UNITED STATES PATENT OFFICE.

NICOLAS LÉBÉDEFF, OF ST. PETERSBURG, RUSSIA.

PROCESS OF EXTRACTING IRON OR STEEL OR OTHER METALS FROM ORES.

SPECIFICATION forming part of Letters Patent No. 468,546, dated February 9, 1892.

Application filed February 3, 1891. Serial No. 380,045. (No specimens.)

To all whom it may concern:

Be it known that I, NICOLAS LÉBÉDEFF, of the city of St. Petersburg, Russia, have invented Improvements in Processes of Extracting Iron or Steel or other Metals from Ores or Metalliferous Materials, of which the following is a full, clear, and exact description.

My invention relates to the direct extraction or manufacture of iron or steel or other metals by treating ores or other metalliferous materials or substances with carbonic oxide in the manner hereinafter described.

The process consists, essentially, in first melting the ores or materials and afterward treating them with carbonic oxide produced under certain conditions, as hereinafter set forth, by the reaction of carbon upon carbonic acid obtained from limestone or dolomite.

In working this process in practice the ore or other substance containing metal—copper or nickel, for example—in the condition of oxygenized combination is subjected to a fusing or melting process with such proportions of limestone or dolomite (uncalcined) as are calculated to produce a certain reaction, as hereinafter explained. This reaction may be expressed by the following formula, in which R represents the metal to be extracted and whose oxide is contained in the materials under treatment:

$$2RO+nSiO_2+CaOCO_2+C=(2RO,CaO)nSiO_2+2CO=2R+CaOnSiO_2+2CO_2.$$

Directly after the ore commences to melt and generate carbonic acid from the limestone I place upon the surface of the ore a thin layer or covering of carbon, (coke, anthracite, charcoal, or the like.) The carbonic acid eliminated from the limestone or dolomite penetrates the melted mass in jets or streams, and then by the action of the carbon layer is converted into carbonic oxide. The melted ore in contact with this gas is reduced, the reaction which takes place being such as that expressed by the foregoing formula. In case the materials are poor in silica, quartz, clay, or the like may be added in order to convert into slag or liquefy the lime or magnesia.

The operation may be performed in an ordinary or regeneration reverberatory furnace having a hearth or sole preferably of basic materials. For metals easily fusible—such as copper—a simple furnace with flame may be employed. For metals requiring higher heat I prefer to use a Siemens furnace. Furnaces suitable for this operation being well known require no description.

It will of course be understood that suitable fluxes are used where they are required to effect the fusion of the ore.

In order to utilize the carbonic acid to the best advantage and prevent carburation of the metal, the materials employed are arranged in the furnace in the manner next hereinafter described. The limestone or dolomite is placed on the sole in the first place and a layer of ore is placed over it with a suitable flux, if necessary. When the ore commences to melt, a small or thin layer of coke, anthracite, or charcoal, preferably ground or pulverized, is placed on the top. The pure iron, not being fusible, may be drawn out of the furnace in the form of loops or balls, as from a puddling-furnace, or after running off the slag some ordinary pig-iron, or preferably spiegeleisen, may be added in order to convert the said iron into fusible steel containing the required percentage of carbon.

From the foregoing it will be understood that what distinguishes or characterizes my process is the melting of the ore before the carbonic oxide is caused to act thereon, the said oxide being obtained by the reaction of the carbon and of the limestone or dolomite, as hereinbefore described.

I do not broadly claim in connection with the extraction of metals the employment in a reverberatory furnace of mixtures of ore with limestone and carbon either in the form of a free or loose mass or in the form of blocks, this not being new in itself.

I claim—

The process for the direct manufacture of iron and steel, also applicable to other metals, consisting in melting the ore or metalliferous materials or placed upon a bed of limestone or dolomite (uncalcined) and adding or introducing carbon at the time when the mass commences to melt, all substantially as and for the purpose hereinbefore described.

The foregoing specification of my improvements in extracting iron or steel or other metals from ores or metalliferous materials signed by me this 22d day of January, 1891.

NICOLAS LÉBÉDEFF.

Witnesses:
ROBT. M. HOOPER,
ERNEST EISSIN.