United States Patent Office 3,709,742 Patented Jan. 9, 1973

3,709,742

MULTI-COLOR ANODIZING PROCESS FOR ALUMINUM

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No Drawing. Filed Feb. 16, 1971, Ser. No. 115,836
Int. Cl. C23f 5/04
U.S. Cl. 148—6.1 5 Claims

ABSTRACT OF THE DISCLOSURE

In producing multi-color designs on an anodized aluminum, a first solution of either an acid or a base is applied to a dyed surface to produce a color change, and a second solution of either the acid or base not previously used, is applied to a portion of the already treated surface to produce another color change.

This invention relates to the treatment of aluminum to provide a functional and decorative anodic coating; and, more particularly to a process that will produce multi-color patterns of flowery or marbleized appearance. It also pertains to the developing of random designs and patterns on aluminum articles, each article having colors and patterns which are somewhat different from those of articles subjected to the same process.

It is the object of this invention to provide a process that will produce a multi-colored finish on anodic-coating by a variety of chemical treatments which react with the anodic coating, without the use of masking materials, resists, or other presently known multi-operation processes. This invention also provides methods for producing colors and hues in designs and patterns by means of chemical reactions with the anodic coatings, that are not necessarily produced by using organic, origal, azo, pigments, or other known dye materials. Certain colors and hues are the result of chemical processing sequences rather than depending on some form of organic or other type dye to produce a decorative, functional, multi-colored finish with or without a general overall pattern or design.

In the present state of the art, the method of producing multi-color designs on anodic coatings on aluminum involves the application of various resists such as wax, paints, epoxies, tapes, etc. The resists mask a portion of the surface of a previously dyed, but not sealed anodic coating. After application of the resist, the surfaces are treated with nitric acid which leaches out the dye completely from the surfaces not protected by the resist. An additional dyeing process is then applied to provide the desired color on these surfaces. In this manner, by repeating the processes of dyeing, resist application, leaching, and further dyeing, an anodic coating with multi-color patterns and designs are produced. The color patterns so obtained are of definite design as determined by the resist applications. It is evident, however, that the process becomes expensive if a variety of colors are desired or if the patterns are intricate because of the time and labor required to perform the process operations.

It is an object of this invention to provide a practical process for enabling multi-colored finishes on anodic coatings for aluminum, including both light and dark colors, by means of chemical treatments applied to the anodic coatings.

It is a further object of this invention to provide a process for producing multi-color designs and patterns on anodic coatings for aluminum without the need for maskants or resists, but relying on the method and sequence of applying certain chemical treatments.

It is a still further object of this invention to provide a practical process for producing multi-color designs and patterns on anodic coatings for aluminum, such designs and patterns being readily changed in shape or color to enable infinite variations, so that in the production of a large number of aluminum articles, each article would have a somewhat different appearance from all others.

It is a still further object of this invention to provide a process for readily and inexpensively enabling intricate, random, flowery, and also marbleized color patterns in anodic finishes for aluminum.

In accordance with the process of the present invention, it has been found that the objects and advantage described may be readily obtained. In the present invention, a previously dyed unsealed anodic coating is treated with chromic acid, either by spray, droplets, sponge, or similar method. The wetting properties of the chomic acid cause it to spread, and the chromic acid will leach and discolor the portions of the previously dyed surface which has been wetted by the acid. The reaction of the pattern being generated can be stopped at any point by rinsing the chromic acid with water. The next essential operation of the process is to apply an alkaline solution on the surfaces previously treated with chromic acid. The alkaline treatment will generate new patterns and colors which may have a flowery appearance. The article may then be immersed in a second dye solution to increase the number of colors or to super-impose a particular color on the variety of colors produced by the aforementioned chemical treatments. The article may then be sealed or the chemical and dying treatments may be repeated as often as desired to a desired degree of color or pattern intricacy. Experience has shown that an unlimited number of designs, patterns, colors, and hues can be obtained.

This process facilitates the use of many different acidic and alkaline solutions and a water rinse to act as a neutralizer to stop the development of a given pattern or patterns.

In general, the basic description of this invention has been outlined above. To further improve the decorative effect of the end product, certain known methods of mechanical finishes may be used prior to the anodizing process. It may be desirable to add additional steps of chemical polishing or electro-chemical polishing prior to anodizing. There are many known methods for the mechanical finishing of metals including special finishes for aluminum.

The following is a typical process procedure in accordance with this invention which will produce a unique decorative multi-colored finish on an anodic coating on aluminum:

(1) Clean the product to be treated with a degreaser such as Tri-Clor ethylene or some other solvent to remove grease and heavy soils.

(2) Mechanically polish the products or pieces of aluminum to a smooth scratch-free surface.

(3) Remove the buffing compound with a suitable solvent or non-alkaline type cleaner and rinse thoroughly.

(4) Chemically polish the workpieces or products in a bath containing 85% phosphoric acid, 15% nitric acid at a temperature of 185° to 250° F. for a period of 30 sec. to 5 minutes depending upon the luster required for the end products. Rinse the workpieces and deoxidize either in a commercially available bath or a bath of 50% nitric acid and 50% water at 65° F. to 95° F., for a period of 30 sec. to 3 min. Rinse the workpieces and proceed with the anodic coating.

