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PROCESS OF AND MATERIALS FOR CHROMIUM PLATING

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This invention relates to chromium plating and has for its object the provision of a new and useful process for effecting chromium plating.

A further object of the invention is to provide materials which are most efficient for effecting chromium plating.

Further objects of the invention will appear more fully hereinafter.

The invention consists substantially in the steps of procedure and the materials employed in connection therewith all as will be more fully hereinafter set forth and described in the appended claims.

It has been found impractical to electro-plate chromium directly on the base metals such as brass, copper, or zinc die castings, etc., since in the case of the sulphate catalyst chromic acid plating solution the plate flaked off after a short time, and in the case of the aluminum catalyst, chromic acid plating solution it was found impossible to consistently obtain a clear, bright plate. In fact the aluminum catalyst solution was found impractical of normal operation because of the large percentage of lusterless or cloudy plates obtained, and the impracticability of buffing or coloring the plated piece. It was further found that a large percentage of the plates with this solution which appeared good at the time of plating lost their luster on standing and eventually flaked off. To overcome this the standard practice in chromium plating is to apply a coating of nickel to the base metal and then apply a thin chromium plate over the nickel, as nickel is a metal which is not readily attacked by the chromic acid solution. The nickel plating is an extra operation and only a thin coating of chromium will adhere to its surface. These disadvantages had to be borne so as to have a metal present which was not readily oxidized and attacked by the chromic acid.

We have found that these difficulties were remedied when the base metal was introduced in the solution in such a way as to produce the minimum oxidation prior to plating. It is a known fact that the action of chromic acid is both etching and oxidizing, and we have determined that it is the exposure to this action that is largely responsible for the poor quality of plate obtained when chromium is plated directly on the base metal. Adding to this adverse condition is the fact that all commonly employed methods of cleaning pieces prior to plating tend to oxidize the surface, and apparently the chromium plate is extremely susceptible to adverse conditions, both as to effecting its bond to the base metal and the brilliance and clearness of the plate. It should be emphasized that in plating chromium where a smutty plate requiring buffing or coloring is obtained, the ease with which this plate is colored is of paramount importance and the predominating factor in the determination of the commercial application of the process.

This difficulty in obtaining a clear chromium plate which could be readily buffed or colored and getting a good adherence of the plate to the base metal, we found could be overcome by applying a thin plate or "strike" of a metal (the oxide of which is readily soluble in chromic acid) to the work before chromium plating. The most common and economical metal fulfilling this requirement is zinc, although other metals, such as cadmium can be used. Therefore while zinc will be used throughout this description it is understood that this invention is not limited thereto. We have further found that a freshly deposited film of metal such as zinc is more readily soluble in the chromic acid than even pure zinc metal, and a decidedly better plate is obtained on rolled zinc sheet, when treated in this way, than if cleaned in a common cleaning solution and plated. When impure or alloyed zinc, such as die castings, is used, this treatment becomes imperative as the etching of these surfaces leaves a dark haze over the work which reduces the luster of the chromium plate.

In accordance with our invention the preparatory solution most effective and efficient for our purpose should be formed of the following materials in substantially the proportions named, to wit: in a mixture containing ½ pound caustic soda per gal. and ½ pound sodium cyanide per gal. three pounds of the metal such as metallic zinc is allowed to dissolve per hundred gallons of preparatory solution.

In this solution the work is treated electrolytically as in any electrolytic cleaner. In this case, however, the solution performs a dual function i. e., the piece is cleaned in the presence of liberated hydrogen without the formation of an oxide as generally occurs in cleaning solutions, and the required bright zinc film is formed on the surface. The piece is then washed and entered in the chromium plating solution. While different proportions than given above are possible, these proportions have been found best to produce the dual properties as outlined.

The unique function filled by this solution is best illustrated by the treatment of brass. It is well known to those skilled in the art that a zinc

plate is absorbed in time in brass, so that a normal zinc plate followed by a chromium plate would not be stable. If the piece, however, is subjected to the above solution for about ten to twelve seconds at six volts, and then placed in the chromium solution for the period normally required to wet the piece and make the connection to the cathode bar, then quickly washed, it will be found that the film has been entirely dissolved and a bright brass surface remains. Chromium plates deposited on brass timed to produce this result are of exceptional brilliance, easily buffed and found to possess a high bond between the base metal and the chromium plate.

