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TIN-PLATING OF ALUMINUM

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This invention relates to the production of tin coatings on aluminum and aluminum base alloys, and relates particularly to the production of such coatings by a dip plating process. As used hereinafter, the term "aluminum" is intended to include both aluminum and aluminum base alloys.

It has been proposed previously to tin coat aluminum articles by immersing them in an aqueous solution of sodium stannate, and allowing tin to deposit on the aluminum from the solution. However, if the plating solution is too alkaline, the coatings produced are rough, crumbly, and non-adherent. For that reason it is advisable that the free alkali in the bath should not exceed 1.25 ounces per gallon of plating solution. In the operation of the process the alkalinity of the plating solution increases as succeeding pieces are coated, and soon reaches the point where the tin coatings produced are rough and non-adherent. When that condition is reached, the excess alkali can be counteracted by the addition of dilute acetic acid to the solution, but when this is done much care must be exercised in adding the acetic acid to avoid the precipitation of stannic acid from the plating solution, with a consequent loss of tin from the solution. Furthermore, the acetic acid must be added frequently, and the plating solution must be tested at frequent intervals to determine whether it is necessary to add acetic acid.

It is an object of this invention to provide an improved process for applying a tin coating to aluminum by means of a solution of an alkali metal stannate. It is a further object of this invention to provide an improved process for applying a tin coating to aluminum by immersing the aluminum in a solution of an alkali metal stannate, in which process the rate at which the alkalinity of the plating solution increases as the solution is used is retarded.

We have discovered that if a small amount of sodium acetate is added to a plating solution in which an alkali metal stannate, such as sodium stannate, furnishes the tin to be deposited on the aluminum, smooth adherent tin coatings can be produced on the aluminum for a much greater time without having to add acetic acid to the bath to counteract increased alkalinity than is possible if sodium acetate is not added to the bath. Consequently, acetic acid need not be added to the solution as frequently. The amount of sodium acetate used varies, depending on the amount of sodium stannate in the solution, but it is preferred to use a plating solution in which the sodium stannate constitutes about 4 to 13 per cent of the solution by weight, and the sodium acetate constitutes about 0.7 to 3 per cent of the solution by weight.

In coating aluminum with tin in accordance with my invention, the plating solution is prepared by dissolving sodium stannate and sodium acetate in water in the amounts indicated above. The amounts of sodium stannate and sodium acetate used in the plating solution, and the temperature of the solution during the plating operation, depend to some extent on the particular material being treated in the solution. With aluminum base alloys containing substantial amounts of silicon or copper, a solution containing about 6 ounces of sodium stannate and 1 ounce of sodium acetate per gallon of water is preferred, and the solution is maintained at a temperature of 170° to 175° F. during the plating operation. With aluminum base alloys of the type containing magnesium silicide (Mg_2Si), it is preferable to use 12 ounces of sodium stannate and 3 ounces of sodium acetate per gallon of water, and to maintain the solution at a temperature of 140° to 150° F. The aluminum articles to be coated are immersed in the plating solution and allowed to remain there for a short time; ordinarily a period of 2 to 10 minutes is satisfactory. When a coating of the desired thickness has been formed, the coated aluminum articles are removed from the solution and rinsed in water.

Before placing the aluminum articles in the plating solution, they should first be cleaned of grease and other undesirable substances by immersing them in a mild alkaline solution, such as a solution made by dissolving 3 ounces of sodium carbonate and 3 ounces of trisodium phosphate in a gallon of water, the solution being at a temperature of 175° to 185° F. The articles should then be rinsed in water and, in order to insure against any of the cleaning solution being carried over into the plating solution, they may next be dipped for a few seconds in a dilute nitric acid solution, such as a solution containing 10 to 20 percent nitric acid, and then be rinsed in water.

The above-described procedure for applying a tin coating to aluminum is particularly useful for tin coating aluminum pistons which are to be used in internal combustion engines. Because of the close tolerances at which such pistons must operate in an engine, and the wear to which they are subjected, it is important when a tin coating is used on them that the coating be both smooth and adherent. Such coatings can be

produced on pistons by means of the process described.

As an example of our invention, objects which had a surface area of one-half a square foot, and which were made of an aluminum base alloy consisting of aluminum, plus about 12 per cent silicon, 1 per cent magnesium, 2.5 per cent nickel, 0.8 per cent copper, and 0.8 per cent iron were tin coated in 5 gallons of a plating solution prepared by dissolving sodium stannate and sodium acetate in water in the proportions of 6 ounces of sodium stannate to 1 ounce of sodium acetate per gallon of water. Each of the specimens being coated was allowed to remain for 4 minutes in the solution, which was at a temperature of 170° F., and the resulting tin coating was about 0.0025 inch thick. For comparison, similar material was tin coated in 5 gallons of another plating solution containing 6 ounces of sodium stannate per gallon of water, but no sodium acetate. These specimens likewise were allowed to remain in the solution for 4 minutes, the solution being kept at a temperature of 170° F. With the plating solution containing sodium acetate, 118 square feet of material were tin coated before the solution became too alkaline and produced rough and non-adherent coatings, whereas with the plating solution which did not contain sodium acetate, only 35 square feet could be coated before the solution became too alkaline and the coatings produced were rough and non-adherent. Furthermore, over a period of 47 hours it was necessary to add acetic acid only twice to the solution containing sodium acetate to keep the solution at the proper degree of alkalinity, a total of 0.2 ounces of acetic acid being added, whereas with the solution which did not contain sodium acetate, acetic acid had to be added ten times to keep the alkalinity of the solution below the level at which the tin coatings produced are rough and non-adherent, a total of 1 ounce of acetic acid being added.

We claim:

1. The process of tin plating aluminum articles comprising the steps of dissolving sodium acetate and an alkali metal stannate in water, and subsequently immersing the aluminum articles in said solution for sufficient time to produce on said articles a coating of tin by chemical deposition from said solution.

2. The process of tin plating aluminum articles comprising the steps of preparing a plating solution by dissolving sodium stannate and sodium acetate in water, and subsequently immersing the aluminum articles in said solution for sufficient time to produce on said articles a coating of tin by chemical deposition from said solution.

3. The process of tin plating aluminum articles comprising the steps of preparing a plating solution by dissolving sodium stannate and sodium acetate in water in the proportions of about 4 to 13 per cent by weight of sodium stannate and at least 0.7 per cent by weight of sodium acetate, and subsequently immersing the aluminum articles in said solution for sufficient time to produce on said articles a coating of tin by chemical deposition from said solution.

4. The process of tin plating aluminum articles comprising the steps of preparing a plating solution by dissolving sodium stannate and sodium acetate in water in the proportions of about 4 to 13 per cent by weight of sodium stannate and about 0.7 to 3 per cent by weight of sodium acetate, and subsequently immersing the aluminum articles in said solution for sufficient time to produce on said articles a coating of tin by chemical deposition from said solution.

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