

UNITED STATES PATENT OFFICE

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ELECTROPLATING MAGNESIUM AND ALLOYS THEREOF

No Drawing.

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It might be assumed from statements made in certain publications, although without credit or responsibility as to individual authorship, that magnesium and magnesium base alloys may be readily coated by the process of electroplating. Thus, for example, in a handbook entitled "Magnesium", published by American Magnesium Corporation (1923), it is indicated that satisfactory results can be obtained by thus electroplating with alkaline, neutral or cyanide solutions providing the surface to be plated has been properly prepared, e. g. by sand blasting. As a matter of fact, careful investigation has disclosed that a closely adherent electrodeposited coating cannot be obtained with any of the solutions named nor is the method of preparing the surface a satisfactory one, Magnesium or magnesium base alloys, i. e., alloys in which magnesium is the predominant constituent, tend to oxidize very readily, and while a coating of another metal may be deposited thereon employing such familiar methods of electroplating, these coatings actually are separated by a film of oxide or other compound on the surface of the article and may be readily separated from such surface.

The object of the present invention, accordingly, is to provide for the electrodeposition of a metallic coating directly on a magnesium or on a magnesium base alloy article, which coating will be permanently adherent and so afford substantial protection against further surface deterioration of such article.

To the accomplishment of the foregoing and related ends, the invention, then, consists of the steps hereinafter fully described and particularly pointed out in the claims, the following description setting forth but several of various ways in which the principle of the invention may be carried out.

As indicated above, it has been found upon investigation not only that acid formulæ must be avoided, as stated in the cited publication, but that any watery solution, whether alkaline, neutral or cyanide, is unsatisfactory. On the contrary, I have discovered that the desired metal may be deposited from a solution of such salt in a substantially an-

hydrous medium, for example, substantially absolute ethyl alcohol or equivalent, non-aqueous alcoholic body, by which term I would include acetone, as well as ketones derived from such alcoholic bodies. In the use of a solvent medium of this sort, it has been further discovered necessary to select a metallic salt that will dissolve in sufficient amount therein to give a solution of requisite density if the electroplating operation is to proceed satisfactorily. Finally, it has been discovered, as also indicated above, that the preparation or cleaning of the surface to be plated must be of such a character as substantially entirely to avoid the presence of oxide or other compound of magnesium on the surface of the article prior to its immersion in the electrolytic bath.

The procedure now to be outlined has been followed with satisfactory results in actual practice in the case of various magnesium base alloys and particularly those in which zinc and/or cadmium is an alloying ingredient. The alloy may contain in addition to one or both of the foregoing alloying ingredients, other minor constituents, such as copper and aluminum.

The cleaning of the alloy article preparatory to plating has been accomplished (1) by abrasion, filing, sandpapering, etc., in the absence of moisture. An ordinary sand blast is not satisfactory for the reason that the presence of moisture in the blast cannot very well be avoided; and (2) by acid treatment consisting in immersing the article in a 10 per cent. solution of hydrochloric acid, then successively rinsing it in absolute alcohol and in a solution of the electrolyte, following which the article must be introduced into the electrolytic cell at once. The surface to be plated must not be allowed to remain in contact with the air longer than is necessary to transfer it from one solution to the next.

For the electrolyte I have employed the following solutions, viz:—

1. An absolute ethyl alcohol solution of zinc chloride containing not less than 50 per cent. and preferably 65 per cent. $ZnCl_2$ prepared in the same manner as the acetone solution described below.

2. An absolute ethyl alcohol solution of zinc bromide containing not less than 50 per cent. and preferably 80 per cent. ZnBr_2 , also prepared in the same manner as the foregoing acetone solution.

3. An acetone solution of zinc chloride prepared by fusing the zinc chloride, ZnCl_2 , cooling the fused mass in a sealed container, adding acetone distilled over lime, and agitating with or without heat until not less than a 50 per cent. and preferably a 62 per cent. zinc chloride solution is obtained. The result is a syrupy liquid containing an excess of zinc chloride which is then used as the electrolyte.

4. A 65 per cent. ZnCl_2 solution in which a mixture containing 35 per cent. methyl alcohol and 65 per cent. butyl alcohol was used as the solvent.

