Patented Aug. 25, 1942 2,294,334

UNITED STATES PATENT OFFICE

2,294,334

METHOD OF TREATING ALUMINUM

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No Drawing. Application April 10, 1940, Serial No. 328,877

6 Claims. (Cl. 148—6)

This invention relates to a method of surface treating aluminum and more particularly to such a method whereby a surface protective coating is imparted by chemical treatment.

Aluminum has come into very extended use in industry and the arts because of its many desirable properties, such as its relative inertness chemically in the presence of many ordinarily corrosive agents, its light weight, attractive appearance, and the like. Along with the foregoing advantageous qualities, aluminum possesses the disadvantages of a relatively soft and malleable nature and of being readily attacked by certain chemical reagents. As an example, in the use of aluminum as the shell material for blasting caps, it is impossible to use certain compositions of charges because of the chemical attack or corrosive effect of such charges on the cap walls.

One method that has been suggested for overcoming the above disadvantages has been to impart a coating of aluminum oxide to the metal by suitable treatment, as by an anodic oxidation process or by purely chemical methods. No chemical process of the prior art has been entirely satisfactory, however, both from economic and technical points of view.

The object of the present invention is a novel and improved method of imparting a corrosion-resistant surface coating to aluminum objects. A further object is a process which is economically attractive and which utilizes relatively inexpensive chemical agents, but which gives a surface coating characterized by excellent corrosion resistance, improved appearance, and enhanced resistance to abrasion. Additional objects will be disclosed as the method is described more in detail hereinafter.

I have found that the foregoing objects are accomplished, according to the process of my invention, by treating the aluminum surface with a hot solution of an alkali metal carbonate and a soluble chromate, and subsequently subjecting the above treated surface to the action of steam at pressures above atmospheric. The resulting aluminum product is characterized by an insoluble chromium-containing surface coating, and displays a high degree of corrosion resistance.

While I do not wish to be limited to any one alkali carbonate, I find sodium carbonate very suitable for the purpose because of its properties and availability. Various soluble chromates may likewise be used, such as sodium chromate or dichromate, potassium dichromate, and others, and these are all effective agents. Sodium dichromate, however, is my preferred material for use. The treatment with high pressure steam, following the chemical treatment, is essential to give the requisite hardness and resistance to corrosive materials.

The procedure followed in carrying out my method of treatment is illustrated by the following specific examples.

Example 1

A treating solution was prepared consisting of 36 grams of technical soda ash and 6 grams of $Na_2Cr_2O_7—2H_2O$ in 1½ liters of water. Two hundred and fifty aluminum blasting cap shells were immersed in the above solution, which was maintained at the boiling point, with agitation, for ½ hour. The reaction was vigorous at first, but gradually slackened. The shells were removed from the bath, drained, and rinsed thoroughly with water. They were now dark gray in color and were placed in an autoclave where they were held for one hour in an atmosphere of steam at approximately 95 pounds pressure. The shells were now of a silvery gray color and were removed from the autoclave and dried.

Shells, which had been subjected to the above treatment, were loaded with a pressed charge of a 50—40—10 mixture of lead sulfocyanate, potassium chlorate, and sulfur, which is a commercially employed ignition mixture for blasting caps. The loaded cap shells were placed in storage at a temperature of 38° C. and at 100% relative humidity. Even under these severe conditions, the loaded shells were unattacked after ten months, whereas untreated aluminum shells, and shells which had been treated chemically but not with high pressure steam under similar storage conditions, were severely corroded after only 24 hours' and 5 days' storage, respectively.

