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PLATED ARTICLES AND METHOD OF PRODUCING SAME

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The present invention relates to an improved process for the metallization or electroplating of metallic and non-metallic articles, and to the products obtained thereby.

It is the general object of the invention to provide a method for the metallization or electroplating of articles of various kinds whereby uniformly dense and strongly adhering metallic deposits are obtained.

The present invention is applicable to the electroplating of metals, and particularly of magnesium and aluminum and their alloys, including magnesium-aluminum alloys, and likewise to articles made of or coated with non-metallic materials, such as plastic substances, as for example Celluloid, synthetic resins, cellulose acetate plastics and the like, rubber, wood, stone, plaster, and other, preferably hard, normally non-conducting substances.

The process of the present invention makes it possible to provide articles made of the materials above described with a very adherent layer of copper which may itself be subsequently covered with other metallic deposits, such as nickel, bronze, silver, chromium, etc. According to the invention, the surface to be coated is first thoroughly cleaned, and in particular, freed as thoroughly as possible from oils, grease, etc., and if porous, is subjected to a suitable treatment whereby the entrained air or other gases are expelled without at the same time destroying any irregularities on the surface of the article which it is desired to preserve in the finished, electroplated article. The article is then coated uniformly with a lacquer or varnish containing ingredients which promote the chemical precipitation upon the article of a continuous film of a highly conducting metal, such as silver or of silver mixed with other metals.

The lacquer or varnish film has imbedded therein a fine metal powder, preferably copper powder, and preferably also a pigment, which increases the density of the film and aids in promoting the adhesion of the chemically precipitated metallic film to the lacquer or varnish coating. A pigment which has proved to be highly satisfactory is lithopone, but other, preferably light colored pigments can also be employed, either alone or mixed with the lithopone.

The article coated with the film just described is now subjected to the action of chemical solutions which operate to deposit a uniform and continuous film of a metal, such as silver, upon the article. I prefer to deposit this intermediate metallic film in several layers, and to this end I provide separate tanks, one containing a solution of the metal to be deposited, such as silver nitrate, either alone or mixed with another salt, preferably in ammoniacal solution, and the other containing a precipitating bath, for example, one containing a reduced compound, such as pyrogallic acid in acid solution, or formaldehyde, or other known precipitating agent for the metal in question. The article is immersed alternately in the two solutions until a number of deposits have been obtained. This metallic layer provides the base upon which the first electrolytic film is deposited. The article is now ready for the electroplating bath.

As already indicated, the first electrolytic deposit may be followed by deposits of other metals, or it may constitute the sole electrolytic deposit. By reason of the intermediate, chemically produced metallic deposit, an extremely firm bond is established between the electrolytic deposit or deposits and the lacquer or varnish film on the surface of the article being treated.

In order that my invention may be more fully understood, I shall describe the same more in detail hereinbelow in connection with certain specific materials and reagents, it being understood, however, that the invention is not restricted thereto.

Where the article to be coated is porous, such as articles of wood, plaster, certain stones, etc., it must first be rendered impermeable and for this purpose may be soaked for several hours in a bath of gum lac or of very light, colorless, cellulose varnish (or lacquer), molten paraffin (where the article is not injured by the elevated temperature) or other similarly inert material, until air bubbles cease to appear. If necessary the surface of the article should then be cleaned to remove any excess of the lacquer or paraffin to restore any surface relief which it may be desired to preserve.

Plastic articles should be rubbed prior to their further treatment; while other hard substances such as glass, porcelain, rubber, etc., should be thoroughly cleaned, and to this end they may be washed with alcohol or other solvent for fats, oils, greases and the like. They may then be placed for a short time in a hot bath of caustic soda composed of 100 grams of caustic soda per 5 liters of water. The articles are then rinsed in fresh water and allowed to dry thoroughly.

The completely dry, oil and grease-free object, for example, an article made of magnesium, aluminum, or their alloys, is now coated with a thin film of a nitrocellulose lacquer or similarly

clear lacquer or varnish containing lithopone and copper powder prepared in the following way: Suspend 75 grams of lithopone in 375 grams of a nitrocellulose or other clear lacquer or varnish of good quality. About 280 grams of thinner are then added, preferably only a part of the thinner being first mixed in so as to facilitate solution. Thereupon 65 grams of red copper powder are slowly added with constant stirring, and finally the rest of the thinner is added and the whole thoroughly mixed. This preparation should be made the day it is to be used as the copper powder causes decomposition on standing. The coating material can be applied with a spray gun, and in order to make certain that the materials have been thoroughly and uniformly mixed, the lacquer or varnish may first be sprayed on a smooth surface to ascertain whether the composition will pass through the gun and whether there are any lumps present, as the latter will be harmful to the metallized finish. If the mixture should be too thick, a small quantity of thinner can be added until all the lumps disappear.

