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BATH FOR AND ELECTROLYTIC TREATMENT OF MAGNESIUM AND MAGNESIUM ALLOYS

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This invention relates to a method of and a bath for forming corrosion resistant coatings on magnesium and alloys thereof by electrolytic treatment in a aqueous solution.

It is an object of this invention to provide a bath for the formation of protective films on magnesium and its alloys wherein the resultant coating on the article is a distinct improvement over coatings produced in well known treatments.

A further object is to provide a simplified method of producing a protective coating having mechanical and corrosion resistant characteristics superior to those produced by more complex methods.

It is well known in the art that protective coatings may be applied to magnesium and magnesium alloy articles by anodic treatment in a dichromate-phosphate solution and that the coating produced in this manner may be improved by several well known sealing treatments. It is also known that this type of coating may be greatly improved by first preparing the surface of the article to be coated in hydrofluoric acid. Thus, over and above the primary cleaning treatment used as accepted procedure in all chemical coating methods, three steps, namely, hydrofluoric acid pre-treatment, anodizing, and sealing are necessary to produce what is commercially recognized as the best coating on magnesium. I have discovered that magnesium and its alloys may be electrolytically treated in one step in an aqueous solution containing a water soluble salt of chromic acid, a water soluble phosphate and magnseium fluoride. The coatings produced in my bath by the single-step process are superior to the well known three-step process aforementioned.

The bath used in my improved method consists essentially of an aqueous solution containing (1) one or more soluble salts of chromic acid, or a mixture of chromic acid and a salt thereof soluble in the solution, or a mixture of chromic acid and oxides soluble in a chromic acid solution so as to produce the desired salts of chromic acid; (2) water soluble phosphates; and (3) magnesium fluoride. The concentration of the salts of chromic acid and phosphates are limited only by their solubility in the solution but may be varied to conform to the temperature of the solution, current density, time of application, and quality of coating desired, whereas, the third ingredient of the bath must be magnesium fluoride, of which, being only slightly soluble, very minute additions in terms of percentage up ot the saturation point are effective. Any water soluble

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chromate or dichromate and water soluble phosphate may be used in my solution. However, sodium, potassium and ammonium salts are preferred because of commercial availability.

The method of practicing my invention is as follows:

The article to be coated is throughly cleaned, a clean surface being essential to the formation of good films. Electrolytic cleaning is very satisfactory, although other known methods of accomplishing this result may be used instead. After cleaning and washing, the article is made the electrode in a bath containing water soluble salts of chromic acid and phosphates in concentrations from ½% up to the limit of solubility of the respective salts in the bath, and magnesium fluoride in varying quanities up to the saturation point of the fluoride in the bath. The pH of the solution is preferably adjusted between 3 and 6.5, the temperature being between 20° and 100° C. and applied current ranging from 1 to 100 amperes per square foot. The time for treatment depends upon the strength of the solution, current density and the thickness of film desired. As a specific example, when the current density is 5 to 10 amperes per square foot and the temperature of the bath is 50° C., a very satisfactory film is formed in 30 to 60 minutes. As an example of the solution's strength, I have used varying amounts from 1% to 30% water soluble salts of chromic acid, more particularly chromates and dichromates, ½ of 1% to 2% water soluble phosphates and magnesium fluoride from minute additions up to the saturation point in the solution. After the film has been formed, the article is removed from the solution, washed and dried.

More specifically, the method may be applied by first cleaning in acid (the accepted procedure for all chemical coating methods) the article to be coated and then anodizing the article in a bath containing 10% sodium dichromate and 2% monobasic sodium phosphate saturated with magnesium fluoride for a period of 45 minutes at a range of from 2 to 10 amperes/square foot and 50° C. Instead of the sodium salts, I have also used ammonium salts and potassium salts with very good results.

The article to be coated functions as an electrode in the bath and either alternating or direct current may be employed, but, when direct current is used, the article to be coated should be made the anode. It is well known that the current range is dependent on the type of magnesium alloy used, that is, the magnesium manganese alloys require low current densities in the

order of 4 amperes per square foot, whereas, the magnesium aluminum alloys may take up to 100 amperes per square foot, the preferable amperage being 10 amp./sq. foot for this alloy.

The above mentioned substances used in my improved coating treatment are mentioned by way of illustration and not limitation, since the invention comprehends a treatment of the character indicated broadly above and is not to be limited except by the appended claims.

The invention described herein may be manufactured, used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. A method of producing corrosion resistant coatings on a class of metals consisting of magnesium and magnesium base alloys, comprising subjecting the metals to an anodic action in an electrolytic bath consisting essentially of an aqueous solution containing a water soluble salt of chromic acid, a water soluble phosphate and magnesium fluoride, the pH of the solution being adjusted to and maintained within the range of pH3 and pH6.5.

2. A method of producing corrosion resistant coatings on a class of metals consisting of magnesium and magnesium base alloys, comprising passing an electric current having a current density of from 1 to 100 amperes per square foot through the metal while it is functioning as an electrode in a bath consisting essentially of an aqueous solution containing a water soluble phosphate, magnesium fluoride and a water soluble compound selected from the group consisting of the chromates and dichromates; the magnesium fluoride being present in the solution from minute additions in percentages up to the saturation point of this substance in the solution and the remaining substances being present in the solution in concentrations from ½ percent up to the limit of solubility of each of said substances, the

pH of the solution being adjusted to and maintained during treatment within the range of pH3 and pH6.5.

3. A method of producing corrosion resistant coatings on a class of metals consisting of magnesium and magnesium base alloys, comprising subjecting the material to anodic action in an electrolytic bath consisting of an aqueous solution containing sodium dichromate, mono-basic sodium phosphate and magnesium fluoride, the pH of the solution being adjusted to and maintained during treatment within the range of pH3 and pH6.5.

4. A method of producing corrosion resistant coatings on a class of metals consisting of magnesium and magnesium base alloys, comprising passing an electric current having a current density of from 1 to 100 amperes per square foot through the metal while it is functioning as the anode in an electrolytic bath consisting of an aqueous solution containing approximately 10 percent sodium dichromate and substantially 2 percent monobasic sodium phosphate, saturated with magnesium fluoride, the pH of the solution being adjusted to and maintained during treatment with the pH range of pH3 and pH6.5.

5. A bath for electro-chemically treating a class of metals consisting of magnesium and magnesium base alloys, consisting essentially of an aqueous solution containing a water soluble salt of chromic acid, a water soluble phosphate and magnesium fluoride, the solution having a pH range from 3 to 6.5.

6. A bath for electro-chemically treating a class of metals consisting of magnesium and magnesium base alloys consisting essentially of an aqueous solution containing approximately 10 percent sodium dichromate, substantially 2 percent monobasic sodium phosphate and saturated with magnesium fluoride, the bath being adjusted to and maintained within a pH range of 3 to 6.5.

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