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CHROMIUM PLATING.

No Drawing.

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This invention relates to chromium plating; and it comprises a method of obtaining coatings of chromium on other metals, and particularly iron and steel, by electrodeposition wherein the article to be plated is temporarily made an anode in a plating bath and is then made a cathode and plated; all as more fully hereinafter set forth and as claimed.

In electroplating the ordinary metals and alloys, such as silver, gold, copper, nickel, zinc, cadmium, brass, etc., there are no particular problems in an operative or manipulative way. While the baths and electrical conditions vary, the procedure in plating the metal is always much the same. The article is properly cleaned according to standard plating room methods and is then suspended in the plating solution from rods serving as cathodes, the current usually not being on at the time of suspension, though in some cases the current may be applied while the work is being hung. In a general way, it may be said that the surface of any of these metals suffers no change here important in the preliminary operations before the action of the current makes it a cathode in a plating bath. And in changing from one metal to another, no unusual phenomena are observed requiring any variation from this standard procedure.

Conditions, however, are quite different in plating chromium and particularly with the most successful type of bath, that using chromic acid, or CrO_3 , as an electrolyte; what takes place at the surface of the metal when it first contacts with the bath is important. This solution is one of a highly oxidizing nature, wherein it differs from most of the common electroplating baths. And it makes an important difference in the procedure whether the article is suspended from the cathode rod with the current on or off. Surfaces of iron, steel or nickel brought into contact with a solution of chromic acid with the current off apparently assume a passive condition; this passivity however not being uniform. Localized areas differ from each other. Where passivity exists deposition of plating metal is resisted. I have found that very high initial plating voltages are required to break down this passivity and permit deposition of the chromium. And where the shape of the article to be plated is such as to offer local high relief and

local low depressions, even with these high initial voltages, there is a tendency at times towards retention of the passive condition locally, with a corresponding variation of the time at which a coating begins to be deposited on different portions of the surface. In other words, the ordinary tendency in any electroplating bath to produce a thicker coating on portions in relief is considerably accentuated in working with chromium. Occasionally, it happens that an article remaining in the plating bath for a normal plating period receives absolutely no chromium in depressions and it is very frequently the case that the depressions receive merely a film coating. This phenomenon in chrome plating baths requires constant attention if commercial chrome plating is to be effected. Flaws and faults resulting from defective plating are in many cases serious, since the chromium coating is employed in many cases as a protection against corrosion, erosion and abrasion. Articles to be protected must be completely and evenly covered with chromium. The stated trouble occurs to a greater extent where the article is put into the bath with the current off, but it occurs to some extent even when the article is placed in the bath with the current on. And there are practical difficulties contingent upon hanging articles in the bath with the current on, this being partly because of the high current densities used. It is a well known fact that chromic acid solutions, while giving good deposits, have but a low throwing power value.

It is the purpose of the present invention to obviate the stated difficulties and make conditions in chrome plating more nearly analogous to those in ordinary plating; that is, so that the article to be plated can be placed and handled in the bath as readily as in ordinary plating operations. To this end, I subject the article to be plated to a certain surface-preparing treatment, preliminary to the actual plating. Prior to the plating process proper, in which the metal is, of course, made a cathode, I electrically treat its surfaces in various ways; in particular making the surface to be plated an anode for a time. The article to be plated should be cleaned according to the ordinary plating practice in a suitable alkaline cleaning solution. Its surface should be free not only of dirt or grease, but of oxids, etc. In the

cleaning solution, in order to assure this it is advantageous to make it cathodic, current being applied for a minute or two with the article gassing vigorously. The article is then rinsed off in cold water and suspended preferably by an iron wire in a chromium plating bath of an ordinary composition in which it is made an anode, the current being so regulated as to make the article gas slightly. Here I allow it to remain for a varying time, from a few seconds up to, perhaps, a minute. I have found that when the article is made an anode in one of these solutions, it apparently reaches a condition of equal passivity or uniformity over its whole surface. At all events, when the current is subsequently reversed; that is when the article is made a cathode in a chromium plating bath, the deposit which forms is now much more even and is thrown into the recessed and shaded portions in a very desirable way. The bath in which the article is made anodic may be the same as the bath in which plating is subsequently effected, making the article a cathode, or it may be a separate bath used only for this preparatory treatment.

In some cases I have found it advantageous to make the article a cathode in a chromium plating bath prior to making it an anode; that is, to throw down on it a little coating which is taken off again in the anode stage. In other words in my preparatory treatment instead of continuously maintaining the current in such direction as to make the article cathodic, it may be intermittently reversed. In so doing, in the final anode stage the treatment should be continued somewhat longer; occasionally as long as three minutes, since it is necessary to strip the coating made before in addition to adjusting surface conditions.

The chrome plating may be done with the article cathodic in any of the ordinary ways. Usually, and with the average bath, there are required about 50 amperes per square foot, although the plating range may be from 40 to 200 amperes. Where an article is to be buffed to color after plating, it is advisable, as soon as the required thickness of

chromium deposit has been approximately reached, to lower the current density to the minimum, say, to 40 amperes per square foot and so maintain it for a few minutes. Coats deposited at the lower current range are believed to color more readily. Since gray chromium coats are hard and difficult to buff, this is very desirable.

What I claim is:—

1. In the electrodeposition of chromium on articles having a surface of iron, steel or nickel, the process which comprises temporarily making such a surface an anode in a chrome plating bath and then making it a cathode in a chrome plating bath and depositing a layer of chromium thereupon.

2. In the electrodeposition of chromium on articles having a surface of iron, steel or nickel, the process which comprises temporarily making such a surface a cathode in a cleaning bath, then temporarily an anode in an electrolytic chrome plating bath and thereafter making it a cathode in a chrome plating bath and depositing a layer of chromium thereupon.

3. In the electrodeposition of chromium on articles having a surface of iron, steel or nickel, the process which comprises temporarily making such a surface a cathode in a cleaning bath, then temporarily an anode in an electrolytic chrome plating bath with occasional reversals to make it temporarily a cathode, and thereafter making it a cathode in a chrome plating bath and depositing a layer of chromium thereupon.

4. A process of plating a metal article with chromium in an electrolyte containing chromic acid, which consists in directing an electric current first through the article as an anode and then through the electrolyte to an electrode contacting with the electrolyte, and then reversing the current flow so that it passes through said electrode and then through the electrolyte and the article to be plated, said article thus being made the cathode in the bath.

In testimony whereof, I have hereunto affixed my signature.

HARRIE C. PIERCE.