The film is allowed to dry for at least one and preferably several hours; a longer time will be required for certain types of varnishes. To insure that the surface of the coated article is entirely free from oils and grease, whether left by contact with the fingers of the workmen or contained in the varnish or lacquer film, the article is immersed in a hot alkaline solution to effect removal of fatty and greasy material from the surface of the film. The solution may be a soap solution or one of alkali metal hydroxide or carbonate. Immersion for two or three seconds in a hot solution of about 150 grams of potassium carbonate in 5 liters of water has proved to be highly satisfactory. This treatment should of course not be so long or so vigorous as to injure the coating film. In certain cases this treatment aids in so modifying the surface of the film that it is more easily and thoroughly wetted by the solution, to which it is next subjected, although with the particular treatment about to be described, satisfactory wetting is accomplished by the acid solution referred to below. The article is then rinsed with water which, if desired, may be warm.

The articles are now suspended from a non-annealed, red copper wire, crosswise, or in a swinging wire cradle, in order to facilitate their passage through solutions which act to deposit chemically a uniform layer of metal upon the lacquer film. Where the chemically precipitated metal is to be silver, the solutions are prepared as follows:

The first solution comprises a bath containing 90 grams of pyrogallic acid and 10 grams of acetic acid per liter of water. The second solution is prepared by dissolving 20 grams of silver nitrate in 30 centiliters of commercial ammonia and adding the solution thus obtained to one liter of water. To the mixture there are then added 2 grams of mercuric chloride. The two solutions should be kept in glass receptacles in order to avoid precipitation on the walls.

The articles to be coated, suspended from the copper wires, and, if desired, after immersion in the hot solution of potassium carbonate or equivalent agent, followed by rinsing, are now passed, preferably while still comparatively hot or warm, through the pyrogallic acid solution. The articles are kept in this first bath just long enough to insure wetting of all of the surfaces of the articles. The latter are then removed from the bath and the excess pyrogallic acid solution allowed to drip off. The articles are then immediately immersed in the second bath and swung back and forth in the bath five or six times to insure a uniform deposit of metal upon the articles. The articles are then withdrawn from the second bath and again immersed in the first bath, which should always be stirred for a few seconds. They are thereupon again immersed in the second solution and swung back and forth therein in the manner indicated above. It is important to immerse the articles as deeply as possible in the silver solution as thereby a continuous and uniform metallization is insured. The procedure described is preferably conducted five or six times in the two baths consecutively. Touching of the articles with the fingers should now be avoided, and care should be taken that the suspending copper wires are not too tight to prevent the deposition from being uniformly applied throughout the whole surface of the articles.

The silver-coated articles are now rinsed in fresh water and are then placed directly into an acid-copper electrolytic bath composed of 5% by weight of concentrated sulfuric acid, and 22–25 Bé. copper sulfate, electrolytic red copper anodes being employed. The voltage may vary from ½ to 1½ volts, depending upon the installation or the size of the vats. In any case, the voltage should be so regulated as to prevent the articles from burning. The thickness of the metal deposit will, of course, depend upon the length of time that the articles are left in the bath; however, in order to obtain a well polished article, it is necessary to count on two hours of copper plating so as to produce a deposit sufficiently thick to withstand a good polishing.

After the deposit of the copper, the article may be further plated with any desired metal, such as bronze, nickel, chromium, silver, gold, etc.

Where it is desired to exclude the copper deposit from any parts of the articles, such parts should be coated with a non-conducting material of any suitable type. Thus a solution of Jew's pitch (bitumen of Judea), which should not be too thick, can be applied with a brush or spray gun as a coating on the selected parts before the articles are placed in the copper bath. The non-conducting coating should be allowed to dry before the articles are further treated.

My process is of particular advantage in the coating of metal articles which tend to oxidize rapidly in the air, such as aluminum, magnesium, and their alloys. By providing articles of these metals with an oxidation- and rust-resisting metallic surface in accordance with the present invention, they are protected against oxidation, while at the same time the normal advantages such as lightness, cheapness, strength, etc., of these materials are preserved.

The articles coated in the manner above described, whether the base or core is metallic or non-metallic in nature, are characterized by a uniform and dense metallic coating which will not strip off from the base material. Sections cut through articles prepared and electroplated in the manner above described show a metallic coating of uniform thickness imbedded in or fused with the thin lacquer film, the latter acting to anchor the electrolytic deposit or deposits firmly and permanently upon the base material. By the process described hereinabove, electrolytic coatings of permanent character can be pro-

vided upon both metallic and non-metallic articles which ordinarily either will not receive an electrolytic deposit or which permit such a deposit to be readily stripped off. My invention is, of course applicable not only for the coating of an article or surface with a desired electrolytic deposit, but also for protecting other coatings against injury; thus, in accordance with the invention, the silver or reflecting surface of a mirror can be protected against injury in the manner described above.

It will be understood that the plating of the article upon which the layer of chemically precipitated metal, for example silver, has been deposited, can be carried out in the various ways known in the art. The silver deposit, in conjunction with the lacquer film, provide an excellent conducting surface to which various electrolytic deposited metals will firmly adhere.

It will be obvious that variations from the specific procedures, compositions, and proportions above described may be resorted to within the scope of the appended claims without departing from the spirit of the invention. Thus, instead of swinging the articles in the silver-depositing bath, the articles may be held stationary, especially where they are quite large, and the solution circulated about them by means of a pump or otherwise.

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