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METHOD OF CHROMIUM PLATING

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This invention relates to methods of chromium plating, and particularly to a method of plating whereby chromium may be deposited without exposure of the metal underlying the chromium plate by reason of cracks or pores, or with a minimum of such exposure, and provides improvements therein.

Baker and Rente, in Transactions of American Electrochemical Society, Vol. 54, page 337 (1928) have discussed the question of high temperatures of the chromium plating bath as related to the porosity of chromium plate.

I have discovered, in order to obtain chromium plated articles on which the underlying metal is not exposed, the chromium plated article not showing copper deposits when placed as cathode in an acid copper plating cell for a limited time (Dubpernell's method), or on which there is only slight exposure as revealed by fine copper lines when tested by said Dubpernell method, that not only is it desirable to use a relatively high temperature of the bath but a current-density should be used which at the temperature (and bath composition) employed is the minimum which will produce a coating of chromium over the surface to be plated, or in the lower part of the current density range for that temperature. Also, to secure the minimum of exposure of the underlying metal, on articles having pronounced edges or projections, expedients should be used to obtain uniformity of the current density over the entire surface to be plated, particularly on such projections or high spots and around such edges, expedients for this purpose being shields, "robbers" or special anodes.

According to the present invention, in order to obtain chromium plated articles on which the metal underlying the chromium plate is not exposed by pores and cracks, or with the minimum of such exposure, the article to be chromium-plated is placed as cathode in a chromium-plating bath of definite composition (such for example as described in Fink Patents Nos. 1,581,188 and 1,802,463) having a relatively constant temperature above 45° C., and plated with chromium at a current density in the lower part of the range of current density for producing a bright or mirror surface plate for the temperature and bath composition chosen, or at current densities below the range for mirror-surface deposits, the current densities being those which produce deposits which completely cover the surface to be plated.

The range of current density for the chosen temperature and bath composition may be found by passing current through the solution to a series of similar test articles to be plated, starting from a point of low current density at which no deposit is obtained and increasing by steps, to a point where the article being plated is first completely covered with chromium. This current density should be noted and may be designated as (*a*). The chromium plate obtained at this current density (*a*) will generally be "milky". The current-density should then be increased to a point where a bright mirror-surface deposit which completely covers the article is first obtained. This current-density should be noted and may be designated as (*b*). The current-density can then be further increased to a point where nodular or burnt deposits are first observed. This current-density should be noted and may be designated as (*c*). The current densities which give the advantages herein described, and which are herein spoken of as current densities in the "lower part of the current density range" are those from (*a*) as described above to about half-way between (*b*) and (*c*).

To avoid error in obtaining the current density for initial deposits in some cases where the surface of the article to be plated is made passive by the chromic acid bath or enters the chromic acid bath in a so-called passive condition (nickel-plated articles for example) the surface should be "struck" or "flashed", as by raising the plating voltage momentarily.

"Milky" deposits, where desired, may be buffed to produce a mirror surface.

To secure the advantages of the invention, the chromium plate should not be less than .00002 inch thick.

A mode of procedure for producing ornamental mirror-surface chromium-plate on commercial articles (such as a waffle iron cover) having a "color-buffed" mirror nickel surface prior to plating, and on which there is substantially no exposure of the nickel surface underlying the chromium deposit (little or no cracks or pores) as revealed by the aforesaid Dubpernell test, is substantially as follows:

Bath, 400 grams per liter CrO_3. 4 grams per liter SO_4.

Temperature, 55° C.

Current density (with high spots protected against concentration of current), 2.25 amperes per sq. inch.

Time, 3 minutes.

With a bath having the composition and tem-

perature stated, the current-density range for obtaining good ornamental mirror-surface plate on such waffle iron covers is approximately 2 to 4 amperes per square inch.

For a longer time of plating at the above temperature and with the bath composition given, a current-density from 1.2 to 2 amperes per square inch is recommended, the surface of the chromium plate at the lower current-densities being "milky".

For a temperature of 50° C. with a bath of the composition given above, a current-density of around 1.5 amperes per square inch is recommended for obtaining chromium deposits having a mirror surface.

For a temperature of 60° C. with a bath of the composition given above, a current density of 2.5 to 3 amperes per square inch is recommended for obtaining chromium deposits having a mirror surface, but at this temperature and above the deposits have a quite perceptible bluish tinge which at the present time is not ordinarily desired for ornamental chromium plate.

Chromium deposits obtained in accordance with this process give superior results in resisting atmospheric corrosion to deposits heretofore obtainable.

The invention may be carried out by other modes of procedure than those herein specifically described.

What is claimed is:—

1. A method of chromium-plating from aqueous baths of the chromic acid type to produce chromium plated articles on which there is no exposure or minimum exposure of the metal underlying the chromium plate, comprising passing current to the article to be plated as a cathode, in a bath of definite composition at a substantially constant temperature above 45° C., and at a current-density substantially uniform over the surface to be plated, in the lower part of the current-density range for the solution composition and temperature chosen.

2. A method of chromium-plating from aqueous baths of the chromic acid type to produce chromium plated articles on which there is no exposure or minimum exposure of the metal underlying the chromium plate, comprising passing current to the article to be plated as a cathode, in a bath of definite composition at a substantially constant temperature above 45° C., and at a current-density substantially uniform over the surface to be plated, in the lower part of the current-density range for the solution composition and temperature chosen, and in that part of said lower part of the current-density range at which mirror-surface chromium deposits are obtained.

3. A method according to claim 2 wherein the bath temperature does not exceed approximately 60° C.

4. A method according to claim 1 wherein the bath temperature is approximately 55° C. and the current-density from 1.2 to 3 amperes per square inch.

5. A method according to claim 2 wherein the bath temperature is approximately 55° C. and the current-density from 2 to 2½ amperes per square inch.

6. A method according to claim 1 wherein the plating is continued to produce a plate exceeding 0.00002 inch.

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