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SURFACE TREATMENT FOR ALUMINUM

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This invention relates to the treatment of aluminum and aluminum base alloy surfaces to produce thereon a white matte finish.

The invention is primarily directed to a method of treating aluminum and aluminum base alloy surfaces for the purpose of producing a white matte finish which is substantially free from visible metallic luster and which produces an optically dead white surface appearance to the material treated.

The etching procedures which have previously been employed for the treatment of aluminum and aluminum base alloy surfaces usually result in the production of a frosted surface appearance that exhibits a definite metallic sheen or luster. This metallic appearance is undesirable for many applications where a minimum degree of specular reflection is desired. For example, where the surface is to serve as a background for printing. In the past when such a flat white matte finish has been desired on aluminum or aluminum base alloy surfaces, it has usually been obtained by the use of pigmented paints, lacquers and the like.

It is an object of this invention to provide a simple and economical etching treatment for aluminum and aluminum base alloy surfaces which will provide a surface having a white matte finish free from apparent metallic luster when viewed from any angle.

It is a further object of the invention to provide an etching treatment to produce a white matte finish on such surfaces which is permanent in nature and will not smudge when subjected to handling.

A still further object is the provision of a method of surface treatment that will produce a flat white appearance on aluminum and aluminum base alloy objects which makes it possible to obtain a uniform white appearance over the entire surface regardless of the extent of the area of the surface.

Other further objects will present themselves upon consideration of the specification and claims when taken in conjunction with the specific examples of the method of the invention given herein.

The invention, in its essentials, comprises a multi-step process in which the aluminum or aluminum base alloy article or surface which, when necessary, has been cleaned to insure the removal of any oil, grease or other foreign material in any suitable manner is subjected to an etching treatment in a solution containing hydrofluoric acid and ferric chloride. After the initial treatment in the hydrofluoric acid-ferric chloride solution, the surface is removed and cleaned and subsequently again immersed for a period in the hydrofluoric acid-ferric chloride etching solution. The surface is again removed from the solution and treated in an acid cleaning solution and finally washed in water.

In the practice of the invention the aluminum or aluminum base alloy surface to be treated is immersed in the etching solution, which is preferably employed at a temperature of between 80° F. and 100° F. While the etching solution is preferably used at or near this temperature, it may be employed at higher or lower temperatures with suitable modifications of the treatment. The concentration of the hydrofluoric acid-ferric chloride solution to obtain the best results is rather critical. In general, the best results are obtained with a solution containing from 10 to 15 per cent by weight of hydrofluoric acid (HF) and 5 to 15 per cent by weight of ferric chloride ($FeCl_3 \cdot 6H_2O$). Upon its initial immersion in the etching solution, the aluminum or aluminum base alloy surface will be vigorously attacked. The reaction becomes less violent with time and comes almost to a complete stop in a period of about from 3 to 4 minutes. Upon removal of the material being treated from the solution, it will be found to be covered with a dark gray deposit. This deposit is removed from the surface by washing or it may be wiped off with a cloth or other suitable means.

After the cleaning step above referred to, the surface being treated is again immersed in the etching solution, and it has been observed that the reaction during this second immersion is less violent than the reaction during the initial immersion. After a period of about ½ to 1 minute, the reaction appears to come to a complete stop. Upon removal from the etching solution the surface will be found to be uniformly covered with a light gray layer which appears to be a definite coating on the aluminum or aluminum base alloy surface.

This light gray layer formed in the second etching step may be removed by a number of acid solutions which are customarily used for the removal of coatings or discoloration from aluminum surfaces. Among the best of the acid solutions used for this purpose are concentrated nitric acid solutions, solutions containing both nitric and sulfuric acids and hot chromic and sulfuric acid solutions. Both chromic and nitric acids appear to have inhibiting effects on aluminum and aluminum base alloy surfaces and

they are usually found as constituents of such cleaning or acid stripping solutions. Suitable stripping solutions may, for example, consist of nitric acid having a concentration of 750 grams HNO_3 per liter. This solution may be used cold. An alternative solution may contain 500 grams per liter of nitric acid (HNO_3) and 170 grams per liter sulfuric acid (H_2SO_4). This solution may also be used cold. Another solution frequently employed contains 175 grams per liter of sulfuric acid (H_2SO_4) and 35 grams per liter chromic acid anhydride (CrO_3). This latter solution is preferably employed at a temperature of 170° F. to 180° F. to give the best results.

