

UNITED STATES PATENT OFFICE

2,200,486

MATERIAL AND METHOD FOR REMOVING
COATINGS OF NICKEL OR THE LIKE
FROM A METAL BASEEarl F. Burdick, Chicago, Ill., assignor to West-
ern Electric Company, Incorporated, New York,
N. Y., a corporation of New YorkNo Drawing. Application May 10, 1939,
Serial No. 272,755

9 Claims. (Cl. 148-5)

This invention relates to materials and methods for removing coatings of nickel or the like from a metal base.

An object of this invention is the provision of an improved and inexpensive solvent that will rapidly remove a coating of nickel or similar material from a ferrous base without attacking the base, and methods for using the solvent efficiently.

Many metal products, especially articles made of iron, steel or other ferrous base materials, are provided with an ornamental or protective coating of nickel which is usually applied by electroplating. Often the weight of the nickel coating is critical and in most cases an unduly heavy coating is unnecessarily expensive. For these reasons it is nearly always important to apply a coating that lies within a specified weight range. To permit effective control of the electroplating process, and consequently of the coating weight, a rapid and accurate coating weight determination method is required. To make this determination, it is desirable to remove the coating completely and selectively so that the weight of the article before and after stripping will quickly disclose the coating weight.

Solvents have been used for stripping various coating and base metal combinations, but the chemical properties of nickel and iron are so similar that it is difficult to effect a separation of these two particular metals. As a result, the prior methods for stripping nickel from iron have been very slow, or it has been necessary to sacrifice accuracy to gain speed by using agents that tend to attack the ferrous base.

In one prior method, the nickel was removed by immersing the coated article in concentrated nitric acid. An accurate result is available with this method, but the action of the acid is very slow. It requires several hours to dissolve a standard 50 milligrams per square inch nickel coating in nitric acid, which correspondingly delays any adjustment of the plating procedure that is indicated by a coating discrepancy.

Because iron precedes nickel in the electromotive series, dilute acids are not very suitable for this purpose without the addition of some selective inhibitor for the iron. Nitric acid is one of the best acid solvents for nickel, but it is an oxidizing agent and most of the effective inhibitors are organic compounds which are not compatible with oxidizing agents. Alkaline solutions, such as ammonium hydroxide plus bromine or hydrogen peroxide, are unsatisfactory because their action is not sufficiently rapid.

Separation of these metals on the basis of differences in their physical properties is not very practical. The difference in the expansion coefficient of nickel and iron is not sufficiently great to cause the plate to crack off when the article is heated in air and heating in hydrogen or molten sodium cyanide or charcoal does not facilitate removal of the plate.

Experience with these various prior methods has emphasized the need for a procedure that will measure the nickel coating rapidly and accurately and thus provide an effective control of the plating process for regulating the weight of the coating as the coating is being applied. In accordance with one embodiment of this invention a coating of nickel having a weight around 50 milligrams per square inch is removed completely and accurately from a ferrous base in less than five minutes by immersing the plated article in concentrated nitric acid and a small quantity of chlorine.

The effective chlorine content of the solvent mixture is important and the proper quantity of chlorine is supplied by adding a compound or material that is a source of chlorine in concentrated nitric acid. Suitable addition agents are sodium chloride, potassium chloride or hydrochloric acid. If sodium chloride is used, .056 gram of the chloride is added for every 100 cubic centimeters of nitric acid having a specific gravity of 1.40-1.42 at 60° F. This particular concentration gives the best results but the proportion of sodium chloride can vary between .03 and .10 gram per 100 cubic centimeters of nitric acid to provide proportionately effective solutions.

If hydrochloric acid is employed, the best results are obtained with a mixture containing .08 part of concentrated hydrochloric acid (Sp. Gr. 1.18-1.19 at 60° F.) and 100 parts of concentrated nitric acid (Sp. Gr. 1.40-1.42 at 60° F.) by volume. By reducing this hydrochloric acid concentration to .04 part of hydrochloric per 100 parts of nitric acid, which affects the total solution volume very slightly, the process is substantially retarded but the reduced speed is still much greater than the speed available with nitric acid or other prior agents. An increase in the hydrochloric acid to .20 part of hydrochloric per 100 parts of nitric acid by volume accelerates the solvent action somewhat, but the upper limit of this increased concentration approaches a range where objectionable attack of the ferrous base occurs.

