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SURFACE TREATMENT FOR ALUMINUM

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This invention relates to a process of treating aluminum and aluminum base alloy surfaces in preparation for applying an adherent coating to them.

In U. S. Patent 2,171,546 to Kappes there is described a process for preparing aluminum and aluminum base alloy surfaces prior to applying to them a metallic or non-metallic coating, such as electrochemically deposited coatings, paint films, and the like. That process consists essentially of treating the aluminum surface with an aqueous solution comprising an alkali metal carbonate and a chromate to etch the surface and provide it with an oxide coating, and then removing the oxide coating and passivating the metal surface by means of a solution of nitric acid or chromic acid.

It is an object of this invention to provide an improvement in the above-described process, whereby improved adhesion and bonding of metallic and non-metallic coatings to aluminum surfaces is obtained. It is a further object of this invention to provide an improved process for treating aluminum in order to furnish a surface on which firmly adherent coatings may be produced.

We have found that the results obtained by the process of the above-mentioned patent can be improved, particularly in the case of aluminum on which a coating is subsequently deposited electro-chemically, if the alkali metal carbonate-chromate solution used to etch and oxide coat the surface of the aluminum also contains a small amount of an alkali metal chlorate. Potassium chlorate and sodium chlorate are particularly suitable for the purpose, and of these, potassium chlorate is preferred. The proportion of alkali metal chlorate in the solution may be varied, it being preferably from about 0.1 to 3.5 per cent by weight of the solution, the exact proportion of alkali metal chlorate employed depending on the strength of the carbonate-chromate solution and the particular results desired. In general, it is desirable to govern the amount of alkali metal chlorate in the solution by the amount of alkali metal carbonate and chromate present in the solution; if the solution is relatively weak in carbonate and chromate, less alkali metal chlorate is used than if a relatively large proportion of carbonate and chromate is present. A solution which gives particularly good results is one made by dissolving in a liter of water about 35 grams of anhydrous sodium carbonate, 8 grams of sodium bicarbonate, 14 grams of so-

dium chromate, and 20 grams of potassium chlorate.

Alkali metal carbonate-chromate solutions for producing oxide coatings on aluminum are well-known in the art. They may be produced by dissolving sodium carbonate and sodium chromate in water, although potassium chromate, or chemically equivalent amounts of alkali metal dichromates may be employed instead of sodium chromate, and sodium bicarbonate may be substituted for all or part of the sodium carbonate. Generally, solutions in which the alkali metal carbonates and chromates are present in the ratio of about 3 to 1 by weight are preferred.

In treating aluminum in accordance with the invention, any dirt, grease, or other foreign material is first removed from the aluminum surface to which a metallic or non-metallic coating is eventually to be applied. This cleaning operation may be accomplished with any suitable mild alkaline cleaning solution or organic cleaning compound. An oxide coating is then produced on the metal by immersing the metal in an alkali metal carbonate-chromate solution containing a small amount of an alkali metal chlorate. The solution is kept at a temperature of about 170–212° F., a temperature of about 200–212° F. being preferred. This treatment may be conducted for a period of from 3 to 15 minutes, or longer if desired, but from 5 to 7 minutes is ordinarily satisfactory. After rinsing the oxide coated article in water, the oxide coating is next substantially removed by immersing the article in a solution containing an acid or acid salts, leaving a uniformly etched surface. When a metallic coating is to be applied to the metal it is preferred to use in the step just mentioned a nitric acid solution containing from 5 to 70 per cent by weight of nitric acid, the treatment being continued for a time sufficient for substantially removing the oxide coating. Immersion of the metal in a 50 per cent nitric acid solution for about one minute at room temperature has been found to be particularly suitable. If a paint, enamel, or lacquer coating is to be applied, it is preferable to use a chromic acid solution to remove the oxide coating, in which case a treatment for about 15 minutes in a chromic acid solution containing about 5 per cent of chromic acid by weight, at a temperature of about 180° F., is suitable. Lower temperatures may be employed, but in that event a longer time of treatment is desirable.

