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METHOD OF PRODUCING ALUMINUM
TREATED ARTICLES OF IRON

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This invention relates to the production of aluminum treated articles of iron and steel.

Various ways of treating iron and steel to clad the same with aluminum have heretofore been proposed. Efforts have been made to cast aluminum in contact with iron to weld one of these metals to the other so as to provide a laminated structure. It has also been proposed to spray iron or steel with molten aluminum, and then to coat the sprayed surface with a silicate, such as sodium silicate, to exclude air from the sprayed aluminum while the aluminum is diffusing into the iron, the use of the silicate coating being necessary during this period of diffusion as otherwise the penetration of air into the extremely porous aluminum coating produced by spraying would result in oxidizing the aluminum to a greater or less extent so that the desired bond would not be effected. These procedures for cladding or treating iron or steel with aluminum have been found to be more or less complicated and expensive to carry into effect, and have involved limitations which have rendered them unsatisfactory for many purposes.

It is an object of the present invention to provide an improved process for treating iron or steel with aluminum or aluminum alloy so as to obtain the advantages incident to the use of aluminum coatings on iron or steel while overcoming the disadvantages and difficulties heretofore encountered.

Another object of this invention is to provide a method of treating iron or steel with aluminum or aluminum alloy which eliminates the high temperatures required in casting or welding one metal to the other.

Another object of this invention is to provide a method of treating iron or steel with aluminum or aluminum alloy which eliminates need for coating the aluminum to exclude air therefrom during the period of dispersion of aluminum into the iron or steel.

Another object of this invention is to provide a method of treating iron or steel with aluminum or aluminum alloy whereby the advantages of aluminum clad or treated iron or steel can be obtained by procedures which are simple and inexpensive to carry out, which requires no expensive equipment, and which is available for treating a wide variety of objects.

Another object of this invention is to provide a novel aluminum treated iron or steel which is possessed of distinctive advantages in its resistance to high temperatures, in its capacity for

use when immersed in a bath of molten aluminum, etc.

Other objects will appear as the description of the invention proceeds.

The invention can be applied to a wide variety of iron or steel objects where the advantages of an aluminum treated surface are desirable, as for example, where resistance to relatively high temperatures is desired, as in the case of grate bars, etc., but the invention has also been found to be possessed of particular utility when employed in the treating of iron or steel objects, such as rollers designed for use within a bath of molten aluminum, as for example a roller for guiding through an aluminum bath a strip or wire that is to be coated with aluminum and which roller must be capable of functioning for an indefinite period of time while immersed in molten aluminum without being materially affected thereby; when steel and cast iron and highly alloyed steel rollers are used without being treated as set forth, they show rapid alloying and subsequent solution by the molten aluminum bath, this being particularly so when the rollers are used as guides for a material traveling through the bath, as wire or strip.

The invention will be described more particularly with respect to its use in treating an iron or steel casting, but it is to be expressly understood that the invention is not restricted there-
ever it is desired to obtain aluminum treated iron or steel of the character herein referred to.

In accordance with the present invention the cast iron or steel object to be treated is first thoroughly cleaned, as by sand blasting or scratch brushing, so as to remove all foreign material, scale, oxide, etc., from the surface of the casting. The thoroughly cleaned casting is then plunged into a bath of molten aluminum or aluminum alloy after skimming the surface thereof so as to minimize contact of the casting with oxidized aluminum at the free surface of the bath. The casting is retained in the bath long enough to become completely coated, the time of immersion being dependent upon the temperature of the molten aluminum. For example, we have used an aluminum bath at 800° C. with an immersion time of 1-2 minutes in coating cast iron rollers. When the article has thus become completely coated, it is removed from the bath and any aluminum that is not adherent as a coating is removed from the surface, and then the coated article is subjected to intense heating in the open air at a temperature above the melting

point of aluminum, until no liquid metal can be observed on the surface of the iron. During this period of intense heating in the air, diffusion of the aluminum into the iron is occurring at the interface between the coating and the core, the continuous coating obtained by immersion being sufficient to substantially prevent air from penetrating the aluminum so as to interfere with the dispersion and forming of an intimate bond between the two metals, while at the same time the free surface of the aluminum under the intense heating in the open air is rapidly oxidized so as to provide a hard, tough, resistant skin on the article. When no molten aluminum can be observed the aluminum of the coating has therefore become dispersed into the iron except at its surface where it has been converted largely if not entirely into resistant aluminum oxide.

