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METHOD OF ELIMINATING EMBRITTLEMENT AND CORROSION OF PICKLED METAL

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2 Claims. (Cl. 204—1)

This invention relates to a method of treating steel after mill scale has been removed therefrom by a pickling operation to eliminate subsequent corrosion of the pickled surface and embrittlement of the steel normally caused by the pickling operation.

More specifically this invention relates to the elimination of hydrogen absorbed by steel or other metals during a pickling operation.

The removal of mill scale from ferrous metals and the like, such as, for example, steel and wrought iron, is most rapidly and cheaply effected by dipping the metal in a pickling bath. Dilute acid solutions of various concentration are generally used. The bath is preferably heated so as to act more quickly on the mill scale. After a few minutes in the acid bath, the scale is removed and the metal is subsequently washed with water. In some instances lime water is used to neutralize the last traces of acid adhering to the metal.

While the picking method of removing mill scale is the simplest and cheapest of known methods, it must be carried out with great care or hydrogen which is adsorbed at the surface of the metal or absorbed into the metal during the pickling operation causes a rapid corrosion of the pickled surfaces and an embrittlement of the metal.

If the pickled metal is allowed to remain for several hours in a warm atmosphere the absorbed and adsorbed hydrogen is largely given up and the metal retains its original toughness. However, where the metal is to be plated, commercial operations require that the same be used immediately after pickling so that the pickled surfaces are not oxidized by the atmosphere. The plated surface on the metal, of course, retards the liberation of hydrogen from the metal and the metal becomes brittle. In some cases, it has been found that although the metal may be ductile and tough immediately after the plating operation, it is converted into a brittle state upon aging.

These disadvantageous features of pickling to remove scale have necessitated the use of more expensive and less efficient methods of removing mill scale from the metal when the metal is to be subsequently electroplated.

I have now discovered a method of eliminating the hydrogen absorbed by the metal during the pickling operation and thereby preventing corrosion of the pickled surfaces and embrittlement of the metal. According to this invention the pickled metal is dipped in an oxidizing bath and connected as an anode in an electrical circuit. I have found that dipping the pickled metal into a weak nitric acid solution, such as about a 10% solution by weight, and connecting the metal as an anode in a circuit supplying about 65 amperes per sq. ft. of metal surface for about two seconds sufficiently removes all of the hydrogen from the metal so that the metal will not become brittle. It is obvious, of course, that the acid dip may be shortened or lengthened in time to meet various conditions. The time of immersion in the bath has been varied from 1 to 15 seconds and the concentration of the nitric acid has been varied from 5% to 15% by weight without seriously affecting the quality of the work.

It is therefore an object of this invention to provide a process for eliminating the embrittlement of metals normally occurring after a pickling operation for the removal of mill scale.

Another object of this invention is to eliminate hydrogen from pickled metals.

A further object of this invention is to provide a process for removing hydrogen absorbed or adsorbed by metals during an acid pickling operation to prevent embrittlement of the metal.

A specific object of this invention is to provide a process that comprises dipping pickled metals in an oxidizing bath and connecting the pickled metal as an anode in an electrical circuit to remove hydrogen from the metal.

Other and further objects of this invention will be apparent from this specification and appended claims.

The following examples illustrate preferred embodiments of the invention. It should be understood that the proportions indicated are capable of being widely varied without departing from the scope of the invention. Percentages indicated therein are percent by weight.

Example 1

Steel from the rolling mill is dipped in a bath containing 10% of hydrochloric acid until the mill scale is completely removed from the metal. The pickled metal is then dipped for two seconds in a 10% nitric acid bath. During the immersion in the nitric acid bath, the metal is connected as an anode in an electric circuit supplying about 65 amperes per sq. ft. of metal surface.

The nitric acid treatment sufficiently removes hydrogen absorbed or adsorbed by the metal during the pickling operation so that the metal retains its original ductility and toughness.

Example 2

Steel coated with a substantial layer of mill scale is dipped in a heated bath of 2% sulphuric

acid until all of the mill scale is removed from the metal. The pickled metal is then dipped in a nitric acid bath of about 5% nitric acid. The metal is connected as an anode in an electrical circuit supplying about 65 amperes per sq. ft. of metal surface. The current is applied for about 15 seconds. At the end of this time the metal is sufficiently freed from hydrogen absorbed or adsorbed during the pickling operation. The so treated metal may be further washed and immediately electroplated.

Example 3

Metal from the mills containing coatings of mill scale thereon is dipped in a heated sulphuric acid bath containing about 15% of sulphuric acid. The metal is allowed to remain in the bath until all the mill scale is removed therefrom. Generally about 1 to 2 minutes immersion is sufficient.

The pickled metal is next placed in a bath containing about 7% of nitric acid. The metal is connected as an anode in an electrical circuit capable of supplying about 65 amperes per square foot of metal surface. The current is applied for about one second. During this short time sufficient hydrogen is eliminated from the pickled metal so that the resulting metal retains its original toughness and ductility and may be immediately inserted in a plating bath for the deposition of nickel, chromium and other metal coatings thereon.

It has been found that some plated metals prepared from a base metal which has been subjected to a pickling operation are ductile immediately after the plating operation but become brittle after aging. Other metals become brittle immediately after the plating operation and in some instances have been known to revert to the ductile state after aging. In other instances the brittleness is retained in the metal. The final outcome is not capable of prediction and therefore results in rejection of many plated articles by the consumer. The present method of definitely eliminating the embrittlement effect of pickling operation makes possible the production of uniform plated articles having the same ductility and toughness as the original metal.

It should be understood that oxidizing baths other than nitric acid baths may be used in the process. For example a bath containing a dissolved oxidizing agent therein such as sodium dichromate, a perborate or a chlorate or some other per-salt such as a persulphate, a permanganate and the like may be used. The bath merely acts as an oxidizing agent and any oxidizing solution which is not unduly corrosive toward the metal may be used. However, the use of nitric acid is preferred not only because of its cheapness and availability but also because its use leads to very adherent coatings where the treated metal is subsequently plated.

The current density may be widely varied without departing from the scope of the invention. Likewise, the time of the treatment in the oxidizing bath may be varied within wide limits.

I am aware that numerous details of the process may be varied through a wide range without departing from the principles of this invention, and I, therefore, do not purpose limiting the patent granted hereon otherwise than necessitated by the prior art.

I claim as my invention:

1. In a method of cleaning metal, removing the surface impurities from the metal by immersing the metal in an acid pickling bath, thereafter immersing the metal in an electrolyte bath having a concentration of five to fifteen percent by weight of nitric acid, connecting the metal so immersed as an anode in an electric circuit using a current density in the neighborhood of 65 amperes per square foot of metal surface, and maintaining the metal so immersed for one to fifteen seconds whereby to remove the hydrogen resulting from the pickling operation and prevent the embrittlement of the metal caused thereby.

2. In a method of electroplating metal, removing the surface impurities from the metal by immersing the metal in an acid pickling bath, thereafter immersing the metal in an electrolyte bath having a concentration of five to fifteen percent by weight of nitric acid, connecting the metal so immersed as an anode in an electric circuit using a current density in the neighborhood of 65 amperes per square foot of metal surface, maintaining the metal so immersed for one to fifteen seconds whereby to remove the hydrogen resulting from the pickling operation and prevent the embrittlement of the metal caused thereby, and electroplating the thus treated metal substantially immediately after such deembrittlement treatment.

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