After the second etching step, the aluminum or aluminum base alloy surface being treated is immersed in one of the above mentioned cleaning or stripping solutions under the described conditions, and after removal from this stripping or cleaning solution it may be again washed in water. The light gray layer remaining on the surface after the second etching treatment will be completely removed in the cleaning or stripping solution and the surface will be found to be practically dead white with no visible metallic luster when viewed from any angle. The surface will be found to be smooth and uniform.

While the above described treatment can be employed advantageously on any aluminum or aluminum base alloy surface, the best results from the standpoint of producing a decorative white matte surface will be obtained when the aluminum or aluminum base alloy, among its other constituents, contains from about 0.06 to 0.3 per cent copper. When the above described treatment is used with aluminum base alloys including small amounts of copper, the resulting product has wide application for decorative purposes and may be used for metallic name plates or numbering tags and such purposes. The decorative effects may, of course, be modified by the use of stop-offs during the etching treatment in the well known manner.

As a specific example of the practice of the invention, a piece of aluminum sheet containing about 0.16 per cent copper was immersed in a solution made up of 200 cc. of commercial hydrofluoric acid of about 48 per cent HF concentration, 150 grams of ferric chloride crystals and enough water added to make 1000 cc. of total solution. The temperature of the solution was held at about 90° F. to 100° F. The sheet was etched in this solution until the reaction had practically stopped. This treatment in the etching solution took a total time of about 3 minutes. The material was then removed from the etching solution, washed thoroughly with water, and returned to the etching solution and allowed to etch again for about ½ minute, after which time the reaction of the solution with the metal had practically stopped. The material was then removed from the solution and again washed in water. The gray layer or coating on the material was then removed by immersion in a solution of nitric acid which had a concentration equal to about 750 grams HNO_3 per liter. The material was then removed and again washed in water. The surface was found to have a practically dead white matte finish with no metallic luster apparent when viewed from any angle.

It will be understood, of course, that while this invention has been described with reference to certain preferred embodiments thereof, various modifications and changes may be made therein within the spirit of the invention as set forth in the appended claims.

I claim:

1. The method of producing a white matte finish on aluminum and aluminum base alloys which consists in immersing the surface in a solution containing 10 to 15 per cent by weight of hydrofluoric acid and 5 to 15 per cent by weight of ferric chloride, removing said surface and cleaning the same of the products of the reaction with said solution, immersing the surface again in said solution and again removing said surface from the solution and subsequently cleaning and stripping the surface of the discoloring products of the reaction in an acid solution.

2. The method of producing a white matte finish on aluminum and aluminum base alloys which consists in immersing the surface in a solution containing 10 to 15 per cent by weight of hydrofluoric acid and 5 to 15 per cent by weight of ferric chloride at a temperature of from 80 to 100° Fahrenheit, removing said surface and cleaning the same of the products of the reaction with said solution, immersing the surface again in said solution and again removing said surface from the solution and subsequently cleaning and stripping the surface of the discoloring products of the reaction in an acid solution.

3. The method of producing a white matte finish on aluminum and aluminum base alloys which consists in immersing the surface in a solution containing 10 to 15 per cent by weight of hydrofluoric acid and 5 to 15 per cent by weight of ferric chloride at a temperature of from 80 to 100° Fahrenheit, removing said surface and cleaning the same of the products of the reaction with said solution, immersing the surface again in said solution and again removing said surface from the solution and subsequently cleaning and stripping the surface of the discoloring products of the reaction in a cleaning solution containing a material selected from the group consisting of chromic and nitric acids.

4. The method of producing a white matte surface on aluminum and aluminum base alloys which consists in immersing the surface in a solution containing 10 to 15 per cent by weight of hydrofluoric acid and 5 to 15 percent by weight of ferric chloride, removing said surface and washing the same in water, immersing the surface again in said solution and again removing said surface from the solution and subsequently cleaning and stripping the surface of the discoloring products of the reaction in an acid solution.

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