This invention relates to the treatment of aluminum and aluminum alloy surfaces to produce thereon a colored coating. The term “aluminum”, as used herein and in the appended claims, includes that metal in every degree of purity and all alloys thereof containing sufficient aluminum to permit the formation of a suitable oxide coating on the surface of the article, as explained hereinafter, that is to say, alloys in which the 10 aluminum content is 50 per cent, approximately, or more.

The many and varied uses of aluminum in both the practical and decorative arts have made very 15 desirable the development of suitable process by which aluminum surfaces may be colored, and the provision of such a process is one of the objects of my invention. A further object is to provide a process which is simple in operation and which may be practiced on a large scale with reasonable cost and a minimum of difficulty.

In the course of an extensive investigation directed toward the development of suitable process and methods for the coloring of the surfaces of aluminum and its alloys, I have 20 discovered that certain colors are particularly difficult to obtain on aluminum. Thus the production of a brown color, which color is often desired on aluminum surfaces, is one which presents particular difficulty. Such color, however, 25 can be readily obtained by my present invention, which, briefly stated, comprises first treating the aluminum article to provide on its surface a hard and to a substantial degree adsorbed oxide coating and thereafter treating this coating with a solution of a soluble salt of permanganic acid.

According to the preferred practice of the method, the aluminum article is first treated to produce upon its surface an oxide coating which is hard and dense and which has sufficient ad- 30 sorptive qualities to retain, when immersed in or equivalently treated with a liquid, an appreciable quantity of such liquid within and upon it. The term “oxide coating”, as used herein, is a well known designation in the art to describe a layer of aluminum oxide artificially produced on the aluminum or aluminum alloy surfaces by chemical treatment, with or without the use of externally applied electrical energy, but the term does not include the thin film of 35 aluminum oxide which is normally formed upon the metal by contact with the air.

In the various methods of producing oxide coatings, there are certain reagents which I have found particularly effective for the purpose of my present invention. These reagents are alkali carbonates and soluble dichromates, and I 40 use both in the preferred practice of the invention. A solution of any alkali carbonate and any soluble dichromate may be used, but I prefer a solution of sodium carbonate and potassium dichromate containing about 0.5 to 6 per cent of the carbonate and about 0.1 to 1 per cent of the dichromate, and I have had excellent results with about 2 per cent of the former and about 0.5 per cent of the latter. Simple immersion of the piece to be coated in the treating solution, or spraying it with the solution, is in general sufficient without the application of any external electrical energy.

After the desired oxide coating has been formed on the aluminum surface I treat the coated metal, say by immersion or spraying, with a solution of a soluble salt of permanganic acid. While I prefer to use potassium or sodium permanganate, any soluble salt of permanganic acid may be used for this purpose. The concentration of the permanganate solution does not appear to be a critical factor, as I have found that solutions containing as little as 1 per cent of the soluble compound or compounds used, and solutions which are completely saturated, will produce the colors desired. I prefer to use concentrated solutions, however, since I have observed that the adsorption of the solution by the oxide coating is more rapid than with dilute solutions. I have further determined that the temperature of the solution of the salt of permanganic acid at the time at which the oxide-coated metal is introduced therein is not a governing factor and that satisfactory colors may be produced whether the 90 solution be cold or hot. The use of a hot solution facilitates drying of the article afterwards.

As has hereabove been mentioned, the color produced on the aluminum or aluminum alloy surface in the practice of my novel method is brown or some shade thereof, and I have found that the depth of color and the particular shade desired may be regulated by varying the thickness of the oxide coating which is originally produced on the aluminum or aluminum alloy surface. If the aluminum, in the oxide-coating process, is immersed in the solution for a brief period, a thin film of oxide coating will be obtained. With longer immersions, the thickness of this oxide coating increases and in this way a satisfactory adherent, adsorbent oxide coating of the desired thickness may be produced, a deeper color and darker shade being, in general, produced with a heavy coating than with a thin coating.
As a specific example of the method in which my invention may be practiced, an aluminum article was immersed for 10 to 15 minutes in an aqueous solution containing 20 grams per liter of sodium carbonate and 5 grams per liter of potassium dichromate. At the end of this time, the metal was removed from the solution, washed, and while in a moist condition immersed in a hot saturated solution of potassium permanganate for a period of 2 to 5 minutes. The article, after removal from the permanganate solution and drying, had on its surface a brown color which, for all practical purposes, was stable and permanent and completely adsorbed in the oxide coating.

