UNITED STATES PATENT OFFICE.

ARTHUR P. SCOTT, OF BRACKENRIDGE, PENNSYLVANIA.

METHOD OF PRODUCING PRACTICALLY PURE IRON.

1,017,473. Specification of Letters Patent. Patented Feb. 13, 1912.

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To all whom it may concern:

Be it known that I, ARTHUR P. SCOTT, a citizen of the United States, residing at Brackenridge, in the county of Allegheny and State of Pennsylvania, have invented new and useful Improvements in Methods of Producing Practically Pure Iron, of which the following is a specification.

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

It is well known that all iron heretofore produced, examined under the microscope is found to be impregnated to a greater or less extent with occluded slag particles and oxids.

One of the objects of the present invention is to provide iron which is practically free from these impurities.

Experience has shown that while so called corrosion-resisting iron has been prepared, which under accelerated corrosion tests seem to give results, such material when exposed to the unaccelerated corrosion of natural agents, has signally failed to resist the corrosive action of such agents.

One of the objects of my invention is to provide iron which because of its purity and homogeneity will resist the attack of natural corrosive agencies, such as sulfurous or briny air, sea water, mine water, swamp water, etc.

Iron from which the carbon and manganese have been almost wholly removed is very apt during the last stages of the refining process, and while tapping, to take up nitrogen from the furnace gases or from the air, and become thereby unreliable from the well known effects of this element.

In carrying out my improved process the metal is so treated that at no stage of the process has it had an opportunity to take up nitrogen.

A bath of iron low in carbon and manganese, in contact with a basic slag, becomes superoxidized, and superoxidized iron can never be fully reduced or reclaimed.

By my process I remove practically all the carbon and manganese without oxidizing the iron, and the product thereby obtained contains at least 99.5 per centum of iron; does not contain over .904 per centum of nitrogen; and does not contain over .02 per centum of oxids and occluded slag. Ingots cast from this product are practically free from blow holes and have little or no piping.

In carrying out my improved process I melt down and refine in an open hearth furnace, or in an electric furnace, or in any combination of the two, a charge of pig iron with iron or steel scrap, and any or all of the fluxes and reagents commonly employed. The impurities usually encountered such as carbon, manganese, phosphorus, silicon, and sulfur are oxidized and eliminated in the usual way until the carbon reaches .20 per centum, or such point as in each individual case may represent the stage just before that at which the iron of the bath commences to suffer oxidation. It will be understood that previous to this stage of the process the metal of the bath has already been subjected to strongly oxidizing conditions for possibly eight hours or more without suffering any appreciable oxidation of the iron. In fact the oxidation of the bath is selective, manganese, silicon, phosphorus and carbon are being removed, some of them more rapidly than others, while the iron remains untouched. This is because the impurities act as a protection for the iron and prevent its oxidation so long as their aggregate amount suffices. When, however, the carbon has reached .20 per centum, the aggregate impurities are no longer present in sufficient amounts to insure the iron against oxidation. I, therefore, at this point increase this protective aggregate by adding titanium in such amounts and at such times that, being itself readily oxidized, it completely disappears from the bath shortly after the carbon has been reduced to the desired extent, meanwhile serving as the required protection against oxidation of the iron. The injection of titanium continues until the carbon has been reduced to not exceed from .10 per centum to .15 per centum, by the oxidizing slag in the usual way. I prefer to use ferro-titanium in connection with the foregoing step, but do not desire to limit myself thereto as any other alloy or substance containing titanium may be employed. At this state sticks of wood are preferably forced below the surface of the metal bath, whereby violent agitation and ebullition of the bath ensues, causing the supernatant slag to intimately mix with the metal, whereby the smaller occluded particles of slag combine with the larger bodies of slag, and practically all of the slag rises to the top.

If desired, the wood treatment may be

started simultaneously with the addition of the titanium.

The early introduction of titanium serves to eliminate any nitrogen which may be present in the bath and the metal is prevented from taking up nitrogen from the furnace gases or from the air, by the further addition of small quantities of titanium in the ladle.

The product thus obtained is highly malleable and ductile; may be worked at a low heat; and by reason of the fineness of its surface is particularly receptive to metal coatings of any kind.

I claim as my invention:—

1. The process of producing iron of high purity comprising the subjecting of a bath of crude iron to oxidizing conditions until the carbon has been reduced to approximately .20 percentum and without substantially oxidizing the iron, then adding an oxidizable agent, and finally continuing the oxidation and removal of the carbon without oxidizing the iron until the carbon has been reduced to not over .15 per centum.

2. The process of producing iron of high purity comprising the melting down of iron in combination with the usual fluxes and reagents to remove impurities and until oxidation of the iron commences, then introducing titanium into the said bath, and finally continuing the oxidation and removal of the impurities.

3. The process of producing iron of high purity comprising the melting down of iron in combination with the usual fluxes or reagents to partially remove carbon and other impurities and until oxidation of the iron commences, then introducing an oxidizable agent to protect the metal in the bath, and finally continuing the oxidation and removal of the carbon until its content has been reduced to not exceed .15 percentum.

4. The process of producing iron of high purity comprising melting down iron in combination with the usual fluxes or reagents and removing the impurities therein, then introducing titanium into the bath and introducing sticks of wood.

5. The process of producing iron of high purity comprising melting down iron in combination with the usual fluxes or reagents and removing the impurities therein, then introducing titanium into the bath and introducing sticks of wood, and finally adding titanium to said metal bath while in the ladle.

6. The process of producing iron of high purity comprising melting down iron in combination with the usual fluxes or reagents and removing the impurities therein, then adding titanium to the bath and introducing sticks of wood, and then introducing a denitrogenizing agent.

7. The process of producing iron of high purity consisting of melting down iron in combination with the usual fluxes or reagents and removing the impurities therein, then adding titanium to the bath at intervals and below the slag, and introducing sticks of wood, and then again introducing titanium.

8. The process of producing iron of high purity consisting of melting down iron in combination with the usual fluxes or reagents and removing the impurities therein, then adding titanium to the bath at intervals and introducing sticks of wood, and then again introducing titanium.

9. The process of producing iron of high purity comprising melting down iron and removing the impurities therein without oxidizing the iron and then injecting a denitrogenizing agent into the bath below the slag.

10. The process of producing iron of high purity comprising melting down iron and removing the impurities therein without oxidizing the iron and then injecting titanium into the bath at intervals.

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

ARTHUR P. SCOTT.

Witnesses:
ROBERT LOCK,
A. C. TUCKER.