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CHROMIUM PLATING

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9 Claims. (Cl. 204—1)

The principal objects of the present invention are to devise a process of chromium plating that is cheaper, more facile and more rapid than processes heretofore practiced and which will produce a bright and more adherent coating.

Heretofore it has been generally considered that an electrolyte bath would be very unsatisfactory if the ratio of chromic acid to sulphuric acid (CrO_3:SO_4) therein is smaller than 1 to 50 or 1 to 40. I have found, however, that under certain conditions hereinafter set forth, a bath with such low ratio will produce an unusually bright coating which is not only very adherent but also very resistant to shock.

According to the present process, an electrolyte bath is made comprising a chromic acid solution containing sulphate. A suitable bath comprises 240 grams of chromic acid (CrO_3) per liter and 13 grams of sulphuric acid (SO_4) or equivalent soluble catalytic salt per liter. In this example, the ratio is about 18.5 parts of chromic acid (CrO_3) to one part of sulphuric acid (SO_4). Care is exercised to avoid the presence of iron in the bath. For this purpose, the bath is used in a lead lined tank and preferably lead anodes are used, although small steel anodes have been used successfully. Preferably the density of the current is approximately 900 amperes per square foot, although it is practicable to operate with a considerably lower amperage, say as low as 575 to 600 amperes per square foot. For the sake of rapidity it is preferable to keep the current density above 750 amperes per square foot. The temperature of the bath is about 130° to 135° Fahrenheit. Otherwise the process is carried out in accordance with the ordinary practice of electro-deposition of chromium.

The chromium content of the bath is partly trivalent chromium (Cr^{III}) and partly hexavalent chromium (Cr^{VI}) preferably in the approximate ratio of one part of trivalent chromium to five of hexavalent chromium ($1Cr^{III}:5Cr^{VI}$). The content of trivalent chromium in the bath can be increased by the addition of chromic carbonate or other soluble trivalent chromium salt or by ageing, that is, by allowing the bath to work a sufficient time to become active. The operation of ageing is a progressive change of hexavalent chromium to trivalent chromium; and it may produce satisfactory results in a few hours or it may require several days, its purpose being to produce the desired ratio of trivalent chromium to hexavalent chromium, such ratio being readily ascertainable by suitable test or chemical analysis of the bath.

When the process of electro-deposition is carried out under the conditions specified, the operation is rapid, facile and economical, and the resulting coating is very bright, adherent, shock resistant and of uniform thickness; in fact, my process produces much better coatings up to .06 inch thick than are produced by other processes now in use; and it does so in much shorter time than is required by such other processes.

In carrying out my process, it is practicable to vary from the specific strength, ratios, temperature and composition of the bath above set forth, and also the current density. Thus, the temperature and the amperage may be varied considerably in accordance with knowledge familiar in the art. Likewise, the ratio of chromic acid to sulphate may be varied through a range of ten to forty parts of chromic acid to one part of sulphate. The ratio of trivalent chromium to hexavalent chromium also admits of variation but should not be less than one part of trivalent chromium to ten parts of hexavalent chromium and good results are attainable when the ratio is one to one.

What I claim is:

1. In the process of electroplating with chromium, the improvement which comprises maintaining a ratio of chromic acid (CrO_3) to sulphuric acid (SO_4) in the bath less than 40 to 1, the bath containing trivalent chromium and hexavalent chromium in the proportion of not less than 1 to 10.

2. In the process of electroplating with chromium, the improvement which comprises maintaining a ratio of chromic acid (CrO_3) to sulphuric acid (SO_4) in the bath of from 10 to 20 parts by weight of chromic acid (CrO_3) to 1 part by weight of sulphate (SO_4), such chromic acid comprising trivalent chromium and hexavalent chromium in a ratio of between 1 and 10 parts by weight of hexavalent chromium to 1 part by weight of trivalent chromium.

3. In the process of electroplating with chromium, the improvement which comprises maintaining a ratio of chromic acid (CrO_3) to sulphuric acid (SO_4) in the bath less than 40 to 1, the bath being kept at a temperature of approximately 130° to 135° Fahrenheit and containing trivalent chromium and hexavalent chromium in the proportion of not less than 1 to 10.

4. The process of electroplating with chromium, which comprises maintaining a bath wherein chromic acid (CrO_3) and sulphuric acid (SO_4) are present in a ratio of less than 40 parts by weight of chromic acid (CrO_3) to one part by

weight of sulphuric acid (SO_4) with the chromium present in the proportion of about 1 part by weight of trivalent chromium to from one to ten parts by weight of hexavalent chromium, the temperature of the bath being approximately 130° to 135° Fahrenheit, and the current density being in the neighborhood of 600 to 900 amperes per square foot.

5. The process of electroplating with chromium, which comprises maintaining a bath substantially free from iron and wherein chromic acid (CrO_3) and sulphuric acid (SO_4) are present in a ratio of less than 40 parts by weight of chromic acid (CrO_3) to one part by weight of sulphuric acid (SO_4) with the chromium present in the proportion of about one part by weight of trivalent chromium to from one to ten parts by weight of hexavalent chromium, the temperature of the bath being approximately 130° to 135° Fahrenheit, and the current density being in the neighborhood of 600 to 900 amperes per square foot.

6. The process of electroplating with chromium, which comprises maintaining a bath wherein chromic acid (CrO_3) to sulphuric acid (SO_4) are present in a ratio of about 18.5 parts by weight of chromic acid (CrO_3) to one part by weight of sulphuric acid (SO_4) with the chromium present in the proportion of about one part by weight of trivalent chromium to about five parts by weight of hexavalent chromium, the temperature of the bath being approximately 130° to 135° Fahrenheit.

7. The process of electroplating with chromium, which comprises maintaining a bath substantially free from iron and wherein chromic acid (CrO_3) and sulphuric acid (SO_4) are present in a ratio of less than 40 parts, by weight of chromic acid (CrO_3) to one part by weight of sulphuric acid (SO_4) with the chromium present in the proportion of about one part by weight of trivalent chromium, to about five parts by weight of hexavalent chromium, the temperature of the bath being approximately 130° to 135° Fahrenheit, and the current density being in the neighborhood of 600 to 900 amperes per square foot.

8. The process of electroplating with chromium, which comprises maintaining a bath substantially free from iron and wherein chromic acid (CrO_3) and sulphuric acid (SO_4) are present in a ratio of about 18.5 parts by weight of chromic acid (CrO_3) to one part by weight of sulphuric acid (SO_4) with the chromium present in the proportion of about one part by weight of trivalent chromium to about five parts by weight of hexavalent chromium, the temperature of the bath being approximately 130° to 135° Fahrenheit, and the current density being in the neighborhood of 750 to 900 amperes per square foot.

9. The process of electroplating with chromium, which comprises maintaining a bath substantially free from iron and wherein chromic acid (CrO_3) is present in the proportion of about 240 grams per liter, and sulphuric acid (SO_4) is present in the proportion of about 13 grams per liter, chromium being present in the proportion of about one part by weight of trivalent chromium to about five parts by weight of hexavalent chromium, the temperature of the bath being approximately 130° to 135° Fahrenheit, the current density being in the neighborhood of 600 to 900 amperes per square foot.

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