In addition, to the named ingredients, I have found that finer crystals of zinc are produced in the electrodeposited plate where either of the following agents has been added to the foregoing solutions, viz., shellac up to 5 per cent., glycerine up to 10 per cent., and ethyl acetate up to 5 per cent., all by weight, as well as up to 10 per cent. by volume of 80 per cent. zinc bromide absolute alcohol solution which has been boiled for a minute or two, such last mentioned additive agent being particularly effective with the second of the foregoing solutions, viz., one consisting of zinc chloride in absolute ethyl alcohol.

The electrolytic cell preferably comprises a sealed container having zinc anodes, an agitator, and means for controlling the temperature of the electrolyte which should be maintained at from room temperature up to 70 degrees C. A current density of up to 15 amperes per square foot is satisfactory. In making relatively thick plates (0.001 to 0.0015 in.), the loose and treed zinc should frequently be removed by scraping during the process, and in any event after the plating is completed, the thick electrolyte should be rubbed off and the plate quickly and thoroughly washed in absolute ethyl alcohol and then dried.

By means of the foregoing procedure, satisfactory plates up to 0.0015 inch in thickness have been obtained on magnesium alloys containing not only aluminum, but also copper, zinc and cadmium. The original plate obtained in the manner described above may then be increased in thickness by electroplating from a standard zinc or copper cyanide bath in the usual manner. Exacting tests have shown that the plate obtained by my improved process is truly and permanently adherent, being formed directly on the metallic surface of the article.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the method herein disclosed, provided

the step or steps stated by any of the following claims or the equivalent of such stated step or steps be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. A method of plating articles composed of magnesium or a magnesium base alloy, which comprises electro-depositing thereon zinc from a solution of a zinc halide in a substantially anhydrous alcoholic medium.

2. A method of plating articles composed of magnesium or a magnesium base alloy, which comprises electro-depositing thereon zinc from a solution of a zinc halide in substantially anhydrous ethyl alcohol.

3. In a method of plating articles composed of magnesium or a magnesium base alloy, the step which consists in electro-depositing zinc from an approximately seventy per cent. solution of zinc chloride in absolute ethyl alcohol.

4. In a method of plating articles composed of magnesium or a magnesium base alloy, the step which consists in electro-depositing zinc from an approximately seventy per cent. solution of zinc chloride in absolute ethyl alcohol, such solution including a small percentage of an additive agent capable of producing finer crystals of such metal in plate.

5. In a method of plating articles composed of magnesium or a magnesium base alloy, the step which consists in electro-depositing zinc from an approximately seventy per cent. solution of zinc chloride in absolute ethyl alcohol, such solution including a small percentage of zinc bromide.

6. In a method of plating articles composed of magnesium or a magnesium base alloy, the step which consists in electro-depositing zinc from an approximately seventy per cent. solution of zinc chloride in absolute ethyl alcohol, such solution including up to ten per cent. of previously boiled zinc bromide absolute alcohol solution.

7. In a method of plating articles composed of magnesium or a magnesium base alloy, the steps which consist in electro-depositing thereon zinc from a solution of a halide of such metal in a substantially anhydrous medium, and then increasing the original plate by electrodepositing more metal from an aqueous bath.

8. In a method of plating articles composed of magnesium or a magnesium base alloy, the steps which consist in electro-depositing zinc from an approximately seventy per cent solution of zinc chloride in absolute ethyl alcohol, and then increasing the original plate by electrodepositing more metal from an aqueous cyanide bath.

9. A method of plating articles composed of magnesium or a magnesium base alloy, which comprises electro-depositing thereon

zinc from a solution of zinc chloride in a substantially anhydrous alcoholic medium.

10. A method of plating articles composed of magnesium or a magnesium base alloy, which comprises electro-depositing thereon zinc from a solution of zinc chloride in a substantially anhydrous ethyl alcohol.

11. In a method of plating articles composed of magnesium or a magnesium base alloy, the step which consists in electro-depositing thereon zinc from a solution of a zinc halide in a substantially anhydrous alcoholic medium, such solution including a small percentage of an additive agent capable of producing finer crystals of such metal in the plate.

12. In a method of plating articles composed of magnesium or a magnesium base alloy, the step which consists in electro-depositing thereon zinc from a solution of a zinc halide in substantially anhydrous ethyl alcohol, such solution including a small percentage of an additive agent capable of producing finer crystals of such metal in the plate.

Signed by me this 19th day of January, 1927.

IVAN A. KENAGA.