Aluminum surfaces prepared in the above manner are very receptive to coating with metals

paints, lacquers, and the like, and the coatings adhere to the surfaces very firmly. The process is particularly useful in preparing an aluminum surface for receiving an electrochemically deposited nickel coating.

Examples

An aluminum base alloy casting was cleaned to remove dirt and foreign material, and was then immersed for 5 minutes in an oxide coating solution consisting of 35 parts by weight of sodium carbonate, 8 parts by weight of sodium bicarbonate, 14 parts by weight of sodium chromate, 20 parts by weight of potassium chlorate, and 1000 parts by weight of water. The solution was maintained at a temperature of 205° F. during the treatment. The metal was then removed from the solution and immersed for one minute in a 50 per cent nitric acid solution to remove the oxide coating formed in the previous treatment. After rinsing the metal in water, a coating of nickel was electroplated on it in a well-known manner. The nickel coating was found to adhere to the metal exceeding firmly when subjected to the usual tests for determining the adherence of metal coatings to the base metal, and much better than nickel coatings applied to the same type of material which had been subjected to the same treatments as those described in this paragraph except for the omission of potassium chlorate from the alkali metal carbonate-chromate solution.

In another example, aluminum sheet was oxide coated in the same manner as described in the preceding paragraph, after which it was immersed in a 5 per cent chromic acid solution for 15 minutes—the solution being at a temperature of 180° F.—to remove the oxide coating and etch the surface. It was then rinsed in water and coated with a heat reactive phenolic resin lacquer which is sold under the name "Heresite." The coating adhered tightly to the metal and more firmly than similar coatings on the same type of material which had undergone the same treatments except that potassium chlorate had not been added to the alkali metal-carbonate solution used to produce the oxide coating.

By the term "aluminum" as used herein and in the claims is meant both aluminum and aluminum base alloys.

Various modifications can be made in the invention as described above without departing from the spirit and scope of the appended claims.

We claim:

1. In the method of treating an aluminum surface preparatory to applying an adherent coating thereon which comprises treating the aluminum surface in an alkali metal carbonate-chromate aqueous solution to produce a substantial oxide coating on the surface, and thereafter removing the oxide coating with an aqueous solution of an acid; the inclusion in the first mentioned solution of an alkali metal chlorate.
2. In the method of treating an aluminum surface preparatory to applying an adherent coating thereon which comprises treating the aluminum surface in an alkali metal carbonate-chromate aqueous solution to produce a substantial oxide coating on the surface, and thereafter removing the oxide coating with an aqueous solution of an acid; the inclusion in the first mentioned solution of an alkali metal chlorate selected from the group composed of sodium chlorate and potassium chlorate.
3. In the method of treating an aluminum surface preparatory to applying an adherent coating thereon which comprises treating the aluminum surface in an alkali metal carbonate-chromate aqueous solution to produce a substantial oxide coating on the surface, and thereafter removing the oxide coating with an aqueous solution of an acid; the inclusion in the first mentioned solution of potassium chlorate.
4. In the method of treating an aluminum surface preparatory to applying an adherent coating thereon which comprises treating the aluminum surface in an alkali metal carbonate-chromate aqueous solution to produce a substantial oxide coating on the surface, and thereafter removing the oxide coating with an aqueous solution of an acid; the inclusion in the first mentioned solution of 0.1 to 3.5 per cent by weight of potassium chlorate.
5. A bath for use in treating an aluminum surface preparatory to applying a coating thereon, said bath comprising an alkali metal carbonate-chromate aqueous solution containing an alkali metal chlorate.
6. A bath for use in treating an aluminum surface preparatory to applying a coating thereon, said bath comprising an alkali metal carbonate-chromate aqueous solution containing an alkali metal chlorate selected from the group composed of sodium chlorate and potassium chlorate.

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