UNITED STATES PATENT OFFICE.

HENRY MARBEAU, OF PARIS, FRANCE, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE NICKEL-STEEL SYNDICATE, (LIMITED,) OF LONDON, ENGLAND.

ALLOY AND METHOD OF PRODUCING IT.

SPECIFICATION forming part of Letters Patent No. 457,205, dated August 4, 1891.

Application filed May 26, 1890. Serial No. 353,236. (No model.) Patented in France August 30, 1889, No. 200,497; in Belgium August 30, 1889, No. 87,572, and in Italy December 31 1889, XXIII, 26,263.

To all whom it may concern:

Be it known that I, HENRY MARBEAU, of Paris, in the Republic of France, have invented a certain Improved Alloy and Method of Producing it, (which improvement has been patented in France, No. 200,497, dated August 30, 1889; in Belgium, No. 87,572, dated August 30, 1889, and in Italy, No. 26,263, Vol. XXIII, dated December 31, 1889,) of which the following specification is a full, clear, and exact description.

In the manufacture or preparation of the binary alloys of nickel and iron known as "ferro-nickel" and "steel-nickel" on a commercial scale it has been customary hitherto to employ either metallic or pure nickel or the crude nickel or nickel mattes derived from the smelting or treatment of oxidized nickel ores carried on only up to the point where the elimination of the iron would begin. Pure or metallic nickel is, however, a costly metal, because of the operations necessary to eliminate sulphur, silicon, and other impurities. On the other hand, crude nickel or nickel mattes contain a considerable proportion of foreign substances, the presence of which in the manufacture of ferro-nickel or steel-nickel is not desirable.

Now the present invention consists in the manufacture and in the employment for the production of ferro-nickel or steel-nickel of a carbureted alloy containing nickel, iron, and manganese obtained by the reduction of a suitable mixture of oxidized nickel ores with iron ores and manganese ores, the reduction being preferably effected in a blast-furnace.

This alloy containing nickel, iron, and manganese, which may appropriately be called "nickelo-spiegel," is cheaper than pure or metallic nickel, while it is purer and less mixed with foreign substances than crude nickel or nickel mattes. It is also better adapted than the pure metal or the crude nickel or nickel mattes either for direct transformation into ferro-nickel or steel-nickel containing any desired percentage of nickel or for use as an addition for transforming cast-iron, iron, or steel into alloys of iron and nickel more or less rich in carbon and in nickel.

In the preparation of the nickelo-spiegel or alloy of nickel, iron, and manganese an important proportion of manganese is employed. Very basic slags are thus obtained, which are, however, very fusible. The total reduction of the nickel contained in the ores is thus insured. The charge or batch is, moreover, calculated so that the sulphur and silicon become completely removed.

It has heretofore been proposed to produce meltings or castings with a base of nickel and iron, or of nickel, iron, and manganese; but such meltings have no resemblance to the nickelo-spiegel produced as herein described. The main difference between the composition of the present alloy and that of the meltings or mixtures above referred to is that the latter contain a large quantity of silicium and sulphur—say from five to eight per cent. of silicium and two to three per cent. of sulphur—whereas in the nickelo-spiegel merely a trace of these impurities remains. The important difference in properties resulting from this difference in composition is found in the fact that the meltings heretofore made in which manganese was an ingredient could not be employed in making nickel-steel alloys, which is the chief utility of the nickelo-spiegel. The essential and novel characteristic of the process by which the nickelo-spiegel is produced resides in the employment of manganese ores or manganesiferous iron ores rich in manganese in such proportion as to obtain in the reduction and by one and the same operation the elimination of the silicium and sulphur. The latter impurity is not always found in nickel ores in such quantity as to prove seriously detrimental; but when such is the case an excess of manganese proportionate to the quantity of sulphur is introduced, resulting in elimination of sulphur by formation of sulphate of manganese.

The relative proportions of the nickel ores, iron ores, and manganese ores will vary according to the percentage of the three metals required in the carbureted alloy. The following may be given as an example: nickel ores, (ten per cent. nickel,) two tons; iron ores, (fifty per cent. iron,) twelve hundred weight;

manganesiferous iron ores, (ten per cent. manganese and forty per cent. iron,) one ton.

The alloy resulting from the above charge has the following composition: iron, seventy-two per cent.; nickel, twenty per cent.; manganese, five per cent.; carbon, two and five-tenths to three per cent.; silicium, sulphur, and phosphorus, five-tenths per cent. This is the typical alloy which I recommend for obtaining with facility alloys of nickel and steel for industrial use; but, as stated, it is possible to obtain by this process alloys richer or poorer in nickel. In such case the proportions of manganese will vary, as illustrated by the following table:

Nickel	5	10	15	25	35	50
Manganese	3	4	5	5	6.7	8
Iron	89.5	83.5	77	67	53.5	37
Carbon	2.3	2.3	2.3	3.4	4.5	4.5
Silicium, sulphur, and phosphorus	0.2 0.5	0.2 0.5	0.2 0.5	0.5	0.5	0.5

It will be observed by reference to this table that the quantity of manganese increases with the proportion of nickel, though not in the same ratio.

In the employment of nickelo-spiegel for the production of ferro-nickel or steel-nickel the nickelo-spiegel can be treated directly in a converter, so as to obtain a steel-nickel or ferro-nickel containing the required percentage of nickel. The presence of an excess of manganese in the nickelo-spiegel permits of obtaining the heat necessary for the good working of the operation in the absence of silicium; or the nickelo-spiegel can be treated directly in an open-hearth furnace, so as to produce a steel-nickel containing the required percentage of nickel. The refining is obtained by the addition of iron or steel scraps or iron ore; or the nickelo-spiegel can be treated in an open-hearth furnace, just as for making ordinary steel, by starting with a mixture of nickelo-spiegel and cast-iron and scrap; or the nickelo-spiegel is added to a bath or melt of ordinary steel, either in an open-hearth furnace or in a converter. The nickelo-spiegel will be added either melted or simply heated to redness, either in lumps or pulverized. The addition will preferably be made when the desired decarburation has been attained, so as to avoid a subsequent oxidation of the manganese.

In the two last-described methods of employing nickelo-spiegel for the production of ferro-nickel or steel-nickel any insufficiency of manganese can be corrected by additions of spiegeleisen or ferro-manganese or metallic manganese, and complete deoxidation can be effected by a final addition of aluminium or ferro-aluminium.

I claim as my invention—

1. The method of producing alloys of iron and steel with nickel, consisting in first producing the described nickelo-spiegel or carburized alloy containing nickel, iron, carbon, and manganese and free or practically free from sulphur and silicon by the reduction of a mixture of nickel ores, iron ores, and manganese ores in substantially the proportions indicated, and employing this nickelo-spiegel in the production of ferro-nickel or nickel-steel, substantially as and in the manner herein set forth.

2. The described carburized alloy or nickelo-spiegel, composed of iron, carbon, nickel, and manganese in substantially the proportions herein specified, said alloy being practically free from silicon and sulphur and suitable for use directly in the production of nickel-steel.

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

HENRY MARBEAU.

Witnesses:
JOSEPH COURNIER,
R. J. PRESTON.