All common base metals such as copper, lead, aluminum, aluminum alloys, zinc die castings, etc., can be handled indiscriminately through the same preparatory solution and yield a uniform high luster and color for the chromium plate, so that pieces composed of different metals can be plated without the color variation generally obtained when different metal bases are used.

In accordance with our invention the most efficient plating solution for chromium plating is one which contains no acid radical such as sulphate. The brilliance and silvery lister which we obtain indicates that the deposit contains a low zinc or other metal alloy content with the chromium. While this zinc content is so low that it shows no detrimental effects as to the permanence, hardness, and nontarnishing property of the chromium, the result is a most beautiful deposit for color and luster. It is of further benefit inasmuch as the chromium plate deposited under these conditions is as easily polished or colored as a nickel plate, in contrast with the well known difficulty of buffing chromium deposited from either the sulphate or aluminum catalyst solution.

Apparently the reaction which we obtain is the dissolving of the zinc in the film of chromium plating solution adhering to the surface of the piece and the redepositing of this zinc with the chromium when the piece is connected with the cathode bar. We have further found that the addition of zinc to the chromium plating solution in the making of a new plating bath is of advantage in having the solution start off under best operating conditions. The maintenance of the desired zinc content is taken care of by the introduction of the zinc film on all pieces to be plated. That this dissolved zinc plates out as an alloy is indicated by the fact that we have operated a solution without change over a period of time and passed through it tons of zinc castings and other work without the dissolved zinc building up to any appreciable proportions.

In view of these basic facts we have found that the most efficient plating solution is formed by the following materials in substantially the proportions named, and formed in the manner set forth, to wit: 2½ pounds of bichromate of soda and 4 pounds of water, and 15 pounds of chromic acid are mixed.

This mixture is brought to a boil and 2½ pounds of alumina hydrate gradually added and the resulting solution boiled for approximately fifteen minutes, or until all parts of the mixture are fully dissolved indicating that the reaction is complete. The mixture is then allowed to cool and there is then added thereinto seventy-five pounds of unheated chromic acid and one-half pound of zinc carbonate.

The mass is then thoroughly mixed and the plating solution made by dissolving the mixture in water to a concentration of around 28° Baumé and higher.

It will be seen from the foregoing description that we have found that the addition of zinc, or other metal the oxide of which is readily soluble in chromic acid, to a preparatory solution for use in chromium plating is a matter of great importance, and we are enabled to obtain many results, such as increasing the efficiency and practicability of the plating operation which, heretofore, could not be obtained. We have likewise found that by utilizing some form of aluminum as the catalyst in the plating solution for use of plating objects in the presence of zinc or other metal, the oxide of which is readily soluble in chromic acid, enables the production of results and an expansion of the applicability of electrolytic plating heretofore thought impossible.

In the compounding of the above plating solution the formula given is what we have found most practical, but the proportions will operate over quite a varied range such as either the elimination of the bichromate of soda or the substitution of potassium bichromate, or the omitting of the zinc in the original bath, as soluble oxides normally enter the solution through operation as outlined above and the solution works in with time. While such variations are possible, the above proportions yield very satisfactory results.

Having now set forth the objects and nature of our invention and having given an example thereof, what we claim as new and useful and of our own invention and desire to secure by Letters Patent is:

1. The method of chromium plating which comprises a preliminary step of coating the object to be plated with a thin film of metal of the group consisting of zinc and cadmium, by subjecting it to electrodeposition in a mixture containing one-half pound of caustic soda per gallon, one-half pound of sodium cyanide per gallon, and three pounds of the metal per one hundred gallons, and then subjecting it to electrodeposition in a plating solution consisting of a mixture of two and one-half pounds of bichromate of soda, four pounds of water, and fifteen pounds of chromic acid which has been brought to a boil and to which two and one-half pounds of alumina hydrate has been gradually added and the resulting solution boiled for approximately fifteen minutes, and then allowed to cool, to which after cooling there has been added seventy-five pounds of unheated chromic acid and one-half pound of zinc carbonate, the mass thoroughly mixed, and dissolved in water to a concentration of approximately 28° Baumé.

2. A preparatory deposition or strike for use in a process of chromium plating for primarily treating the object to be plated, which is formed of the approximate proportion of one-half pound of caustic soda, one-half pound of sodium cyanide, and approximately one-half ounce of a metal of the group consisting of zinc and cadmium, dissolved per gallon of solution.

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