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PROCESS OF ORNAMENTATION

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When ornamental aluminum objects such as medallions, plaques, and the like, are produced, it is common to produce on the aluminum, contrasting surfaces composed of contiguous, rough, abraded areas and high-lighted or light-reflecting areas.

By suitable disposition of these roughened and high-lighted surfaces, it is possible to build up pleasing or ornamental designs which can later be preserved by the application thereto of protective oxide coatings. The processes for achieving such effects are well-developed and appear adequate for purposes where cost is not a major factor or where large numbers of the same article need not be produced. However, with the advance of this type of ornamentation, occasions have arisen where the ornamental articles have practical and functional aspects such as may be exemplified by aluminum evaporator doors for household refrigerators. These doors, while performing the function of closing the ice-freezing chamber, are desirably ornamented on their outer surfaces so as to present a pleasing design to the eye. When the problems of manufacturing large numbers of such articles are faced, it is found that the previous and well-developed methods of ornamentation are too costly, and it becomes necessary to provide some less expensive procedure by which the same or better results may be obtained. The present invention relates to new ornamentation processes of this character and has as its objects, methods of ornamenting aluminum surfaces by the use of high-lighted areas and roughened background, such methods being so designed as to eliminate many of the steps previously used and thereby decrease the cost of, and usually raise the efficiency and general effect of the process.

When high-lighted and roughened surfaces are to be provided on the same aluminum surface for the purpose of producing an ornamental effect, it is customary to first buff or otherwise polish the entire aluminum area which is to be so treated. The area thus treated is then masked off by the use of such well-known expedients as masking tapes or stencils in such a way as to expose only those portions of the surface which are to be roughened. The unmasked aluminum surface is then subjected to an abrading means or medium, such as a sand blast, with the result that the unmasked areas are roughened and take on a dark gray and mottled appearance. The masking is then removed from the aluminum surface and the whole surface is then subjected to a kind of bleaching treatment which usually

consists in immersion in a caustic solution which etches the entire surface and thus changes the dark gray and mottled surfaces to surfaces which have a uniform and lighter appearance. This treatment, however, does not remove the roughened characteristics of the surface. Because these etching solutions also etch and dull the high-lighted and unroughened areas which were previously masked during the roughening operation, it becomes necessary to subject these high-lighted areas to a second buffing operation in order to restore their smoothness and brightness. Following this second buffing operation, the surface, including both the buffed and roughened areas, is then provided with a transparent oxide film by artificial oxidation, usually but not necessarily by anodic oxidation, which film serves to protect the underlying surfaces against mechanical injury without diminishing in any material aspect the decorative effect obtained.

Although these processes have been considered satisfactory, the necessity for rebuffing the high-lighted areas following the etching treatment is a decided disadvantage. The second buffing operation increases the cost of the process, and moreover, during this operation, it becomes extremely difficult to prevent accidental marking of the whitened background or roughened areas by contact therewith of the fingers or the buffing wheel. Since any mark thus formed upon the roughened background areas at this stage of the process is difficult to remove without considerable expense and, if allowed to remain during the subsequent artificial oxidation, detracts from the appearance of the ornamented surface, a high percentage of articles produced by the method above described fails to pass inspection and is rejected.

In my new process these disadvantages are overcome and the cost of the process materially reduced by the provision, after the roughening operation, of a cleaning or etching step which is of such nature that the originally buffed and high-lighted areas remaining after the roughening operation are in no wise affected. Essentially my process consists in treating the originally buffed and thereafter partially roughened surface electrolytically in a brightening electrolyte, the article being made the anode of the electrical circuit for this purpose. After this treatment with the use of a brightening electrolyte, the final oxide coating is usually immediately applied. Brightening electrolytes are known in the art, and the term "brightening electrolyte" as used herein and in the appended

claim comprehends that well-known class of electrolytes in which aluminum surfaces may be brightened by anodic treatment. While I prefer to use those brightening electrolytes which contain hydrofluoboric acid, I have found that other electrolytes, such as those containing hydrofluoric acid or phosphates and carbonates, are also useful, and I intend, therefore, to comprehend within the term "brightening electrolyte" all of that well-known class of electrolytes.

Certain of the brightening electrolytes, particularly those containing hydrofluoboric acid, leave after this treatment a thin superficial film, composed essentially of aluminum oxide, over the brightened surface of the article which is transparent but which exhibits an iridescent appearance. This film is usually objectionable because it has been found to cause a smudge upon the aluminum surface when the latter is subsequently handled. When it occurs, therefore, I prefer to remove it, and this may be done by treating the surface with a solvent which will preferentially attack or so loosen the superficial aluminum oxide film that it may be removed by washing, and which at the same time does not attack the high-lighted and brightened background surfaces of the metal. A suitable film solvent for this purpose is an alkaline solution of a chromate, such as sodium chromate, or other alkali metal chromate in a solution containing an alkali metal carbonate. It has been found that the conditions of use control, to a large extent, the concentration of the solution. A solution high in carbonate dissolves the film more readily, but continued contact with such a solution sometimes impairs the surface beneath the film. As the chromate concentration is increased, the action of the carbonate becomes retarded. It has been found desirable to have the chromate somewhat in excess of the carbonate content. A convenient solution is one prepared by dissolving about 0.5 to 3 per cent sodium dichromate and 1 to 8 per cent sodium carbonate in water. This solution, when applied hot, will remove substantially all of any undesirable film in about 1 to 4 minutes. Thereafter the article is rinsed in cold water and is ready for the application of a protective oxide coating.

