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ELECTROPLATING

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1 Claim. (Cl. 204—7)

This invention relates to a process of electroplating and particularly a method and means for eliminating certain objections that have been a constant source of trouble in plating.

5 In the process of electro depositing metal, a large percentage of plated articles have been rejected, because of grey areas, which have appeared on the articles, and which have detracted from the desired uniform appearance of the
10 entire plated surface. Such areas have been particularly objectionable in chromium plated articles, as the plated surface is usually characteristically bright. The greyiness referred to is distinguished from that which results from a
15 double contact, such as occurs when the current is interrupted during deposition, and is also to be distinguished from that which is known in the trade as "burnt chrome" which results from the contact of the cathode with the anode.
20 Moreover, it is not identical with the grey chrome that has resulted from the localized high current densities on articles of irregular design, such as those having protrusions and the like. It has occurred on smooth surfaces,
25 and also on those articles with which great care has been taken to eliminate all known variables in the plating bath.

Chromium plating as practiced in many plants today, necessitates constant control and super-
30 vision. For example, it has been necessary to analyze the chrome solution three or four times a day; to make additions of chromic acid or of chromic sulphate, then to lower the chromium sulphate such as by the addition of barium car-
35 bonate, adjust the temperature up, then down, and vary the current density. In fact, it has been necessary constantly to adjust all the variables after which little if any improvement in the correction of grey areas would be noted.

40 An effort to correct the difficulty in chromium plating has been made by passing the work lightly over a buffing wheel, as a result of which some improvement was noticed, but the results obtained were not sufficiently uniform to elimi-
45 nate the objection. Again, the nickel plated articles have been scrubbed with pumice stone immediately prior to the immersion in the chrome bath. It was thought that different kinds and types of buffing compounds might
50 contribute to the cause of the difficulty and so a study of the buffing compounds, as to fineness, color, overlaps, whorls, buffing grease and the like was made, but it was definitely established that some compounds resulted in more grey and deeper areas than others, and that the

worst offenders were those which burnished rather than cut the nickel in buffing. Moreover, some compounds produced a grey cast throughout the surface when plated at high current density, but only on local areas when plated at normal operating current densities.

The electro-plating of chromium on aluminum has heretofore been regarded as an impractical accomplishment on a commercial scale unless
10 some other metal, such as copper, or copper and nickel has been plated on the aluminum prior to chromium. The addition of the copper has been generally regarded as necessary, for other-
15 wise the chromium would not plate bright. Furthermore, so far as I know, it has been impossible to replating with chromium a surface from which the chromium has been stripped with hydrochloric acid without subjecting the surface to a buffing action, as otherwise, the grey areas or cast would be too pronounced to permit ac-
20 ceptance commercially.

A well known formula for commercial plating has necessitated an accurate ratio between chromic acid and sulphate, the ratio being 100 to 1 to 200 to 1, and the temperature being ac-
25 curately maintained from 105 degrees Fahrenheit to 125 degrees Fahrenheit. Such conditions necessitate constant analysis of the solution and make electro plating of chromium a hazard-
30 ous undertaking on large scale production.

An object of my invention is to provide a method for eliminating the greyiness which has occurred in the electro deposition of metals. In addition, my invention is concerned with a
35 method, which will enable chromium to be electrically deposited on aluminum without the need for an intervening plate of metal other than aluminum and chromium.

An additional object of my invention is to provide a method for treating metal, so as to permit
40 the electro-deposition of chromium without necessitating the constant supervision of conditions in the bath and without maintaining the accurate ratio between chromic acid and chromium sulphate, such as heretofore has been re-
45 garded, as necessary for satisfactory plating.

I have discovered, as a result of an extensive investigation on this subject, that the cause of the grey areas on plated metal is the presence
50 of an oxide in the form of a thin film on the surface to be plated, which interferes with the proper deposition; and I have discovered that if the surface is so treated, as to remove the oxide, immediately in advance of the plating operation, not only are the grey areas and grey

cast completely eliminated, but that chromium can be deposited directly on aluminum.

There are several methods by means of which the oxide film can be removed. For example, I may subject the article to an electrolytic action, which would reduce the oxide or I may reduce it in a vessel containing hot hydrogen in the presence of a catalyst.

