Patented Apr. 3, 1928. 1,665,146

UNITED STATES PATENT OFFICE.

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PROCESS OF MAKING COMMERCIALLY-PURE IRON ALLOYS.

No Drawing. Application filed October 4, 1923. Serial No. 666,611.

Our invention relates to the production of alloys of commercially pure iron particularly ingot iron as produced in the open hearth furnace.

The Carnahan process of manufacture of ingot iron, that is to say, a highly purified product produced in a manner analogous to that of steel, taught that with a high powered furnace, and long sustained at high temperatures, it was possible with regularity to obtain a highly refined iron product in molten condition, provided certain outside limits were established for the analysis of the final product, and provided a de-gasification with aluminum or some other like acting metal was thoroughly made. De-gasification in the ladle was the preferred method employed by Carnahan, and in such alloys as he spoke of, the de-gasification was called for, to be completed after the alloying metal had been incorporated with the pure iron base.

In the production of a number of the alloys of iron, particularly chromium alloys, it is advantageous to have the final product very low in carbon to facilitate cold working and forming. This is also true of alloys with nickel, vanadium, cobalt, molybdenum, titanium and the like.

Referring more particularly to the production of an alloy on a base of commercially pure iron which has been produced economically in the open hearth furnace, the danger point in the operation lies in the tendency of irons so produced having an excessive oxygen and gas content generally due to the long continued heating and high temperatures.

In the production of chromium alloys and other alloys of pure iron in which the added metal is itself more readily "burned up" than iron, the loss from burning of the alloying metal is not only a financial loss but results in a non-uniform product being produced as it is difficult to predetermine the amount which will be consumed.

It may be generally stated as the object of our invention to provide a process whereby the production of alloys of pure iron may be carried on, particularly chromium alloys, with the result of producing a material regularly and uniformly rollable into sheets, strips, and other shapes, and soft enough for subsequent forming operation such as stamping, drawing and the like.

Such chromium alloys will have corrosion resistant properties which are commonly termed rustless or stainless, and our process is directed toward the production of stainless iron products in which the carbon content is extremely low.

One of the objects of our invention also, is to provide for the use of molten ingot iron, having very low impurity range, and produced in the open hearth furnace, in such a way that a portion of the production of such ingot iron may be diverted into alloy making, and the balance used in the production of the pure ingots. There is a great quantity of this open hearth ingot iron produced and used at the present time, and it is of essential commercial importance to provide a process in which a portion of the molten metal obtained by tapping from the open hearth furnace can be diverted into alloy making, without interfering with the use of the same heat of metal in the usual ingot iron production.

So far as we are advised, all very low carbon base iron alloys, particularly with chromium have been produced in what may be termed a single operation, utilizing the electric furnace, and while our process has points of value and novelty over such methods of production in the past, it is to our mind more important from the point of view of the possibility of using thereby a portion of the product of the open hearth furnace, thereby cutting down the cost of production, and eliminating the equipment cost used in the production, of alloys on a pure iron base.

We will describe in detail the process using chromium, or chromium silicon alloy, in the production of a very mild alloy material.

Molten commercially pure iron from an open hearth furnace or other furnace is poured into an electric furnace which should be preheated to high temperature. A reducing slag is made on the bath with lime and ferro silicon or aluminum, and the metal is thoroughly de-oxidized or "killed" in the furnace with ferro silicon, aluminum, or other de-oxidizer. A calcium carbide slag may be made if care is taken to prevent the carbon powder from getting into contact with the metal.

The process of the invention may be carried out all in one electric furnace by making commercially pure iron under an oxidiz-

ing slag until the desired purity is reached, then removing the oxidizing slag and making a reducing slag and killing the bath as above described.

A bath of molten iron having been obtained and thoroughly deoxidized or "killed," very low carbon chromium or ferro chromium is added in necessary amounts to give any desired chromium content up to 20% chromium. It is immaterial whether the chromium addition be made cold, preheated, or molten, except that the hotter is the addition the shorter will be the time for melting and thorough mixing. It is during this period that great care must be taken to prevent the absorption of carbon by the bath.

It should be noted of our process that it varies from Carnahan's ideas and teachings in that the alloy is made after the ingot iron has been de-oxidized or de-gasified, or "killed," and while the reducing slag is on the surface of the bath. This results in the safety of the remainder of the process and avoids the expensive treatments hitherto advanced in the production of low carbon alloys with materials which will so act as to re-carburize the bath as well as dissipate themselves. It also permits of using the ingot iron material of high purity range by tapping it direct from open hearth furnace.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent, is:—

The process for production of alloys of low carbon content which consists in forming a bath of molten iron having very low carbon and very low metalloid content under oxidizing conditions, said molten iron while purified and molten but without degasification being located in an electric furnace, degasifying the molten iron in the electric furnace, in such a way as to "kill" the iron, and without alloying the iron forming a reducing slag on the surface of the "killed" iron, and while maintaining the heat in the electric furnace adding a substantially carbon free alloying metal.

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