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METHOD OF COATING STEEL WITH NICKEL-BORON

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4 Claims. (Cl. 117—65)

This invention relates generally to methods of coating metals with nickel-boron and similar alloys.

The excellent flowing properties and wear resistance of nickel-boron, cobalt-boron and nickel-cobalt-boron alloys have made these alloys particularly desirable as coatings for steel. However, the application of such alloys to steel, as coatings, has always presented a difficult problem.

It has long been known that borohydrides precipitate nickel boride (Ni_2B) or cobalt boride (Co_2B) from aqueous solutions of salts of these metals. Such precipitates are well adapted for the formation of alloy coatings of the character described, but have not heretofore been used successfully for this purpose, because they do not adhere readily to steel.

We have discovered, however, that if the reactants (i. e., sodium borohydride and nickel or cobalt chloride or mixtures thereof) are first dissolved in absolute ethanol, the character of the precipitate is such that it adheres readily to steel surfaces, so that it becomes possible, in this way, to deposit nickel and cobalt borides and mixtures thereof on steel, and sinter them by heating to redness in hydrogen or other reducing atmospheres, thereby producing a bonded coating of a nickel-boron, cobalt-boron, or nickel-cobalt-boron on steel.

Instead of absolute ethanol, we have found that other solvents are also useful for this purpose, such, for example, as methanol, isopropyl alcohol, isopropylamine, ethylenediamine, and pyridine. The ethanol and ethylenediamine solutions were found to be particularly stable in this connection.

In alloys of the character described, the boron content is about 3%. The boron content of Ni_2B is about 8 to 9%. In order to lower the boron content, we found that a mixture of nickel boride and nickel hydroxide could be employed, which, when heated in a reducing atmosphere

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gave a nickel-boron alloy of any desired composition. The gelatinous nature of nickel hydroxide aided in the adherence of the coating to the steel parts. The nickel boride-nickel hydroxide mixture may be prepared by addition of sodium borohydride-sodium hydroxide mixtures to nickel chloride, the solvent being either water, ethanol, other alcohols, amines or mixture thereof.

The foregoing remarks apply also to mixtures of cobalt boride and cobalt hydroxide.

Other thickening agents have also been found useful to yield thicker layers of nickel boride (or the corresponding cobalt compound) on the steel. Among these are commercial products such as carbomethoxy-cellulose, carbomethoxy-starch, lignin sulfonates, agar and related bodies.

It will be understood that various changes may be made in the methods described, and in the materials used, without departing from the spirit of the invention or scope of the appended claims.

Having thus described our invention, we claim:

1. The method of coating steel with alloys containing nickel and boron, said method comprising reacting a borohydride with a nickel salt in a solution selected from the group consisting of absolute ethanol, methanol, isopropyl alcohol, isopropylamine, ethylenediamine, and pyridine, to form a precipitate of nickel boride, coating the steel with said precipitate, and then heating the coated steel in a reducing atmosphere to form an alloy containing nickel and boron on the steel.

2. The method, as recited in claim 1, in which a hydroxide is incorporated in the reaction mixture to render the solution more gelatinous in nature.

3. The method of coating steel with alloys containing nickel and boron, said method comprising reacting sodium borohydride with nickel chloride in a solution of ethanol, to thereby form a precipitate of nickel boride having excellent adherence properties, coating the steel with said precipitate, and heating the coated steel to form an alloy containing nickel and boron on the steel.

4. The method of coating steel with alloys containing nickel and boron, said method comprising reacting a mixture of sodium borohydride and sodium hydroxide with nickel chloride in a solution selected from the group consisting of water, ethanol, other alcohols, amines, and mixtures thereof, to thereby form a mixture containing nickel boride and nickel hydroxide, coating the steel with said last-named mixture, and heating the coated steel to form an alloy containing nickel and boron on the steel.

No references cited.