The electrolytic action for removing the oxide film may be accomplished by making the work the cathode, and utilizing lead anodes in the acid rinse, and electrolytically treating the work immediately prior to the introduction of it into the chromium plating bath. The acid for the rinse may comprise sulphuric acid and the impressed current may be any amount between 25 and 100 amperes per square foot. Under such conditions, the oxide can be reduced by impression of the current for a few seconds. This applies particularly to articles which have been nickel plated and buffed to a bright nickel in advance of the deposition of chromium. The method works not only with articles, which have been hand buffed lightly, but also those which are made of heavy steel and which are buffed mechanically. The latter articles have heretofore shown a larger proportion of grey areas, notwithstanding the extent to which the bath has been maintained in as nearly perfect condition, as is possible.

I believe that the oxide film on the articles has been due to different causes; such as the heat that is developed during the mechanical buffing operation, and the acid fumes in a plating room. Thus, on nickel, the film would be nickel oxide; on aluminum, aluminum oxide and the like, but by reducing the oxide to the metal, and then immediately plating with chromium before another film of oxide has an opportunity of being formed, I have entirely eliminated a very serious difficulty in electro-plating.

My invention, in addition to eliminating the grey areas, has enabled a metal such as chromium to be plated by electro deposition directly upon aluminum; a procedure which heretofore has been regarded as impractical without the use of an intermediate plate of copper or other metal. I have found if the aluminum is subjected to a treatment that will eliminate aluminum oxide on its surface, that the chromium will be free from grey areas.

I have further found that the presence of the oxide on the article to be plated is undoubtedly the cause of a supposed need for maintaining an accurate ratio in the chromium plating bath between chromic acid and chromic sulphate, for when the oxide is removed, bright chrome may be satisfactorily deposited within a very wide range in the ratio of chromic acid to chromic sulphate, and that the limits which have heretofore been established in the trade for such pur-

pose are incorrect. For example, satisfactory results following the electrolytic treatment in the acid rinse were obtained in a bath having a chromic acid (CrO_3) concentration of 37.0 ounces per gallon, and sulphate in the proportion of .50 ounce per gallon. This is the equivalent of a ratio of 100 to 1 between chromic acid and the sulphate. The concentration of chromium sulphate was raised in successive steps to 4 ounces per gallon and still satisfactory results were obtained at all stages. This is equivalent to a ratio of 12 to 1 between chromic acid and the sulphate.

My invention has accomplished an additional surprising result in that it has enabled a surface to be replated with chromium after the chromium had been stripped with hydrochloric acid and without subjecting the stripped surface to a buffing operation. I have found that articles that have been chrome stripped in hydrochloric acid and then immediately immersed in the sulphuric acid rinse and electro-chemically treated, as aforesaid, could be immediately plated with chromium without the occurrence of any of the objectionable grey areas or casts.

A further advantage of my invention is the fact that the temperature in the chromium bath can be varied over a wide range and that the current densities can likewise be varied, and that chromium can be satisfactorily plated within such ranges. For example, I have varied the temperature of a chromium plating bath from 70 to 175 degrees Fahrenheit, and I have varied the current density from 125 to 650 amperes per square foot, and I have even plated with the highest density mentioned in a bath of 70 degrees Fahrenheit.

The reduction of the oxide by gas may be accomplished by placing the article to be plated within a vessel containing hydrogen, at a temperature between 200 and 300 degrees Fahrenheit, and by utilizing a catalyst, such as powdered nickel, within the vessel.

While I have explained the operation of my invention principally in connection with the electro-deposition of chromium upon nickel and aluminum, it is to be understood that it is applicable to the plating of chromium on other metals.

I therefore claim:

A method of chromium plating comprising electro-depositing a plating of nickel on an article, buffing the nickel plated article, then subjecting it to a cathodic electric treatment in an acid for a period not exceeding a few seconds, removing the article from the acid before an oxide film has an opportunity of being formed on the nickel plated surface, transferring it to a chromium plating bath, and electro-depositing chromium on the article while it is in said last named bath.

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