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DISSOLVING OF NICKEL-PHOSPHOROUS ALLOYS

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4 Claims. (Cl. 75—97)

This invention relates to the process of stripping relatively thin metal coatings from a base metal structure and particularly to a process and composition for stripping nickel-phosphorous alloy or chemical nickel plating from the metal upon which it has been deposited.

Nickel-phosphorous alloy plating or chemical nickel plating is a process well known in the art for depositing upon ferrous, cuprous, aluminum and certain other metals and alloys a coating of an alloy having a composition of from 85 to 99.9 percent nickel and from 0.1 to 15 percent phosphorus without the use of an electrical current. Prior to the advent of this process, nickel had been plated or deposited by electrolytic methods and the nickel thus deposited was substantially pure nickel. To strip the thus conventionally deposited nickel from the steel specimens or body upon which it had been plated, was accomplished by a reverse electrolytic process, using sulfuric acid and similar solutions, by the use of fuming nitric acid as described in U.S. Patent No. 2,200,486 or by the use of an alkaline solution such as suggested in U.S. Patent No. 2,649,361. The foregoing three methods for removing or stripping conventional electro-plated nickel however, have been found unsatisfactory for the stripping or removal of nickel-phosphorous alloy plating inasmuch as the deposit, as noted above, is of a substantially different composition. The use of the reverse electrolytic process results in pitting of the base material particularly in the deep recesses. The other two methods of stripping noted above were unsuccessful in stripping nickel-phosphorous alloy plating since the deposited alloy did not respond as electrolytically deposited nickel would respond and in the first case the solution did not attack the alloy and in the second the alloy was merely made porous.

This invention contemplates a composition which has proved effective in stripping nickel-phosphorous alloy coatings from ferrous and aluminum alloys and a process of using said composition for the successful stripping of said plating.

It is therefore an object of this invention to provide an improved nickel-phosphorous alloy stripping composition.

It is another object of this invention to provide an improved nickel-phosphorous alloy stripping composition which attacks nickel-phosphorous alloy plating but does not attack base metals upon which said plating may be deposited such as ferrous alloys and aluminum alloys.

It is another object of this invention to provide an improved method of stripping nickel-phosphorous alloy plating from the metal upon which it has been deposited.

It is another object of this invention to provide a method and composition for stripping nickel-phosphorous alloy plating from ferrous and aluminum alloys which does not attack or pit the base metal.

Other objects will become apparent from the following specifications:

The preferred composition of the stripper described in this invention is a mixture of acids consisting of fuming nitric acid (specific gravity 1.49–1.50) 41.5 mole percent and aqueous hydrofluoric acid solution 24.5 mole percent and water 34.0 mole percent. The stripping is accomplished by immersion of the nickel-phosphorous alloy plated specimen in the above mixture at ambient temperature. The time required to strip a given thickness of nickel-phosphorous alloy plating varies with the relative concentrations of the above acids and extremely wide deviations from the above basic formulation may be made without departing from the scope of this invention.

This invention contemplates formulations using nitric acid concentrations ranging from 72.0 mole percent to 9.0 mole percent and hydrofluoric acid concentrations ranging from 50.3 mole percent to 0.0 mole percent and water content ranging from 28.0 mole percent to 58.6 mole percent. Formulations composed of acids containing nitrate ions, aqueous acid solutions of fluoride ions or any salt containing the fluoride ion are also considered to be within the scope of this invention.

The following examples illustrate the effect of varying the relative concentrations of nitric acid and hydrofluoric acid in the above compositions:

Example 1

A mixture of 68.4 mole percent nitric acid, 2.9 mole percent hydrofluoric acid and 28.7 mole percent water was placed in a tank lined with polyethylene in clean and dry condition and a clean, dry nickel-phosphorous alloy plated steel specimen was immersed in the solution. After one and one half hours immersion, the specimen was removed, washed, dried and observed to have a light grey metallic appearance of exposed basis metal. A copper sulphate test showed positive results of complete stripping. Visual inspection under a 3 power glass showed no attack of the basis metal. The thickness of the specimen before immersion was 0.045 inch and after immersion was 0.042 inch, indicating that the stripper had removed 1.5 mils of nickel-phosphorous alloy per side.

