

UNITED STATES PATENT OFFICE.

ROBERT D. CAMPBELL, OF PITTSBURGH, PENNSYLVANIA.

METHOD OF DENITROGENIZING PRACTICALLY PURE IRON.

1,017,620.

Specification of Letters Patent.

Patented Feb. 13, 1912.

No Drawing.

Application filed May 24, 1911. Serial No. 629,191.

To all whom it may concern:

Be it known that I, ROBERT D. CAMPBELL, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented new and useful Improvements in Methods of Denitrogenizing Practically Pure Iron, of which the following is a specification.

This invention relates to an improved method of denitrogenizing practically pure iron.

In the manufacture of practically pure iron as carried out in the basic open hearth process and in the electric furnace, great pains are taken to effect the highest degree of purity practically attainable with reference to carbon, silicon, manganese, phosphorus, sulfur and oxygen. No account, however, is taken of the most noxious known impurity in the iron, namely, nitrogen. This element—either occluded, dissolved, combined, or otherwise held,—consequently remains in the otherwise practically pure iron to the great detriment of the latter, producing, as is well known, brittleness and unreliability, conditions all the more dangerous in that they may not be anticipated and are difficult to detect. Nitrogen in such product in amounts exceeding .007 per centum is highly deleterious, while even in this amount it is a well known cause of brittleness and failure in service. The danger arising from excessive nitrogen content is all the greater inasmuch as it is difficult to detect or forecast by any of the ordinary methods of analysis.

The object of the present invention is to so treat the metal in the course of manufacture as to eliminate a large percentage of the nitrogen ordinarily remaining in the iron as before mentioned.

In carrying out my improved process, I preferably charge a basic open hearth furnace with the metal to be treated, in any suitable or preferred form, and treat the same by the improved open hearth method. I do not desire to limit myself in this particular; however, as the metal may be treated in an electric furnace by the ordinary electro-metallurgical method, or in any other form of apparatus or by any other method. In addition to the foregoing treatment and as a step in my improved process I add to the molten metal, either in the furnace, in the converter, or in the ladle, before,

during or after tapping, a suitable amount or amounts of the metal titanium—either as such, or as any other alloy or substance containing titanium,—and thereby the nitrogen is practically completely removed from the metal; or at all events reduced to at least .004 per centum.

It is common practice and generally recommended by metallurgists that when titanium is added to a metal bath, the same should be added in a cold state. I have found, however, that when cold titanium is added to the bath the time required for the molten metal to heat the same is so great that the titanium floats to the top of the bath before it becomes fully effective. To overcome this condition I preheat the titanium before introducing the same into the molten metal. I have also found, however, by experiment, that when the titanium is overheated it becomes pasty and floats to the top of the molten metal in a mass and without accomplishing the effect desired. As the result of these experiments I have determined that it is not safe to preheat the titanium to a greater temperature than 500 degrees centigrade, and for the purposes of my process I keep within this maximum.

As far as I am aware, in the processes involving the use of titanium as heretofore carried out, the temperature of the molten metal has not exceeded 1575 degrees centigrade. In producing a metal low in carbon and with the high percentage of metallic iron as contemplated in my process, I have found that the titanium becomes most effective as a denitrogenizing and deoxidizing agent when the molten metal has been brought to a temperature of from 1575 to 1700 centigrade. When heated to these temperatures the metal remains liquid for a long period and thereby permits the free escape of practically all the resulting titanium oxide as well as of the gases which are concurrently liberated from the molten metal.

From the foregoing it will be noted that I produce a product that is structurally safe, highly ductile and malleable and which may be rolled into plates and sheets of excellent surface and without exhibiting hot-shortness at the medium red temperatures, or which may be drawn into wire with comparatively little anneal. The metal so produced is also so freed from gaseous and other impurities that it will solidify without blow holes or

spongy top, and with little or no piping, forming a sound ingot that may be rolled without showing any surface defect.

As my process is carried out the titanium, or titaniferous substance may be added in such quantity and in such manner that it passes off entirely with the slag, or else in such excess and manner as to provide for any desired percentage of titanium in the finished product.

By practically pure iron as used in this specification and in the claims, I desire to be understood as referring to an iron product containing not more than .10 percentum of the ordinary impurities such as carbon, manganese, silicon, sulfur and phosphorus in the aggregate, and not exceeding .04 percentum of oxygen and occluded slag.

I claim as my invention:—

1. The method of denitrogenizing iron consisting in introducing into the molten metal titanium preheated to a temperature not exceeding 500 degrees centigrade.

2. The method of denitrogenizing iron consisting in introducing into the molten metal titanium preheated to a temperature not exceeding 500 degrees centigrade, the molten metal being at a temperature of not less than 1575 degrees centigrade.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

ROBERT D. CAMPBELL.

Witnesses:

A. H. McNAMEE,
ANNA R. LEHAN.