

UNITED STATES PATENT OFFICE

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PROCESS OF ELECTRODEPOSITING CHROMIUM

No Drawing.

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My invention relates to a process of electrodepositing chromium, and more particularly to a process involving the use of a chromic acid solution.

In the electrolytic depositing of chromium, particularly in the plating of various articles, great difficulties have been experienced, due in part to the varying resistance conditions in the bath during the plating operation, and in part to difficulties in securing a continuous, uninterrupted deposit of chromium upon the surface of the article. There have also been difficulties in securing a condition in the bath which will secure reliability in the electrolytic action.

In most baths heretofore used there is a strong ebullition of noxious fumes making the depositing operation somewhat hazardous to workers.

In some instances it is found that while an apparently satisfactory chromium surface is secured, after a short interval the chromium plating will strip or fleck from portions of the surface due to corrosion of the material upon which the chromium is deposited beneath the plated surface.

Great difficulties have also been experienced in securing a uniform deposition of the chromium throughout the entire surface.

With the above conditions in mind, I have developed a process for the electro-deposition of chromium in which the ingredients of the bath are of a character which will not only avoid the presence of fumes injurious to the workmen, but which will offer a low, substantially uniform resistance to the flow of the electric current, thus avoiding those difficulties arising from a failure, during the process, to continuously deposit the chromium at a uniform rate due to the development of excessive resistance throughout, or in different parts of the bath, whatever the cause of such phenomena may be.

A bath used in the process of my invention is ready for immediate use upon the mixing of the solution, and the process may be carried on at ordinary factory temperatures or at a slightly elevated temperature, according to the character of the surface desired, or the

rapidity with which it is desired to throw the chromium.

In electro-depositing chromium, the reactions are accompanied by a decomposition of the water of the electrolyte, and the presence of minute bubbles of hydrogen at the cathode, which interfere with the adherence of the reduced chromium salt. There is also, with some baths, a formation of a brownish film upon the cathode which must be removed therefrom at the completion of the plating process.

In the bath used with the process of my invention, the cathode is kept free of hydrogen gas bubbles, and the deposited chromium, when the cathode is removed from the bath, is in a clean, bright condition without any evidence of the brown scum above referred to, thus requiring a mere washing of the cathode to clean it.

I find it essential to thoroughly clean the surface of the cathode before immersing it in the bath, and to protect the surface thereof from the action of oxygen thereon with a film of clear water, before so immersing it in the bath.

In the practice of the process of my invention, I form a bath consisting of a solution, the active ingredients of which consist solely of chromic acid (CrO_3) and sodium carbonate (Na_2CO_3), these ingredients being added to the bath in the form of a saturated solution of the chromic acid, and a solution of the sodium carbonate of a density of about 16° Baumé.

I have gotten highly satisfactory results by using to each gallon of water in the solution, 20 ounces of the chromic acid solution and 10 ounces of the sodium carbonate solution. These proportions, however, are subject to variation within a reasonable range, without materially impairing the efficiency of the bath.

While it is possible to use either a lead or a chromium anode, I have found that the latter gives the best results, since with it the chromium content of the bath is replenished to an extent to keep the bath in good working condition. By raising the temperature of the bath to from 110° to 130° F., a bright, smooth

adhering deposit upon the cathode of metallic chromium may be immediately secured with the use of an electric current at a voltage of from 5 to 10, and an amperage of from 1 to 2, or more, per square inch of the cathode.

The use of sodium carbonate (soda ash) not only reduces the resistance of the electrolyte, but during the reactions adjacent the cathode, apparently forms combinations with the hydrogen causing the sodium carbonate to recombine with the water of the bath before it has been reduced to its metallic form and precipitated. The sodium carbonate also apparently has the effect of keeping the cathode clean in respects other than avoiding the accumulation of hydrogen bubbles upon and adjacent the cathode. It also appears to prevent the colloidal condition of the solution at the cathode, since there is an absence of the brownish colloidal film upon the surface of the cathode when removed from the bath.

In a bath containing sodium carbonate and chromic acid without other ingredients than water, the only metallic salts which may be reduced and thrown upon the cathode, are those contained in the chromic acid, and hence the deposited surface will consist of pure chromium applied directly to the metal of the cathode.

By using the higher temperatures in the bath as stated above, the hardness of the deposit and the brilliancy of its finish are increased. With a lower temperature bath, the surface will be somewhat duller and will also be somewhat softer. Under any circumstances, however, the deposited chromium will be very hard, and when a bright finish is secured in the bath, no subsequent polishing or buffing is required. Ordinarily in plating with chromium, a deposit of from .0001 to .0002 of an inch is all that is required.