Example 2

A steel specimen immersed in a solution of 64.5 mole percent nitric acid, 6.0 mole percent hydrofluoric acid and 29.5 mole percent water for a period of one hour was completely stripped of its 0.002 inch nickel-phosphorous alloy coating. Tests and inspection described above showed complete plating removal and no attack of the basis metal.

Example 3

The experiments of Examples 1 and 2 were repeated but with 59.0 mole percent nitric acid and 10.8 mole percent hydrofluoric acid and 30.2 mole percent water for a period of 30 minutes. The decrease in thickness was observed to be 1.5 mil per side and the specimen was tested and shown to be completely stripped with no visible attack of the basis metal.

Example 4

In this example the solution consisted of nitric acid 41.5 mole percent, hydrofluoric acid, 24.5 mole percent and water, 34.0 mole percent. In a time of 20–25 minutes a decrease in thickness of 1.6 mil per side was observed and the above tests revealed complete stripping without visible attack to the basis metal. This solution appeared to be near optimum.

In the foregoing it was observed that while solution No. 4 appeared to be optimum, a fairly wide variation in composition and proportions of constituents involved can be tolerated without seriously affecting the quantity of the stripping accomplished. It was observed that it is

highly important that the tanks be lined with inert materials such as polyethylene and that the parts to be stripped be extremely clean of grease, dirt and moisture. Because of the evolution of gas during the chemical stripping, work must be held in such a manner as to permit the gases to escape from any recesses.

Processing of large volumes of work through the stripping solution will cause an excessive increase in the temperature. For quality stripping, free of surface etching, the temperature must be controlled at a maximum of 150° Fahrenheit. No minimum temperature has been established as temperature reduction will decrease the stripping rate but in no other way detrimentally affects the stripping efficiency.

Although the invention has been described and illustrated in detail, the same is to be understood to be by way of illustration and example only, the spirit and scope of the invention being limited only by the terms of the appended claims.

We claim:

1. The method of stripping nickel-phosphorous alloy plating from a steel workpiece without attacking the base metal, including the step of: immersing the workpiece in a stripping bath containing from about 41.5 mole percent to about 68.4 mole percent fuming nitric acid, from about 2.9 mole percent to about 24.5 mole percent hydrofluoric acid, and the remainder water.

2. The method of stripping nickel-phosphorous alloy plating from a steel workpiece without attacking the base metal, including the step of: immersing the workpiece in a stripping bath containing about 41.5 mole percent fuming nitric acid, about 24.5 mole percent hydrofluoric acid, and the remainder water.

3. The method of stripping nickel-phosphorous alloy plating from a steel workpiece without attacking the base metal, including the step of: immersing the workpiece in a stripping bath maintained at a temperature no greater than about 150° Fahrenheit and containing from about 41.5 mole percent to about 68.4 mole percent fuming nitric acid, from about 2.9 mole percent to about 24.5 mole percent hydrofluoric acid, and the remainder water.

4. The method of stripping nickel-phosphorous alloy plating from a steel workpiece without attacking the base metal, including the step of: immersing the workpiece in a stripping bath maintained at a temperature no greater than about 150° Fahrenheit and containing about 41.5 mole percent fuming nitric acid, about 24.5 mole percent hydrofluoric acid, and the remainder water.

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CERTIFICATE OF CORRECTION

Patent No. 2,954,289 September 27, 19(

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It is hereby certified that error appears in the printed specificatio of the above numbered patent requiring correction and that the said Letter Patent should read as corrected below.

Column 2, line 71, for "quantity" read -- quality --.

Signed and sealed this 11th day of April 1961.

(SEAL)
Attest:
ERNEST W. SWIDER

Attesting Officer

ARTHUR W. CROCKER
Acting Commissioner of Patents