of the crucibles is avoided, and the alloys are produced economically in large quantities and in the easily-transportable ingot or granulated form, or cast directly in metal or sand ingot-molds. A sufficient quantity of carbon only for the preservation of the surfaces exposed in some cases to the action of the air carried along with the flame may be added. The maximum proportions for a charge containing seventy per cent. of nickel and thirty per cent. of iron containing a small amount of sulphur are the following: binoxide of manganese containing 63.30, twelve parts; ferro-cyanide of potassium, sixteen parts; aluminium, one-tenth of a part. It is to be understood that these proportions are varied according to the intended use of the alloy. If when working this process the crucible is used, the broken pig or mat is put in the crucible with the binoxide of manganese previously mixed with the ferro-cyanide or cyanide of potassium, and the whole is melted together, allow-



ing it to slightly exceed the melting-point in order to facilitate all the reactions; and, lastly, in order to render the alloy more homogeneous, the aluminium is added at the moment of casting. If there is any trace of sulphur, a few grams of chloride of ammonium will suffice for each kilogram of the material under treatment.

The pigs or mats above mentioned malleable by the process may be used also in various proportions in the manufacture of malleable cast-iron and in the various manufactures of iron and steel. These malleable alloys may be used in lock and gun making, for navy purposes, for mining, and for gold and silver smith's work and other purposes.

I do not here desire to claim anything described in English Patent No. 1,194 of 1876.

I claim—

The process above described of producing malleable ferro-nickel and ferro-cobalt by the direct employment of pigs or mats of these metals, these pigs or mats being combined at one and the same fusion with ferro-cyanide or cyanide of potassium and one of the oxides of manganese, adding at the moment of casting a small quantity of aluminium.

The foregoing specification of my improvements in the process of making malleable ferro-nickel and ferro-cobalt signed by me this 7th day of January, 1884.

HENRY MARBEAU, AINÉ.

Witnesses:

GEORGE WALKER,  
ALBERT MOREAU.