With the process of my invention, a flash of chromium may be applied to the cathode instantly upon placing it within the electrolytic bath, and while the time interval may vary with different temperatures in the bath, very excellent results can be secured by intervals of from twenty minutes to one hour. Of course if it is desired to increase the thickness of the deposit, this time interval may be increased, there being no tendency of polarization of the bath, or an increase of its resistance, with a prolongation of the time interval.

If it be desired to remove the chromium surface from the cathode, this may be done by using an alkaline bath in which the cathode is immersed, raising the temperature of this bath to from 110° to 130° F., and reversing the direction of flow of the current, using the article from which the chromium surface is to be stripped as the anode.

The thorough cleaning of the cathode before its immersion in the bath is necessary to

the production of a chromium surface thereon of the desired fine texture and continuity. In cleaning the cathode, I immerse same in an alkaline bath, using it as a cathode of an electrolytic couple, the anode of which may be carbon plates or graphite rods. The voltage and amperage used is the same as that used in the plating bath. A very short time is required to thoroughly cleanse the cathode, three minutes having been found ample. The cathode is then removed from the cleaning bath, thoroughly rinsed in clear water, and immersed in the plating bath, the handling of the plate being done without disconnecting it from the electrical source.

The process of my invention may be used in surfacing flat or irregularly shaped articles, chromium plating being particularly desirable as a surfacing for articles which require frequent cleaning or are subject to corrosion as a result of exposure. The hardness of the chromium permits it to be cleaned with the use of various detergents and abrasives, since such will have no effect whatever upon the surface except the removal of superficial matter therefrom. The cleaning action need not be accompanied by any polishing, since the removal of superficial deposits thereon will merely expose the finish of the surface, which will not become dim or dull by oxidation, corrosion or otherwise.

Chromium surfacing is particularly desirable in plumbing fittings, in fittings for boats, ships and automobiles, in master plates used in engraving machines, in copper and steel printing plates, and in various other articles wherein resistance to wear, or the avoidance of corrosive action of the elements thereon are matters of importance. A chromium surface while very attractive in appearance by reason of its blue-gray and other color effects, nevertheless possesses advantages apart from its pleasing appearance.

Notwithstanding the hardness of the chromium surface, the article may be readily formed after the chromium surface has been applied thereto, without the formation of minute cracks or checks. The surfacing in the event of long continued wear may be readily removed and restored without injury to the surface of the cathode or article upon which the chromium is electro-deposited.

I attribute the successful results secured by the process of my invention in large measure to the control of the hydrogen upon and adjacent the cathode, which of itself will lower the resistance of the bath, although the presence of sodium carbonate in the bath will contribute largely toward an increased conductivity of the bath and uniformity in the resistance condition, irrespective of the age of the bath or its extent of use.

What effect the sodium carbonate has in reducing the chromic acid, I have been unable to determine. Its chief utility appears

to be the reduction of the resistance of the electrolyte, the reduction of surface tension at the cathode resulting from either the rapid separation of hydrogen bubbles from the cathode or the combination of hydrogen with the oxygen of the sodium carbonate in a manner to avoid the presence of free hydrogen upon or adjacent the cathode and preventing the depositing of the colloids upon the cathode.

The solution is not only simple as to the nature of the ingredients entering thereinto, but requires no acquired skill in the forming of the bath or in its upkeep.

While certain gases are evolved during the electrolytic action, the volume of such is small, and the effect of same upon the worker is not at all serious, even if the precaution is not taken to provide a hood and vent, or other methods for dissipating these gases.

It is not my intention to limit myself to the precise temperatures, time intervals, or the constituents of the bath as herein described, it being apparent that such may be subjected to variation without departing from the spirit and scope of the invention.

Having described the invention, what I claim as new and desire to have protected by Letters Patent, is:—

1. The herein described process of electrodepositing chromium, consisting in cleaning the surface of the article upon which the chromium is to be deposited, immersing the article in an electrolytic bath, the active ingredients of which consist solely of chromic acid and sodium carbonate in solution in water, and in operative relation to an anode, and passing an electric current through a circuit containing therein the anode, the electrolyte and the article as the cathode.

2. The herein described process of electrodepositing chromium, consisting in cleaning the surface of the article upon which the chromium is to be deposited, immersing the article in an electrolytic bath, the active ingredients of which consist solely of chromic acid and sodium carbonate in solution in water, each gallon of water in the bath containing substantially 20 ounces of a saturated solution of chromic acid, and 10 ounces of a solution of sodium carbonate having a density of 16° Baumé, and in operative relation to an anode, and passing an electric current through a circuit containing therein the anode, the electrolyte and the article as the cathode.

In witness whereof I have hereunto affixed my signature this 20th day of October, 1926.

WILLIAM S. EATON.