I am aware that it has been proposed to impart a brown or black color to porous articles by successive treatments with separate reagents, one an oxidizable compound and the other potassium permanganate to oxidize the same. In my invention I produce the brown color by treating the oxide coating with potassium permanganate or other permanganic compound without prior or subsequent treatment.

I do not claim herein broadly the coloring of aluminum by adsorbing, in an adsorbent oxide coating on the surface of the metal, successive reagents which react in the coating to precipitate a colored inorganic compound, but do so in my copending application Serial No. 474,655, filed August 11, 1930.

It is to be understood that the invention is not limited to the specific details herein described but may be carried out in other ways without departure from its spirit.

I claim—

1. The method of permanently coloring the surfaces of aluminum or aluminum alloy articles, comprising treating the metal surface with a solution containing an alkali carbonate and a soluble dichromate to form thereon an adsorbent oxide coating, and thereafter without further treatment impregnating the coating with a soluble salt of permanganic acid.

2. The method of permanently coloring the surfaces of aluminum or aluminum alloy articles, comprising forming on the metal surface an adsorbent oxide coating, and thereafter without further treatment treating said surface with a solution of potassium permanganate, for the purpose herein described.

3. The method of permanently coloring the surfaces of aluminum or aluminum alloy articles, comprising treating the metal surface with a solution containing an alkali carbonate and a soluble dichromate to form thereon an adsorbent oxide coating, and thereafter without further treatment treating the coating with a 100 solution of potassium permanganate, for the purpose herein described.

4. The method of permanently coloring aluminum or aluminum alloy by impregnation of an adsorbent oxide coating previously formed on the surface of the metal, which consists in immersing the article in a solution of a salt of permanganic acid.

MARTIN TOSTERUD.

CERTIFICATE OF CORRECTION.

Patent No. 1,971,240.

August 21, 1934.

MARTIN TOSTERUD.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, line 33, for "adsorbed" read adsorbent; 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 25th day of September, A. D. 1934.

Leslie Frazer
Acting Commissioner of Patents.
As a specific example of the method in which my invention may be practiced, an aluminum article was immersed for 10 to 15 minutes in an aqueous solution containing 20 grams per liter of sodium carbonate and 5 grams per liter of potassium dichromate. At the end of this time, the metal was removed from the solution, washed, and while in a moist condition immersed in a hot saturated solution of potassium permanganate for a period of 2 to 5 minutes. The article, after removal from the permanganate solution and drying, had on its surface a brown color which, for all practical purposes, was stable and permanent and completely adsorbed on the oxide coating.

I am aware that it has been proposed to impart a brown or black color to porous articles by successive treatments with separate reagents, one an oxidizable compound and the other potassium permanganate to oxidize the same. In my invention I produce the brown color by treating the oxide coating with potassium permanganate or other permanganic compound without prior or subsequent treatment. I do not claim herein broadly the coloring of aluminum by adsorbing, in an adsorbent oxide coating on the surface of the metal, successive reagents which react in the coating to precipitate a colored inorganic compound, but do so in my pending application Serial No. 474,651, filed August 11, 1930.

It is to be understood that the invention is not limited to the specific details herein described but may be carried out in other ways without departure from its spirit.

I claim—

1. The method of permanently coloring the surfaces of aluminum or aluminum alloy articles, comprising treating the metal surface with a solution containing an alkali carbonate and a soluble dichromate to form thereon an adsorbent oxide coating, and thereafter without further treatment impregnating the coating with a soluble salt of permanganic acid.

2. The method of permanently coloring the surfaces of aluminum or aluminum alloy articles, comprising forming on the metal surface an adsorbent oxide coating, and thereafter without further treatment treating said surface with a solution of potassium permanganate, for the purpose herein described.

3. The method of permanently coloring the surfaces of aluminum or aluminum alloy articles, comprising treating the metal surface with a solution containing an alkali carbonate and a soluble dichromate to form thereon an adsorbent oxide coating, and thereafter without further treatment treating the coating with a 100 solution of potassium permanganate, for the purpose herein described.

4. The method of permanently coloring aluminum or aluminum alloy by impregnation of an adsorbent oxide coating previously formed on the surface of the metal, which consists in immersing the article in a solution of a salt of permanganic acid.

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