The invention may be carried out by use of suitable aluminum alloys as well as by use of relatively pure aluminum. Thus aluminum iron alloys have been successfully employed, thereby enabling use of scrap or alloys which may be too brittle for commercial use because of iron content. Hence, wherever the term aluminum is used in the claims herein it is to be expressly understood that the term is used as generic to and intended to embrace suitable alloys of aluminum, as iron aluminum alloys, as well as relatively pure aluminum.

Experience has demonstrated that a cast iron roller so produced can thereafter be used indefinitely in a bath of molten aluminum without apparent attack by the aluminum. Similarly, a casting so treated can withstand relatively high temperatures for relatively long periods of time without apparent alteration.

It will therefore be perceived that by the present invention a method of producing aluminum treated iron or steel has been provided which eliminates the high temperatures heretofore required when one metal has been cast into contact with the other or one metal has been welded to the other, and whereby the complexities and expense incident to the use of inert atmospheres or coatings to exclude the air have been eliminated. The procedure can be carried out simply and expeditiously with ordinary apparatus for cleaning castings, an ordinary aluminum bath and an ordinary kiln or oven for heating the casting in the presence of air. Therefore, expensive equipment has been eliminated and all of the operations can be performed by relatively unskilled labor. The resulting product possesses the advantages of aluminum treated iron or steel as heretofore produced and additionally is possessed of additional advantages owing to its uninterrupted surface skin of aluminum oxide with the aluminum therebeneath well diffused and bonded to the iron or steel.

While the details of the preferred procedure have been described specifically, it is to be understood that the invention is not limited thereto as changes may be made therein, as will now be ap-

parent to those skilled in the art. Reference is therefore to be had to the appended claims for a definition of the invention.

What is claimed is:

1. The method of treating ferrous article with aluminum which includes the steps of thoroughly cleaning the surface of the article, immersing the cleaned article in a bath of molten aluminum, and then heating the coated article in the open air to a temperature above the melting point of aluminum until no molten aluminum can be observed on the surface of the article.

2. The method of treating ferrous articles with aluminum, which includes the steps of thoroughly cleaning the surface of the article, removing the oxide film from the surface of a bath of molten aluminum, immersing the cleaned articles in said molten aluminum, and then heating said article in the open air to a temperature above the melting point of aluminum until no molten aluminum can be observed on the surface of the article.

3. The method of treating ferrous articles with aluminum which includes the steps of thoroughly cleaning the surface of the article, immersing the cleaned article in a bath of molten aluminum for a period on the order of two minutes, and then heating the article in the open air to a temperature above the melting point of aluminum until no molten aluminum can be observed on the surface of the article.

4. The method of treating ferrous articles with aluminum which includes the steps of thoroughly cleaning the surface of the article, immersing the cleaned article in a bath of molten aluminum, removing any excess aluminum adhering to the surface of the article, and then heating the article in the open air to a temperature above the melting point of aluminum until no molten aluminum can be observed on the surface of the article.

5. In the method of treating ferrous articles with aluminum, the steps of immersing the article in a bath of molten aluminum to form a complete coating of aluminum on the surface thereof, and then heating the coated article in the open air to a temperature above the melting point of aluminum until no molten aluminum can be observed on the surface thereof.

6. In the method of treating ferrous articles with aluminum, the steps of coating the article with aluminum, and then heating the article in the open air to a temperature above the melting point of aluminum until no molten aluminum can be observed on the surface of the article.

7. In the method of treating ferrous articles with aluminum, the steps of immersing the article in molten aluminum, and then forming a resistant aluminum oxide skin thereon by heating the coated article in the open air to a temperature above the melting point of aluminum until no molten aluminum can be observed on the article.

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