UNITED STATES PATENT OFFICE.

JOHN GORDON, OF RIO JANEIRO, BRAZIL.

PROCESS OF DEPHOSPHORIZING STEEL OR OTHER METALS.

SPECIFICATION forming part of Letters Patent No. 609,341, dated August 16, 1898.

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To all whom it may concern:

Be it known that I, JOHN GORDON, a citizen of the United States, and a resident of Rio de Janeiro, Brazil, have invented a new and useful Improvement in Processes of Dephosphorizing Steel or other Metals, of which the following is a full, clear, and exact description.

My invention relates, chiefly, to the manufacture of iron and steel and to the removal of phosphorus from them; but the process may be used also for dephosphorizing other metals—for instance, copper.

I have observed that in rock-forming magmas, slags, &c., the phosphorus present seeks, by preference over other substances, the metals of the cerium group and their oxids, forming monazite, xenotime, and other similar phosphates. I have also found in the manufacture of steel by the basic or lime process that while most of the phosphorus present combines with the lime some still remains in the molten metal and that it is possible to remove a further amount, if not all, by using the metals of the cerium group or their oxids or the carbids, fluorids, cyanids, silicates, or other salts or alloys of such metals or mixtures of these compounds. These metals, oxids, and carbids possess a stronger affinity for phosphorus than lime or magnesia.

Of course theoretically I can employ only such compounds as will be decomposed at the temperature at which the process of fusion is carried out; but so far as I have been able to ascertain the high temperature developed in a Bessemer converter is sufficient to decompose all compounds of the above-indicated class.

My invention therefore consists in causing to react with the molten metal containing phosphorus either the metals of the cerium group or their oxids, carbids, or other compounds or the alloys thereof, or two or more of these substances, all as hereinafter described and claimed.

So far as I am aware the following metals belonging to the cerium group are now known: cerium, lanthanum, neo-didymium, praseodidymium, erbium, holmium, decipium, samarium, scandium, thorium, thulium, terbium, yttrium, and ytterbium. These are in fact the usual bases of the minerals monazite, xenotime, and allied phosphates. It is probable, however, that these minerals and perhaps others contain undiscovered elements similar in the strongly basic properties of their oxids with respect to phosphorus to those above enumerated and forming part of the same group.

In dephosphorizing iron or steel I cause to react with the molten metal the oxids of the elements above defined or these elements themselves in a metallic state or as carbids. This treatment is applicable and effective with the open-hearth process as well as with the Bessemer or basic process. I may also employ as dephosphorizing agents alloys or compounds of the metals of the cerium group or of their carbids with iron or with iron and manganese, (ferromanganese,) forming new metals or alloys. I find that these elements as oxids or in the metallic state or as carbids, &c., especially when previously alloyed with iron or ferromanganese, act as strong bases with respect to phosphorus, and by their use I effect a very intimate union with the phosphorus contained in the iron or steel and facilitate the combination, the result being the slagging off of the phosphorus as phosphids or phosphates.

It will be understood that the quantity of the dephosphorizing agent will depend on the amount of phosphorus contained in the metal to be dephosphorized and on the nature (chemical equivalent) of the said agent. The percentage of phosphorus is determined by ananalysis, say, of the pig-iron, and the quantity of oxid required is a mere matter of calculation in the manner well known to metallurgical chemists. Thus for cerium oxid the quantities, calculating by the chemical equivalents, will be in the proportion phosphorus, .54; cerium oxid, 2.83, so that roughly speaking the quantity of the oxid would be about five to six times the percentage of phosphorus determined by analysis in the pig iron of the charge.

As hereinbefore stated, the process is applicable to the dephosphorizing of any metal, the operation being substantially the same in all cases—namely, consisting in the production of a reaction between the above-defined dephosphorizing agents and the molten metal.

It will be understood that I employ as dephosphorizing agents the metals of the cerium group either in the metallic state or in the nature of compounds, such as oxids, fluorids, cyanids, carbids, silicates, or other salts or of alloys, or a plurality of such substances may be used conjointly. Theoretically I can employ only such compounds as are decomposed by the heat of the molten metal or of the furnace in which the fusion takes place. So far as I have been able to determine the practical conditions by experiments the high temperature in a Bessemer converter is sufficient to decompose all compounds of the above-indicated description. The claim hereunto appended is to be read and interpreted accordingly.

What I desire to secure by Letters Patent is—

The herein-described method of dephosphorizing metals, which consists in subjecting the metal in fusion to contact with, and the chemical action of, the metals of the cerium group which act as strong bases with respect to phosphorus, substantially as described.

JOHN GORDON.

Witnesses:
JOHN T. LEWIS,
R. CLEARY.