The protective oxide coating which is used to protect the ornamental surface obtained may be applied by any of the methods known to the art, and such methods form no part of this invention. These methods include both chemical treatments where the article is immersed in a bath capable of forming a suitable oxide film or by electrolytic treatment where the article is made anode in a suitable electrolyte. However, I prefer to use an electrolytic method in which the article is made anode in an electrolyte of sulphuric acid, oxalic acid, or chromic acid, or mixtures thereof. When using sulphuric acid, the electrolytic solution should preferably contain between about 15 and 18 per cent sulphuric acid by weight. The current density should be about 12 or 13 amperes per square foot, and the temperature of the bath should be maintained at approximately 68 to 72° F. The duration of the treatment is generally about 5 minutes. This operation produces a hard, dense, adherent, transparent coating consisting chiefly of aluminum oxide upon the surface of the article treated. It is preferred to subsequently impermeabilize the coating so formed by immersing the article in boiling or nearly boiling water, whereby the oxide coating is rendered non-absorbent and non-stain-

ing, without affecting its adherence. Methods for impermeabilizing oxide coatings are known in the art.

Example

Exemplifying the production of a decorative aluminum surface having high-lighted areas and a roughened background upon an aluminum refrigerator evaporator door according to the preferred practice of this invention, the areas to be high-lighted are buffed with a tripoli abrasive using a stitched buffing wheel. The buffed surface is then color buffed using silica brick or Vienna lime applied to a loose-leaf coloring wheel. The buffed high-lighted areas are then masked and the unprotected areas or backgrounds are then sand blasted, and if desired, the work may then be preliminarily cleaned of usual foreign substances which would be found on the surface after such operations, by immersion in a mildly alkaline cleaning solution such as, for instance, one of the well-known solutions of sodium phosphate and sodium carbonate commonly sold under such trade names as "Oakite." If such a preliminary cleaning step seems desirable, it is performed, and the work is then rinsed in clean, cold water and subjected to an electrolytic brightening treatment by preferably making it anode in a 1.2 to 1.6 per cent solution of hydrofluoboric acid and water. A current equivalent to about 15 amperes per square foot of anode surface, at 20 to 25 volts, is applied for about 10 minutes, the temperature of the bath being maintained between 81 and 90° F. during the treatment. The work is then removed from the bath and thoroughly rinsed in clean, cold water and then, if covered with an undesirable iridescent film, is subjected to a film-removing treatment consisting of immersing the work for 1 to 4 minutes in a solution containing 0.5 per cent sodium carbonate and 2 per cent potassium dichromate, held at a temperature of 190 to 200° F. until the superficial film resulting from the brightening operation has been removed. In this, my preferred process, the work is then, after rinsing in water, subjected to anodic oxidation by making it anode in a bath consisting of a 15 to 18 per cent aqueous solution of sulphuric acid for about 5 minutes, using a current density of 12 to 13 amperes per square foot of anode surface while maintaining the temperature of the bath at about 68° F. to about 72° F. The work is then again rinsed in water and the resulting protective aluminum oxide coating impermeabilized by immersing the work in a water bath held at a temperature of 170° F. to 180° F. for a period of about 10 minutes.

As an alternative procedure for producing the initial high-lighted and roughened surfaces, which eliminates the aforescribed masking step, it has been found desirable in certain instances to roughen, as by sand blasting, the entire surface to be decorated, and thereafter producing the high-lighted portions of the surface by suitable localized buffing operations. This procedure readily adapts itself to articles of manufacture which incorporate high-lighted surfaces lying in a single plane, as distinguished from those high-lighted areas which lie in different planes.

The resulting finish upon the surface of the refrigerator evaporator door is characterized by a bright, roughened background and smooth, polished, and bright high-lighted areas, and is protected against scratching and staining by a dense,

adherent, and transparent coating of aluminum oxide.

The high-lighted decorative effect produced upon the aluminum surface by the process of my invention is generally found to be substantially brighter than that produced by the older process recited hereinabove.

It is typical of the process of this invention that the smooth, bright, high-lighted areas have the characteristics of specular reflecting surfaces, whereas the roughened background areas are diffusely reflecting in nature.

The term "aluminum" as used herein and in

the appended claim includes pure aluminum, aluminum containing the usual impurities, and aluminum base alloys.

I claim:

5 A method of ornamenting an aluminum surface which consists in providing said surface with contrasting sand blasted and relatively smooth areas, anodically treating said surface in a
10 brightening electrolyte to brighten said contrasting areas and thereafter applying to said surface a protective coating of aluminum oxide by anodic treatment.

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