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COATED ALUMINUM AND ALUMINUM ALLOY

Helmer Bengston, Indianapolis, Ind., assignor to Aluminum Colors Incorporated, Indianapolis, Ind., a corporation of Delaware

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This invention has to do with aluminum or aluminum alloy articles (herein comprehended and defined by the term "aluminum") coated with an impervious, hard, crystalline coating composed in substantial part of aluminum oxide and with methods by which such coating may be obtained. The invention is particularly concerned with such coatings which have been produced, in part, by a coating solution containing sulphuric acid.

The coatings herein described and claimed are of the genus known as oxide coatings and familiar in several forms to the art. Such coatings, while having the common characteristic of being composed substantially of aluminum oxide, may differ widely in properties, depending upon the methods by which they are produced on the aluminum surface. The term "oxide coatings" as used herein defines those oxide coatings which are produced on the surface of aluminum by the action, with or without the aid of the electric current, of an aqueous, or other liquid, solution of a chemical agent which attacks aluminum. Of such solutions sulphuric acid is to be preferred, as will hereinafter appear, and my invention will be principally described with reference thereto.

In producing such coatings on aluminum the sulphuric acid solution, which may contain from about 2 to 70 per cent, more or less, of sulphuric acid by weight, is made the electrolyte of an electrolytic cell in which the aluminum to be coated is made the anode. Any suitable metal such as lead is made the cathode. A voltage of about 5 to 20 volts is impressed upon the cell, the electrolyte being maintained at temperatures of below about 40 degrees centigrade and the electrolysis continued until the required coating is formed. Under these conditions there is formed on the surface of the aluminum anode an oxide coating which is hard, pervious, and may be of substantial thickness. Such coatings are adsorbent and when placed in contact with dyes, staining liquids and the like, are colored thereby.

In experimenting with oxide coatings of this nature, I discovered that when aluminum so coated was immersed in boiling water for a short time, the coating experienced a fundamental change in properties. This change was found to be manifested by a practical absence of porosity—the coating becoming less adsorbent in nature and often incapable of adsorbing, to any pronounced degree, the dyes and stains which oxide coatings usually adsorb. An investigation of such coatings by means of Roentgen rays revealed that the oxide coating by reason of the treatment in the boiling water becomes crystalline, whereas the coating before treatment is apparently non-crystalline or amorphous in nature. In this change from an amorphous to a crystalline structure the chemical characteristics of the coating are apparently altered as, likewise, are the physical characteristics. A large part or all of the pores of the once adsorbent oxide coating are closed and the porosity of the coating is eliminated or substantially decreased.

The coating which I, therefore, provide on aluminum in accordance with my invention is one which is composed in substantial part of aluminum oxide; which is crystalline rather than amorphous; which is impervious rather than pervious; and which is non-adsorbent rather than adsorbent. In other respects my coatings resemble the best coatings of the art in that they are normally hard and adherent and are resistant not only to abrasion but do not chip or flake off on normal flexing or bending of the metal upon which they are produced.

Although the treatment in boiling water by which the oxide coatings of the above properties are obtained produces these properties to some extent in oxide coatings generally, the properties are most fully realized and developed when the oxide coating under treatment has been produced in sulphuric acid electrolyte. Many such sulphuric acid-produced oxide coatings are, when treated in accordance with my invention, very acceptable commercially and possess, to a full extent, a combination of the novel properties of imperviousness and non-adsorption and the hardness and resistance to abrasion which are otherwise characteristic of good commercial coatings.

It is preferable to practice my invention by treating oxide-coated aluminum in water at the boiling temperature, but it has been found that the basic change to crystalline state which characterizes my novel coatings is produced at a practical rate in water at temperatures as low as 80 degrees centigrade and after treatment above about 80 degrees centigrade the distinguishing characteristics of the crystalline coating are likewise evident. In water below about 80 degrees centigrade, this change takes place very slowly, if at all, and, usually, the coatings do not sufficiently change in characteristics or at a rapid enough rate to justify the use of the treatment. In practicing my invention, I prefer to immerse the oxide coated aluminum in water above about 80 degrees centigrade for periods of at least about

10 minutes or until the desired characteristics are obtained in the treated coating. An oxide coating produced on an aluminum anode which has been electrolyzed in sulphuric acid electrolyte containing 25 per cent by weight of sulphuric acid should preferably be treated in boiling water for about 30 minutes.

The hard, impervious, non-adsorbent crystalline oxide coatings produced on aluminum in accordance with my invention are very useful and have such properties as open up new fields of usefulness for oxide coated aluminum. It is quite often true, as in the case of oxide-coated aluminum cafeteria trays, that the usually desirable adsorptive property of a normal oxide coating becomes undesirable. Thus in the case mentioned, coffee or other colored liquids, particularly those of a colloidal or semi-colloidal nature, when spilled on the oxide coated tray are adsorbed by the coating leaving a lasting and colored stain. In such cases, aluminum coated with my novel oxide coatings which are non-adsorbent in nature, find particular application. Likewise the corrosion resistance of my novel oxide coatings is greatly superior to the resistance of oxide coatings heretofore produced on aluminum. The increased resistance produced in oxide coatings heretofore utilized because of their normal corrosion resistance is a property the importance of which is far reaching in effect.

I claim:

1. The method of coating aluminum comprising forming on the surfaces thereof a pervious and adsorbent oxide coating composed in substantial part of amorphous aluminum oxide and thereafter treating the coated aluminum in water held at a temperature between about 80 to 100 degrees centigrade.

2. The method of coating aluminum, comprising anodically forming on the surfaces thereof a pervious and adsorbent oxide coating composed in substantial part of amorphous aluminum oxide, and thereafter treating the coated aluminum in water held at a temperature between about 80° to 100° C.

3. Method of coating aluminum, comprising anodically forming in a solution of sulfuric acid, an oxide coating on the surfaces thereof, said coating being composed in substantial part of aluminum oxide, and thereafter treating the coated aluminum in water held at a temperature between about 80° to 100° C.

4. A method of decreasing the porosity and adsorptive capacity of a pervious and adsorptive coating formed on an aluminum surface and consisting substantially of aluminum oxide, comprising treating said coated aluminum surface with water held at a temperature of about 80° to 100° C.

5. Method of coating aluminum, comprising forming on the surfaces thereof an oxide coating composed in substantial part of aluminum oxide, and thereafter treating the coated aluminum in water held at a temperature between about 80 to 100° centigrade, the said oxide coating being anodically formed on the aluminum in a solution containing 2 to 70 per cent by weight of sulfuric acid.

HELMER BENGSTON.