

UNITED STATES PATENT OFFICE.

HENRY MARBEAU, OF PARIS, FRANCE, ASSIGNOR TO THE SOCIÉTÉ ANONYME
LE FERRO-NICKEL, OF SAME PLACE.

PROCESS OF MANUFACTURING IRON AND STEEL ALLOYS.

SPECIFICATION forming part of Letters Patent No. 419,274, dated January 14, 1890.

Application filed April 8, 1889. Serial No. 306,432. (No specimens.)

To all whom it may concern:

Be it known that I, HENRY MARBEAU, of Paris, in the Republic of France, have invented a certain new and useful Improvement in the Process of Manufacturing Iron and Steel Alloys, of which the following specification is a full, clear, and exact description. The invention relates to the production of malleable alloys of iron and steel with nickel and other metals.

Heretofore I have obtained ferro-nickels and steel nickels with a high percentage of nickel, varying from ninety-nine per cent. to twenty-five per cent. of nickel, possessing the peculiar properties of the latter metal, such as brilliancy, incapability of oxidation, &c., and which are capable of being substituted for nickel for many purposes. A description of the process of manufacturing such alloys is given in British Patent No. 7,179, dated June 12, 1885. In pursuing experiments in this direction I have now succeeded, by reducing the percentage of nickel below twenty-five per cent., in producing a series of alloys which, although belonging to the same class as those formerly described and patented, are possessed, on account of their constitutive elements and mode of production, of new properties, and constitute a distinct class of alloys, forming a new manufacture.

The present invention relates not to alloys of a relatively high price, which might replace pure nickel, owing to their richness in nickel, but to alloys which may be compared to iron and steel, and in which the addition of a proportion even small of nickel modifies the structure or constitution of the metal without materially augmenting its cost, (for the low percentages,) and produces a remarkable improvement in the quality of the iron or steel employed.

The present invention has for its object the production of malleable alloys of iron or steel with nickel in a proportion varying from about twenty-five per cent. down to a mere trace of nickel, these alloys being capable of being employed in the same way as iron and steel of commerce, but possessing superior qualities to those metals as heretofore obtained.

The new processes consist in simultane-

ously using manganese and aluminium with or without the addition of charcoal or other form of carbon or metallic cyanides or ferrocyanides. With regard to manganese, either pure manganese is employed or oxides of this metal mixed with a reducing agent or ferro-manganese. In the same manner, with regard to the aluminium, either pure aluminium is employed or a mixture of iron and aluminium. The nickel itself is introduced either in the form of pure nickel or in that of a malleabilized metal, or in the form of a matt or speiss more or less rich in nickel, derived from the smelting of metal ores carried on up to the beginning of the elimination of iron or derived from a previous melting of cast or other iron or steel with nickel.

The following is an example of a convenient method of conducting the process in order to obtain a good result: It is preferable to take the nickel pure or alloyed with iron at the first stage of the operation. The manganese, in whatever shape it is used, mixed or not mixed with the carburizing agents, is added, either all at once or in two or more successive additions during the course of the fusion. The necessary proportion of aluminium is thrown in at the end of the operation, either in the melted metal in the furnace or in the casting-ladle. As regards the melting apparatus, any suitable apparatus—such as those used at the present time for metallurgical purposes, crucibles, reverberating furnaces, converters, Siemens furnace, cupolas, and the like—can be employed.

The following may be taken as an example of the proportions which may be employed with good effect; but the invention is not limited to the precise proportions specified: For every thousand parts, by weight, alloy to be produced take from about one-tenth of a part to about one part of aluminium and from about one to twenty parts of manganese, according to the proportion of nickel and the quality of the product to be manufactured.

With regard to the carburizing agents, the carbon or cyanides are to be used in different proportions, according to the nature of the alloys required—that is to say, according as the alloys to be produced are hard or soft, carburized or not carburized, with the same

percentage of nickel. Thus it is by the use of ferro-cyanide with manganese and aluminium, even without the addition of nickel, iron can be transformed into ready-tempered steel, capable of being forged directly into turning-tools without further tempering.

As an example, the proportions hereinafter specified are suitable for making on an open hearth a ferro-nickel with five per cent. of nickel, starting from a nickeliferous melt.

The operation is conducted as in making steel, and after the partial or complete decarburization (according to the quality of the alloy to be obtained) the metallic manganese or ferro-manganese is added, and when the time comes for running, the aluminium is thrown in, either in the open hearth or in the casting-ladle.

In order to make five hundred kilos (or thereabout) of alloy, the following may be used:

	Kilos.
Iron containing twenty-five per cent. of nickel.....	100.
Soft iron or steel.....	400.
Ferro-manganese containing seventy-five per cent. of manganese.....	8.
Aluminium.....	250
	503. 250

The characteristic points of these different alloys are as follows: They possess a much more perfect homogeneousness than iron or steel obtained by the usual processes, and consequently they have very superior qualities, such as those of malleability, ductility, resistance, and elasticity. The ingots solidify very quickly, and blow-holes are avoided. Ferro-nickels with twenty-five per cent. nickel cannot be tempered whatever may be the proportion of carbon they contain; but in proportion as the quantity of nickel is reduced their capacity for being tempered increases, and with a percentage of seven, five, and three of nickel and downward alloys are obtained which can be tempered just in the same manner as ordinary steels and according to the same rules.

The percentage of carbon, the distribution and the special forms of carbon in the cement and metallic nucleus, which modifications are due to the presence of nickel, (the cement referred to being the part containing the greater part of the carbon and surrounding the nucleus, which is constituted chiefly by the iron,) the fall of temperature between the heating and cooling, the rapidity of the cooling intervene to produce different qualities of hardness, as could have been foreseen from the complete analysis made according to the very accurate methods recently discovered and from the remarkable discoveries relating to the innermost constitution of the steel which have been made in the last few years.

The influence of the agents of malleabilization in the application of our processes is demonstrated by the fact that even when these agents are used without addition of nickel the products obtained possess qualities by far superior to those of iron and steel made by the ordinary processes.

Heretofore and prior to this invention I have produced ferro-nickel and ferro-cobalt by the direct fusion of pigs or mattes with one of the oxides of manganese and cyanide or ferro-cyanide of potassium, adding at the moment of tapping a small quantity of aluminium. Such process is described and claimed in British Patent No. 2,573 of 1884, granted on a communication from me. That process, however, related exclusively to the treatment of pigs or mattes of nickel and cobalt, whereas the process herein described is particularly applicable to pure or refined nickel. The former process related exclusively to alloys resembling nickel in their properties and containing upward of twenty-five per cent. of that metal, whereas the present invention relates exclusively to alloys containing less than twenty-five per cent. of nickel and from that down to a mere trace, such alloys constituting, as already stated, an entirely distinct class, possessing different and peculiar properties. Moreover, by the present invention a great economy is effected in the agents of malleabilization, and the new process differs radically from the former one in the proportions of these ingredients. I employ, according to the present invention, about one-ninth the quantity of manganese, about one-half the quantity of aluminium, and a much smaller proportion of carburizing agents to the same quantity, by weight, of the alloy.

I claim as my invention—

1. The herein-described process of manufacturing malleable alloys containing iron or steel and nickel by fusing the iron or steel with a comparatively small proportion (less than twenty-five per cent.) of nickel and with manganese and aluminium in approximately the proportions stated, as set forth.

2. The herein-described malleable alloy, composed of iron or steel and nickel, the proportion of nickel being less than twenty-five per cent. of the whole, with manganese and aluminium in approximately the proportions set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

HENRY MARBEAU.

Witnesses:
MAURICE GENZ,
JOSEPH BOURNIER.