(5) The aluminum pieces should be anodized in an aqueous bath containing 12% to 30% sulfuric acid at a temperature of 65° F. to 105° F. and 12 to 36 amps. per sq. ft. The time required to develop the anodic coating will vary with the aforementioned conditions from 20 to 60 minutes.

After the anodizing process, the parts or products should be thoroughly rinsed in water and submersed in an aqueous dye bath to produce a base color. There are many known dyes and chemicals that produce almost any desired base color. For example, a bath containing 1 to 50 grams per liter of a commercially black organic dye was used at a temperature of 90° F. to 150° F., a pH of 7.0 to 7.5 and workpieces were immersed for a period of one to thirty minutes. After the desired base color (black) is produced, the art claimed by this inventor applies.

The workpieces are removed from the base color bath and rinsed in an aqueous bath containing a wetting agent and while still wet are treated in selected areas with a 10% to 80% solution of CrO_3. The chromic acid will attack the base color and leave a rich brown to golden color in the areas to which the C_rO_3 was applied. The workpieces are then rinsed in water to stop the first reaction of the CrO_3.

The next procedure is to apply an alkaline bleach in the same general areas that have been attacked in the preceding operation. The alkaline bleach is applied to portions or all of the areas previously treated by CrO_3 solution in such a manner as to achieve different patterns of designs and an overall marbleized effect. This bleach will withdraw the golden brown colors and return the workpieces to their natural aluminum color in the areas where the bleach is applied, leaving the other areas in shades from gold to deep brown.

The part can now be sealed in an aqueous bath containing 5 grams per liter of nickle acetate at a pH of 5.5 to 6.5 and a temperature of 210–212° F. for a period of 15 min. After sealing the part is rinsed, dried, and polished and will have a marbleized multi-color anodic coating composed of black, gold, brown, and silver.

Experience has shown that an article treated as specified in the preceding paragraphs and sealed with a commercial seal such as Sandofix may develop additional colors during sealing (i.e., the areas left rich brown by the chromic acid attack will change from rich brown to shades of grey). If other color combinations are desired, this can be accomplished by immersing the articles in a second color bath before the sealing operation. A descriptive procedure for this follows:

After the workpieces have been treated locally by the acid and alkaline solutions and rinsed, they may be immersed in an aqueous solution containing ½ to 10 grams per liter of blue dye at a pH of 5.0 to 6.5, a temperature of 90° to 150° F. for 1 minute to 30 minutes. This will produce a finished article containing blacks, blues, greys, and browns and golds. The sequence of operation and wetness of the workpiece treated will determine the end patterns developed. For example—if the $CrCo_3$ bath is applied first and the alkaline solution second, a flowery or spreading pattern will result. If the process is reversed, an overall marbleized pattern will develop. The aforementioned procedure may be repeated many times to produce an end product containing many colors.

The chemical treatments that were used in the development of this invention that produced the desired

amount of leaching and pattern development included the following acids: chromic acid 10–75%, nitric acid 50–100%, sulfuric acid 50–100%, oxalic acid 10–75%, magnesium sulfate 10–50%. In addition the following alkaline solutions were successfully used: sodium hypochlorite 5–20%, sodium hydroxide 1–10%, and potassium permanganate 1–50%.

All of the aforementioned chemicals were used in an aqueous solution with concentrations ranging from 1–100% and temperatures from 60–100° F. The sequence of application, the wetness of the surface being treated, and the number of solutions used determine the end designs, patterns, and multi-color effect produced.

To bring additional information to this invention, it will be necessary to mention that the temperatures of succeeding colors should decrease starting with the highest temperature and the darkest color. Also the said process will develop different designs and patterns with the method of application (i.e., stippled, sprayed, droplet, etc.).

This invention may be embodied in other forms or performed in other ways without departing from the essential characteristics of this invention. The present embodiment is illustrative and not restrictive, and the scope of the invention is described by the appended claims; and, all equivalencies are considered part of this invention.

I claim:

1. A process for producing a multi-color design on a dyed anodic coated aluminum surface comprising the steps of:
   (a) applying a first solution comprising an aqueous solution of an acid or an aqueous alkaline solution to said dyed surface to produce a color change on said surface; and
   (b) applying a second solution other than said first solution and comprising an aqueous solution of an acid or an aqueous alkaline solution to at least a portion of said color changed surface produced in step (a) to produce another color change.

2. A process according to claim 1, wherein said aqueous acid solution is selected from the group consisting of chromic acid, nitric acid, sulfuric acid, oxalic acid, and magnesium sulfate.

3. A process according to claim 2, wherein said alkaline solution is selected from the group consisting of a hyperchlorite, hydroxide and permanganate.

4. A process according to claim 3, comprising rinsing the surface in water after step (a).

5. A process according to claim 3, wherein said first solution is an acid solution.

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U.S. Cl. X.R.

204—35 N; 117—127