Example 2

Sheets of metallic aluminum, in the form of 2-inch squares, were immersed in the treating bath of Example 1, and were then exposed to high pressure steam as described. The coated sheets thus obtained were subjected to an abrasion test in which the test piece was fastened to a wooden disc adapted to rotate in a horizontal plane in the manner of a phonograph record at a uniform speed of 15 R. P. M. A steel pin, rounded at the end, was carried on a hinged arm so that the pin was inclined about 15° from the vertical. A definite pressure was maintained on this pin. An electric circuit was then set up,

including the treated test piece and the steel pin, and closed except for the non-conducting oxide film on the aluminum. The testing procedure consisted in causing the rotation of the test piece on the disc and in lowering the guided steel pin so that it followed a single circular path on the test piece. As soon as the oxide coating was broken, the electric circuit was closed and a light flashed. The resistance to abrasion was judged by the number of rotations over the circular path required to break the coating. Tests of a large number of aluminum pieces treated in accordance with my process indicated that 20 rotations were required to break the coating, as against a much smaller number for pieces to which the final steam treatment had not been given.

In the foregoing Example 1, the process of my invention was applied to the treatment of cap shells of aluminum, where there was particular need of a resistant surface because of the corrosive material which was to be in contact with the treated aluminum. While blasting cap shells constitute an important application for my improved process, it should be understood that the method can be advantageously used for all aluminum surfaces which are to be exposed to corrosive atmospheres or reagents.

In carrying out my process, it should be understood that a certain amount of protection is given by the treatment of the aluminum with the alkaline chromate solution. The coating obtained, however, is not sufficiently resistant to the attacks of solutions and reagents to be satisfactory. The subsequent steam treatment is essential and the steam apparently sets the coating and renders it inert to attacks by corrosive agents.

In utilizing my method of treatment, varying amounts of reagents may be used, but relatively dilute solutions are in all cases desirable. I find, for example, that when sodium carbonate and sodium dichromate are employed, a satisfactory concentration is around 24 grams of Na_2CO_3—H_2O and 4 grams of $Na_2Cr_2O_7$—$2H_2O$. Whatever the amounts, a ratio of around 6 to 1 in the weights of these two materials dissolved is considered suitable. In my preferred method, I maintain the treating solution at its boiling point, but it will be understood that some deviation from this temperature is permissible, the requirement being that a hot solution be used. The time of treatment should probably be between 10 and 50 minutes, but I find a 30-minute time satisfactory when a boiling solution is employed. The treating bath may be used more than once, if desired, depending on the relative amounts of solution and material for treatment.

It is known that surface coatings on aluminum are not new to the art. One well known method has comprised an "anodic oxidation", whereby a hard, corrosion- and abrasion-resistant oxide coating was imparted to the surface of the aluminum. Such a method produces a coating of considerable merit, but the method is not readily carried out under all circumstances and is also somewhat costly. Purely chemical methods have likewise been proposed, but no known method has been entirely satisfactory in the product obtained.

The method of the present invention gives a surface to the aluminum characterized by hardness and a resistance to corrosion not obtained by use of any of the chemical treatment methods heretofore proposed. In the foregoing, I have described my method in detail. It will be understood, however, that many changes may be made in compositions of solution, conditions, and details of treatment without departure from the spirit of the invention.

I wish to be limited therefore only by the following claims:

1. The method of surface-coating aluminum, which comprises treating the metal surface with a hot solution of an alkali carbonate and a soluble chromate, and subsequently exposing the treated surface to the action of steam at superatmospheric pressure.

2. The method of claim 1, in which the alkali carbonate is sodium carbonate.

3. The method of claim 1, in which the soluble chromate is sodium dichromate.

4. The method of coating aluminum, which comprises subjecting the metal surface to the action of a solution of an alkali carbonate and a soluble chromate at substantially the boiling temperature, washing said surface substantially free from the treating solution, and exposing said surface to the action of high pressure steam.

5. The method of coating aluminum, which comprises subjecting the metal surface to the action of a solution of sodium carbonate and a sodium chromate at substantially the boiling temperature, washing the metal surface substantially free from the treating solution, and exposing said surface to the action of steam at a pressure of 50 to 150 lbs.

6. The method of imparting a corrosion-resistant coating to the surface of aluminum blasting cap shells, which comprises subjecting said shells to the process of claim 4.

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