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METHOD OF COLORING OXIDE-COATED
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Ind., a corporation of DelawareNo Drawing. Application August 17, 1933,
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4 Claims. (Cl. 41-41)

The invention relates to the production of multicolored oxide coatings on aluminous metal (aluminum and aluminum base alloy) surfaces, and is particularly concerned with a method of producing variegated dyed oxide-coated aluminum surfaces.

Various methods of producing colored oxide coatings on aluminum have been proposed, in which the coloring is produced by adsorbing the dye in the oxide coatings, and such dyed oxide coatings have found extensive commercial application. However, it is sometimes desirable to produce oxide-coated aluminum articles having a variety of colors, or a variety of tones or shades of the same color, on a single surface. The method of producing multicolored finishes heretofore known, in which a stop-off is used to prevent coloring certain areas during the several dyeing operations, is cumbersome. Furthermore, while this method permits the production of variously colored areas in predetermined designs, it does not lend itself to the production of irregular and shaded color effects, particularly such as are produced in various shades of the same color.

It is an object of this invention to provide a new and simple method of producing multicolored aluminum oxide-coated articles. A further object of this invention is to provide a method of producing shaded coloring in an oxide-coated aluminum surface.

This invention is predicated upon the discovery that when an aluminum article, provided on its surface with an oxide coating which has been dyed to color it, is treated with a solution of certain oxidizing agents, the dye may be wholly or partially removed from the coating in the treated area without materially modifying the form and properties of the oxide coating itself. It has been found by treatment of such oxide-coated aluminum surfaces with a solution of a strong oxidizing agent, such as nitric acid, an alkali permanganate, or a chromic acid compound, that the color may be wholly or partially removed, either in definite designs or irregular mottled effects, depending upon the exact method of applying the decolorizing solution, and it has been found that these decolorized areas may be recolored by dyeing, if desired, since the oxide coating retains its adsorbent properties. Thus it is possible to produce oxide-coated articles having adjacent areas of distinctly different color, or having adjacent shaded areas of the same color.

The oxide coatings may be formed on the alu-

minum surfaces by various methods. The aluminum may be made the anode in an electrolytic cell containing an electrolyte such as a solution of sulfuric acid, or chromic acid, or oxalic acid. When external electrical energy is impressed upon the cell, a hard, adherent and adsorbent coating composed in substantial part of aluminum oxide is formed on the aluminum surface. In another type of method the aluminum is immersed in a hot alkaline solution, such as a solution of sodium carbonate containing a small amount of a dichromate, and the oxide coating is formed by chemical reaction without the use of electrical energy. In all cases the oxide coating to which this invention relates is thus produced by artificial means, and the term "oxide coating" is intended to include all such coatings currently so designated in the art but does not include the very thin natural film of oxide occurring on all aluminum surfaces.

For the purposes of my invention, the method by which the oxide coating is produced is of relatively small importance, so long as the coating is relatively hard and adherent and sufficiently porous and adsorbent so that it may be successfully dyed. When the coating is thick the amount of dye adsorbed is greater and the subsequent decolorizing action must be somewhat prolonged to secure the same results as when a thinner coating which had adsorbed less dye is treated. It is preferable to treat coatings of ordinary thickness or relatively thin coatings, so that the process may be carried out without undue delay, although the usefulness of my invention is not limited to the treatment of any particular thickness of coating. For my purposes, oxide coatings produced by anodic treatment, such as by electrolysis in a sulfuric acid bath, prove quite satisfactory.

The adsorbent oxide-coated surface may be colored by dyeing by immersion in an aqueous solution of a direct or acid dye, or by a preliminary treatment of the coating with an acid mordant and subsequent treatment by immersion in an aqueous solution of a basic dye. A uniformly colored surface is thus obtained.

The decolorizing of the dyed surface is accomplished by wetting the surface with an aqueous solution of the decolorizing agent in the desired design. The decolorizing action is a function of time of contact and concentration of the decolorizing solution. The concentration of the decolorizing solution is limited to the strength which will not substantially attack the oxide film or modify its properties in the time required to

oxidize and thereby decolorize the dye to the desired degree, whether totally or partially. Nitric acid has proved to be particularly satisfactory, being an efficient decolorizing agent which may be used in either concentrated or dilute solution with substantially no attack on the oxide coating in the time required for decolorizing. Chromic acid and permanganic acid compounds also have satisfactory decolorizing action.

The method of wetting the dyed surface with the decolorizing solution may be varied to produce various color effects in the finished article. If it is desired to reproduce a definite design, the decolorizing agent may be applied with the assistance of a stencil to confine the solution to the areas it is desired to decolorize, or it may be applied by means of a rubber transfer roll or stamp. In this latter case it is generally desirable, in order to restrict the decolorizing agent to a definite area, to mix the decolorizing solution with an inert material in the form of a paste. A paste of nitric acid and barium sulfate has proved satisfactory for this purpose. In these methods, in which the decolorizing action is restricted to a definite area, a sharply outlined design is produced with a definite line of demarcation between the colored and the decolorized areas. Other methods may be used where it is desired that the colored and decolorized areas blend or shade into each other. For example, an irregular stippled or mottled effect may be obtained by the use of a rubber sponge or other means commonly used to produce like effects on painted surfaces. Or the decolorizing solution may be applied and allowed to creep outwardly from the point of application with the production of an extensively shaded effect.

In all of these methods, a complete or partial decolorizing of the treated areas may be obtained by regulating the time of contact of the decolorizing agent with the coating. When the color has been sufficiently removed from the treated areas, the decolorizing agent is washed off the surface. The time required for decolorizing will vary with the amount and nature of the adsorbed dye, as well as with the decolorizing agent used, but in general the time required for decolorizing is quite short, being in some cases not more than a few seconds.

The surface thus prepared consists of a background of the original color with areas either in

fixed design or irregular which are wholly or partially decolorized. The article may be further treated by dyeing with a different color so that the decolorized areas are again colored to produce a surface having areas of two distinct colors. Furthermore, the process is not limited to the production of a two-colored surface, but the decolorizing and dyeing operations may be repeated to produce as many color combinations as are desired.

When the production of the finished article is to involve two or more dyeing operations, some care is desirable in the selection of colors and the order in which they are applied to the oxide coating. In general it is preferable to apply the darker colors first, as substantial advantages are obtained thereby. For example, in producing a design in black and yellow, or black and red, it is preferable to first dye the whole surface black, decolorize the desired areas, and subsequently dye the whole surface yellow or red. Or, for example, to produce a green and yellow design the whole surface may be first dyed blue, the desired areas decolorized, and then the whole surface dyed yellow. The decolorized areas are colored yellow, while the adsorption of the yellow color on the blue colored areas produces green.

I claim:

1. A method of producing variegated colored oxide coatings on aluminous metal surfaces, comprising decolorizing a dyed oxide coating by treatment with a solution of nitric acid.

2. A method of producing variegated colored oxide coatings on aluminous metal surfaces, comprising treating an oxide-coated surface to uniformly adsorb a dye therein and subsequently treating a portion of said dyed surface with a solution of nitric acid to decolorize said treated portion.

3. A method of producing variegated colored oxide coatings on aluminous metal surfaces, comprising impregnating said surface with a dye solution, decolorizing a portion of said surface by treatment with a solution of nitric acid, and subsequently impregnating said surface with another dye solution.

4. A method of producing variegated colored oxide coatings on aluminous metal surfaces, comprising partially decolorizing a dyed oxide coating by treatment with a solution of nitric acid.

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