Other chlorine compounds that are soluble in the nitric acid and which do not contain an element that will inhibit or impair the solvent action

can be used. If some material other than hydrochloric acid or sodium chloride is used, a quantity that will supply an equivalent proportion of chlorine to the above described ratios is added to the nitric acid.

As soon as the coated part is immersed in the solution, violent gassing begins. The gas generation continues for a few minutes or until the nickel is completely dissolved and then ceases abruptly. The ferrous base is not appreciably attacked by the solvent and the solvent also protects a base containing an appreciable proportion of nickel, such as magnetic alloys of the "Permalloy" type. The solvent has been used for stripping nickel plate from Permalloy containing 45% nickel and the balance iron, and removed the nickel without attacking the base sufficiently to effect the accuracy of the coating weight determination.

With this method a nickel coating of around fifty milligrams per square inch of base surface, which is used quite generally, can be removed in three and one-half minutes. All of the coating is dissolved during this interval and the coating weight is determined by merely weighing the base before and after the stripping process. Because this determination is made very rapidly, as well as accurately, a close control of the electroplating procedure is possible to minimize the production of defective articles.

The solvent is also useful for stripping nickel coatings from ferrous base articles in cases where replating of defective or used articles is necessary. Replating of large quantities of parts is made economical by rapid removal of the old coating in a process which preserves the dimensions of the base and also avoids the necessity for grinding or machining the base before the new coating is applied.

The solvent is also used in connection with microscopic examinations of nickel coatings. A quick dip of the plated surface in the solvent produces a surface etch which reveals the crystal structure of the plate effectively.

It will be apparent that other uses and adaptations of the invention are feasible and it is to be understood that the invention is limited only by the scope of the appended claims.

What is claimed is:

1. A solvent for removing a coating of nickel from an iron bearing base comprising concentrated nitric acid, and a chlorine compound that is soluble in the nitric acid, the chlorine compound being added to the nitric acid in sufficient quantities to establish the same nitric acid - chlo-

rine ratio that is provided when from .03 to .10 gram of sodium chloride is dissolved in 100 cubic centimeters of concentrated nitric acid.

2. A solvent for removing a coating of nickel from a ferrous metal base comprising 100 cubic centimeters of concentrated nitric acid, and from .03 to .10 gram of sodium chloride dissolved in the nitric acid.

3. A solvent for removing a coating of nickel from a ferrous metal base comprising 100 cubic centimeters of nitric acid having a specific gravity of 1.40-1.42 at 60° F., and about .056 gram of sodium chloride dissolved in the nitric acid.

4. A solvent for removing a coating of nickel from a ferrous composition base comprising 100 parts by volume of concentrated nitric acid, and from .04 to .20 part by volume of concentrated hydrochloric acid.

5. A solvent for removing nickel from a ferrous metal base comprising 100 parts by volume of nitric acid having a specific gravity of 1.40-1.42 at 60° F., and .08 part by volume of hydrochloric acid having a specific gravity of 1.18-1.19 at 60° F.

6. A method of stripping a coating of nickel from an iron bearing base which comprises the step of immersing the coated base in a combination of concentrated nitric acid and a chlorine compound that is soluble in the nitric acid, the compound being added in quantities that will supply the same proportion of chlorine that is provided when from .04 to .20 part by volume of concentrated hydrochloric acid is added to 100 parts by volume of concentrated nitric acid.

7. A method of stripping a coating of nickel from a ferrous metal base which comprises the step of immersing the coated base in a mixture of 100 parts by volume of nitric acid having a specific gravity around 1.41 at 60° F., and .08 part by volume of hydrochloric acid having a specific gravity around 1.18 at 60° F.

8. A method of removing a coating of nickel from a ferrous metal base which comprises the step of immersing the coated base in a solvent solution of 100 cubic centimeters of concentrated nitric acid and about .056 gram of sodium chloride.

9. A method of removing a coating of nickel from a ferrous composition base which comprises the step of immersing the coated base in a solvent solution of nitric acid and sodium chloride in the proportion of .03 to .10 gram of sodium chloride to 100 cubic centimeters of concentrated nitric acid.

EARL F. BURDICK. 55

CERTIFICATE OF CORRECTION.

Patent No. 2,200,486.

May 14, 1940.

EARL F. BURDICK.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 21, claim 5, for "1.40-1.42" read --1.40-1.42--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 30th day of July, A. D. 1940.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.