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METHOD OF IMPROVING THE RESISTANCE TO CORROSION AND ABRASION OF CERTAIN COATED ALUMINUM SURFACES

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2 Claims. (Cl. 148—6.16)

1

This invention relates to the art of coating aluminum and alloys thereof in which aluminum is the principal ingredient and in the following disclosure, as well as in the appended claims, the word "aluminum" is intended to be understood as including alloys thereof in which aluminum is the principal or dominant ingredient.

It has been known to those skilled in this art that aluminum surfaces can be improved as to their corrosion resistance and paint holding ability if they are coated by subjecting them to the action of an acid aqueous solution, the essential coating-producing ingredients of which are fluoride ions, dichromate ions and ions from the class of acids consisting of phosphoric and arsenic acids. Coating treatments of this kind are fully described and claimed in my prior U. S. patents, No. 2,438,877 issued March 30, 1948, and No. 2,471,909 issued April 5, 1949, as well as in my copending application No. 38,192 filed on July 12, 1948, now U. S. Patent No. 2,494,910. Another treatment of this nature is disclosed in the U. S. Patent No. 2,472,864 issued on June 14, 1949 to James H. Thirsk and myself. In the several disclosures just mentioned, various methods and materials are described for the coating of aluminum by treating it with acid aqueous solutions of the nature above specified.

The present invention is based upon the discovery that aluminum surfaces which are coated in accordance with the teachings of the foregoing patents and application may have their resistance to corrosion and abrasion substantially improved if the coated surfaces are subsequently treated with certain aqueous solutions to be described below and the principal object of the present invention is to so improve such coated aluminum surfaces. Another important object is to provide a method for treating such coated aluminum surfaces which will permit a much greater tolerance to wider variations in the coating solutions heretofore familiar to those skilled in the art—for example, those disclosed in the above referred to patents and application. A concomitant object of the present invention is to make it possible to practice the prior coating procedures with somewhat less exactitude and care, and therefore with less experienced personnel which, of course, results in a corresponding decrease in the costs of the coating operation. The present invention also has for an object the provision of a method which minimizes the tendency to powder, which has heretofore been characteristic of some of the coatings produced by prior procedures unless the processes are operated with a great deal of care and exactitude,

2

By way of examples of coatings produced by previous methods upon which coatings my present invention is particularly useful, I wish to cite the following. For instance, a coating may be produced by means of a solution which is formulated in accordance with

Formula I

	Grams
Sodium fluoride	5
Chromic acid (CrO_3)	10
Phosphoric acid, 75%	64

Water, to make 1 liter.

A coating may be obtained by immersing the aluminum surface in the foregoing solution or by flowing or spraying the solution upon the work or by any other convenient technique familiar to the art. Of course, the solution must be left in contact with the metal long enough to act thereupon until the coating is produced. The time required to produce the coating will vary, of course, with the temperature and method of applying the solution to the metal. At ordinary living temperatures it may require as much as five to ten minutes to produce an appreciable coating with the above solution when the solution is flowed upon the metal but this time can be substantially reduced, say to as little as one to two minutes or even less by suitably heating the solution and using it in a spray process.

Other representative formulae for various coating solutions of the nature disclosed in the above referred to patents and application are as follows:

Formula II

	Grams
Ammonium acid difluoride	30
Potassium dichromate	20
Ammonium dihydrogen phosphate	80

Water, to make 1 liter.

Formula III

	Grams
Sodium fluoride	5
Chromic acid (CrO_3)	10
Phosphoric acid, 75%	61
Arsenic acid	2

Water, to make 1 liter.

Formula IV

	Grams
Sodium fluoride	5.0
Chromic acid (CrO_3)	10.0
Arsenic acid	92.5

Water, to make 1 liter.

After treatment with any of the typical solutions described above or with other coating solu-

tions of a similar nature, the essential coating-producing ingredients of which are fluoride ions, dichromate ions and ions from the class of acids consisting of phosphoric and arsenic acids, the coated surface may be rinsed with water and then treated in accordance with the present invention, or the method of the present invention may be applied without a prior rinse with water. The solutions used in carrying out the present invention may be applied by dipping the work into the solution or by spraying or flowing the solution over the surface or by means of any other convenient technique in which the solution can be brought into contact with the coated surface. The length of time in which the coated metal surfaces are in contact with the solution is not critical, and, in fact, may be rather brief, say 20 to 30 seconds or so. Also the temperature of the solution is not critical, although it is better not to use a solution which is hotter than 140° F. and I prefer to use it at approximately 120° F., or lower. After removal from the solution drying of the surface completes the treatment whether or not preceded by a water rinse.

The treatment of the present method makes use of a non-alkali metallic chromate in a chromic acid solution which is characterized by containing at least 5, but not more than 250 grams per liter of non-alkali metallic chromate calculated as $ZnCrO_4$ and by having a free to total acid ratio of from 1:1.5 to 1:2.5 with the pH ranging between 3.5 and 6.0. The free to total acid ratio mentioned above is determined by titrating a diluted sample of the treating bath with a standard sodium hydroxide solution using successively the endpoints of bromcresol green and phenolphthalein. The amount of the sodium hydroxide consumed to the bromcresol green endpoint is proportional to the "free acid" content and the amount consumed to the phenolphthalein endpoint is proportional to the "total acid" content. The ratios of these two quantities of caustic consumed are, therefore, equal to the ratio of "free acid" to "total acid" of the solution. Only those non-alkali metallic chromates which are sufficiently soluble in a chromic acid solution to yield a content in grams per liter falling within the range given above are suitable for the purpose. Typical examples of these are zinc, strontium and copper chromates, the two latter being stoichiometrically calculated as zinc chromate as pointed out above.

It will, of course, be apparent that many variations in the formulation can be readily calculated without departing from the spirit of the invention. However, as a guide the preparation of a suitable concentrated formulation is given below:

Formula V

	Pounds
Chromic acid, flake technical grade	7.123
Zinc oxide	2.910
Zinc carbonate, precipitated	0.083
Water, to make 1.000 gallon.	

The water is heated to a fairly high temperature and the chromic acid dissolved in it. Then the zinc oxide is slowly added and stirred until dissolved. This may require as long a time as several hours. When the temperature of the mixture has fallen to 110° F., or below, the zinc carbonate is slowly added and stirred for an hour or so. The solution will contain a small amount of solids which may be allowed to settle and the clear liquid separated by decanting.

The concentrate is then diluted with water to the desired degree and used as described above.

This application is a continuation-in-part of my earlier application Serial No. 90,561, filed April 29, 1949, now abandoned.

I claim:

1. In the art of coating aluminum to increase its resistance to corrosion and abrasion where the surface of the metal is coated by the action of an acid aqueous solution, the essential coating-producing ingredients of which are fluoride ions, dichromate ions, and ions from the class of acids consisting of phosphoric and arsenic acids; the method which consists in treating a surface so coated with an aqueous solution of a non-alkali metallic chromate in chromic acid, said non-alkali metallic chromate having a solubility in the chromic acid sufficient to yield a concentration of at least 5 but not more than 250 grams per liter calculated as $ZnCrO_4$, the treating solution being characterized by having a pH of from 3.5 to 6.0 and a free to total acid ratio of 1:1.5 to 1:2.5.

2. The method of claim 1 in which the treating solution is maintained at a temperature not to exceed approximately 140° F.

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REFERENCES CITED

The following references are of record in the file of this patent:

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